THE TWO-YEAR MASS RADIOGRAPHY CAMPAIGN IN SCOTLAND. 1957 - 1958.

A study of tuberculosis case-finding by community action.

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THESIS

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DOCTOR OF MEDICINE

by

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CONTENTS

ILLUSTRATIONS

(Short titles)

ILLUSTRATIONS - continued

Footnote: **Tuberculosis means respiratory tuberculosis. Notifications mean confirmed tuberculosis notifications.**

APPENDICES
(Short titles)

APPENDICES - continued

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FOREWORD.

This thesis presents a detailed study of the technical planning, execution and results of a mass radiography Campaign designed and carried out on a community basis in Scotland during 1957 and 1958.

The author, in his capacity as adviser on tuberculosis to the Department of Health for Scotland, was responsible for all medical aspects of the planning of this operation and for the analysis and evaluation of the findings contained in this thesis.

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INTRODUCTION.

[illegible] was 4,657 (94 per [illegible] 100,000) in 1939, [illegible] by 21 per cent., [illegible] (66 per 100,000) in 1951, to a peak of 3,613 (106 per 100,000) in 1947. Between 1939 and 1949, the number of registered [illegible] rose by 70 per cent., from 17,700 to 30,700.

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Respiratory Tuberculosis in Scotland up to 1955

Between the two world wars the control of respiratory tuberculosis was based on a programme of case-finding which would be considered inadequate by modern standards, the segregation of infectious persons and treatment by non-specific methods. In spite of this, the number of new cases reported annually in Scotland fell by 40 per cent. and the number of deaths by 34 per cent. Following the outbreak of the second world war these trends were reversed, and a substantial and progressive increase in the rates occurred, both being projected into the post-war period. New notifications increased by 86 per cent., from 4,657 (93 per 100,000) in 1939, to a peak of 8,653 (169 per 100,000) in 1949, while deaths from respiratory tuberculosis rose by 26 per cent., from 2,717 (54 per 100,000) in 1939 to a peak of 3,415 (66 per 100,000) in 1948. Between 1939 and 1949, the number of registered cases rose by 70 per cent., from 17,700 to 30,700.

Apart from the fact that these retrograde trends were greater and lasted longer, Scotland shared the experience of most other countries in Europe, Scandinavia and North America in the post-war years (Macgregor, 1955). Between 1948 and 1955 the annual number of new notifications fell by 20 per cent., from 8,204 (158 per 100,000) to 6,541 (127 per 100,000) while, in the same period, deaths were reduced by 75 per cent., from 3,415 (66 per 100,000)

to 860 (17 per 100,000). In contrast, the number of registered cases of respiratory tuberculosis rose by 65 per cent., from 30,683 to 49,463, a change attributed to the improved expectation of life resulting from the earlier ascertainment of the disease and the introduction of effective drug therapy. These trends are illustrated in Table 1.

TABLE 1.

Respiratory tuberculosis notifications, deaths and registered cases (Scotland)

	Annual Deaths		Annual Notifications		Registered cases
	Number	Rate	Number	Rate	Number
1919-23	4,103	84	7,707	157	
1934-38	2,746	55	4,846	97	
1939	2,717	54	4,657	93	17,654
1948	3,415	66	8,204	158	30,683
1949	3,084	60	8,653	169	32,471
1955	860	17	6,541	127	49,463

Apart from the inauguration of mass radiography in 1944, no developments in the tuberculosis services were possible during the war years to meet the growing need. The post-war period was, therefore, a time when every component of an effective anti-tuberculosis organisation was deficient and during which the major effort was directed to the development of the preventive and clinical services on modern lines. In 1948, the number of staffed beds available for the treatment of patients suffering from

respiratory tuberculosis was 4,390 and the number awaiting admission to hospital, 2,600. By 1955, the hospital provision had been increased to 6,000 beds and the waiting list abolished. An important contribution to this latter development was made by a scheme under which 1,100 Scottish patients were treated in sanatoria in Switzerland. Equally important, however, was the increasing use of domiciliary care and the substantial reduction in the duration of hospital treatment, made possible by the extended use of chemotherapy. During this period a scheme of B.C.G. vaccination was introduced for exposed population groups (nurses, medical students and contacts) and children approaching school leaving age. Out-patient diagnostic and treatment services were expanded and the mass case-finding programme by photofluorography developed. By 1955 the number of mass miniature radiography units had been increased to ten and more than two million examinations had been made.

The most important contribution to tuberculosis control in the post-war years was the discovery of the specific anti-tuberculous drugs, their effective use and the realisation, as experience grew, that treatment at home could be effective even for patients whose medical condition and domestic circumstances would previously have been regarded as unsuitable. Although out-patient or home treatment could not be regarded, at that time, as a substitute for hospital care, it was becoming clear that chemotherapy alone was likely to be of considerable benefit, especially when the disease

was identified at an early stage, an occurrence which was becoming more frequent. It was this concept, and the opportunities it presented, which led to the deployment of the mass radiography service in a series of experimental X-ray surveys, with the object of intensifying the case-finding programme and gaining experience in the community approach. This decision was taken at a time of acute shortage of hospital accommodation, with the knowledge that many of the patients identified would not receive immediate sanatorium care. At that time, also, there was good reason to believe that the public were ignorant of the improved outlook for the tuberculous and the added advantages of early diagnosis. It thus became the primary object of all publicity and propaganda used in the mass X-ray Campaign in Scotland to present these facts. It was believed to be in the best interests of the public, and the individual, that the benefits of drug treatment should be available as widely as possible to those requiring it. Finally, since the mass radiography service was becoming increasingly engaged in the re-examination of easily accessible population and industrial groups, with diminishing returns, an extension of its range of activity could best be achieved by community action.

In this paper the term "community X-ray survey" is used to indicate the deployment of the mass radiography service in a defined area for the purpose of examining the whole population, excluding children, and not merely industrial or other special groups.

Community Surveys in Scotland, 1953-56

When it was decided in 1953 to study the community approach to tuberculosis case-finding, the diagnostic and treatment services were still being expanded. The deficiency in hospital accommodation was measured by the fact that nearly 1,800 patients were awaiting admission and that over 200 were receiving treatment in Switzerland. The first community X-ray survey was carried out in the Burgh of Greenock in the autumn of that year, when two mass X-ray units examined 13,500 persons in three weeks. The publicity and propaganda services went into action two weeks before the X-ray units arrived and continued at high pressure during the survey period. This practice was employed throughout all the Scottish mass radiography surveys.

The Department of Health for Scotland was responsible for the co-ordination of this programme, while the local arrangements were made by the health authority, with the assistance of X-ray units provided by the Regional Hospital Board. The arrangements for publicity and propaganda were made by the public health services, with the advice and help of the Scottish Information Office, while the clinical assessment of patients, and their disposal, was the responsibility of the general practitioners in the area.

Between 1953 and 1956, community X-ray surveys were carried out in 19 areas in Scotland, involving the examination of 280,000 persons. Since no separate records of non-resident attendances were kept at that time, the response among persons living in the

defined areas cannot be accurately assessed. Details of these surveys are reproduced in Appendix 1, while a brief summary is presented in Table 2.

Since it was believed from the outset that these chest X-ray surveys should be carried out quickly, no attempt was made to prolong them beyond seven weeks. This decision was based primarily on the need to obtain the maximum publicity and propaganda cover and to maintain these at a level which would promote and sustain public interest and co-operation. The effect on both staff and X-ray equipment of working at high pressure and the resulting increased load on the diagnostic and treatment services were not known at that time. These uncertainties had to be faced and the problems measured and resolved during this experimental period.

While judged by present standards most of these surveys were incomplete, they were considered, even in the early stages, to be capable of development to a point where a high proportion of the adult population could be persuaded to attend for examination. Not only was valuable experience gained in method and organisation, but 568 new cases of active respiratory tuberculosis were identified (2.0 per 1,000 persons examined) and a further 1,641 (5.7 per 1,000) placed under observation. Without this experience the chest X-ray surveys carried out during 1957-58 would have presented many more problems and anxieties.

TABLE 2.

Summary of 19 community X-ray surveys carried out in Scotland between 1953 and 1956

		Data for individual Surveys			Total all Surveys
		Highest	Lowest	Average	
Adult populations surveyed (1951 census)		166,000	17,000	45,000	858,000
Adults X-rayed		28,104	2,648	14,738	280,031
Attendance (per cent)[x]		80	7	33	33
X-ray units employed		4	2	-	-
X-ray unit weeks		21	5	10	200
Duration of Surveys (weeks)		7	2	4	75
Examinations per unit week		2,370	530	1,352	-
Active tuberculosis yield ϕ	number	64	4	30	568
	rate/1,000	4.5	0.9	2.0	-
Yield of tuberculosis requiring observation ϕ	number	213	10	86	1,641
	rate/1,000	13.8	2.4	5.9	-

x Number of adults X-rayed expressed as a percentage of the resident adult population.

ϕ After a minimum of three months follow-up.

[illegible], reference will be made [illegible] major [illegible] tuberculosis case-finding, particular [illegible] between practice in Scotland [illegible] the use of [illegible]graphic technique for the [illegible]ed [illegible] with varying [illegible] approach [illegible]), the [illegible]

OTHER MASS RADIOGRAPHY SURVEYS

[illegible]ately [illegible] carried out [illegible] of [illegible]anson, 19[illegible]). No [illegible] of each of the surveys, the response rates, or the methods used in [illegible]ing people to attend.

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In this part of the paper, reference will be made to the major events in this field of mass tuberculosis case-finding, particular attention being given to the comparison between practice in Scotland and elsewhere. The use of photofluorographic technique for the survey of whole populations has been employed on a very limited scale although a number of attempts have been made with varying degrees of success and using different methods of approach.

In Norway (Riddervolt, 1958) and Sweden (Wegelius, 1958), the community X-ray survey technique forms a part of the routine tuberculosis case-finding programme. In the former country compulsory powers are used to obtain a response of approximately 85 per cent. The results of 16 Norwegian surveys carried out between 1949 and 1953 revealed 4,029, or 2.6 per 1000, cases of active tuberculosis among 1,560,000 persons (Hansen, 1955). No information has been published regarding the duration of each of these surveys, the response rates, or the methods used in encouraging people to attend.

Between 1947 and 1953, the United States Public Health Service gave assistance to 25 local communities to enable them to undertake chest X-ray screening surveys with the object of examining the entire adult population in these areas. The results, published by the U.S. Health, Education and Welfare Department (1953), are briefly summarised in Table 3. During the six years nearly eight million persons were examined by 70 mm. photofluorographic technique and over 5,600, or 0.7 per 1,000, new cases of active tuberculosis

identified. Between 85 and 90 per cent. of these were unknown to the health authorities (Anderson, 1955).

TABLE 3

Summary of 25 community X-ray screening programmes carried out in the United States of America between 1947 and 1953

		Data for individual surveys			Total All surveys
		Highest	Lowest	Average	
Adult population		3,155,000	57,000	462,000	11,566,000
Total examinations		1,867,000	53,000	320,000	7,993,000
Index of coverage x		93%	63%	69%	69%
X-ray units employed		35	9	-	-
X-ray unit weeks		1,470	54	-	-
Duration of surveys (weeks)		42	4	13	322
Examinations/unit days		345	160	-	-
Active tuberculosis yield (new cases)	Number	1,916	10	235	5,643
	Rate	2.9	0.2	0.7	-

x Total miniature films taken expressed as a percentage of the resident adult population.

The population aggregates surveyed in this programme ranged from 57,000 to over 3,000,000 and the yield of new active cases between 0.2 and 2.9 per 1000 persons examined. The response in these surveys, referred to as the "index of coverage", averaged 69 per cent. Since this figure includes all those who attended for examination it is not comparable with the adult response rate of 68 per cent. in the Scottish Campaign in 1957-58, the latter being

calculated after the exclusion of non-residents and children. For example, the resident adult response rate in the Washington D.C. survey was 50 per cent. compared with an index of coverage of 64 per cent. (Payne et al., 1953). Two outstanding features of contrast between the American and Scottish programmes were that the individual surveys in the former lasted considerably longer and examined substantially fewer people over the same period of X-ray unit time. No Scottish survey in the two-year Campaign in 1957-58 lasted longer than five weeks and each X-ray team examined, on average, over 3,000 persons per week. The American Campaign included one survey of over eight months, the average being 15 weeks, while each unit examined approximately 1,400 persons per week. The yield of active tuberculosis in these surveys varied between 0.2 and 2.9 per 1000 persons examined, while the Scottish figures ranged between 0.26 and 3.59 per 1000. Any comparison between these morbidity data must, however, be made with extreme caution.

During the three years 1950-52, the Danish Government financed a mass tuberculosis Campaign with the object of examining all persons between 1 - 6 and 15 - 34 years of age throughout the entire country (excluding Copenhagen County and a few of the small islands). The Campaign, reported by Groth-Petersen et al. (1959), was conducted as part of a research and service programme, the examination consisting of a tuberculin skin test and, for those over 15 years of age, a 35 mm. chest X-ray. Attendance was by invitation but volunteers

were accepted even if they did not belong to the specified groups, the work being completed by four specially trained mass X-ray teams. Of those invited 65 per cent. accepted and the total X-rayed amounted to nearly 800,000, producing 503, or 0.63 per 1000, new cases of active tuberculosis. The response of the pepulation and the yield of new cases in the different age and sex groups is shown in Table 4. In addition to the active cases recorded in this survey, a further 4,846, or 6.4 per 1000, presented radiographic shadows suspicious of tuberculosis.

The Stockholm X-ray survey, completed during 1950-51 by Bauer and Gentz (1953) is of particular interest. The object was to X-ray

TABLE 4

Tuberculosis Campaign in Denmark, 1950-52

Adult response and yield of new cases of active tuberculosis

	Males					Females					Both sexes
	15-	25-	35-	45+	All Males	15-	25-	35-	45+	All Females	
Response (per cent)	60	63	40	13	-	68	70	46	12	-	65
New cases	42	77	48	38	200	61	132	74	31	289	503ϕ
Rate/1000	0.36	0.61	0.57	0.68	0.54	0.47	0.94	0.81	0.60	0.72	0.63
Confirmed %x	93	93	94	95	94	95	93	99	93	95	94

x Bacteriologically positive.

ϕ 14 cases excluded since bacteriological investigation incomplete.

all residents over ten years of age on a voluntary basis, the first year being devoted to industrial surveys and the second to members

of individual households invited to attend by personal letter and, in the case of default, by personal visitation. The response was 423,000, or 71 per cent. of the resident population over ten years. Evidence of tuberculosis was demonstrated for the first time in nearly 11,000 persons, but 7,500 of these were classed as healed. Of the remainder, 863 were classified as "progressive" and 563, or 0.9 per 1000, of all those examined, were confirmed by bacteriological methods.

The first "total" mass X-ray survey of a selected population in Britain was carried out by Cochrane et al. (1952), in the Rhondda Fach, a mining area in South Wales. The survey which was preceded by the preparation of a census and considerable local and national publicity, was completed by two mobile teams in eight months during 1950-51. The primary object was to investigate the theory that progressive massive fibrosis (P.M.F.) is a tuberculous condition modified by coal dust. Of the defined population comprising all persons over school age, 89 per cent. were examined. The number of infectious cases of tuberculosis identified among the 17,097 persons X-rayed was 108, or 6.3 per 1000, of which about 40 per cent. were identified for the first time. A follow-up survey by the same workers in 1953 (Cochrane et al., 1955), succeeded in examining 21,822, or 91 per cent., of the population over 5 years of age, and 55 per cent. of those previously X-rayed and still resident in the area. Forty-six new cases of tuberculosis were found and the

authors concluded that a marked fall in the prevalence of infectious tuberculosis had occurred amongst women and, to a lesser degree, among younger men while older miners and ex-miners experienced an increase during the interval.

The mass X-ray survey in Broken Hill, Australia, (Wunderly / 1953) carried out with the assistance of the Commonwealth Department of Health, succeeded in examining 20,411 in a period of six weeks. The response was 95 per cent. of the eligible population, this figure being reached after the exclusion of persons recently X-rayed, negative tuberculin reactors and others genuinely unable to attend because of age or infirmity. The yield of active cases of tuberculosis was 32, of which 13 new cases were confirmed bacteriologically.

The community X-ray survey carried out by the Manchester Regional Hospital Board (1954) in the City of Salford employed six mass X-ray teams over a period of nearly nine months in 1953. Of the 88,769 persons examined 65,348 were residents of five years of age or more, the response being about 40 per cent. of the resident population. Two-fifths of the residents X-rayed were school children. The yield of new cases of active respiratory tuberculosis was 157, or 1.8 per 1000, of whom 110, or 1.7 per 1000, were residents. This survey was carried out with considerable publicity and with the assistance of voluntary organisations.

In 1955, the Newcastle Regional Hospital Board (1955) carried out a combined mass radiography and tuberculin survey in the town of Blyth over a period of seven weeks, using three X-ray teams and the facilities at the local chest clinic. Publicity was used on a large scale and 20,900 persons were examined. This response amounted to 60 per cent. of residents of five years of age and over. Forty cases of active tuberculosis were identified, the rate being 1.9 per 1000 persons X-rayed.

The most complete X-ray survey in the United Kingdom was that carried out in the Annandale district of Dumfriesshire in 1956 by Cochran et al. (1957). Based on the work of Cochrane et al. (1952), in South Wales, using the personal approach, 95 per cent. of the population of 8,658 of five years of age and over were examined with a yield of ten, or 1.2 per 1000, new cases of active tuberculosis, four of whom were found to be infective. This survey was completed in five months by one mass X-ray team. A further survey, reported by the same authors (1959), was carried out in the town of Dumfries during a period of five months in 1957, with the object of determining the prevalence of tuberculosis among residents of 15 years of age and over, measuring the influence of a prior census and of intensive home visiting on the response. The overall response was 14,136, or 70 per cent. of the adult population, the figure being 88 per cent. in the area in which home visiting was employed, and 65 per cent. where it was not. The results were not

influenced by the pre-survey census except among the elderly. The yield of new active cases of respiratory tuberculosis was 21, or 1.5 per 1000 of those X-rayed. In six of these patients the diagnosis was confirmed bacteriologically.

The most recent community mass X-ray survey was carried out in Liverpool in the spring of 1959. In the interim report, Semple and Lloyd Hughes (1959) discuss the preliminary findings of this very successful Campaign, in which 454,286 were examined by 25 X-ray units in four weeks. Of the adult population of this City 77 per cent. were examined. The final details of the tuberculosis yield are not yet available.

TWO-YEAR MASS RADIOGRAPHY CAMPAIGN

SCOTLAND, 1957 - 1958

The two-year X-ray Campaign against tuberculosis was one of the most comprehensive exercises in diagnostic and preventive medicine ever undertaken on a national basis. Its character was unique in that each of the 22 community chest X-ray surveys which it involved were completed in a few weeks by the deployment of national resources and intensive local effort. Although higher population responses had been obtained in some parts of the United Kingdom, these had been achieved only by making use of the individual approach over long periods and by the provision of a scale of equipment and staff far in excess of what is possible in a national programme. The Campaign was designed as a service operation with the following objectives:

(i) To X-ray, by 35 mm photofluorography, as many as possible of the adults (15 years and over) in those areas of Scotland where tuberculosis prevalence was highest;

(ii) To identify and control as many previously undisclosed cases of tuberculosis as possible; and

(iii) To reduce substantially the pool of infection in the community and, thereby, to lower the future incidence of tuberculosis.

The first two of these objectives have been achieved and it is the purpose of this paper to outline the methods by which the work was accomplished and to present the immediate results. How far the initial success of the programme will affect future tuberculosis trends will be the subject of future study. The strong temptation to engage in epidemiological, radiological or clinical studies had

to be resisted, since the size and complexity of the operation demanded a service streamlined to meet the immediate need and without the resources to do more. Reference will, however, be made to a specially designed investigation, carried out within the framework of the Campaign, in the City of Edinburgh.

Preliminary discussions concerning the need and practicability of the exercise began in the Spring of 1955. Although the results of some of the early experimental surveys were disappointing, sufficient experience had been gained to promote confidence in the designing of a more intensive and ambitious programme. It was clear that, to achieve success, both technical and publicity methods required substantial modification. In February 1956, the Secretary of State for Scotland announced the Government's intention to carry out a massive and determined attack on tuberculosis, using the mass miniature radiography service as the spearhead of an intensive case-finding operation during the years 1957 and 1958.

1. Selection of the areas for mass chest X-ray survey

The selection of places to be surveyed was based on a study of the levels of tuberculosis mortality and morbidity during the five preceding years in the 55 local health authority areas. These data, revised on the basis of the 1952-56 statistics, are reproduced in Appendices 2 and 3, and illustrated in Figures 1 and 2. These illustrations, showing the mean annual morbidity and mortality levels during this period in the County areas (incorporating

the large Burghs) and in the four Cities separately, illustrate the relatively high rates in central Scotland and in the Cities.

Consideration was also given to the accessibility of populations and to the numerical distribution of new cases and deaths from respiratory tuberculosis which were being reported in different parts of the country. Appendix 3 shows those areas where the populations are greatest and where the largest number of tuberculosis notifications and deaths were occurring immediately before the start of the Campaign. The proportionate distribution of confirmed notifications of respiratory tuberculosis in these areas, illustrated in Figure 3, shows the high concentration in the Cities, where over 50 per cent. of the new cases were being reported, and in the industrial midlands.

On the basis of these data, and taking into consideration the work being carried out during the latter part of the 1953-56 programme, the following 21 areas, mainly in central Scotland, were selected for survey during 1957 and 1958:-

Glasgow City
Lanark County
Airdrie Burgh
Coatbridge Burgh
Motherwell & Wishaw Burgh
Rutherglen Burgh
Edinburgh City
Renfrew County
Greenock Burgh
Paisley Burgh
Port Glasgow Burgh
Kirkcaldy Burgh
Dundee City
Ayr Burgh
Kilmarnock Burgh
Aberdeen City
Dunbarton County
Dumbarton Burgh
West Lothian County
Midlothian County
Perth Burgh

Since it was not possible to carry out a survey in Kirkcaldy Burgh, this period was allocated to a part of Fife County not

RESPIRATORY TUBERCULOSIS

CONFIRMED NOTIFICATION RATES IN COUNTY AREAS INCLUDING LARGE BURGHS CITIES SHOWN SEPARATELY

MEAN ANNUAL SCOTTISH RATES PER 100,000 DURING 1952-56

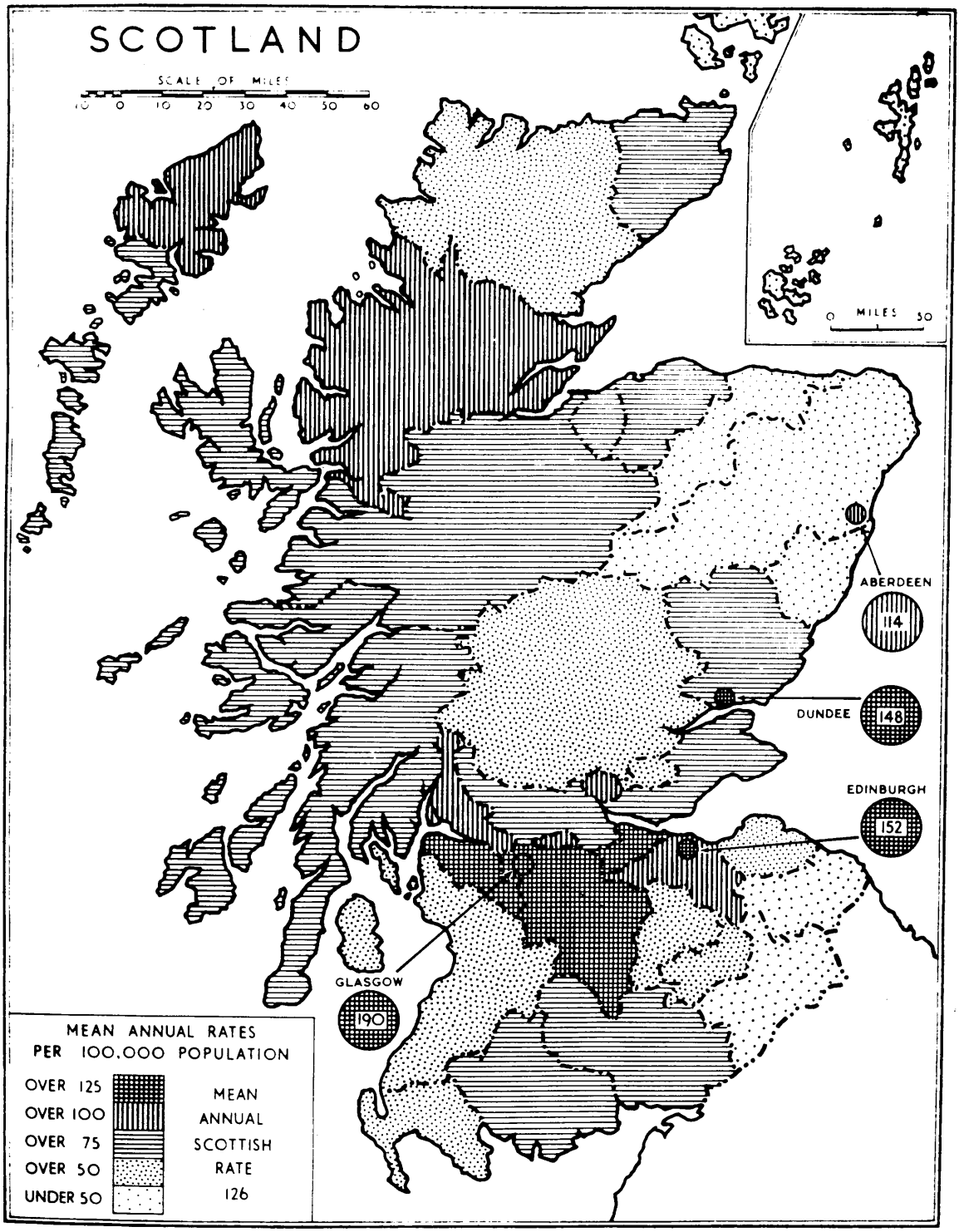

Figure 1.

RESPIRATORY TUBERCULOSIS

DEATH RATES IN COUNTY AREAS INCLUDING LARGE BURGHS CITIES SHOWN SEPARATELY

MEAN ANNUAL SCOTTISH RATES PER 100,000 DURING 1952-56

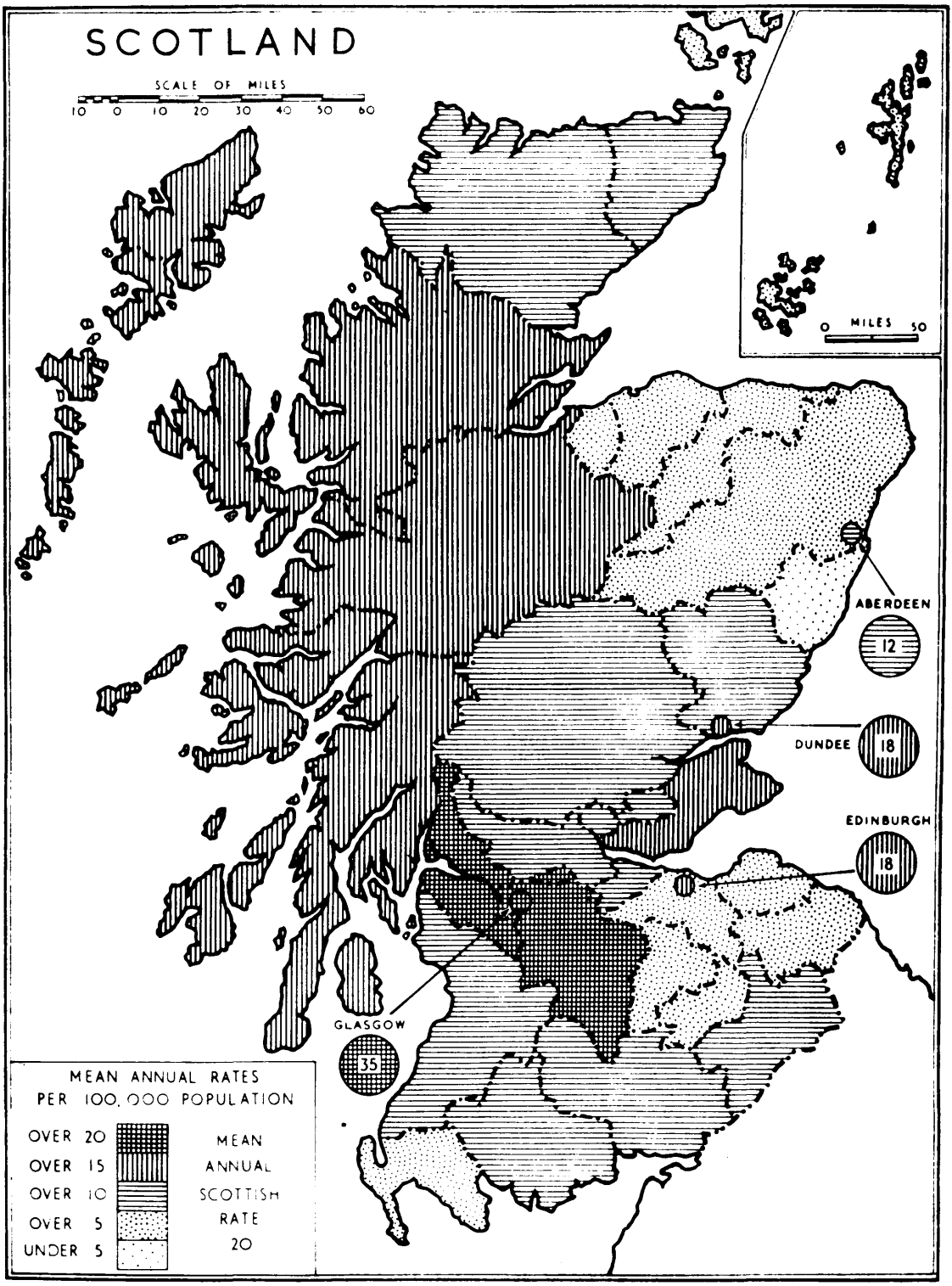

Figure 2.

RESPIRATORY TUBERCULOSIS

CONFIRMED NOTIFICATIONS IN COUNTY AREAS INCLUDING LARGE BURGHS
EXPRESSED AS A PERCENTAGE OF THE SCOTTISH TOTAL DURING 1952–56

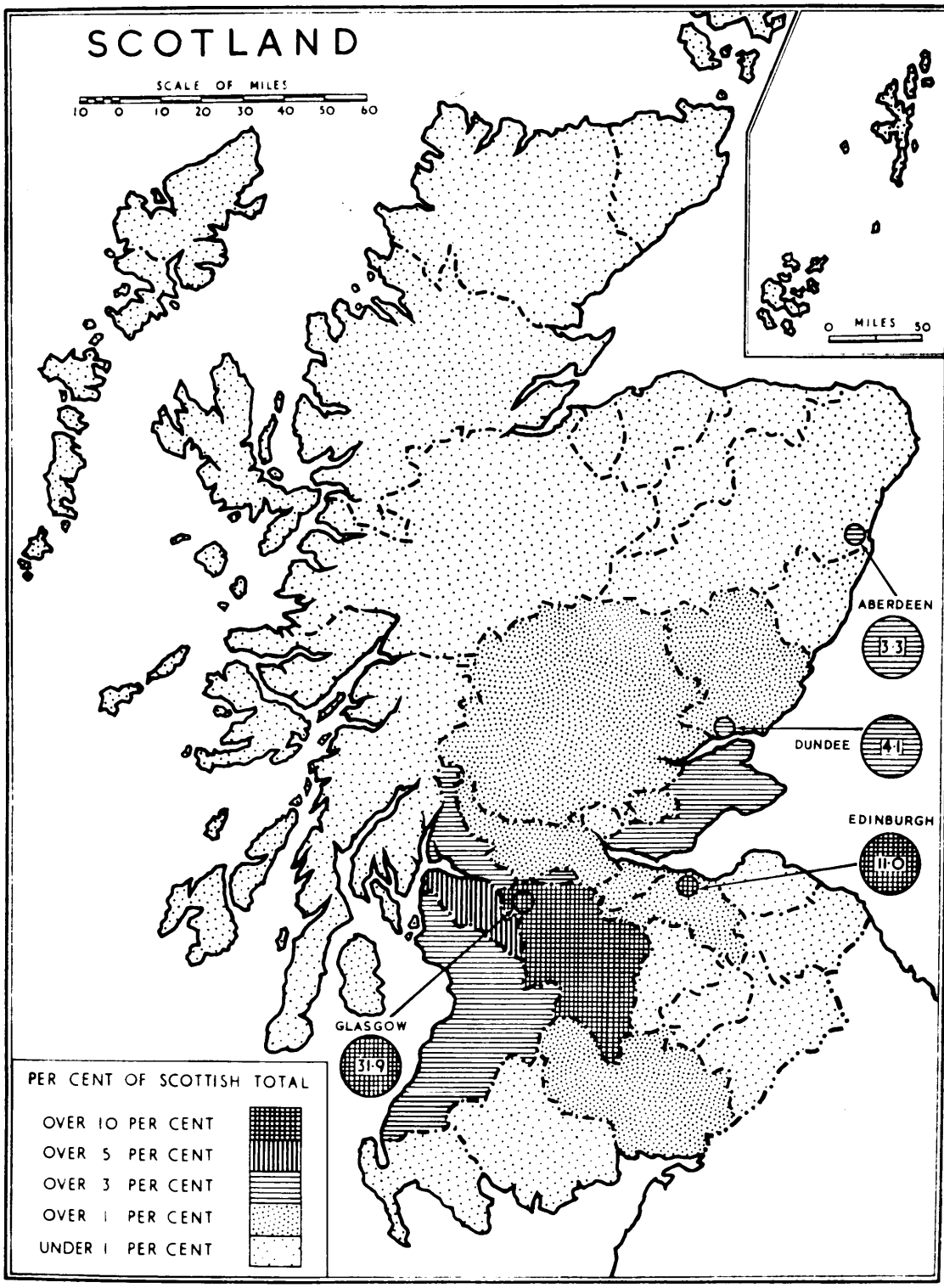

Figure 3.

included in the earlier (1953-56) programme. The Burgh of Dumfries was also excluded since a special study was being projected for this area by Cochran et al. (1959). A few of the more remote areas were excluded on account of non-accessibility of the population and a few because X-ray surveys were being carried out in 1956. The extent of the programme, and the levels of tuberculosis mortality and morbidity experienced in the survey and non-survey areas during the 1952-56 quinquennium, are summarised in Table 5, while details of the individual areas are tabulated in Appendix 4.

TABLE 5

Populations, tuberculosis mortality and morbidity rates in the 21 areas included in the 1957-58 Campaign

	Population (1954 estimates)		Respiratory Tuberculosis (mean 1952-56 data)					
			Notifications			Deaths		
	Number (all ages)	Per cent	Rate/ 1000	Number	Per cent	Rate/ 1000	Number	Per cent
Survey areas	3,225,212	63	1.54	4,981	77	0.25	789	77
Non-survey areas	1,898,124	37	0.82	1,474	23	0.13	241	23
Scotland	5,123,336	100	1.26	6,455	100	0.20	1,030	100

The Campaign was designed to cover about two-thirds of the entire Scottish population in which about three-quarters of the deaths and notifications from respiratory tuberculosis were being

reported. The geographical location of the areas selected, together with the mean quinquennial 1952-56 mortality and morbidity rates, is illustrated in Figure 4.

2. Administrative arrangements

Following the Secretary of State's announcement, the provisional survey programme was discussed and agreed, subject to the formulation of detailed plans, in consultation with the local health authorities concerned. The Department of Health for Scotland assumed responsibility for overall policy, planning and co-ordination, while the Scottish Information Office undertook to give assistance in matters of publicity and propaganda. Each local survey was carried out under the joint control of the local health authority (publicity, propaganda, selection of sites, co-ordination of voluntary services, etc.) and the appropriate Regional Hospital Board (control of the mass radiography teams and the diagnostic and treatment services). The various responsibilities are illustrated in greater detail in Appendix 5.

3. Survey programme

For technical and publicity reasons it was decided to complete each survey in the shortest time compatible with efficiency, in the expectation that about half of the adult population would attend. A minimum of two weeks was required to establish a survey as a going concern and to ensure that most of those recalled for diagnostic X-ray examination would be dealt with before the teams

AREAS SURVEYED DURING THE TWO-YEAR CAMPAIGN 1957-58.

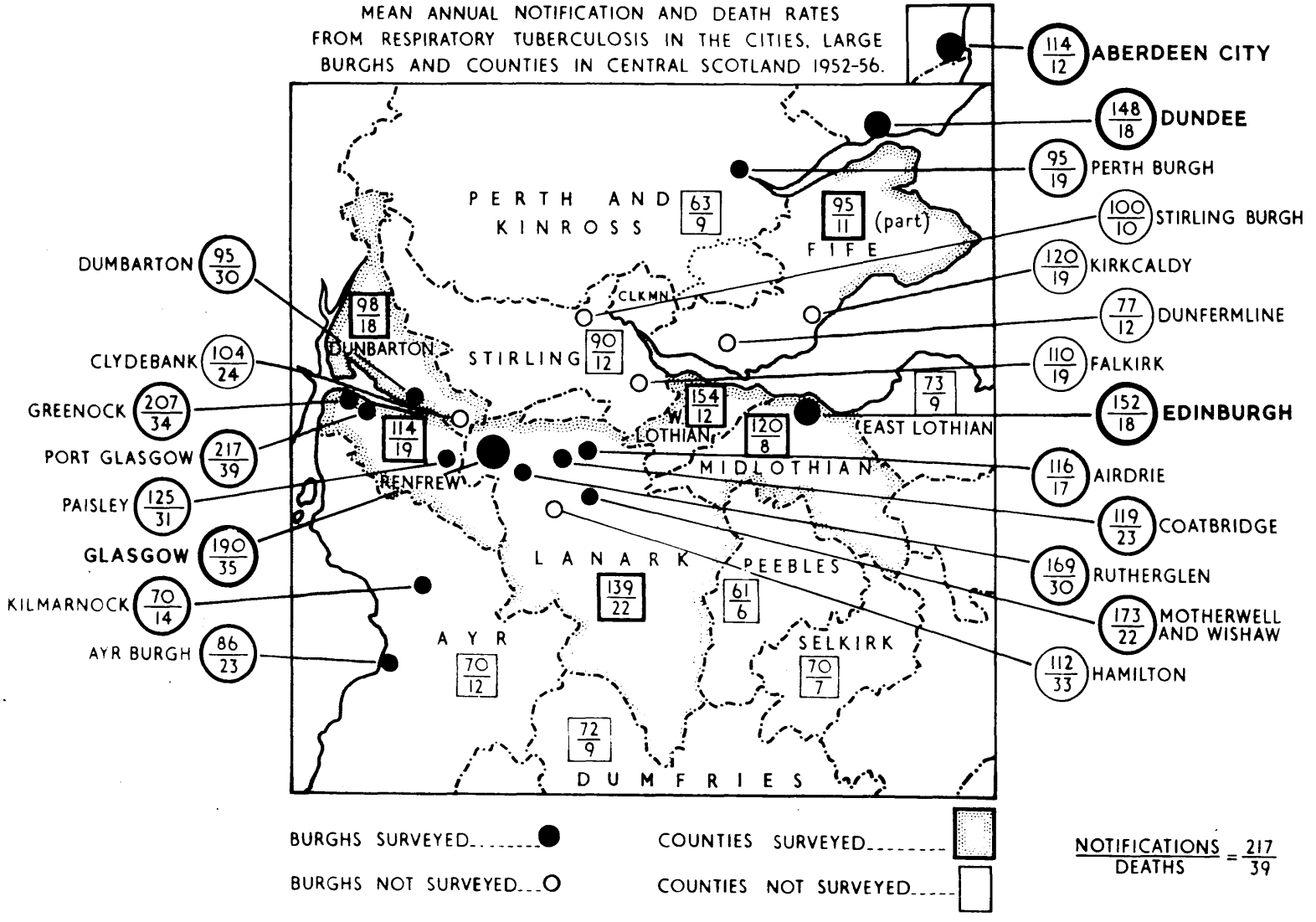

Figure 4.

moved elsewhere. It was believed that publicity and propaganda could not be sustained at a sufficiently high level for more than five weeks and plans were made to ensure that all local programmes were completed within that time. Single units were occasionally retained for a few days longer to complete the large film work which could not be carried out within the advertised period, and which could not be conveniently and quickly dealt with by the local diagnostic services. Since weather conditions during the hard winter months were likely to be unsuitable for this kind of operation, no surveys were planned for December, January or February. As the popular holiday months of July and August had also to be avoided, the whole Campaign had to be completed within a period of approximately 60 weeks.

The population data used was obtained from the Registrar General's 1951 Census Report. Estimates of the potential and the likely performance of the X-ray units, population response and tuberculosis yield were made from a study of the incomplete information available from the early surveys of the 1953-56 programme, after consultation with the mass radiography service. A summary of these estimates, which formed the basis of the detailed technical planning, is reproduced in Table 6. It was clear, however, that fairly substantial variations in performance and yield were likely in view of the different characteristics and tuberculosis experience of the individual survey areas. Owing to the dispersal of population and

services, the performance of the X-ray units and the public response in County areas were likely to be substantially lower than in the towns, while the tuberculosis yield was expected to vary considerably since morbidity, during the 1952-56 quinquennium, ranged from 70 to 217 and mortality from 8 to 39 per 100,000 of the population.

TABLE 6

Summary of estimates of population, services required and tuberculosis yield in areas selected for survey during 1957-58

			Individual survey estimates			All Surveys
			Highest	Lowest	Average	
Adult population (over 14 years)			820,000	15,000	110,000	2,400,000
Response (50 per cent.) †			410,000	7,400	55,600	1,200,000
Examinations expected per unit per week †	Miniature film		2,500	1,500	2,000	2,000
	Recalls (5 per cent.)		150	-	100	100
Survey period (weeks)			5	2	4	85 x
X-ray units required			36	2	-	10 ϕ
X-ray unit weeks			180	4	-	584
Yield of new cases of tuberculosis	Active	Rate/1000	-	-	2	2
		Number	820	22	-	2,400
	Requiring observation	Rate/1000	-	-	6	6
		Number	2,460	66	-	7,200

x Since some of the surveys overlapped, the national programme was completed in approximately 60 weeks.

ϕ Additional X-ray units were required to supplement the ten Scottish teams in Glasgow and Edinburgh.

† Ten per cent. to be added for children and non-residents.

The planning of the two-year programme resolved itself into an exercise involving the deployment of the mass radiography service in sufficient strength to ensure the examination of approximately half the adult population in each of the defined areas and the provision of diagnostic and treatment facilities to deal quickly with those found to be in need of further investigation or medical attention. It was estimated that some 1,200,000 adults resident in the survey areas would attend over the whole period, that about 600 X-ray unit weeks would be required and that an average performance of rather more than 2000 miniature films per unit per week would be achieved.

Since there was no practical method of controlling the flow of the public to the examination centres and, since the attendance of children and non-residents would be likely to increase the amount of work which the units would be called upon to carry out, the peak daily performance was expected to be considerably higher than the estimated average figure of 500. An operation on these lines called for special staffing and servicing arrangements. In addition to the work of photofluorography, each unit would be required to examine up to 150 persons recalled for full size diagnostic X-ray films, about one-fifth of the time being allocated for this purpose. With these considerations in mind the detailed programme, tabulated in Appendix 4, was drawn up.

At an early planning stage, it was decided that the survey in Glasgow would open the two-year Campaign and that the second year of the programme would commence in Edinburgh. This was likely

to have many advantages, not the least of which would be the impact of the national publicity which would accompany these very large surveys on the numerically smaller, but equally important, ones to follow. The disadvantages were that the chest clinic services in Glasgow were still being developed and could not be completed in time. Further, the hospital beds required for the very large number of tuberculous patients which were expected to be found in that City, would probably be insufficient for the need. It was fortunate that, between the time of planning and carrying out the Campaign, the demand for hospital care fell so much more rapidly than was anticipated and that this, together with other dispositions on a national scale, made it possible to meet the demand for sanatorium treatment.

4. X-ray equipment

Of the ten Scottish units, seven were mobile and had facilities for generating their own electricity and operating in a self-contained van. The remaining three were transportable, requiring mains electrical supplies and accommodation in which to work. Apart from one 45 mm. unit, all were fitted with 35 mm. cameras from the same commercial source. While it was possible to deploy this equipment to meet the requirements of nearly all the survey areas, it was clear that substantial assistance would be required to carry out the rapid programmes envisaged in Glasgow and Edinburgh. With the help of the Ministry of Health, Regional Hospital Boards in

England and Wales, the Service Departments, the Northern Ireland Tuberculosis Authority and the National Coal Board, 37 units were made available in Glasgow and 27 in Edinburgh. While most of this additional equipment was of the type in use in Scotland, a few units were fitted with 70 mm. cameras. Prior to the commencement of the national Campaign, special arrangements were made for the overhaul of all units and plans were made to provide servicing during the whole period.

5. X-ray teams

In addition to the Medical Director and Organising Secretary, each team was brought up to a basic establishment of two radiographers, one driver technician and four clerks. Since the personnel coming to Scotland for the major surveys in Glasgow and Edinburgh were volunteers and since a number of the units would be likely to be under-staffed on this account, arrangements were made to recruit radiographers and clerks to make good these basic deficiencies and to fill vacancies which might arise from illness or other causes. Substantial technical assistance was obtained, on a full or part-time basis, from the students and qualified radiographers from the training schools and from radiographers who had left the service on marriage. A special training course was arranged for such personnel. Additional clerks, paid at the usual rates, were recruited locally. The six unit hostesses required to handle the public at each of the X-ray centres were recruited from

local voluntary agencies, principally the British Red Cross Society and the Women's Voluntary Services.

6. X-ray centres

The selection of unit sites and their adaptation became the responsibility of each local health authority, advised on technical matters by the mass radiography service. Three types of site were planned - static (where the equipment was installed in suitable premises and remained there for the whole of the survey period), semi-static (where the unit operated on one or two sites during the survey period either in premises or in its van), and mobile (where the unit moved frequently from one site to another and operated entirely in its van). The town surveys were planned mainly on a static and semi-static basis while the county programmes were designed for semi-static and mobile operation. Special attention was given to the selection of sites - the prime requirement being the use of prominent and easily accessible locations. The units occupying central positions were usually located in spacious accommodation, while those working in the residential areas operated in premises or in their vans for brief periods, moving from place to place in the districts where the concentration of population was greatest. Premises and equipment were examined and appropriate action taken to minimise radiation to the staff and to the public in accordance with the recommendations set out in the Code of Practice (1957).

The units engaged in these surveys also undertook the examination of persons recalled for full size films, when the photofluorographic film revealed the presence of a significant abnormality. In the City surveys an appropriate number of mass radiography units was allocated to this task for the whole period, and convenient sites of a character suitable for this purpose were chosen. In the other surveys part of the time of each unit was set aside entirely for recall sessions. About one-fifth of the time of the units was taken up with this work.

7. Working hours

As the result of previous experience it was decided to open the X-ray centres to the public on the afternoons and evenings of each weekday. Additional public sessions were planned for the central sites in the mornings, and on Saturday mornings and afternoons. Units operating in departmental stores kept the usual shopping hours. Special staffing arrangements had to be made for units which were required to provide a continuous service and at some sites it was necessary to have two teams operating a single unit. By using supplementary personnel, it was possible to keep the working hours of the technical staff to within the agreed limit of 35 hours per week on radiographic duties.

8. Film processing

Initial proposals to establish, for the larger surveys, facilities for the central processing of miniature films had to be

abandoned because of lack of experience of this method. It was unfortunate that this technique was not attempted in part at least, since some of the less experienced teams had difficulty in working at a speed which was quite new to them.

9. Records

One of the first considerations in the planning of the national Campaign was the design and handling of records. It was necessary to review this aspect of the mass radiography service in detail to ensure the minimum inconvenience to the public and the maximum efficiency of reporting and recording. This review covered all medical and clerical procedures, with the object of achieving the simplest possible arrangement compatible with the satisfactory management of the individual and the collection of accurate basic statistical material. It is unnecessary to describe the records in detail, but reference to the basic structure is appropriate to the understanding of the data presented later in this paper.

The Campaign was designed as a case-finding programme and not as an instrument of epidemiological research. To achieve this the public would require to be handled efficiently and speedily and any information of epidemiological interest would have to be abstracted from the basic data. It was decided, therefore, that the information recorded at the time of the first visit would be limited to that required for the identification of the individual - viz. name, address and age. In the event of recall for examination

on a large film, further particulars would be collected to assist the reader in reaching a provisional diagnosis and to facilitate the follow-up - brief medical history, contact history and occupation, etc. A few minor modifications were made for the 1958 part of the programme, these being incorporated in the mass radiography card reproduced at Appendix 6. The most important change during the second year of the Campaign was the recording, at the initial visit, of the name of the family doctor - this being done to assist in the disposal of patients presenting a radiological abnormality, for which no further X-ray examination was necessary (including such conditions as cardiac enlargement and skeletal abnormalities), and of the few who failed to keep appointments at the recall units.

10. Procedure for the reference of patients

A number of basic changes in mass radiography procedure had to be made to ensure that, following the identification of a significant photofluorographic abnormality (i.e. constituting a potential health hazard), all patients received convenient, speedy and efficient attention. Some thought was given to the desirability, or otherwise, of giving priority to those in whom a provisional diagnosis of cancer, or of serious tuberculous involvement of the lungs, was made on the initial radiograph. As this would have involved a complicated system of reference, plans were made to refer all patients quickly, as soon as a significant pulmonary abnormality had been detected.

Under previous arrangements, all patients were referred directly from the mass radiography service to their family doctors, the latter being invited to seek consultant opinion in appropriate cases. During the two-year Campaign, the rapid clinical assessment of those presenting a significant radiological abnormality of the lung was achieved by their immediate reference to the local chest clinic. Those presenting non-pulmonary abnormalities were dealt with as before, the future course of action being left to the discretion of the family doctor who was kept informed at all stages.

To those who presented no evidence of a significant abnormality on the photofluorograph, "All Clear" letters were sent, within 48 hours of their attendance at an X-ray centre. Special arrangements were made with the Post Office for the prompt delivery of these notices. The decision to issue "All Clear" letters is believed to have had an important effect on attendance by creating a high level of public confidence.

Apart from persons who defaulted, all those recalled for large films were dealt with within a week of their first attendance. Appointments at the local chest clinics were made direct from the mass radiography service so that patients would receive attention within a few days. The whole system was planned to give the quickest possible service and this was achieved.

11. Diagnosis

Throughout the Campaign the disease classification, reproduced at Appendix 7, was used for the coding of all abnormalities. As the primary object was to detect and deal with respiratory tuberculosis, particular attention was given to this condition. The possibility of employing dual independent radiographic interpretation was considered, and this would have been employed, had the resources permitted, in spite of the delay which would have been entailed in reporting the results. As it was the staff was not available and dual interpretation was possible only in the case of those referred for clinical examination. Since the diagnosis and assessment of lung disease requires investigation beyond radiological examination, the final morbidity data were prepared from reports obtained from chest physicians, to whom all such patients were referred, after a minimum follow-up period of three months. This information, available only for tuberculosis in 1957, was extended to include all pulmonary diseases in 1958. Special arrangements were made in Glasgow and Edinburgh to collect more detailed information about the clinical assessment as well as the number of active cases of tuberculosis discovered in these Cities.

12. Detailed survey arrangements

The detailed plans for each survey were prepared by the local health authority in consultation with the Department of Health for

Scotland and the appropriate Regional Hospital Board. The general plan involved the establishment of a co-ordinating technical headquarters supported, in Glasgow and Edinburgh, by a number of sector headquarters, each responsible for the day-to-day operation of a number of X-ray units, the interpretation of films, the issue of reports and the reference of patients. An operational guide was printed for the two surveys involving the employment of personnel from outside Scotland. These were distributed in advance to all members of the staff and incorporated every detail of the plan, including the deployment of units, arrangements for supplies, servicing of equipment, processing of film, clerical procedures, methods of coding, recording and other matters such as the conditions of service.

13. Expected tuberculosis yield

Those presenting radiological evidence suggestive of tuberculosis, other than merely the presence of a few calcified spots or an obliteration of the costo-phrenic angle, were classified as "significant" and referred from the mass radiography centre to the local chest clinic for clinical examination, diagnosis, assessment and, if necessary, management. Once a clinical diagnosis of tuberculosis was established, each case was placed in one of the following categories, three months being allowed for the final assessment:-

(i) Active tuberculosis. The standard definition used in Scotland is that the disease should be regarded as active where the condition is infectious or the lesion requires treatment or some modification of the patient's normal course of living.

(ii) Tuberculosis requiring observation.* Cases were placed in this category only when the condition was not considered to be active and when a further period of observation was recommended in the patients' interests.

(iii) Inactive tuberculosis. This category was used only when the pulmonary shadow was confidently considered to be healed and no further supervision was necessary.

From previous experience it was expected that the overall yield of active tuberculosis would be 2 per 1000 examinations, producing rather more than 2,400 new cases over the two years of the Campaign. The yield of "observation" cases was estimated at three times the active figure, producing some 7,200 cases.

14. Bed requirements

When the plans for the two-year Campaign were announced, all Regional Hospital Boards in Scotland were requested to make a special review of their sanatorium provision and to ensure that the maximum number of beds were available when the survey commenced in Glasgow. Chest physicians were asked to make a detailed assessment of all tuberculous patients occupying beds and to discharge those whose progress would not be prejudiced by leaving hospital. At the outset of the campaign, it was possible to create a national pool of 1,250 beds for the immediate reception of survey cases. This provision, together with the vacancies arising through normal

* For definition see footnote on page 69 or Glossary of Terms on page 156.

hospital turnover, was considered sufficient on the assumption that the average duration of stay would be four months. In addition, the thoracic surgical centres were alerted to meet the heavy demand for investigational services which would be required for suspected cases of cancer of the bronchus.

15. Publicity and propaganda services

The publicity and propaganda services were organised by each local health authority with considerable assistance from the Scottish Information Office and the Scottish Council for Health Education. The high public response achieved during the two-year Campaign must, to a large extent, be attributed to the efficiency of these services. They employed an exhaustive range of material and ideas which included banners, posters, loud speaker vans, window displays and bills, Press conferences, notices and articles, leaflets in workers pay packets and with rent demands, library bookmarks, letter seals, motor car sticker labels and letters to householders. Cinema propaganda made use of films from the library of the National Association for the Prevention of Tuberculosis, local and visiting celebrities examined with full publicity cover, radio and television programmes arranged and, in most areas, prizes awarded at random to persons attending the X-ray centres. One of the most successful publicity features was the issue of specially designed badges to those examined and, soon after each survey started, it became the fashion to wear one.

The recruitment of voluntary workers created another opportunity to engage public opinion and to make known, in a simple booklet, the improved outlook for the tuberculous, the value of early diagnosis and the importance, to 99 out of every 100, of knowing that they did not suffer from the disease. Probably one of the best advertisements was the atmosphere of intense activity created by the persistent queues of people at the more prominent X-ray centres. To be X-rayed became the popular thing to do.

TWO-YEAR MASS RADIOGRAPHY CAMPAIGN

SCOTLAND, 1957 - 1958

1. Attendance during Campaign, 1957-58

During the 60 weeks of the Campaign a total of 1,844,268 persons were examined by chest photofluorography in 22 surveys. This result was 50 per cent. higher than the 1,200,000 expected when the programme was planned and it was achieved by a speed of work, by both staff and equipment, not previously thought possible. Details of the attendance, unit performance and response in each survey are given at Appendix 8 and summarised in Table 6a. The attendance at individual surveys ranged from 12,815 in Port Glasgow Burgh to 714,915 in the City of Glasgow, with a median value of 37,508. In 15 of the 22 surveys the number examined was between 20,000 and 60,000.

TABLE 6 a.

Summary of attendance and unit performance in 22 chest X-ray surveys in Scotland, 1957-58

		Attendances at individual surveys		Attendances at all surveys
		Highest	Lowest	
All persons		714,915	12,815	1,844,268
Average per unit per week	Cities (4)	3,928	2,732	3,513
	Burghs (11)	3,974	2,136	3,181
	Counties (7)	2,710	1,762	2,174
	All surveys (22)	3,974	1,762	3,158

2. X-ray unit performance

The X-ray unit performance, that is, the average number of persons examined each week on miniature films by each team, varied substantially from one survey to another (Table 64). In this context "performance" is used as an index of the amount of work done and not as a measure of the efficiency of the units engaged. The highest performance was achieved in Kilmarnock Burgh with a figure of 3,974, the lowest was in Renfrew County with 1,762 and the average for the whole Campaign was 3,158. When the appropriate adjustments are made to take account of the extra sessions provided in the Cities by employing additional radiographer staff from the teaching hospitals and training schools, unit performance in the Cities and Burghs was approximately equal. The much lower figures experienced in the Counties reflect the special problems involved in obtaining a high and rapid response in areas of dispersed population, which necessitated frequent movement of equipment and personnel, and the dissipation of propaganda and publicity services.

When the comparable surveys in the 15 urban areas are considered separately, a significant negative association can be demonstrated, at the $P<0.01$ level, between the number of X-ray units provided per 10,000 of the defined population and the number of persons examined per unit week ($r = -0.671$, SE 0.267). The importance of this observation is not immediately obvious, but it lends support to the impression gained during this Campaign that,

even within the narrow range of X-ray unit provision, the busier units attracted a greater amount of custom.

3. Non-resident attendance

Of the 1,844,268 persons examined 150,236, or 8.1 per cent., were resident outwith the defined survey areas. This contribution to the attendance figures varied from one per cent. in Lanark County to nearly 30 per cent. in Ayr Burgh. It was, unfortunately, not possible to reallocate these persons and to include them, where appropriate, in the survey figures for their areas of domicile.

4. Resident attendance

Of the 1,694,032 residents examined 54,075, or 3.3 per cent., were children under 15 years of age. Although the Campaign was designed to X-ray adults only, and publicity and propaganda directed to this end, children accompanied by their parents were not refused unless there were technical reasons for doing so. The largest contribution made by these children was 6.9 per cent. in Rutherglen Burgh and the smallest, 1.5 per cent., in the City of Edinburgh.

5. Resident adult attendance (response)

After deducting non-residents and children, the number of adult residents examined, referred to as the "response", was 1,639,957, representing 68 per cent. of the defined population for the whole Campaign, or 43 per cent. of the adult population of the whole country. Details of the response and the response rates are given

in Appendix 8, and summarised in Table 7, for the different groups of administrative area included. Of the defined population (that is, adults resident in the survey areas), 59 per cent. were resident in the Cities, 16 per cent. in the Burghs and 25 per cent. in the Counties. These contributed 68, 16 and 16 per cent. of the attendances in the whole Campaign. The highest response rate of 81 per cent. was recorded in Dundee and the lowest of 37 per cent. in Midlothian County. The response rates for the

TABLE 7

Response in 22 chest X-ray surveys in Scotland, 1957-58
(Based on 1957 population estimates)

	Response in individual survey areas						Response in all surveys (number)
	Highest		Lowest		Mean		
	Number	Per cent	Number	Per cent	Number	Per cent	
Cities (4)	622,349	81	106,430	75	278,550	76	1,114,201
Burghs (11)	44,244	78	10,788	60	23,550	68	259,053
Counties (7)	56,841	54	27,163	35	38,100	44	266,703
Campaign (22)	622,349	-	10,788	-	74,503	68	1,639,957

individual surveys are illustrated in Figure 5.

The mean response rates in the Counties, Burghs and Cities show a clear upward gradient. For the reasons already given, the lower rates in the County areas were expected. The difference between the Cities and the Burghs was surprising since it was

TWO-YEAR MASS RADIOGRAPHY CAMPAIGN

RESIDENT ADULT RESPONSE RATES
(Based on 1957 population estimate)

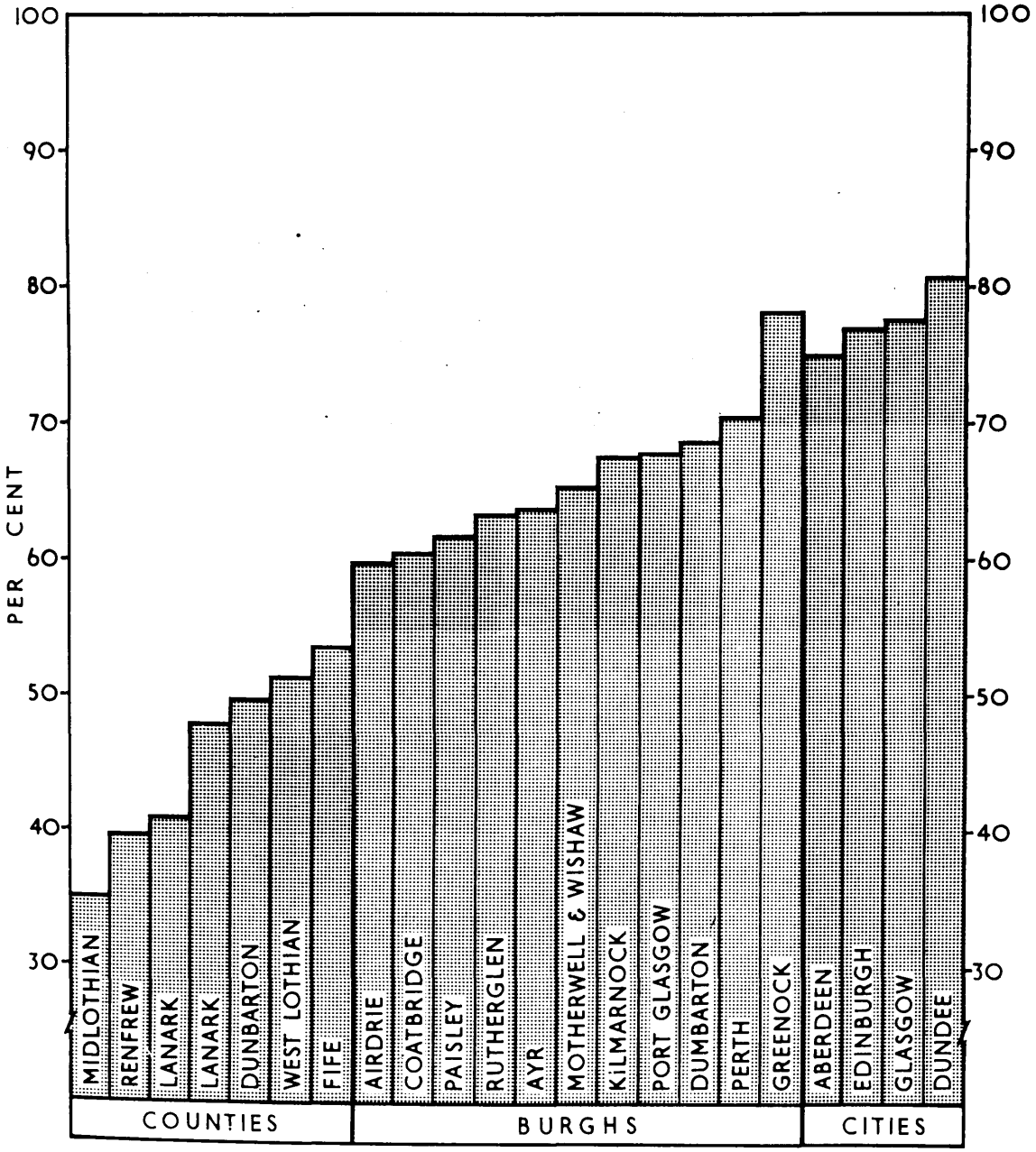

Figure 5.

thought that, given comparable radiological and publicity cover, the smaller urban communities would respond better.

While there was little difference in the amount of X-ray unit time allocated to the two urban groups, the Cities benefited to a greater extent from the more intensive publicity which they were able to attract through the national press, radio and television services. It was, unfortunately, not possible to determine how many persons belonging to the defined populations were examined in areas in which they were not resident and did not, therefore, attend the survey in their own area. Had one-third of those examined in the Cities as non-residents belonged to this category, the response rates in the Cities and the Burghs would have been similar.

6. Factors influencing the response rates

The considerable support given to this Campaign must be attributed to the efficiency of the publicity and the mass radiography services. Added to this was the fact that the rapid completion of each survey made it possible to engage a concentration of effort not previously employed in any mass case-finding programme. The publicity services were primarily responsible for bringing the public to the X-ray centres and their success must be regarded as the cumulative result of all facets of the work. Although some elements of publicity were considered to be of major importance, and while there were variations in degree and emphasis within the comprehensive programme in different areas,

they are not capable of measurement and their relative value must be regarded as a matter of informed opinion. Reference to the outstanding components of this service will be made in a later part of this paper.

The short duration of each survey not only enabled the concentration of publicity effort but ensured that large numbers of the public presented themselves for examination at the outset. The atmosphere of intense activity thus created at the X-ray centres, sited in prominent positions, acted as an encouragement to others. Nor is there any doubt that the staff responded better when the units were busy. The efficiency and speed with which the mass radiography units handled large numbers of the public, and the fact that everyone received a report within three days of examination, did much to create a high degree of confidence in the service.

Some of the other factors which may have influenced the response in different areas have been examined and the results are presented below:-

(i) The level of X-ray unit cover. The level of X-ray unit cover (that is, the number of X-ray units provided for every 10,000 adults resident in each survey area), varied between 2.01 and 4.08. When all of the 22 areas are considered, a small positive association can be demonstrated ($r = +0.415$) between this provision and

the response rates, although this does not achieve statistical significance. The County surveys were, however, different in their character by reason of the relative inaccessibility of the population, the inconvenience of attendance from remote areas, the dispersal of publicity effort and the loss of X-ray time involved in mobile operations. When the 15 urban areas, which can be regarded as comparable survey units, are considered separately, the response rates were not influenced by different levels of unit cover ($r = +0.078$) within the narrow range of provision employed.

(ii) Age and sex compositions of the survey populations.

Since the response rate varied in the different age and sex groups, and was substantially lower among older people, the populations in the survey areas have been studied to ascertain whether, and to what extent, differences in the crude response rates may have been influenced by differences in population distribution. Table 8 shows the proportionate distribution of the adult population in the Cities, Burghs and County aggregates included in the Campaign. While the Cities and Burghs are very nearly similar in this respect the County areas favour a higher response rate in view of the relatively younger population.

TABLE 8

Distribution of the adult population in the City, Burgh and County areas surveyed during 1957-58 (1951 census population)

Age groups (years)	Percentage distribution of adults					
	Cities (4)		Burghs (11)		Counties (5)*	
	Males	Females	Males	Females	Males	Females
15-	8.7	10.2	8.9	10.4	9.4	11.1
25-	9.0	9.8	9.4	10.2	9.0	11.5
35-	9.2	10.2	9.7	10.1	9.4	11.9
45-	11.1	13.4	11.0	12.4	11.3	13.6
60+	7.6	10.9	7.8	10.0	5.8	7.0
All ages	45.6	54.4	46.7	53.3	44.9	55.1
Both sexes	100		100		100	

* Fife County excluded

When the crude response rates are adjusted for age and sex differences in these three groups of survey area, the standardised rates are found to be different by less than two per cent. These rates are compared for all survey areas in Appendix 22 and, for the City, Burgh and County aggregates in Table 9. In no area did the population distribution significantly influence the crude response rates.

TABLE 9

Response rates in City, Burgh and County aggregates standardised to the age and sex composition of the Glasgow (1951 census) population

	Crude response rates	Standardised response rates
Cities	76.4	77.0
Burghs	68.4	69.4
Counties	44.2	45.0

(iii) Attendance of non-residents. The proportion of attendances attributed to non-residents varied between 0.8 and 29.4 per cent. The experience of these surveys suggests that higher response rates were achieved in those places where non-residents contributed a lower proportion of all attendances. While this finding is not apparent when all surveys are considered, an examination of the 15 urban areas reveals a negative association ($r = -0.500$) between the response and the proportion of attendances attributed to non-residents. Since these persons increased the load of work which the X-ray units were expected to carry out, it is of interest to find out whether they forced up the numbers attending or merely prevented residents from being X-rayed by

taking up part of the operational time. A small degree of association ($r = +0.470$) can be demonstrated between the proportion of non-resident attendances and X-ray unit performance. While neither of these correlations is statistically significant, to the $P < 0.02$ level, they suggest that the attendance of people from outside the defined areas not only increased the amount of work done by the units but resulted in lower response rates.

(iv) The experience of tuberculosis incidence and death immediately prior to the Campaign. The survey areas differed materially in the levels of respiratory tuberculosis notification and death which they had experienced in the quinquennium immediately preceding the Campaign, the mean annual rates being between 70 and 217, and between 8 and 39 per 100,000 of the population respectively. Since these indices of prevalence might have induced differing attitudes to the Campaign, a study of the degree of association between them and the response rates has been made. When all of the 22 survey areas are considered, a small positive correlation can be demonstrated between the pre-Campaign levels of notification ($r = +0.345$), and death ($r = +0.399$), and the response rates

experienced. A study of the 15 urban areas, however, does not reveal any association between these pairs of variables. The response rates, therefore, were apparently not influenced by previous tuberculosis experience.

The conclusions to be drawn from these observations are that response was determined by influences other than the level of unit cover, the age and sex composition of the communities or their previous tuberculosis experience. On the other hand, the attendance of persons from outside the survey areas not only made a contribution to the pressure of work but appeared to have an adverse effect on response. While these latter associations do not achieve statistical significance, it is clear that a higher proportion of the defined population could have been examined in some places only by increasing the X-ray service or by curtailing non-resident attendances. For example, the response rates in Kilmarnock and Ayr Burghs could not have been raised much above 70 per cent. since approximately one-third of the time of the units, each operating at the upper capacity limit of nearly 4,000 miniature film examinations per week, was engaged in X-raying non-residents. The significant inverse association between the level of X-ray cover and the performance of the units is not easily explained, in view of the marginal differences in the provision. There was little doubt, however, in the minds of those

engaged in the Campaign, that busy centres not only attracted custom but provided a stimulus to the staff. The experience of these surveys strongly suggests that, in a tuberculosis case-finding programme carried out on these lines, an excess of X-ray cover may well be as great a handicap as too little.

7. Response rates in age and sex groups

Details of the numbers examined and the response rates by age and sex in each survey are recorded in Appendices 9 and 10. These rates are summarised in Table 10 and illustrated in Figure 6, for the aggregates of the Cities, Burghs and Counties separately. Since the County of Fife was not completely covered by the chest X-ray survey it has been omitted from the summary.

TABLE 10

Response by age and sex in 21 survey areas in Scotland (1957-58)
Aggregates for City, Burgh and County areas
(Rates based on 1951 census population)

	Response - per cent.					
	Cities (4)		Burghs (11)		Counties (5)*	
	Males	Females	Males	Females	Males	Females
15-	79.4	80.4	75.7	79.4	45.4	48.8
25-	76.8	77.2	67.1	70.0	41.6	50.3
35-	72.6	77.4	62.5	73.7	43.4	53.3
45-	81.1	84.0	69.7	75.6	44.5	48.6
60+	64.7	65.2	53.3	53.4	31.2	31.8
All ages	75.5	77.0	66.4	70.1	41.8	46.7
Both sexes	76.4		68.4		44.4	

* Fife County excluded

TWO-YEAR MASS RADIOGRAPHY CAMPAIGN

RESPONSE RATES BY AGE AND SEX IN 19 SURVEY AREAS DURING 1957-58.
AGGREGATES FOR CITIES, BURGHS AND COUNTIES.
(PERCENTAGES BASED ON 1951 CENSUS POPULATIONS.)

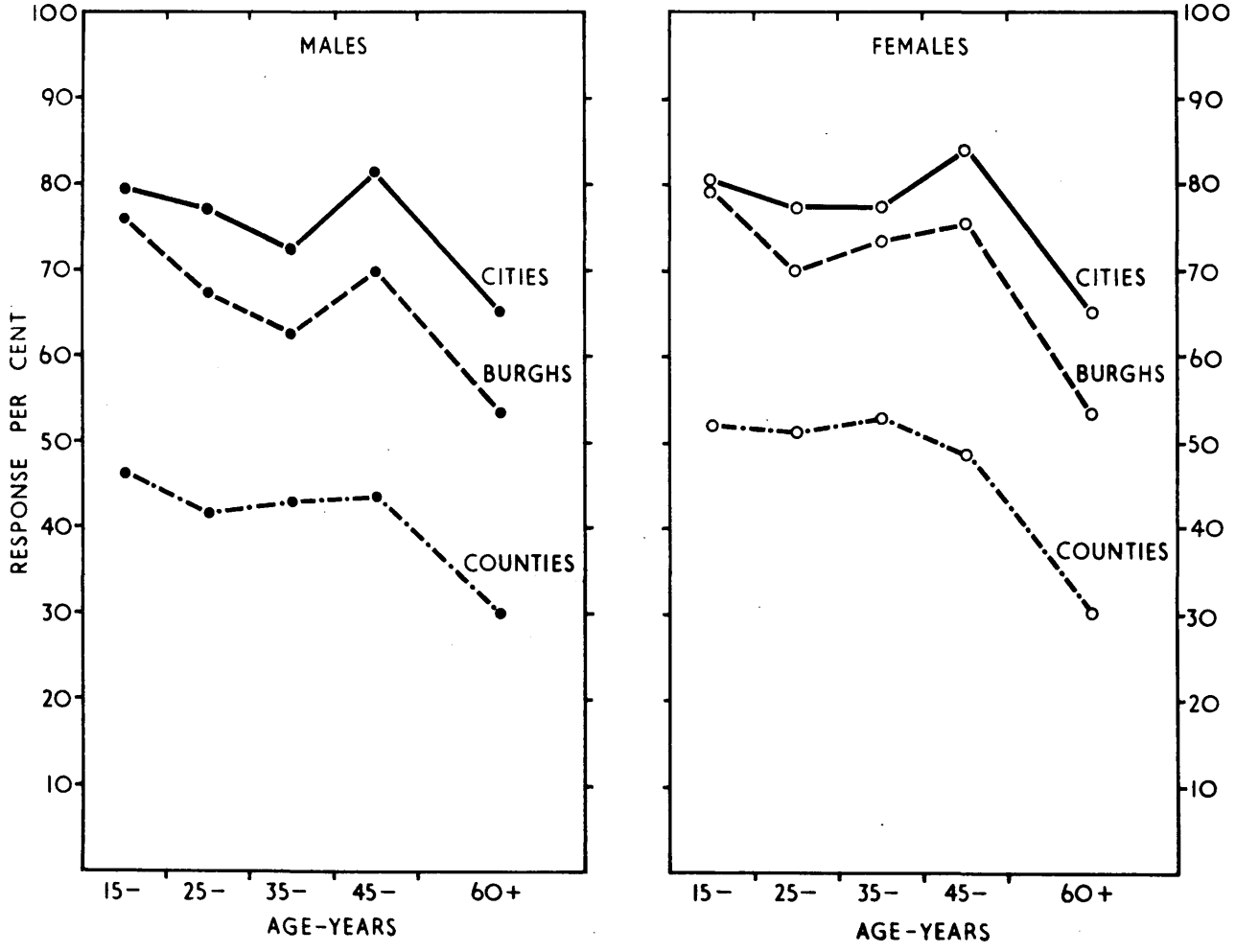

Figure 6.

Apart from the higher response rates in the Cities, a feature of the Campaign was the relatively better support given by women in practically all age groups. The principal areas in which the male response was the greater were Edinburgh, Dundee and Aberdeen, but this was insufficient to divert the City aggregates from the general pattern. The highest response rates were contributed by both men and women belonging to the 15-25 and 45-59 years age groups, the former being greater in the Burghs and the latter in the Cities.

Early in the Campaign it was realised that persons over 60 years of age were providing the poorest response. A special effort was, therefore, made by the propaganda and publicity services to encourage the attendance of older people in the later surveys. As the morbidity figures became available, it became clear that by far the highest yield of pulmonary tuberculosis was being found among older men and that their co-operation was vital to the success of the programme. This finding was in keeping with that of Macgregor (1955) in an earlier study. The intensified propaganda in this direction in Edinburgh and Dundee resulted in the examination of over 70 per cent. of those aged 60 years and over, compared with a response in the earlier surveys in Glasgow of 59 per cent. and in Aberdeen of 64 per cent.

8. Reasons for non-attendance

Immediately following the X-ray survey in the City of Edinburgh a special study, referred to as the Supplementary Survey

was undertaken to ascertain the reasons for non-attendance and the prevalence of tuberculosis among those failing to co-operate (Fletcher et al., 1959). With financial and other assistance from the Department of Health for Scotland and the Royal Victoria Hospital Tuberculosis Trust, this investigation was designed and carried out by a research sub-committee of the Technical Planning Committee for the Edinburgh chest X-ray survey. Consultations with the Tuberculosis Research Office of the World Health Organisation proved helpful in the planning of this study and in the preparation of a Tuberculosis Index for the more detailed long-term evaluation of the results of the mass X-ray survey and of the tuberculosis problem in the City of Edinburgh.

The Supplementary Survey was carried out in the West Leith ward of Edinburgh immediately after the completion of the main survey by one X-ray team using 70 mm. equipment. Population data were specially prepared from the main survey records which were subsequently checked by house-to-house visits. After deducting 262 persons, absent from the area mainly as the result of illness or military service, the available adult population was 13,012, of whom 10,016 or 77 per cent. had been X-rayed during the main survey. Another 1,162 or 8.9 per cent. were examined between December, 1958 and June, 1959 as contacts or as patients at the chest clinic or hospitals in the City. The number X-rayed

during the Supplementary Survey was 526 or 4.0 per cent. of the available population. The total examinations during this period of seven months was, therefore, 11,704 or 89.9 per cent., leaving 1,308 or 10.1 per cent. classified as persistent non-attenders. The reasons for non-attendance, summarised in Table 11, are those obtained by the Health Visitors who undertook the intensive task of visiting all households to seek their co-operation during the Supplementary Survey.

TABLE 11

Reasons for non-attendance in the West Leith ward Edinburgh chest X-ray survey, 1959

	Per cent. of available adults
No reason	4.4
Not contacted	0.6
Frail, Unfit, Sick, etc.	2.0
Special reasons (religious, X-ray hazard, etc.)	0.9
Previously X-rayed	1.4
Previous X-ray claimed but not traced	0.5
Domestic reasons	0.3
	10.1

One of the main conclusions to be drawn from this Supplementary Survey in Edinburgh is that the considerable effort and cost required to raise the response rate by this small amount (from 77 to 81 per cent.) is grossly out of proportion to the results achieved. Reference will be made later to the tuberculosis yield from this study (page 79).

TWO-YEAR MASS RADIOGRAPHY CAMPAIGN

SCOTLAND, 1957 - 1958

Part A. Total tuberculosis yield

1. Collection and presentation of data

As has already been mentioned, all those with a significant pulmonary abnormality revealed on examination by the mass radiography service were referred to the local chest physicians for clinical investigation, assessment and treatment. The "final" diagnosis and classification, on which the morbidity statistics to be presented are based, was made after a minimum follow-up period of three months. Where a diagnosis of tuberculosis was established the disease was classified as "active" or requiring "observation", the sum of these being referred to as the "significant" yield. No further attention is given to tuberculosis cases considered to be healed. With the exception of the Glasgow survey, where special arrangements were made for the collection of morbidity data from the chest clinic service, the information relating to the number of tuberculosis cases found during 1957, and their classification, was obtained from the appropriate Medical Officers of Health co-operating with the local diagnostic services. Because these reports were sometimes incomplete in respect of persons not resident in the survey areas, and therefore not the direct responsibility of the survey authority, arrangements were made, in 1958, to collect all morbidity data from the local chest physicians through the mass

radiography service. This material was then subjected to machine processing by the Department of Health for Scotland. When, for any reason, a patient defaulted at any stage after first attendance, the final diagnosis and assessment was made at the end of the follow-up period on the basis of all the available evidence. These cases are included in the data to be presented but reference will be made to the numbers involved.

Before discussing the morbidity statistics in detail, it is desirable to mention briefly the method of presentation to be adopted. The first part of this section of the paper relates to the yield of cases of tuberculosis regarded as active or requiring observation in the entire Campaign, in aggregates of the City, Burgh and County surveys and in individual survey areas. Reference will be made to the contrast between the actual yield and the figure estimated during the planning of the Campaign. The relationship between the prevalence of new cases found during these surveys and other tuberculosis indices will be studied. This part will also include reference to the bacteriological and radiological findings and will present data relating to defaulters.

The second part of this section will present the tuberculosis findings, analysed by age and sex, in the different survey areas and in selected aggregates. Here again, reference will be made to yield of confirmed cases and to the comparison between the active and observation case rates. The various items of related

data can be easily found by reference to the table of contents incorporated in the facing sheets which precede each main section of the paper.

The yield of new and previously known cases of tuberculosis, regarded as active or requiring observation, in each of the 22 survey areas is presented in Appendix 11 and summarised, for the whole Campaign, in Table 12. The crude and standardised rates for each of the survey areas, are reproduced in Appendix 23.

TABLE 12

Tuberculosis yield during the two-year mass radiography Campaign in Scotland, 1957-58

Rates per 1000 persons examined

Respiratory tuberculosis		New cases					Previously known cases ≠
		Residents			Non-residents x	Total	
		Males	Females	Both sexes			
Active	Number	2,384	1,649	4,033	295	4,328	-
	Rate	3.22	1.83	2.38	2.07	2.35	-
Requiring observation	Number	4,178	3,042	7,267	499	7,766	1,699
	Rate	5.45	3.33	4.29	3.66	4.29	1.03

x Eighteen surveys. ≠ Twenty surveys (residents).

2. Active tuberculosis yield from the entire Campaign

The final yield of active cases, identified for the first time, was 4,328, or 2.35 per 1000 persons examined. Since the data were incomplete for non-residents in four surveys, the actual total is likely to have been about 4,340. Of these 4,033, or 2.38 per 1000, were resident in the defined areas and 3,988, or 2.43 per 1000, were adults.

3. Yield of tuberculosis requiring observation from the entire Campaign

The final yield of new cases in this category was 7,766, or 4.29 per 1000, persons examined. Since the data were incomplete for five of the surveys, this figure is likely to have been nearer 7,850. Of these 7,267, or 4.29 per 1000, were resident in the defined areas and 7,235, or 4.35 per 1000, were adults.

4. Previously known cases of tuberculosis

Excluding two of the smaller surveys, the total yield of cases of previously known tuberculosis was 1,699, or 1.03 per 1000, persons examined. This represents less than five per cent. of the number of registered* cases and about 15 per cent. of all the significant cases found in the survey areas. Although the attendance of such patients was discouraged by personal letter in the later surveys, this seems to have made little difference to the numbers submitting themselves to examination.

5. Estimated and actual tuberculosis yield

A comparison between the estimated and actual response and the tuberculosis yield among adults in the 22 survey areas is made in Table 13. The expected figures are those calculated for planning purposes prior to the start of the Campaign.

* Registered cases are those registered by the local health authority, under Statute, as suffering from or under supervision for tuberculosis.

TABLE 13

Expected and actual response and tuberculosis morbidity in the survey populations

		Adults resident in survey areas		Difference A/E Per cent.
		Estimated	Actual 1957-58	
Attendance		1,200,000	1,639,957	+ 37
Active tuberculosis	New cases	2,400	3,988	+ 66
	Rate/1000	2.0	2.43	+ 22
Observation tuberculosis	New cases	7,200	7,235	-
	Rate/1000	6.0	4.35	- 27

Both the response and the yield of new active cases substantially exceeded expectation. The number of active cases in excess of expectation can be attributed to the considerably higher morbidity in the City of Glasgow, without which the active yield would have been 1.62 compared with 2.43 per 1000 for all surveys. The rate for new active cases throughout the whole Campaign was 22 per cent. and the actual number 66 per cent. higher than expectation. In contrast, the number of cases requiring observation was very close to the anticipated yield, the rate being 27 per cent. less than expected. Further, the proportion of significant cases allocated to the active group was less than one in three, compared with an expectation of one in four.

6. Active and observation cases found in the survey areas

Details of the number and rate of new active and observation cases found in each survey area are contained in Appendix 11 and illustrated in Figure 7.

TABLE 14

Response and tuberculosis yield among adults resident in the Cities, Burghs and Counties

Rates per 1000 adults examined

	Adult residents							
	Response		Respiratory tuberculosis survey yield					
			Active cases			Observation cases		
	Number	Per cent.x	Number	Rate	Per cent.x	Number	Rate	Per cent.x
Glasgow	622,349	38	2,337	3.76	59	4,120	6.62	57
Other three Cities	491,852	30	891	1.81	22	1,887	3.84	26
Burghs	259,053	16	385	1.49	10	559	2.16	8
Counties	266,703	16	375	1.41	9	669	2.51	9
Campaign	1,639,957	100	3,988	2.43	100	7,235	4.35	100

x Per cent. of Campaign total.

Burgh

A summary of the City/and County aggregates for adults is reproduced in Table 14. This shows the extent to which the survey in the City of Glasgow dominated the Campaign - both in terms of the numbers examined, amounting to nearly 40 per cent., and the number of cases of tuberculosis found, amounting to nearly 60 per cent., of the total for the two years. The four Cities,

TWO-YEAR MASS RADIOGRAPHY CAMPAIGN

YIELD OF SIGNIFICANT TUBERCULOSIS (NEW CASES)
RATES PER 1000 EXAMINED

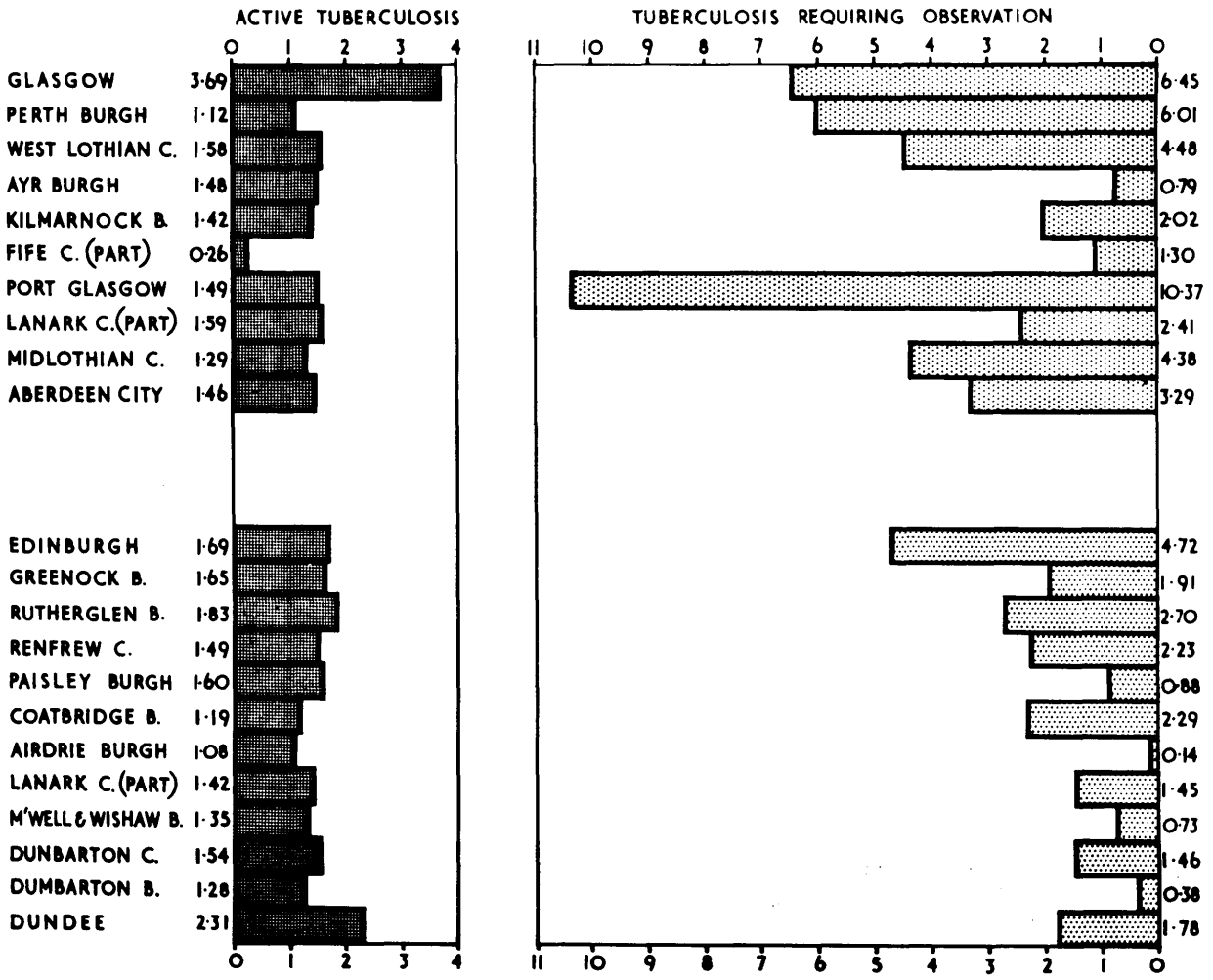

Figure 7.

comprising nearly 60 per cent. of the population of the survey areas, contributed nearly 70 per cent. of the attendances and over 80 per cent. of the new significant cases found. Even when Glasgow is excluded from the City aggregate, the mean rates for active tuberculosis showed a progressive increase from 1.41 in the Counties to 1.49 in the Burghs and 1.81 in the Cities. The rate for observation cases was again highest in the three Cities with a figure of 3.84, but lowest in the Burghs where 2.16 cases were discovered for every 1000 adults examined.

For residents of all ages, 19 of the 22 surveys produced yields of between 1.08 and 1.69 cases of active tuberculosis per 1000 persons examined; of the others Glasgow produced 3.69, Dundee 2.31 and Fife County 0.26. The identification of cases requiring observation varied considerably without any significant association with the rates of yield of active cases ($r = +0.227$, $SE = 0.229$). This lack of correlation, to which further reference will be made, must be attributed to the difficulties with which the physicians were faced in allocating a proportion of borderline cases* to either of these groups. New cases allocated to the observation group were found among 4.29 per 1000 examinations

* The definition of tuberculosis requiring observation presented considerable difficulty. It was not possible to be more precise than to recommend that this classification should be used in cases presenting a radiological pulmonary infiltration or other intra-thoracic abnormality, considered to be of tuberculous origin, which could not, on the one hand, be regarded as active but, on the other, consisted of more emphatic evidence of disease than merely a few calcified spots or an obliteration of the costo-phrenic angle.

throughout the whole Campaign, the highest yield being 10.37 in Port Glasgow Burgh and the lowest 0.14 in Airdrie Burgh. The proportion of significant cases classified as active also varied considerably, from 13 per cent. in Port Glasgow Burgh to 89 per cent. in Airdrie Burgh, the average for the whole Campaign being 36 per cent. The results show that an increasing proportion of the new significant cases were allocated to the active group and that the rate of identification of patients requiring observation fell as the Campaign progressed.

7. Relationship between the survey yield and other indices of tuberculosis prevalence

The indices of tuberculosis prevalence in common use at the present time are the rates of death and new notifications reported to the Registrar General and to Medical Officers of Health of local health authorities respectively. Less frequently, the number of patients registered as under treatment or supervision and, more recently, the frequency with which school children are found to produce a tuberculin skin reaction, have been employed. This later information has become available on an increasing scale since the introduction of the B.C.G. vaccination programme in 1954, for children about to leave school.* Although each of these indices reflects an accumulation of experience over a

* Although a general authorisation for the B.C.G. vaccination programme for school leavers was issued in 1953 (D.H.S. Circular 74/53), and a few authorities had already introduced approved schemes in 1952, the arrangements were not applied on any scale until 1954.

considerable period, they provide the only measures of the extent of the tuberculosis problem in any area in the United Kingdom. The yield of tuberculosis from the two-year Campaign also reflects past experience, since the majority of the cases found were undoubtedly the product of infection acquired many years earlier. Many of them must also have been suffering from active disease for some time before the condition was identified. Since the response rates were unusually high by comparison with previous experience in this or, indeed, in any other country with the possible exception of some areas in the United States and, since the rates of tuberculosis mortality and morbidity were used in the selection of the high prevalence areas for survey, it is proper to study the results now obtained in relation to these indices of past tuberculosis experience. In this study, the survey in Fife has been excluded since only a part of the County was covered. The data from the Lanark survey, completed in two parts, has been aggregated with the result that the following comparisons relate to 20 local authority areas. Since information relating to the infection levels* is not available for Lanark County and Rutherglen Burgh, these areas have been excluded from that aspect of the study. Details of the survey yields, the notification, registration and death rates, and the infection levels are presented in Appendix 16.

* The "infection level" is the proportion of school children reacting to the tuberculin skin test at 13 years of age. The test most commonly employed during the period 1954-56 was the Mantoux test (ten I.T.U.).

Considering first the indices in current use, significant degrees of association ($P < 0.01$) can be demonstrated between the death, notification and registration rates for respiratory tuberculosis experienced in the survey areas during the period immediately before the Campaign commenced. The coefficients of correlation (r) and standard error are tabulated below. The infection levels, on the other hand, show little positive association with these indices and must be regarded as unsatisfactory measures of tuberculosis prevalence in their present form.

Associations	r	SE
Notification rate - death rate	+ 0.586	0.229
Notification rate - registration rate	+ 0.769	
Death rate - registration rate	+ 0.587	

This latter observation was surprising, since the infection levels are usually regarded as a satisfactory, indeed the most sensitive, index of the amount of tuberculous infection in the community. The result is in contrast with that of Palmer et al. (1956), who demonstrated a high correlation between the tuberculosis death rates and the percentage of tuberculin reactors among young adults in the United States of America. This unexpected finding may be attributed to differences in the standards of assessment of tuberculosis cases and of the

tuberculin findings. The influence of selection in determining which children volunteered for tuberculin testing under the B.C.G. vaccination programme and the likelihood that older children were included in the scheme during the first year or two of its operation, would also tend to vitiate the results.

When the rates of survey yield are considered in relation to the indices of tuberculosis prevalence mentioned above, the degrees of association demonstrated are disappointingly low. The correlation between the aggregate yield of active and observation cases and the notification rates in the survey areas is significant to a level of $P < 0.01$ ($r = +0.568$, $SE = 0.229$), while neither of the components reach the $P < 0.02$ level. Neither the active rates nor the aggregate rates comprising the active and observation survey yield are associated to a significant degree with the registration or death rates or with the infection levels. The coefficients of correlation and the standard errors of these associations are reproduced in Appendix 17.

It is difficult to explain why the survey areas did not produce yields of active cases in proportion to their previous levels of tuberculosis experience. Reference will be made, however, to the fact that the age and sex composition of the cases and the quality of disease found in these surveys differed from that of the notifications in the pre-Campaign years; but this was a universal finding and was obtained by the same physicians in

both events. The most likely explanation is that the type of lesion presented to the chest physicians as the result of these surveys was different from the usual run of cases, and that more difficulty was experienced in allocating patients to the active and observation groups. This view is supported by the significant association demonstrated when the aggregate of those groups is related to the rates of confirmed notifications. The conclusion from this study would seem to be that the best index of the probable yield of tuberculosis from this type of survey is obtained from the recent rates of notified cases rather than any of the other current indices of prevalence. A prediction on this basis would, however, measure the total tuberculosis yield and not necessarily what the physicians regard as active disease.

Before going on to consider the age and sex characteristics of the tuberculosis yield, it is desirable to present some supplementary information relating to the crude results reported above. In particular, reference will be made to the bacteriological and radiological findings. It is also convenient to consider, at this stage, the important group of defaulters and the contribution made by these patients to the morbidity results.

8. Bacteriological findings

The findings reported here are those obtained from the chest physicians of the four Cities and from the Medical Officers of Health of all other areas involved in the Campaign. The latter

received this information, together with other relevant data, concerning each patient through the system of intimation.* While the methods of recording the bacteriological results were defined, no special arrangements were made to ensure the use of standard techniques in the collection or laboratory investigation of specimens. The methods in routine use throughout the country were considered satisfactory, even if minor deviations in procedure were employed in different areas.

Of the 4,033 new cases of tuberculosis identified among residents in the survey areas, 1,131, or 28 per cent., were confirmed bacteriologically during the three months period of observation permitted. This yield is equivalent to 0.67 per 1000 persons examined, the rates varying between 0.99 in Kilmarnock Burgh and 0.11 in Fife County. The proportion of active cases which were confirmed ranged from 70 per cent. in Kilmarnock Burgh to 17 per cent. in Greenock Burgh. Details for each survey are reproduced in Appendix 11.

Sufficient information is available from the four Cities to compare the bacteriological status of patients identified during

* The system of intimation was in use in Scotland during the period of the Campaign. This provided for the submission of details of each patient found to be suffering from active tuberculosis for the first time, by the consultant making the diagnosis, on a standard form (Form 7B), to the Medical Officer of Health. This procedure was supplementary to statutory notification and provided a summary of personal details, method of discovery, bacteriological and radiological findings and the disease classification.

the surveys with those found during the normal operation of the tuberculosis services in these areas. Since the number of persons X-rayed in the City surveys represents 68 per cent. of the total for the whole Campaign, the contrast between the pre-survey and survey findings can be accepted as representative of general experience. This comparison, summarised in Table 15, has been made, using the information relating to new cases of respiratory tuberculosis submitted to Medical Officers of Health through the intimation procedure as the measure of experience in 1956. It will be seen that this information was obtained in respect of nearly all patients notified in Edinburgh, Aberdeen and Dundee. In

TABLE 15

Bacteriological findings in the four City surveys compared with those reported during 1956

Survey area	Confirmed notifications 1956			Active survey yield 1957 and 1958		
	Statutory notifications	Intimations per cent	Per cent confirmed	Number	Confirmed	
					Number	Per cent
Glasgow	1,732	24.7	47.2	2,369	523	22.1
Aberdeen	190	96.8	71.2	162	72	44.4
Edinburgh	603	94.2	47.4	473	194	41.0
Dundee	219	97.7	56.1	259	90	34.8

Glasgow, although only one quarter of the notified cases were reported in this way in 1956, the results are comparable with those of earlier years and are believed to reflect the general experience in that City. These findings closely approximate to the regional experience reported by Macgregor (1957).

While the proportion of new notifications of respiratory tuberculosis confirmed bacteriologically in the pre-Campaign period in Edinburgh and Glasgow were similar, the figures for Aberdeen and Dundee were substantially higher, although at different levels from each other. In each case the survey yield of confirmed cases is substantially below expectation on the basis of this earlier experience, this difference being greatest in Glasgow (25 per cent.) and least in Edinburgh (6 per cent.). These findings are in keeping with the expressed intention of the Campaign, namely, to find the disease at an early stage, if possible before it had become infectious to others. On the other hand, it seems likely that the considerably higher load of clinical work which fell on the chest clinics following these surveys affected the results by promoting the immediate use of anti-tuberculosis drugs before full bacteriological investigation had been completed. There seems little doubt that this practice, which is being routinely employed on an increasing scale as a measure of treatment or chemoprophylaxis, was responsible for artificially reducing the level of bacteriological confirmation which would have been demonstrated in the absence of early drug treatment.

The yield of confirmed cases in these surveys was not predictable from any of the other morbidity data. A small positive association with the rate for active cases found in the survey areas is demonstrated ($r = +0.400$, SE = 0.229), but this does not achieve statistical significance. No significant correlation can be demonstrated between the rates for confirmed cases and the aggregate of the active and observation survey yields ($r = +0.152$, SE = 0.229), or with previous experience of the notification ($r = -0.142$, SE = 0.229), or death rates ($r = -0.281$, SE = 0.229). Reference will be made in a later part of this paper (page 100) to the proportion of cases confirmed bacteriologically at different ages in the two sexes.

9. Radiological findings

Information relating to the radiological extent of the disease among residents classified as suffering from active tuberculosis during the surveys in Glasgow, Aberdeen and Dundee has been abstracted for comparison with the experience of new notifications in 1956. The Edinburgh survey data were classified according to the system in current use in the United States and is not comparable with other Scottish material. The latter results, reported by Seiler et al. (1958), show that the yield of new cases from the survey in that City comprised a significantly smaller proportion of advanced cases among adult males ($P < 0.001$) and for the aggregate of both sexes ($P < 0.005$), when compared with the

notification data for 1957. Similar differences were found when the presence of lung cavitation was compared in these two groups. For females the differences were not significant.

The radiological extent of the disease identified in the Glasgow, Edinburgh and Aberdeen surveys, has been measured by the proportion of cases presenting lesions in one or both lungs. An interpretation based on such a classification has severe limitations since it does not measure the amount of lung tissue involved. The findings suggest, however, that a slightly higher proportion of cases were classified as unilateral in the surveys compared with the findings from the 1956 notification data. In Glasgow and Dundee, the proportion of survey cases in which the disease was confined to one lung was 62 and 67 per cent., compared with 56 and 65 per cent. respectively among notified patients in 1956. These proportions were similar in Aberdeen.

10. Prevalence of tuberculosis among persons failing to co-operate during the mass radiography Campaign

It has been stated that one of the major defects of the community X-ray survey lies in the fact that the prevalence of tuberculosis is likely to be higher among those who do not co-operate. One of the principal objects of the Supplementary Survey carried out in one of the municipal wards in Edinburgh (Fletcher et al., 1959) was to find out whether or not this suggestion had any substance. Reference has been made to this

study in an earlier part of this paper (page 58). During the Supplementary Survey, 526, or one-quarter of the 2,156 adults who had failed to attend the main survey or the other examinations carried out in association with it, were persuaded to be X-rayed. Three new cases of active tuberculosis and 12 requiring observation were found. While it is impossible to draw firm conclusions in view of the small response, the results show that the male prevalence of all forms of tuberculosis among those not examined during the main survey was significantly higher at all ages when compared with the survey case yield. For active disease the difference was statistically significant only between 35 and 64 years of age. Among females the only group showing a significantly higher prevalence in the Supplementary Survey were those aged 65 years and over.

11. Defaulters

No special arrangements were made until the start of the 1958 programme to collect routine data relating to those who failed to attend, when invited to do so, at any stage after their first examination by the mass radiography service. Persons were classified as defaulters at two stages, first, when they failed to keep an appointment at a recall unit for a full size chest radiograph and, second, when they failed to attend the local chest clinic for clinical consultation. The former group was

artificially exaggerated by the fact that many people examined at the end of a survey were unable to keep appointments before the recall units were withdrawn. At the end of each survey, the photofluorograms of each defaulter were re-scrutinised and particulars of all those in whom the presence of significant pulmonary disease was confirmed were referred to the local chest clinic. While the number failing to keep an appointment at a recall centre indicates the amount of difficulty experienced in obtaining immediate co-operation at this stage, it does not measure the loss from persistent default. Further, the amount of additional work which these surveys entailed made it impossible for the clinical and public health services to complete their full pressure on all who failed to attend at the chest clinics for further assessment within the prescribed follow-up period. No attempt was made to follow up patients referred direct to their general practitioners for cardiac and other non-pulmonary conditions.

Of the 27,983 persons recalled for examination on large films of the chest during the 1958 programme, 677, or 2.4 per cent., failed to attend. Of these, 385, or 1.5 per cent., presented radiographic evidence of respiratory tuberculosis. During this period 10,655 persons were referred to local chest clinics and of these, 560, or 5.3 per cent., had failed to attend within a period of three months. The number of defaulters regarded as

tuberculous (active or requiring observation) at this stage was 299, or 2.8 per cent. of those referred. Thus, 4.4 per cent. of the total yield of significant cases of tuberculosis failed to present themselves for clinical consultation, within the prescribed follow-up period, during 1958. A summary of these findings is reproduced in Table 16.

TABLE 16

Defaulters during the 1958 survey programme
(Residents and non-residents)

<table>
<tr><td colspan="4">Attendances</td><td>757,869</td></tr>
<tr><td colspan="4">Recalls (all diagnoses)</td><td>27,893</td></tr>
<tr><td colspan="3" rowspan="2">New tuberculosis cases found (including defaulters)</td><td>Active</td><td>1,262</td></tr>
<tr><td>Observation</td><td>2,083</td></tr>
<tr><td rowspan="5">Defaulters</td><td colspan="2" rowspan="2">At recall units</td><td>Tuberculosis cases</td><td>385</td></tr>
<tr><td>Other diagnoses</td><td>292</td></tr>
<tr><td rowspan="3">At chest clinics</td><td rowspan="3">Tuberculosis cases</td><td>Active</td><td>28</td></tr>
<tr><td>Observation</td><td>164</td></tr>
<tr><td>Inactive</td><td>107</td></tr>
<tr><td colspan="2">Other diagnoses</td><td>261</td></tr>
</table>

TWO-YEAR MASS RADIOGRAPHY CAMPAIGN

SCOTLAND, 1957 - 1958

Part B. Tuberculosis yield in age and sex groups

Full details of the tuberculosis yield of new cases in age and sex groups for each area included in the 1957-58 programme of community X-ray surveys are presented in Appendices 12 to 15 and summarised in a number of tables to be presented in this section of the paper. The rates are expressed as the number of patients found among every 1000 of the resident population examined.

12. Tuberculosis yield from the entire Campaign

The age and sex specific rates for active tuberculosis and for tuberculosis requiring observation are illustrated in Figures 8 and 9 while the rates, numbers and distribution of cases found during the whole Campaign are summarised in Table 17.

The rates for active disease were 3.22 for males and 1.83 for females. For disease requiring observation, the corresponding figures were 5.48 and 3.31. The excess among males, due to the substantially higher yield over the age of 35 years for both types of case, was found in all areas with the exception of West Lothian and Fife.

Active disease among men was found with increasing frequency with advancing age, the rates progressing in an almost straight line from 2.11 among those aged 15-24 years to 4.90 among those of 60 years and over. Among women, the position was reversed although here the fall was not pronounced until the age of 35 years was reached. The rates, corresponding to those for men, were

TABLE 17

Tuberculosis Campaign Yield

New cases among residents during 1957 and 1958

Age groups	Active cases			Observation cases			Per cent active
	Rate per 1000	Number *	Per cent	Rate per 1000	Number *	Per cent	
Males							
-15	0.95	26	0.6	0.58	16	0.2	61.9
15-	2.11	322	8.0	1.74	265	3.5	54.9
25-	2.50	372	9.2	3.63	540	7.4	40.8
35-	2.75	399	9.9	5.20	755	10.4	34.6
45-	4.00	761	18.9	8.25	1,571	21.6	32.6
60+	4.90	504	12.5	10.28	1,057	14.5	32.3
All Males	3.22	2,384	59.1	5.48	4,204	57.9	36.2
Females							
-15	0.72	19	0.5	0.61	16	0.2	54.2
15-	2.34	463	11.5	1.83	328	4.5	58.2
25-	2.36	396	9.8	4.09	686	9.4	36.7
35-	2.13	373	9.2	4.25	743	10.2	33.4
45-	1.21	284	7.0	3.58	842	11.6	25.4
60+	0.79	113	2.8	3.14	447	6.2	20.2
All Females	1.83	1,649	40.9	3.31	3,063	42.1	35.0
Both sexes	2.38	4,033	100	4.29	7,267	100	35.7

* Excludes two female cases - age not stated.

2.34 at 15-24 years and 0.79 over 60 years of age. Over this age range the rates for men were more than doubled while those for women were more than halved. A feature of the Campaign was the low rate of discovery of patients among those under 15 years of

TWO-YEAR MASS RADIOGRAPHY CAMPAIGN

ACTIVE RESPIRATORY TUBERCULOSIS

SURVEY YIELD PER 1000 ADULT RESIDENTS EXAMINED IN THE FOUR SCOTTISH CITIES

AGE AND SEX SPECIFIC RATES

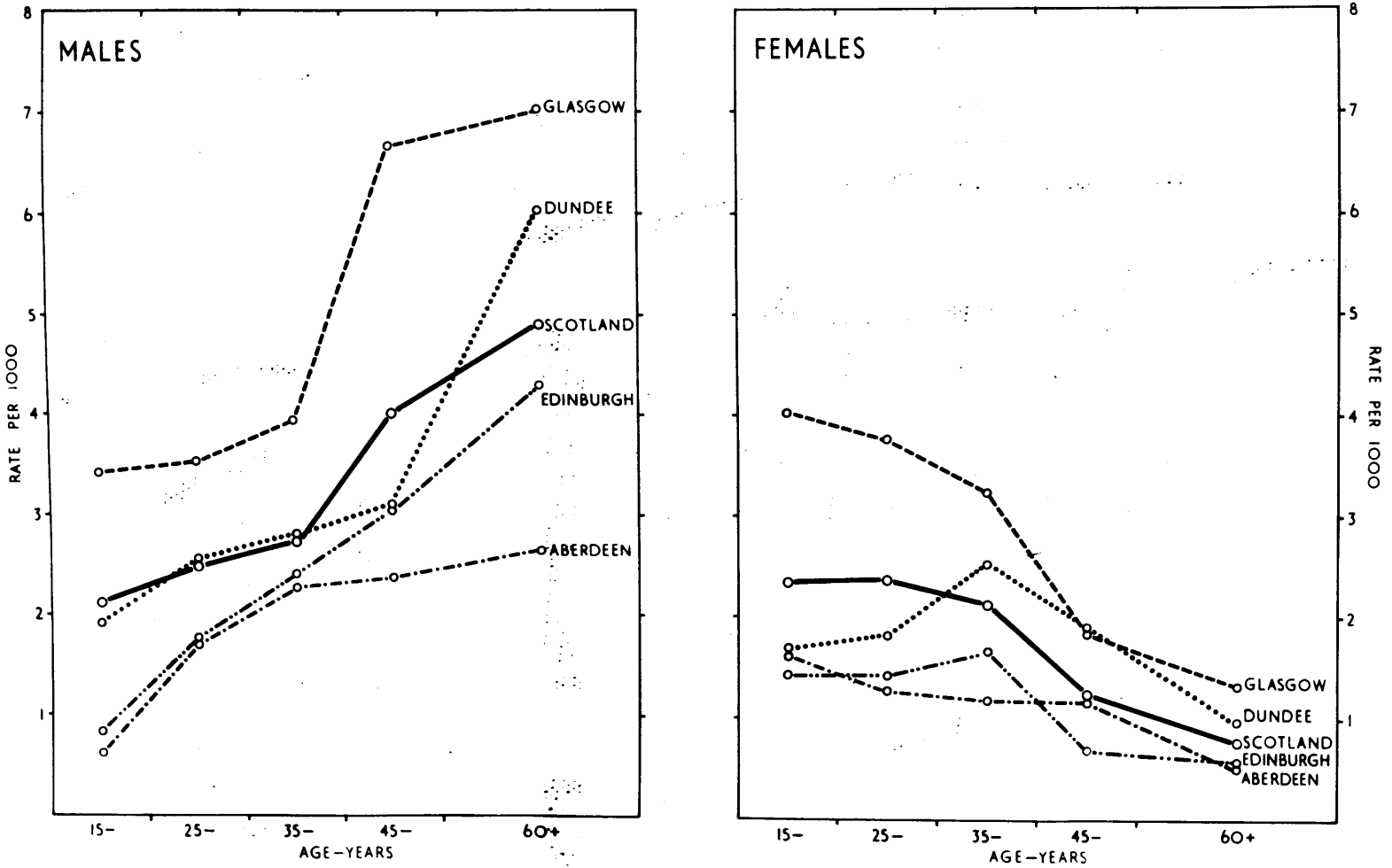

Figure 8.

age. Only 45 active cases were identified among the 54,075 children of both sexes examined, the rate being 0.83. Of these children, 32 were reported in Glasgow.

Tuberculosis requiring observation was also found most frequently among older men, the rates advancing steadily from 1.74 among those aged 15-24 years to 10.28 among those over 60 years of age. The rates for women differed in their age distribution and the shape of the curve contrasted with that for female active cases. The lowest rate of 1.83 in the 15-24 age group was followed by an increase to 4.09 and 4.25 in the middle age range and a reduction to 3.14 among those aged 60 years and over. Here again, the rate of identification among children was low, only 32 cases being found among both sexes at a rate of 0.59 per 1000 examined.

The most profitable sources of new cases were older men and younger women. Rather less than two-thirds of all the active cases found were males and about one-third were men of 45 years or over. More than half of the male active patients were 45 years of age or over and nearly three-quarters of the females were between 15 and 44 years of age. A rather higher proportion (63 per cent.) of the male observation cases belonged to the older group and a lower proportion of female cases (57 per cent.) were young adults.

The proportion of patients allocated to the active and observation groups showed a distinct association with age, the

TWO-YEAR MASS RADIOGRAPHY CAMPAIGN

RESPIRATORY TUBERCULOSIS REQUIRING OBSERVATION

SURVEY YIELD PER 1000 ADULT RESIDENTS EXAMINED IN THE FOUR SCOTTISH CITIES

AGE AND SEX SPECIFIC RATES

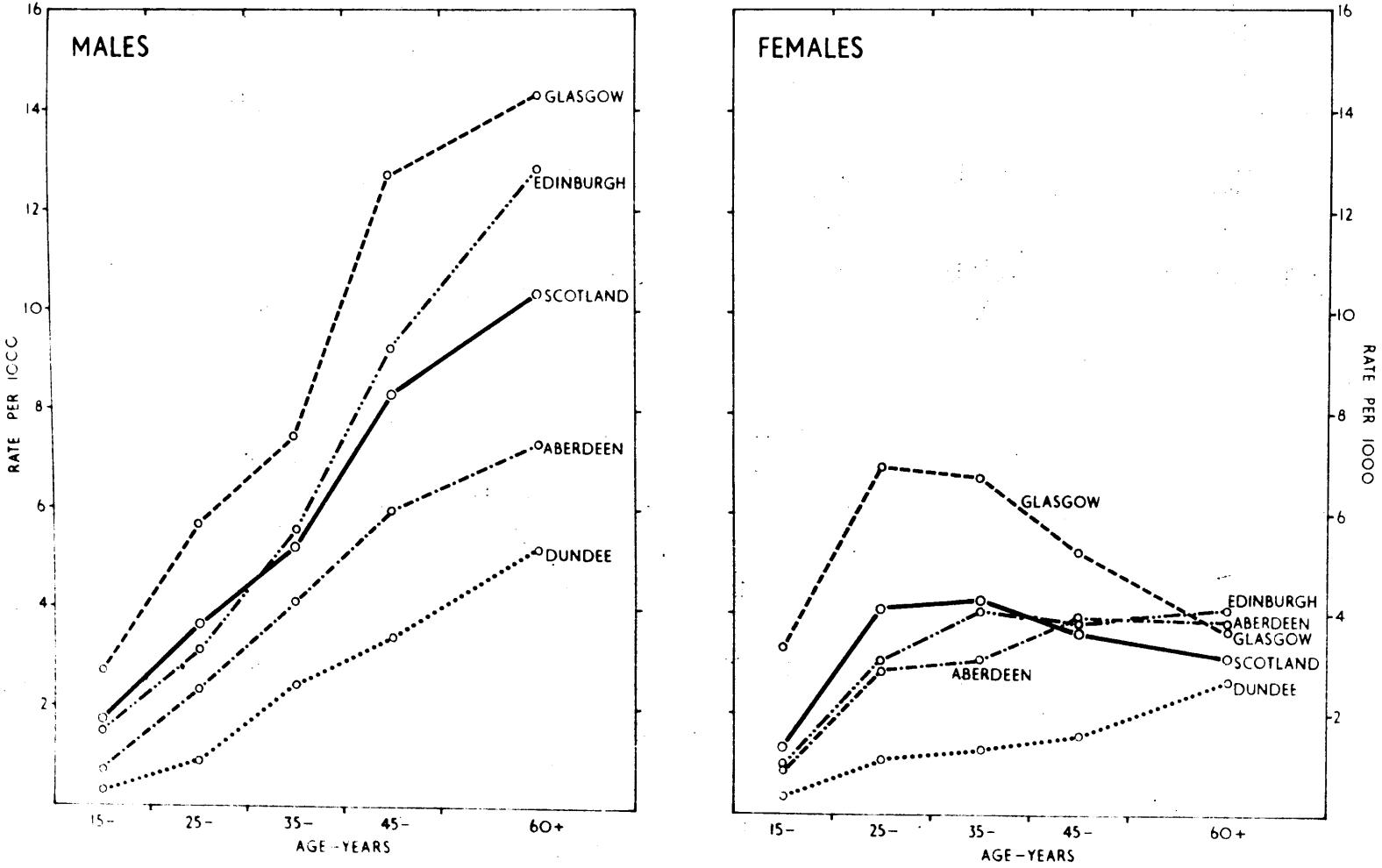

Figure 9.

figure decreasing with increasing years. Over the whole Campaign, approximately one-third of those presenting significant evidence of respiratory tuberculosis were classified as active, the proportion being almost equal in both sexes. Among men the proportion fell from 55 to 32 per cent. and among women, from 54 to 20 per cent. of the significant yield between the youngest and oldest adult age groups. While this finding suggests that the severity of the disease varied with age, it is not unlikely that it was influenced by the tendency among physicians to regard the prognosis more seriously among younger people.

13. Active tuberculosis yield from the City surveys

The yield of new cases of active tuberculosis in the Cities is tabulated, in age and sex groups, in Appendices 12 and 13 and illustrated in Figure 8. Considering first the yield among men, experience in each of these surveys was similar in that the rates increased progressively with advancing years. At every age, however, the yield was substantially higher in Glasgow, followed in order by Dundee, Edinburgh and Aberdeen. Another difference was the extent to which the rates advanced over the adult age span. In Edinburgh, the yield in the oldest age group was five times that among the youngest adults, the comparative figures for Aberdeen, Dundee and Glasgow being four, three and two times respectively. In Edinburgh and Aberdeen the increase in the rates was greatest in young adult life, while in Glasgow and Dundee they advanced most steeply after 35 years of age.

The age distribution of the yield of active cases among women was different in each of the Cities. Although the rates in Glasgow were two or three times higher than those in Aberdeen, experience in both was comparable in that there was a progressive reduction with increasing age. The yield in the oldest group was about one-third of that in the youngest in both cases, while the rate of reduction with advancing years was rather faster among younger and older women in Aberdeen, and in mid-adult life in Glasgow. In Edinburgh and Dundee the rates, and their distribution, were different from those already mentioned, but similar to each other in that there was a peak of prevalence in the 35-44 age group in both cases, this being much more clearly defined in the latter City.

14. Active tuberculosis yield in the Burgh and County surveys

The survey yield of new cases of active tuberculosis, at different ages in the two sexes, in the Burgh and County aggregates are illustrated in the histograms in Figure 12. The rates for a number of the individual areas are illustrated in Figure 10. The Burgh aggregates followed the general pattern for male active cases, the rates increasing progressively with age, while the County aggregates presented a slight but ill-defined tendency in this direction. Both these aggregates illustrate the progressive fall, with increasing age, in the rates for females. The rates for the Cities, Burghs and Counties surveys, reproduced in Table 18, illustrate these trends.

ACTIVE RESPIRATORY TUBERCULOSIS

SURVEY YIELD PER 1000 RESIDENTS EXAMINED IN SELECTED AREAS

AGE AND SEX SPECIFIC RATES

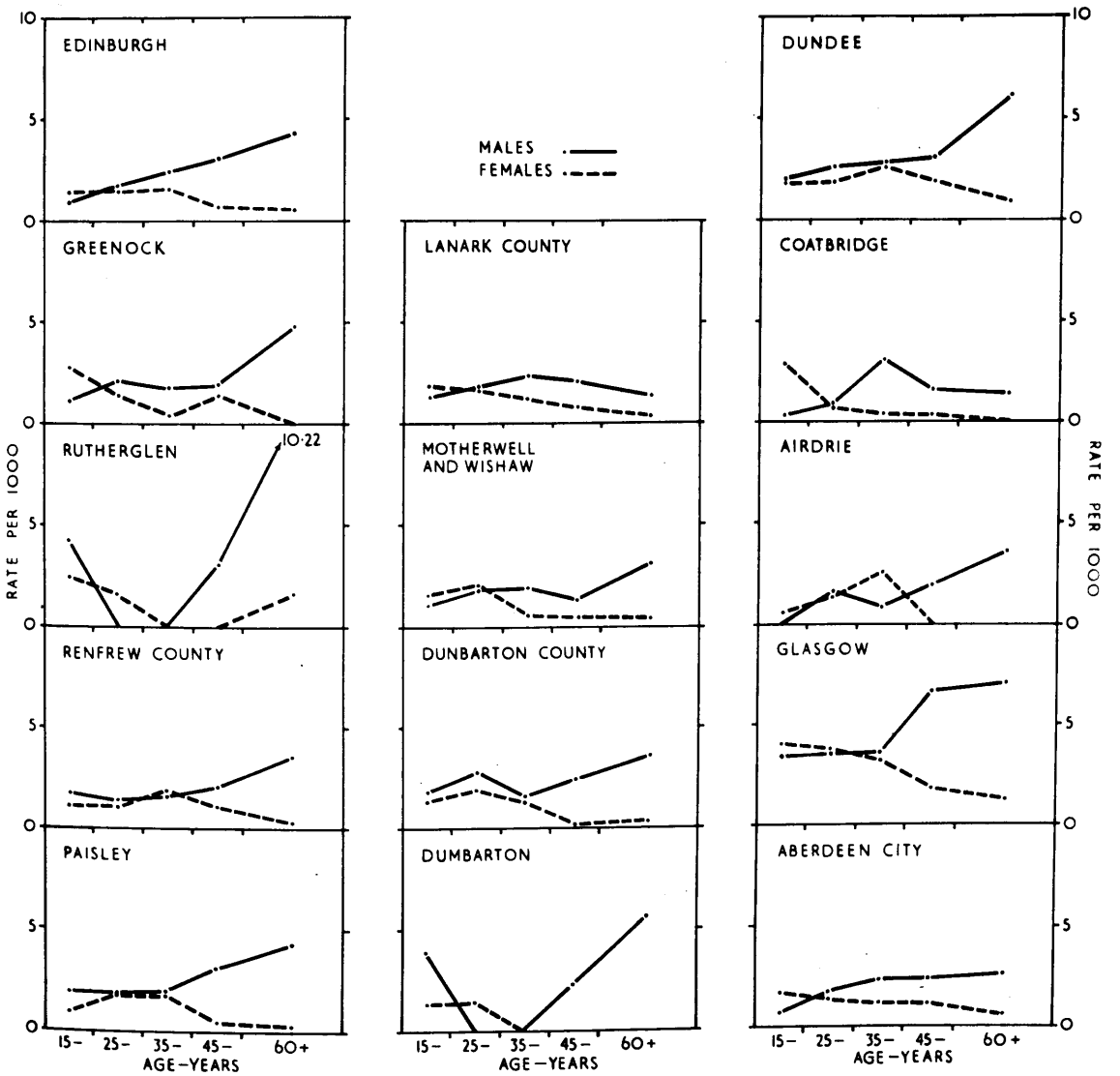

Figure 10.

TABLE 18

Survey yield of active tuberculosis in Glasgow and the aggregates of the other three Cities, Burghs and Counties

Age and sex rates per 1000 adults examined

Survey Areas		Age Groups					All adults	Adults both sexes
		15-	25-	35-	45-	60+		
Glasgow	M	3.4	3.5	3.9	6.7	7.0	4.8	3.8
	F	4.0	3.8	3.2	1.8	1.3	2.9	
Other three Cities	M	1.0	1.9	2.5	2.9	4.4	2.5	1.8
	F	1.5	1.5	1.8	1.1	0.7	1.3	
Burghs	M	1.5	1.7	1.7	2.1	3.9	2.0	1.5
	F	1.5	1.6	1.1	0.6	0.2	1.0	
Counties	M	1.8	2.0	1.7	1.8	2.3	1.9	1.4
	F	2.0	1.6	1.4	0.7	0.5	1.2	

15. Yield of cases of tuberculosis requiring observation from the City surveys

The yield of new cases requiring observation in each of the four Cities is illustrated in Figure 9 for the different age and sex groups. These show prevalence increasing progressively with age among men, Glasgow again occupying the highest place at all ages followed by Edinburgh, Aberdeen and Dundee in descending order. A significant observation is that Dundee occupies the lowest place, after being in the second highest position for the

active case yield. In Glasgow, the rates increased five times between the youngest and oldest adult male age groups while Edinburgh advanced nine, Aberdeen ten and Dundee 17 times over this age span, the rate of the increase being greatest among younger persons in each case.

Among females, the age pattern of the observation group was much less easily identifiable. The rates in Aberdeen, Dundee and Edinburgh tended to increase with age, while those in Glasgow fell fairly quickly after reaching a peak in the 25-34 year period. The rates for observation cases in Glasgow and the aggregates of the three other Cities, the Burghs and Counties surveyed are summarised in Table 19.

16. Yield of cases of tuberculosis requiring observation from the Burgh and County surveys

The rates for males in the aggregates of the Burghs and Counties follow the pattern previously described while the female rates again show an ill-defined distribution. The rather higher County rates were unexpected and may be accounted for by the influence of selection in areas where public response was significantly lower. A similar excess was demonstrated for female active cases in the County areas, especially those in the older age groups. The rates for both aggregates are significantly lower than those for Glasgow and the three other Cities, at all ages over 25 years. The Burgh and County rates for both active and observation cases are presented in Table 19 and illustrated in Figure 12.

TABLE 19

Survey yield of tuberculosis requiring observation in Glasgow and the aggregates of the other three Cities, Burghs and Counties

Age and sex rates per 1000 adults examined

Survey Areas		Age Groups					All adults	Adults both sexes
		15-	25-	35-	45-	60+		
Glasgow	M	2.7	5.7	7.5	12.7	14.3	8.3	6.6
	F	3.3	6.9	6.8	5.2	3.7	5.2	
Other three Cities	M	1.1	2.5	4.6	7.3	10.2	5.1	3.8
	F	0.8	2.6	3.2	3.4	3.7	2.8	
Burghs	M	1.0	2.0	3.3	3.1	4.9	2.7	2.2
	F	1.0	2.4	2.3	1.6	1.3	1.7	
Counties	M	1.5	2.4	3.2	4.5	6.8	3.6	2.5
	F	0.8	1.9	2.4	2.1	2.2	1.9	

17. Comparison between the yield of active cases and those requiring observation

Table 20 shows the proportion of significant cases allocated to the active group in the surveys in Glasgow and the aggregates of the other three Cities, the Burghs and Counties. Under 25 years of age, cases of significant tuberculosis among both sexes were allocated more frequently to the active than to the observation group. Over 25 years, both sexes were more often classified as requiring observation, the proportion assessed in this way

increasing with advancing age. Except in Glasgow, young women were placed in the active category more frequently than young men, while men were classified in this way more often than women above the age of 25 years. Over all, rather less than one-third of those presenting evidence of significant tuberculosis were placed in this category.

TABLE 20

Proportion of significant tuberculosis cases allocated to the active group by sex and age in different survey aggregates

Active cases as a per cent. of significant yield among adult residents

Survey areas		Per cent. active cases in age groups						
		15-	25-	35-	45-	60+	All adults	Adults both sexes
Glasgow	M	56	38	35	34	33	37	36
	F	55	35	32	26	27	35	
Other three Cities	M	49	44	35	28	30	33	32
	F	65	37	35	24	15	31	
Burghs	M	60	45	34	40	44	43	40
	F	62	39	37	26	13	38	
Counties	M	54	51	35	27	25	35	37
	F	71	45	33	25	18	40	

The rates for active and observation cases of tuberculosis are illustrated and compared in the histograms in Figures 11 and 12.

TWO-YEAR MASS RADIOGRAPHY CAMPAIGN

RESPIRATORY TUBERCULOSIS

YIELD OF ACTIVE AND OBSERVATION CASES IN THE FOUR SCOTTISH CITIES 1957-58.
AGE AND SEX SPECIFIC RATES PER 1000 RESIDENTS EXAMINED.

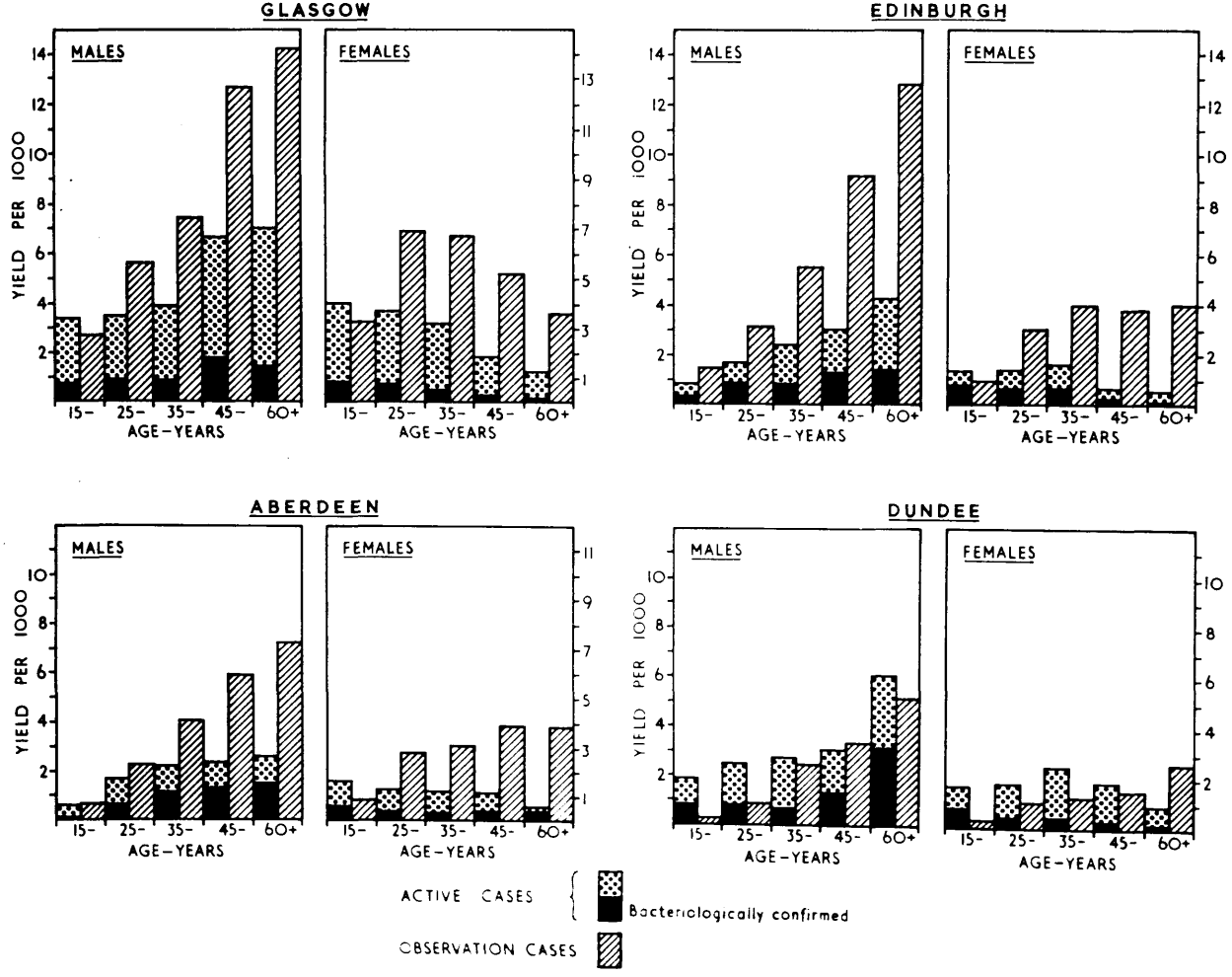

Figure 11.

TWO-YEAR MASS RADIOGRAPHY CAMPAIGN

RESPIRATORY TUBERCULOSIS

YIELD OF ACTIVE AND OBSERVATION CASES IN THE SCOTTISH CITIES, BURGHS AND COUNTIES.
AGE AND SEX SPECIFIC RATES PER 1000 RESIDENTS EXAMINED.

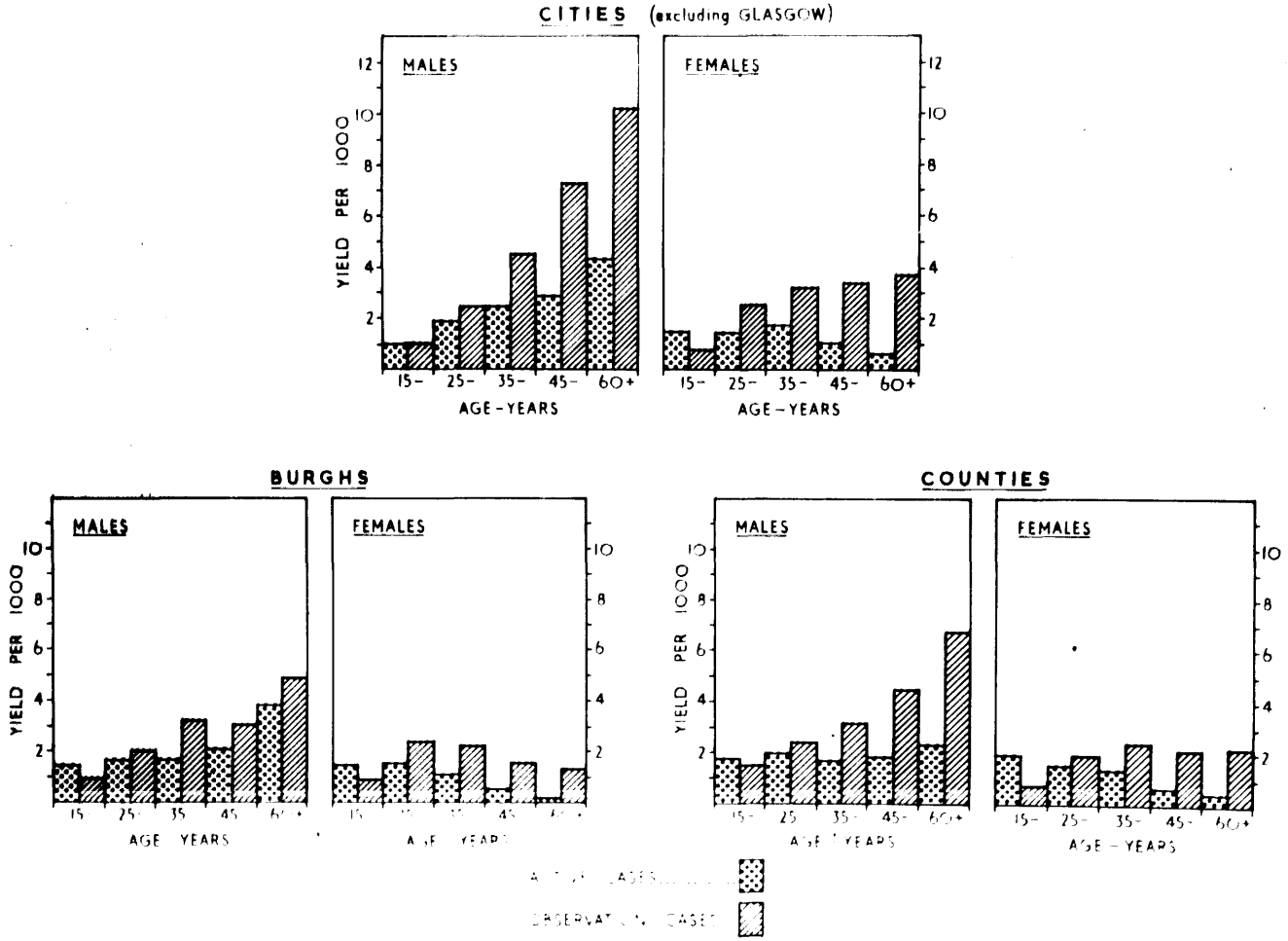

Figure 12.

With the outstanding exception of Dundee, the latter exceeded the former at all ages over 25 years, while the reverse was the almost universal experience among young adults of both sexes. In Dundee, however, the active case rates were higher at all ages, with the exception of men between 45 and 64 years and women of 60 years and over. This latter finding is not likely to be due to bias in favour of the active group on the part of the local physicians since one in five of the significant cases identified in that City were confirmed bacteriologically compared with one in six in Aberdeen, one in nine in Edinburgh and one in twelve in Glasgow. The more probable explanation of this exceptional result in Dundee is that differences in clinical assessment occurred in the borderline cases which could have been allocated to either the observation or inactive groups. Another possibility is that this experience reflects differences in the standards of bacteriological investigation employed in the various areas. It seems likely that both of these factors played a part. The proportion of active cases confirmed bacteriologically in Dundee was 34 per cent., compared with 41 per cent. in Edinburgh, 46 per cent. in Aberdeen and 22 per cent. in Glasgow.

18. Yield of significant tuberculosis.

The combined yield of active and observation cases in the different groups of area surveyed is shown in Table 21. This

TABLE 21

Yield of significant tuberculosis in Glasgow and the aggregates of the other Cities, Burghs and Counties

Rates per 1000 adults examined

Survey areas		Age Groups					All adults	Adults both sexes
		15-	25-	35-	45-	60+		
Glasgow	M	6.2	9.2	10.4	19.4	21.3	13.2	10.4
	F	7.3	10.7	10.0	7.1	5.0	8.1	
Other three Cities	M	2.1	4.4	7.0	10.2	14.6	7.6	5.7
	F	2.3	4.0	5.0	4.5	4.4	4.1	
Burghs	M	2.4	3.7	4.9	5.2	8.8	4.7	3.6
	F	2.5	4.0	3.4	2.1	1.5	2.8	
Counties	M	3.3	4.4	4.9	6.4	9.1	5.4	4.2
	F	2.7	3.5	3.8	2.8	2.7	3.1	

illustrates clearly the substantial excess of prevalence in Glasgow compared with the other aggregates - this excess being experienced by both sexes at all ages, but principally in young adult life. The aggregate rates in Edinburgh, Aberdeen and Dundee were substantially greater than those in the Burghs and Counties after the age of 35 years for both men and women, while the County yield exceeded that for the Burghs over the older age range. For the Cities the rates for both sexes at all ages in Glasgow were considerably higher than those in any of the others, followed in

order by Edinburgh, Aberdeen and Dundee. In all these areas the male rates for significant cases showed the same steep upward gradient with increasing age while the rates for women reached a peak at 25-34 or 35-44 years.

19. Confirmed cases in the four Cities

While the Glasgow rate for adults of both sexes exceeded the others, it did not do so by nearly such a wide margin as that demonstrated when the yield of active and observation cases was compared. The confirmed case rate for this City was only 12 per cent. higher while the active, observation and significant case rates were almost twice that in the three other Cities. The frequency with which confirmed cases were identified in age and sex groups follows the general pattern of yield for active cases in the two sexes at different ages. The same progressive increase with age among men and decrease with age among women, is clearly demonstrated. These features are illustrated in Table 22 and in Figure 13.

TABLE 22

Yield of tuberculosis cases confirmed bacteriologically in the four Cities

Rates per 1000 adults examined

		Age groups					All adults	Adults both sexes
		15-	25-	35-	45-	60+		
Glasgow	M	0.78	0.92	0.90	1.84	1.51	1.16	0.81
	F	0.86	0.78	0.55	0.31	0.21	0.53	
Edinburgh	M	0.35	0.91	0.82	1.35	1.43	0.98	0.70
	F	0.80	0.66	0.66	0.26	0.13	0.45	
Aberdeen	M	0.10	0.64	1.19	1.35	1.55	0.91	0.64
	F	0.60	0.37	0.37	0.43	0.43	0.43	
Dundee	M	0.80	0.81	0.75	0.35	3.09	1.22	0.80
	F	0.80	0.48	0.47	0.38	0.26	0.46	

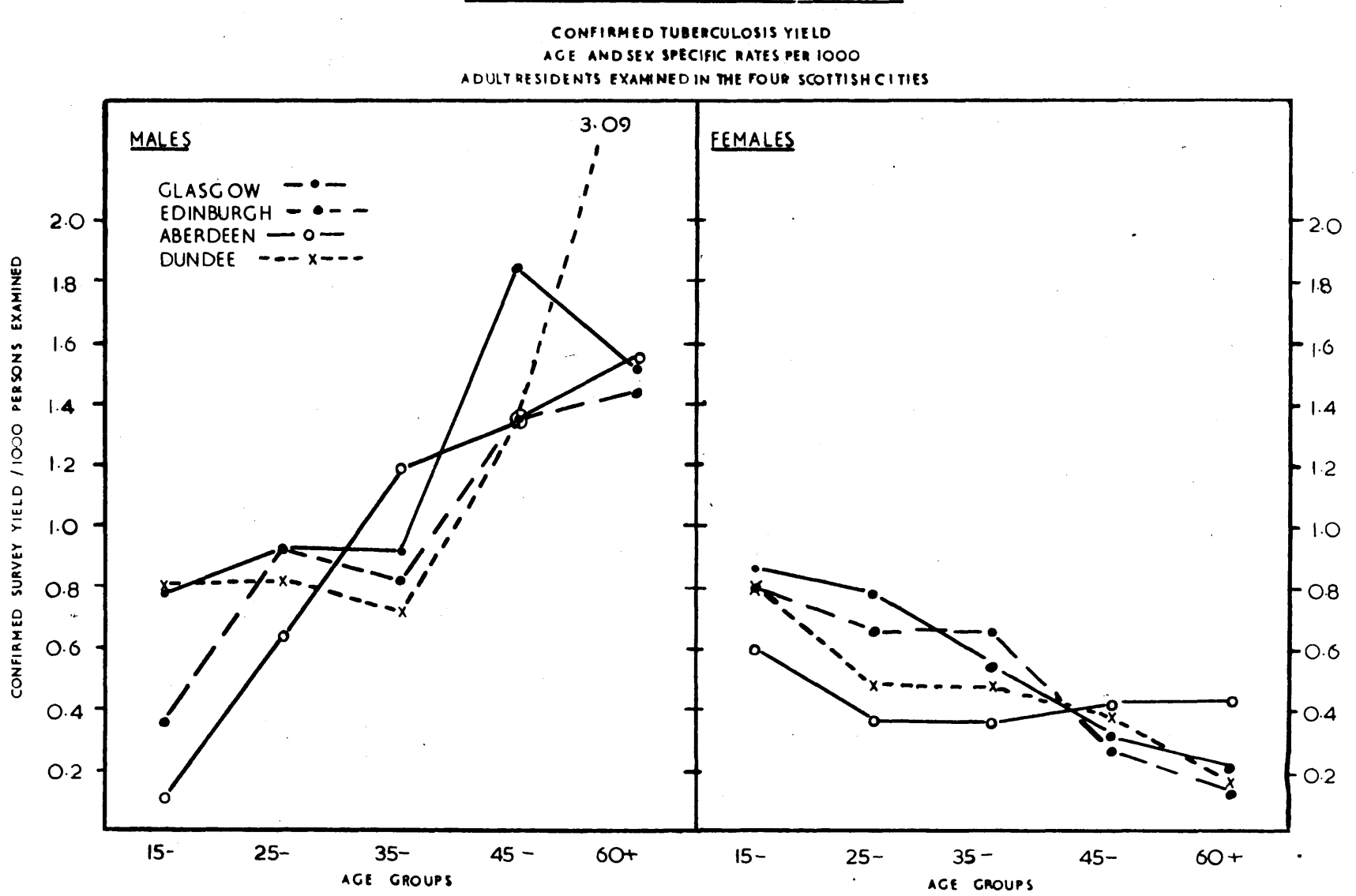
TWO YEAR MASS RADIOGRAPHY CAMPAIGN
CONFIRMED TUBERCULOSIS YIELD
AGE AND SEX SPECIFIC RATES PER 1000
ADULT RESIDENTS EXAMINED IN THE FOUR SCOTTISH CITIES
MALES
FEMALES
3·09
GLASGOW
EDINBURGH
ABERDEEN
DUNDEE
CONFIRMED SURVEY YIELD / 1000 PERSONS EXAMINED
2·0
1·8
1·6
1·4
1·2
1·0
0·8
0·6
0·4
0·2
15-
25-
35-
45 -
60+
AGE GROUPS

Figure 13.

TWO-YEAR MASS RADIOGRAPHY CAMPAIGN

SCOTLAND, 1957 - 1958

[illegible] the measure of the survey yield. [illegible] is measured by the average annual [illegible] of respiratory disease during [illegible] the disadvantage of omitting [illegible] the Campaign, it is the most suitable [illegible] the small number of notifications [illegible] situations year by year. [illegible]

The preceding sections of this paper have been devoted to the presentation of data relating to the yield of cases of tuberculosis from the 1957-58 programme of community X-ray surveys. To assess the immediate value of this method of case-finding under the conditions prevailing in Scotland at the time, these results are now compared with the respiratory tuberculosis morbidity in the defined areas during the pre-Campaign period. The results are also compared with the notifications which would have been expected had no Campaign been carried out.

1. Survey yield compared with tuberculosis notifications in the survey areas

Two indices are used in making this comparison. Since only patients suffering from active disease are subject to statutory notification to Medical Officers of Health, the data relating to new cases of tuberculosis among residents, classified in this way, are used as the measure of the survey yield. Morbidity in the survey areas is measured by the average annual number of confirmed notifications of respiratory disease during 1952-56. Although this figure has the disadvantage of reflecting experience some years before the Campaign, it is the most suitable index in those areas where the small number of notifications received is subject to considerable fluctuations year by year. While the number of notifications

determined in this way will be referred to from time to time as the "expected" morbidity in the survey areas, it should be remembered that the actual expectation, to which specific reference will be made, is likely to be about 20 per cent. less because of the established downward trend in the country as a whole.

The data on which this comparison is based are presented in Appendix 19. These demonstrate the substantial advantage of this method of mass case-finding compared with the identification of patients through the routine diagnostic services. The yield of new cases from each of the surveys, none of which lasted more than five weeks, amounted to a substantial proportion of the annual number of confirmed notifications experienced during the pre-Campaign period. In ten of the areas the survey yield amounted to more than half, while in Glasgow and Kilmarnock it exceeded the annual number of notifications expected at the 1952-56 rates. The smallest relative yield of cases from any survey amounted to 30 per cent. of the annual notifications in Midlothian County.

When notifications and survey results are expressed on a comparable time basis, it will be seen that between five and 25 times the number of notifications expected, at the pre-Campaign rates, were identified in the defined areas during the survey period. For example, during the five weeks of the Glasgow survey the yield of 2,369 cases contrasted with an expectation of 198 notifications. Similarly, yields of 162, 473 and 259 compared

with expectations of 20, 55 and 20 were disclosed in Aberdeen, Edinburgh and Dundee respectively.

2. Age and sex differences between tuberculosis survey yield and notifications

For this comparison the average annual age and sex notifications of respiratory tuberculosis during 1954-56 are contrasted with the survey yield of active cases in the four Cities. A wider comparison is not presented since there is considerable distortion of these rates in the smaller areas. This study provides sufficient evidence of the extent to which the age and sex composition of the survey yield differed from that of cases reported in the pre-Campaign period.

The data on which the comparison is based are presented in Appendix 20. Considering first the number of patients found in each of these Cities, substantial differences are demonstrated between the age distribution of cases found by survey and those reported by notification. Those differences, illustrated in Figure 14 and in Table 23, show clearly that adult patients more frequently belonged to the older age group when these were discovered by mass survey. Among men, 55 per cent. of the active survey cases and 40 per cent. of the notified cases were 45 years of age and over. Among women, on the other hand, 26 per cent. of the active survey cases and 13 per cent. of the notified cases fell into this age range.

TWO-YEAR MASS RADIOGRAPHY CAMPAIGN

YIELD OF NEW CASES OF ACTIVE RESPIRATORY TUBERCULOSIS FROM CITY SURVEYS
COMPARED WITH THE AVERAGE ANNUAL NUMBER OF CONFIRMED NOTIFICATIONS DURING 1954–56.

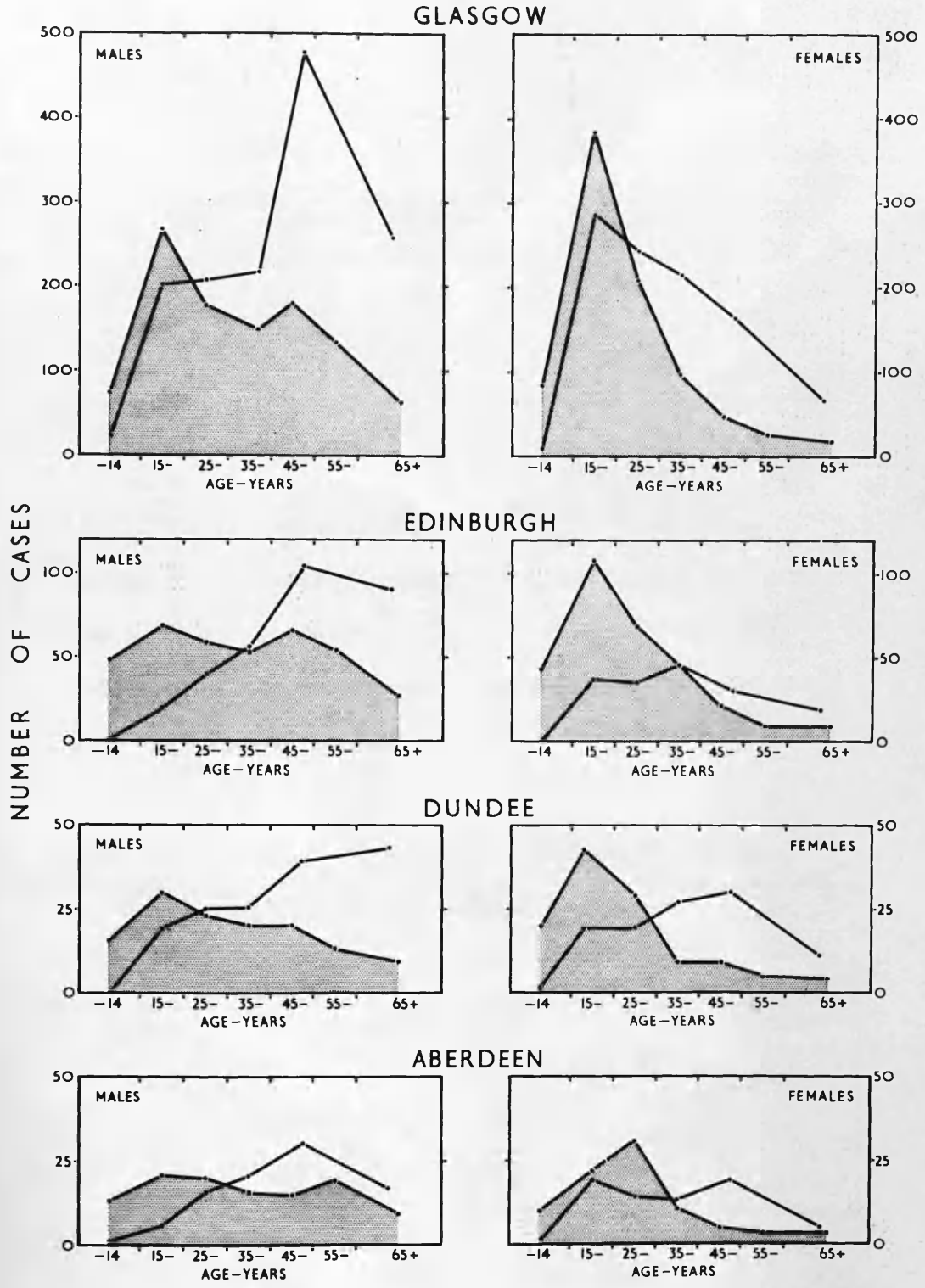

Figure 14.

TABLE 23

Active tuberculosis survey yield and confirmed annual notifications in the four Cities (Patients aged 45 years and over, expressed as a percentage of all adult cases reported)

Survey Area	Males		Females	
	Notifications 1954-56	Survey Yield	Notifications 1954-56	Survey Yield
Glasgow	39	54	12	24
Aberdeen	43	52	15	34
Edinburgh	45	63	15	29
Dundee	37	54	19	39
All Cities	40	55	13	26

The difference between the number of active cases found by survey and the number reported by notification is illustrated in Table 24 which compares the proportion of patients identified during the four or five survey weeks with the annual notifications expected, at the 1954-56 levels, in the four Cities.

TABLE 24

Active tuberculosis survey yield in four to five weeks compared with confirmed annual notifications in the four Cities (Yield as a percentage of notifications)

Survey area (survey duration)	Males		Females	
	15-44 years	45+ years	15-44 years	45+ years
Glasgow (5 weeks)	105	197	108	254
Aberdeen (5 weeks)	75	109	72	218
Edinburgh (4 weeks)	64	131	52	123
Dundee (4 weeks)	96	195	87	228

The table shows that the number of cases of 45 years and over identified by these short surveys was considerably greater than the annual expectation and that this was particularly so for women, among whom the excess was between 23 and 154 per cent., compared with a male excess of between 9 and 97 per cent. With the exception of Glasgow, the number of survey cases under 45 years was below, but considerably more than half, the annual figure of notifications.

Substantial differences, illustrated in Figure 15 and tabulated in Appendix 20, are also demonstrated between the notification and survey rates in age and sex groups in the four Cities. The distribution of the male notification rates is bimodal in each case with peaks of incidence at 15-24 and at 55-64 years, except in Dundee, where the later peak occurs at 45-54 years. In Edinburgh and Aberdeen the later peak is the more prominent while in Glasgow and Dundee the highest level is in the earlier age range. In contrast, the male survey rates increase progressively with advancing age in each of these areas. Among females, on the other hand, the peak notification rate occurs between 15 and 24 years except in Aberdeen where it is ten years later. In Glasgow the peak survey rate corresponds with that for notifications while in Aberdeen it is ten years earlier. In Edinburgh and Dundee the highest point of the female survey curve occurs 20 years later than that for notifications.

TWO-YEAR MASS RADIOGRAPHY CAMPAIGN

YIELD OF NEW CASES OF ACTIVE RESPIRATORY TUBERCULOSIS FROM CITY SURVEYS
COMPARED WITH THE AVERAGE ANNUAL NUMBER OF CONFIRMED NOTIFICATIONS DURING 1954-56
RATES PER 1000

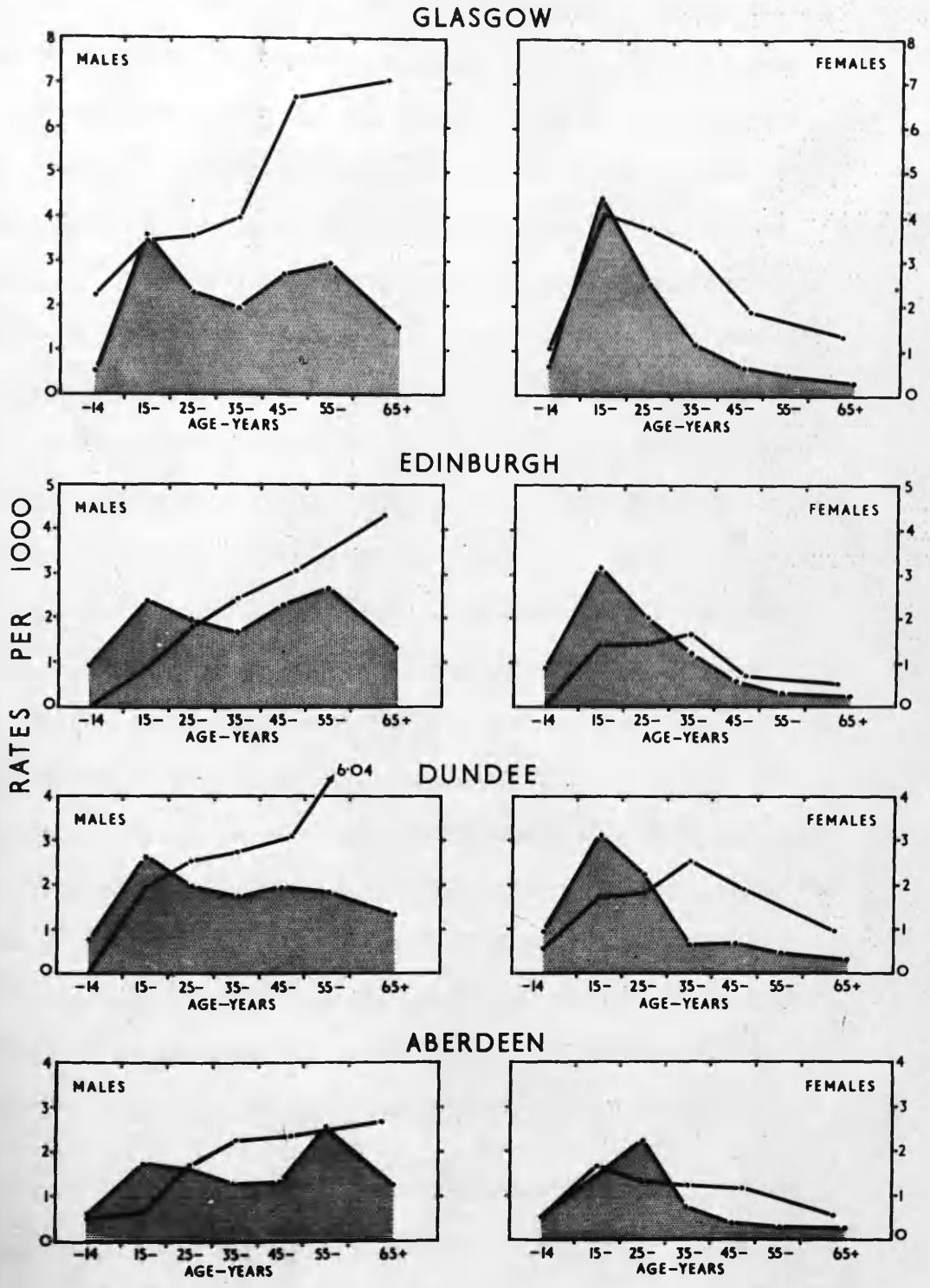

Figure 15.

This study illustrates not only the substantial advantage of mass tuberculosis case-finding, but the considerable difference in the age and sex composition of the survey yield when this is compared with identification through the normal diagnostic services which, it must be remembered, have been supplemented by mass radiography to an increasing extent since the end of the Second World War. In assessing the success of the mass survey technique, account must also be taken of the large number of persons found to require observation because of radiographic evidence of pulmonary disease attributed to tuberculosis. Since persons in this group are at substantial risk of developing active tuberculosis it is of the utmost importance, both to the individual and to the community, that their identification and supervision should result in the prevention of such an occurrence. Again, as has already been mentioned, the contrast between the survey yield and the notifications expected is likely to be substantially greater in view of the falling morbidity in most areas between the pre-Campaign period and the completion of the surveys. This study also underlines the importance of energetic tuberculosis case-finding among older persons, especially men, where the results are likely to be most profitable by comparison with normal diagnostic procedures.

3. Survey yield compared with expected notifications in the survey areas

In this study the trend of morbidity has been calculated on the basis of the average annual reduction in the number of confirmed

respiratory tuberculosis notifications between 1951 and 1956, using the triennial averages around the years 1952-53-54 and 55.ϕ Again, because of substantial fluctuations in the smaller areas, the data for the Burghs and Counties included in the Campaign have been aggregated. The details of actual and expected notifications between 1951 and 1958 are presented in Appendix 21. It is, unfortunately, not possible to include later figures since the information for 1959 is still incomplete. These data are summarised in Table 25 for the four Cities and the aggregates of the Burghs. The Counties have been omitted from this Table since one of the surveys (Fife) was incomplete and another was carried out in two parts, one in each year of the Campaign.

This comparison between the actual and the expected number of annual notifications in the year in which these surveys were carried out is the best available measure of the immediate profitability of this survey method of tuberculosis case-finding, although it ignores the additional advantage to be gained from the follow-up of the large number of persons requiring observation. It will be seen that the actual number of notifications in the Cities during the year in which the surveys were completed was between 53 and

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ϕ The data employed in Edinburgh is related to the period 1952-57 owing to irregularities in the notification figures prior to 1952.

TABLE 25

Actual and expected annual number of confirmed notifications of respiratory tuberculosis compared with active survey yield in the survey year (all ages)

Survey area (survey year)	Respiratory tuberculosis					
	Annual number of confirmed notifications				Active survey yield (2-5 weeks)	
	Expected	Actual	Difference (A-E)		Number	Per cent. expected notifications
			Number	Per cent expected notifications		
Glasgow (1957)	1,706	3,771	2,065	121	2,369	139
Aberdeen (1957)	178	306	128	72	162	91
Edinburgh (1958)	446	694	248	53	473	106
Dundee (1958)	225	426	201	89	259	115
Burghs x (1957-58)	452	610	152	34	388	86

x Average annual notification figures for 1957 and 1958.

121 per cent. above expectation.ø This observation is based on the assumption that a proportion of the survey cases identified would have been diagnosed in the normal way during the year, and that the excess of notifications is the real measure of the immediate success of the Campaign. This means that, taking all the urban areas together, approximately 80 per cent. of the Campaign yield represents the significant addition to the number of tuberculosis cases under control, an addition unlikely, at the morbidity rates

ø In surveys completed towards the end of the year some cases would not be notified until the next calendar year.

expected, to have been discovered for some considerable time, if at all.

In the absence of data with which to follow up the notification trends in the survey areas, it is not possible to forecast the long-term effect of this work. A comparison has, however, been made between the actual and expected number of notifications in 1957 and 1958 in those areas surveyed in the former year. This is reproduced in Table 26, which shows a substantial reduction in all areas in the year following the survey. Only in Glasgow and Aberdeen, however, does this number fall below expectation. The

TABLE 26

Actual and expected confirmed respiratory tuberculosis notifications in areas surveyed in 1957

Survey areas 1957		Confirmed notifications	
		1957	1958
Glasgow	Actual	3,771	1,225
	Expected	1,706	1,613
Aberdeen	Actual	306	99
	Expected	178	169
Burghs	Actual	191	108
	Expected	101	88

Burgh aggregates for notifications in 1958 were still substantially above expectation. This comparison cannot be regarded with confidence as a measure of the benefits of this mass case-finding programme, since a much longer period of assessment will be necessary before the rates of notification are sufficiently stable to enable judgement to be made. In surveys completed towards the end of the year a proportion of the resulting notifications would not be received until the following year. Further, the cases placed under observation will be re-classified in the months following their identification and a proportion of these will be added to the notification figures when clinical activity is established.

TWO-YEAR MASS RADIOGRAPHY CAMPAIGN

SCOTLAND, 1957 - 1958

V. NON-TUBERCULOUS CONDITIONS

While this paper is concerned only with the use of mass chest X-ray survey in the identification of respiratory tuberculosis, it is appropriate to mention briefly the other conditions found as a by-product of this work. It should be stated, however, that these findings cannot be regarded with the same confidence as the diagnosis in a substantial proportion of cases was based entirely on radiological evidence obtained through the mass radiography service. As has been mentioned in an earlier part of this paper, the only non-tuberculous patients for whom follow-up data is available were those referred to the local chest physician during 1958. The findings, presented in Appendix 22, relate to the total yield of abnormalities whether or not these were discovered among those resident in the survey areas and without regard to the fact that they may have been previously known.

Tuberculosis was the condition most frequently diagnosed, such cases being responsible for 25,375 of the abnormalities identified. Next in numerical importance was the group which included bronchiectasis, emphysema and other allied conditions; accounting for 4,956 patients. Cardiac abnormalities were responsible for 4,338 and pneumoconiosis for 2,529 of the conditions recorded. Malignant tumours, including both primary and secondary lung growths, accounted for 746 cases, the rate of identification being 0.43 in 1957 and 0.37 per 1000 persons examined in 1958.

TWO-YEAR MASS RADIOGRAPHY CAMPAIGN

SCOTLAND, 1957 - 1958

VI. THE DISPOSAL OF PATIENTS

The disposal of patients presenting radiological evidence of a significant abnormality on the photofluorogram during the 1958 surveys is shown diagrammatically in Figure 16. Information relating to the numbers referred to their family doctors, to chest physicians and admitted to hospital, for the investigation or treatment of a tuberculous condition, as the result of each survey, is reproduced in Appendix 18. Of the 1,844,268 persons examined during 1957 and 1958, 71,997 were recalled for full size chest X-ray films, representing an average recall rate of 3.9 per cent. This result was substantially less than the 5 per cent. figure employed in the planning of the Campaign. The recall rate, which was contributed to by all diagnoses, varied between 2.7 in Ayr Burgh to 4.6 per cent. in Lanark County, the rates tending to be higher where the yield of significant tuberculosis was greatest. Of those recalled for full size chest radiographs, 29,228, representing 1.6 per cent. of all persons examined, were referred for clinical consultation to the local chest clinics during the two years. The proportion referred in this way varied between 0.7 in Airdrie Burgh to 1.9 per cent. of all attendances in Glasgow.

Information relating to the number of persons referred to their family doctors was incomplete during the first year of the Campaign but these data were collected as a routine in 1958. During this period 5,455, or 0.7 per cent. of the 757,869 persons examined, were referred to their family doctors, the proportion varying from

TWO YEAR MASS RADIOGRAPHY CAMPAIGN

ASSESSMENT AND DISPOSAL OF PATIENTS FROM EACH 100000 EXAMINED

1958 SURVEYS

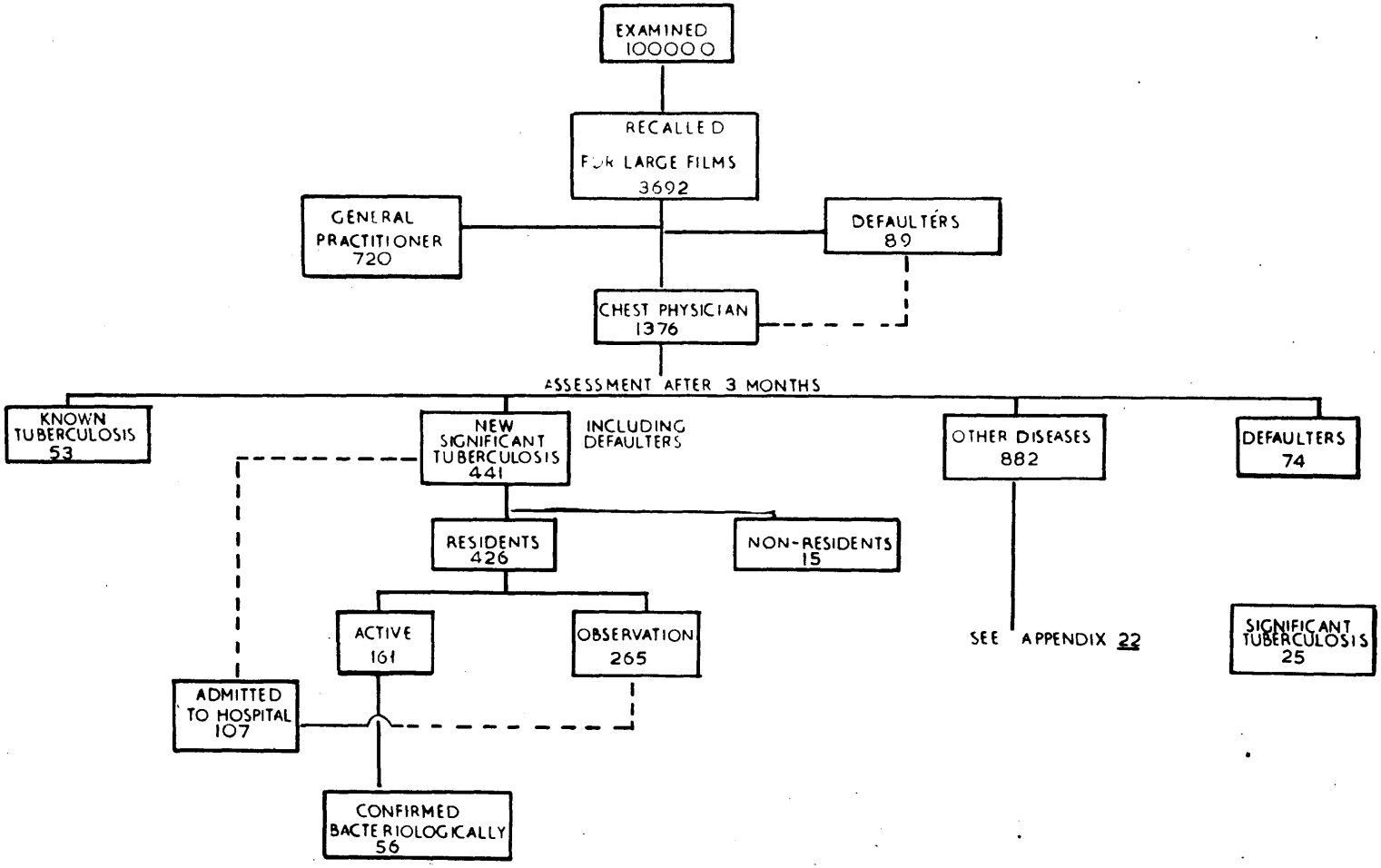

Figure 16.

0.5 in Paisley Burgh to 1.2 per cent. in Lanark County. Rather more than half of those recalled were referred to their general practitioners or to local chest clinics because of a significant radiographic abnormality, the ratio being one of the former to two of the latter.

The number of patients admitted to hospital for the investigation or treatment of a tuberculous condition during the two years was 2,010, or 0.1 per cent., of those examined. This represents 17 per cent. of the 12,094 cases reported as presenting evidence of tuberculosis considered to be active or to require observation, or 46 per cent. of those reported as suffering from active disease. Generally the higher rates of admission were in those areas which produced the highest yield of significant tuberculosis. There was also a tendency for a higher proportion of these patients to be hospitalised as the Campaign progressed. It is likely that this result was influenced, in part at least, by the early saturation of the hospital services throughout the country by patients identified as the result of the survey in Glasgow, which provided nearly half of the patients admitted, followed by the progressive release of beds as the Campaign progressed.

DISCUSSION

DISCUSSION

The X-ray Campaign carried out in Scotland during 1957 and 1958 was not an end in itself but part of a longer term plan of tuberculosis control, preceded by the development of preventive and clinical services on modern lines during the post-war period and followed by a more selective case-finding programme among population groups known, or shown, to be at a higher than average risk of developing or spreading the disease. Details of the latter part of this plan have been commended to those concerned (Department of Health Circular, 1959).

Although the deployment of the mass radiography service for the examination of total communities, regarded as "black spots", for the identification of tuberculosis was commended by the Medical Research Council (1953), this method has been employed in only a few places in the United Kingdom outside Scotland. Apart from the Scottish Campaign, this method of community action against tuberculosis has been employed on a national scale only in the United States of America. Although many more people were examined in the surveys sponsored by the United States Public Health Service (1953), the Scottish Campaign provided a substantially higher national coverage and was completed in a much shorter time at a considerably faster tempo of operation. In Scotland over 40 per cent. of the adult population of the whole country was examined in

60 weeks, compared with about 15 per cent. in six years in the United States. Moreover, when the attendances are compared on the basis of the "index of coverage" (the method employed in the United States to indicate the number of adults examined expressed as a percentage of the resident adult population), the Scottish Campaign achieved a figure of 76 compared with 69 per cent. The X-ray Campaign in Denmark, designed partly as a research project, was limited to persons of 15-35 years of age, took three years to complete and achieved a response of 65 per cent. (Groth-Petersen et al., 1959). This result cannot be directly compared with the response rates in Scotland since it was achieved in a country-wide survey (excluding Copenhagen) which included a considerable proportion of rural communities. Most of the other published data relate to mass X-ray surveys carried out as local operations, employing local resources over long periods of time, using the individual rather than the community approach and designed as research projects. Included among these were the surveys in Rhondda Fach (Cochrane et al., 1952 and 1955), Stockholm (Bauer and Gentz, 1953), Annandale (Cochran et al., 1957) and Dumfries (Cochran et al., 1959). The only local surveys which were broadly comparable with any included in the Scottish Campaign were those in Blyth (Newcastle Regional Hospital Board, 1955), where 60 per cent. of those over 5 years were X-rayed, and in Liverpool (Semple and Hughes, 1959), where the response was 77 per cent. of resident adult population.

The community X-ray surveys in Scotland were unique in that each was carried out at speed, using a concentration of services and equipment never before deployed in such an operation. It was regarded as a major contribution to tuberculosis case-finding and, as such, had to be streamlined to achieve this purpose. The size and complexity of the operation made it impossible to incorporate in its design a number of refinements which would have improved its efficiency and added to knowledge. The speed with which it was completed was dictated by a number of factors. It had become a matter of some urgency to make available, as widely as possible, the benefits of effective drug therapy to those requiring it. The diagnostic and treatment services were being developed quickly and would shortly be in a position to handle all the patients likely to be found. Finally, the publicity and propaganda services were unlikely to be able to sustain public interest and co-operation for more than a few weeks in any area. Having accepted the principle of completing each survey quickly, many operational problems had to be defined and solved and the mass radiography and clinical services had to be geared to a much faster tempo of work. Even so, much thought was given to the use of certain diagnostic and epidemiological techniques either as routine procedures or as special studies in population samples. In the end only one of these reached fruition in the Supplementary Survey in Edinburgh (Fletcher et al., 1959).

The desirability of carrying out a tuberculin survey on samples of these attending the X-ray centres had to be abandoned. The modern technique of tuberculin testing (Heaf, 1951) commended itself for this purpose because of its simplicity and its reliability (subsequently confirmed by the British Tuberculosis Association, 1959). The introduction, however, of another element in the examination involving a second visit for interpretation was regarded as both undesirable and impracticable. The results would have been of considerable academic value, but the full contribution to knowledge could not have been exploited without extending the study to children and following it up to measure future changes in the levels of infection in the different areas. Another difficulty was the fact that all the energies of the staff would require to be applied to the main task in hand.

The most important technical defect in the programme was the fact that dual photofluorographic interpretation could not be employed because of limitations of staff and equipment. The desirability of using this method, in spite of the increased recall rate which would have resulted, was recognised from the work of a number of authors. Groth-Petersen et al. (1952) had found that, on average, a single reader failed to identify, on the miniature films, one-third of the clinically significant pulmonary changes demonstrated on chest radiographs, while two

readers reduced the loss to one-sixth. In a further paper, reviewing the observations on nearly half a million miniature X-ray films, Groth-Petersen and Møller (1955) demonstrated that a second reader contributed an additional 20 per cent. to the number of cases of active tuberculosis found by a single observer. In this study the "missed" cases and those found on single interpretation were of comparable severity. Similar results were reported by Holm et al. (1954) who found that one reader identified three-quarters of the significant abnormalities compared with 94 per cent. when two readers were employed. Straddling and Johnston (1955) and Eley and Paxton (1956) assessed the failure by a single reader at about ten per cent. In a more recent study, Williams (1958) found that, while the single reader failure was 12 per cent., only one of the additional 15 cases identified by the second observer subsequently satisfied the criteria of clinical activity for tuberculosis after a period of follow-up. While all these studies draw attention to the importance of observer-failure, there would appear to be some disagreement regarding its significance to the patient. The most important study is that of Groth-Petersen and Møller (1955) whose tuberculosis cases found by the second reader were as severe as those missed by the single reader, this observation being based on the finding of tubercle bacilli in the secretions and on the radiographic appearances.

The only other technical aspect of the Campaign which need be discussed was the decision not to use central film processing. Although this method has been employed successfully in Scandinavia for some years and would have been ideally suited to this operation, the fact that the technical staff had had no practical experience and were resistant to its use were the factors which finally decided against its adoption. A further anxiety was that, while suitable processing equipment was available from commercial sources, its employment for the first time on the scale envisaged was regarded as accepting too great a risk.

This Campaign demonstrated conclusively the fact that it is possible to mount and sustain a mass radiography programme on these lines at a high level of technical efficiency. The exercise was planned on the basis of a substantially lower maximum potential in respect of both staff and equipment. While it was expected that each X-ray unit would be capable of examining 2,000 persons each week on miniature films, the average performance achieved was over 3,000. Some units managed to X-ray over 1,000 persons each day for sustained periods in Glasgow and Edinburgh, while the number of examinations made by a few of them during the four or five survey weeks would be regarded as a satisfactory year's work. The equipment itself was found to be capable of sustained operation at a level not previously thought possible, without significant loss of

service through mechanical failure. With the exception of the survey in Port Glasgow, where the programme was interrupted on several occasions by the failure of the equipment, the average loss of time on this account was about three per cent.

The success of the Campaign in gaining such a large measure of public support must be attributed to the imaginative, comprehensive and intensive publicity methods employed. While these were not the direct concern of the author they were an integral part of the whole plan. It is appropriate, therefore, to mention briefly the facets of this work which are regarded as having made a major contribution to success. A comprehensive appreciation of this service in the City of Glasgow has been published (Glasgow's X-ray Campaign against Tuberculosis, 1958). The enthusiasm with which the public responded to the Campaign must be regarded as the cumulative product of every aspect of the service. Nevertheless, the considerable propaganda carried out through the national and local press, radio and television services was the dominating influence. The decision to award prizes in most of the survey areas to persons chosen at random was a major departure from tradition and whatever the influence of this practice was, it was sufficiently controversial to stimulate considerable interest.

The large numbers of voluntary workers who undertook various tasks such as visiting people in their homes, acting as unit hostesses, bringing old people to the X-ray centres and performing

some clerical duties played a vital role in stimulating public co-operation. The particular value of home visiting has been recognised by Cochrane et al. (1952) in the survey in Rhondda Fach and by Cochran et al. (1959), the latter assessing the increased response resulting from this practice in Dumfries at 20 per cent. The specially designed X-ray badge which was given to every person examined came to be regarded as an indication of health and as each survey progressed people who were not wearing one became more conspicuous. Finally, the mass radiography service itself contributed to the public response. The efficiency with which they handled the public and the prompt issue of the "all clear" letters created an atmosphere of confidence. The results were achieved by ensuring that everyone in the community knew that a Campaign was in progress and no one was allowed to forget it while there was still an opportunity of being X-rayed.

A factor of major importance in determining the very high rates of response was the concentration of effort over a short period in each survey area. There is little doubt that the busier X-ray centres attracted most custom. This contention is supported by the observation that the average number of weekly attendances at the units engaged in each survey was significantly lower where the number of X-ray teams provided per unit of population was higher, even within the narrow limits of allocation employed. The attendance of persons from outside the defined areas made a substantial

contribution to the amount of work which the X-ray units were called upon to do and, in some places, they took up so much of the unit time that it would have been difficult, if not impossible, to examine more residents. This was certainly true in the Burghs of Ayr and Kilmarnock. The rate of response did not appear to be influenced by the amount of X-ray cover allocated, the age and sex composition of the population in the survey areas or their experience of tuberculosis as measured by the levels of notification or death from respiratory disease during the pre-Campaign period. It might have been possible, however, to anticipate the heavy pressure from non-residents in some places, especially those urban areas where the adjacent rural population was not included in the Campaign. Had this been done, and the appropriate adjustments in X-ray cover made, better response rates might well have been achieved in these areas.

The mean response rate of 68 per cent. for the whole Campaign was regarded as extremely satisfactory and considerably in excess of the 50 per cent. expected. In the 15 urban areas, including the four Cities, 75 per cent. of the resident adult population was examined. These results probably underestimate the actual response. They take no account, for example, of the 150,000 persons excluded from the calculation of these rates because they were not resident in the area in which they were examined and were

not re-allocated to their areas of domicile. Had half of these belonged to the defined population, their inclusion would have raised the overall response from 68 to 71 per cent. No account need be taken of the 36,000 cases of respiratory tuberculosis known to the authorities in the survey areas, most of whom were requested not to attend because of the need to avoid unnecessary radiation and to prevent overloading at the recall centres. Had all these patients stayed away, which they did not, the eligible population would have been reduced by less than one per cent. In Edinburgh it was possible, in view of the timing of the survey, to examine a large number of persons in mental and chronic sick institutions during the pre-survey period. The inclusion of these, and other examinations carried out at the local chest clinic, raised the response in that City from 78 to 84 per cent. The attendance of persons on more than one occasion is not regarded as having had any effect on the response figures. While no special arrangements were made to measure the frequency of this practice, only a few isolated examples came to light. Taking all these factors into consideration it is likely that the Campaign response in the defined areas was rather more than 70 per cent.

The response in the different age and sex groups conformed to the pattern expected, the co-operation of the older people being most difficult to obtain. Nevertheless, the attendance of more

than 60 per cent. of those over 60 years of age in the Cities and over 50 per cent. in the Burghs was an extremely satisfactory result, the credit for which must be given to the special effort made by the publicity services to encourage older people to come forward. The results of the Supplementary Survey in one of the municipal wards in Edinburgh (Fletcher et al., 1959) indicated that it was possible to increase the response rate from 77 to 81 per cent. by considerable effort immediately following the main survey. This finding suggests that the upper response limit of surveys of the kind included in the two-year Campaign in Scotland is between 75 and 80 per cent. and that the additional attendances achieved by the intensive follow-up of those who fail to co-operate is both costly and unrewarding. The findings also suggest that the only significant reason for the lower response among older people lies in the fact that about 8 per cent. of those over 65 years failed to co-operate by reason of illness or infirmity.

This Campaign, involving the examination of 1,844,268 persons, produced 12,094 cases of respiratory tuberculosis regarded as clinically significant. Of these, 4,328 were classified as active, while the remaining 7,766 were considered to require further observation, after a period of three months clinical supervision. No further attention has been given in this paper to those presenting evidence of disease regarded as healed, since the returns in respect of such persons were not required for inclusion

in the records. Among those resident in the defined areas, 4,033 of the new cases found were active and an additional 7,267 required observation. A measure of the immediate success of this Campaign is the fact that the active yield during the few weeks which these surveys lasted amounted to between 30 and 115 per cent., the average for the whole Campaign being over 90 per cent., of the annual number of new cases of respiratory tuberculosis expected through the usual diagnostic channels on the basis of pre-Campaign experience.

The tuberculosis yield of new cases among residents in the 22 survey areas varied between 0.26 and 3.69 for active disease, and between 0.14 and 10.37 for tuberculosis requiring observation. The proportion of the tuberculosis yield allocated to the active group also varied widely, from 13 to 89 per cent. No association could be demonstrated between the rates for active and observation cases; nor was either of these related to the rates of notification, registration or death from respiratory tuberculosis in the survey areas. The finding of a significant correlation between the aggregate rates for these two groups of survey cases and the notification rates, lends support to the view that the separation of the survey yield into the active and observation categories, while administratively convenient, is clinically inaccurate. As the assessment of both the notified and survey cases was made by

the same physicians in their separate areas, there would appear to have been substantial personal variation in their clinical judgment. It seems unlikely that the final allocation to either of these categories, made by the clinician at the end of three months' supervision, was influenced by a lack of judgment on the part of those responsible for the identification of patients on the initial photofluorographic or radiographic evidence. These readers managed to detect cases presenting significant X-ray appearances of tuberculosis at a rate in keeping with the levels of confirmed notifications in the pre-Campaign period. Observer-error on their part would seem more likely to be quantitative rather than qualitative. This view is in keeping with the observation of Groth-Petersen et al. (1959) that the cases missed by the first reader and identified by the second in the Danish X-ray survey were comparable in radiological and bacteriological severity. Further, Clayson et al. (1955) observed that the accuracy of radiological diagnosis was particularly low when the activity of a tuberculous lesion was being assessed. Since only one-quarter of the active cases found in the surveys was confirmed bacteriologically, the radiological evidence must have played a dominating role in determining the allocation of patients to the active or observation groups. In spite of the apparent defect of this classification, the arbitrary separation of the survey cases is necessary to permit, among other things, a comparison

between the survey yield and the experience of notifications in the pre-Campaign period - only active cases of tuberculosis being subject to statutory notification.

It was surprising that the rates for confirmed cases were unrelated to the rates for significant tuberculosis in the different survey areas. Nor were the former associated with the notification and death rates for respiratory tuberculosis experienced in these areas during the pre-Campaign period. The bacteriological findings, on which the confirmed rates have been based, were probably affected by a number of factors which it should have been possible to control had more satisfactory arrangements been made prior to the Campaign. It has always been difficult, however, to obtain reliable routine data in respect of the laboratory findings among new patients in Scotland in view of the lapse of time between the clinical and bacteriological diagnosis when the latter involved the employment of cultural techniques. It was partly to overcome this difficulty that arrangements were made in 1944 for the reporting of these and other findings relating to patients found to be suffering from tuberculosis. Even this system of intimation required the follow-up of a substantial proportion of the new cases reported, before the bacteriological findings could be regarded with confidence. Further, the employment of drug treatment before the completion of full laboratory investigation is likely to have affected the results, the prospect of obtaining bacteriological confirmation receding with the progress of treatment.

The finding that the infection levels among children at the age of 13 years were unrelated to the yield of new cases or to the rates of mortality or morbidity in the survey areas was unexpected and in contrast with the observations of Palmer et al. (1956). These workers were able to demonstrate a high degree of correlation between the infection levels among recruits to the United States Navy and the mortality rates in their States of origin. An examination of the literature, however, fails to reveal any further evidence of a similar character and this must be attributed to the inadequacy of the routine basic data on which these associations should be tested. The major cause of defect in these data probably stems from inaccuracies in the technique of tuberculin testing and particularly, in the recording and reporting of the results. More limited studies among nurses in the United States (Palmer, 1953) and Royal Air Force recruits (Pollock et al., 1959) have shown a definite association between the proportion of those reacting to low doses of tuberculin and the degree of tuberculosis contact. It is apparent from what has been said above that the various indices of tuberculosis prevalence require more accurate definition and more careful recording before they can be accepted with confidence.

So wide are the variations in clinical, radiological and bacteriological assessment of patients and the presentation of the results of different surveys or Campaigns that any comparison

between Scottish and other findings is likely to be both unrewarding and confusing (Cochrane, 1954). With these reservations, the data relating to a number of X-ray surveys are presented in Table 27. It will be noted that, while the yield of new cases of active tuberculosis in the Campaigns carried out in Scotland during 1953-56 and 1957-58 was substantially higher than that in the other places, the rate for confirmed cases during 1957-58 was broadly comparable. The very high proportion of bacteriologically

TABLE 27

Active tuberculosis case yield from different mass X-ray Campaigns

Rates per 1000

Campaign or survey	New active cases of tuberculosis				Remarks
	Total		Confirmed		
	Number	Rate	Number	Rate	
Scotland (1953-56)	568	2.0	-	-	19 surveys
Scotland (1957-58)	4,033	2.4	1,131	0.7	22 surveys
U.S.A. (1947-53)	5,643	0.7	-	-	25 surveys
Denmark (1950-52)	503	0.6	472	0.6	Mainly 15-35 years
Stockholm (1950-51)	863	1.4	563	0.9	
Rhondda (1950-51)	-	-	32*	1.9	Research programme
Rhondda (1953)	46*	1.0	-	-	Research programme
Salford (1953)	110	1.7	-	-	
Blyth (1955)	40	1.9	-	-	
Annandale (1956)	10	1.2	4	0.5	Research programme
Dumfries (1957)	21	1.5	6	0.4	Research programme

* Estimated from published data.

confirmed cases in the Scandinavian surveys is worthy of note. No other comment on these data is appropriate since they are based on widely differing standards. In passing, it should be mentioned that considerable attention is being given by both national and international organisations to the standardisation of terminology and methods of assessment with the object of establishing a reasonable basis on which the results of studies of this kind can be more accurately measured and more confidently contrasted.

One of the outstanding features of the Campaign was the contrast between the survey cases and those reported by notification through the diagnostic services in the pre-Campaign period. In the four Cities the bacteriological results were less frequently positive and in Edinburgh the radiological appearances of the lesions were significantly less severe in the survey cases. This was in keeping with the expressed intention of the Campaign - namely, to find disease at an early stage. Substantial differences were also observed between the yield of active cases in the Cities and the pre-Campaign notifications in respect of their age and sex distribution. These were not unexpected since they had already been observed in the previous series of surveys during 1953-56 and had been reported on by Macgregor (1955). While the rates for active cases from the City surveys tended to be lower than the annual notification rates among young adults they were consistently

higher among older people of both sexes. Using the age of 45 years as an arbitrary division between the younger and older groups of the adult population, it has been shown that the number of adult cases found during the four or five weeks of the City surveys exceeded the annual number of respiratory tuberculosis notifications during the pre-Campaign period by between 9 and 97 per cent. for males and between 23 and 154 for females in the older age group, the latter being higher in each of these areas. In the younger age group the survey yield of active cases amounted to a substantial proportion of the notifications in each of the Cities and was in excess only in Glasgow. Since one-third of the adults in the Campaign areas did not co-operate, these survey findings cannot be regarded as representing the true age and sex distribution of the prevalence of previously undisclosed active tuberculosis (Bradford Hill, 1951). The Supplementary Survey in Edinburgh (Fletcher et al., 1959) suggests that the prevalence of new disease may well be as high, if not higher, among the unco-operative sections of the community, especially among males between 35 and 64 years and females over 65 years of age. Since, however, only one-quarter of those who had failed to co-operate during the main survey in that City were examined, this finding cannot be accepted with confidence. It can, nevertheless, be said that the Campaign was substantially more successful than the diagnostic services had been in finding cases of active tuberculosis and that the success was relatively greater among the older than among the younger population.

The substantial excess of cases of active tuberculosis found among older persons during the Campaign invites further consideration of the relative influence of age and sex on the survey findings. Although the excess of the survey yield over expectation, on the basis of the pre-Campaign notification experience, was proportionately greater among older women, the rate of identification through both the mass radiography and routine diagnostic services was highest under 45 years of age. Among older men the survey technique demonstrated a substantially higher prevalence of new cases than was apparent through the diagnostic services. Does this mean that older men are more liable to develop active tuberculosis in later life or does it mean that the survey method revealed a large number of men who had the disease for many years? The latter view would explain the excess of mortality among older males. Springett (1951), Cochrane et al. (1955), Cochrane et al. (1956) and Groth-Petersen (1959) have studied this problem and have concluded that, although age and sex is not the sole factor determining the onset of tuberculosis after infection has taken place, the attack rate progressively falls in both sexes with advancing years. It would appear, therefore, that the considerable prevalence of new disease among older males is the result of an accumulation of undisclosed morbidity over a considerable period. It should be remembered, however, that the attack rates were measured by these workers over periods of less than four years and

that the findings may not reflect experience over longer periods. These observations do not exclude the possibility of older people developing new disease after having had a clear chest X-ray some years before. Smith (1959), reporting on the previous radiological history of 100 new cases of active tuberculosis among patients over 55 years of age in Glasgow, found that nearly half of them were radiologically clear when examined some time during the previous ten years, nearly one-third of them within the previous five years. This report provides no information, however, on the size of the attack rate.

The success of the Campaign in finding 4,033 new cases of active tuberculosis in the 22 survey areas should be set against the number of new cases which would have been identified had the programme never been carried out. When the County of Fife is excluded from the calculation, since it was not completely covered, the number of new active cases found in the 21 remaining areas was 4,026. During the two years of the Campaign 10,050 new notifications of respiratory tuberculosis were received in these survey areas compared with an expectation of 7,684. The excess of the observed over the expected number of notifications, namely 2,366, might be regarded as representing the gain of active cases. The assessment must, however, take account of the fact that all of the 4,033 survey cases, and the additional 295 discovered among non-residents, were found much earlier than they would have been

had they awaited identification through the diagnostic services. Moreover, an additional 7,267 new cases of tuberculosis were found to require observation for a significant pulmonary infiltration. These individuals have always been regarded as being at special risk of developing tuberculosis in the years following a suspicious finding on a chest radiograph. Groth-Petersen et al. (1959) have measured this risk at seven times greater than that for persons with evidence of healed disease and 14 times greater than that for those with normal radiographic X-ray films.

In assessing the ultimate value of this Campaign regard must be had to the potential advantages and to the limitations of the influence which it can be expected to exert on the future trends of incidence. There were three basic objectives: firstly, to X-ray a large number of persons in the survey areas; secondly, to bring under control a large proportion of those with evidence of disease; thirdly, to reduce the pool of infection and contribute to a more rapid decline in the future incidence of tuberculosis. The first two of these objectives have been achieved with greater success than was expected and the results have been recorded and discussed above. The trends of tuberculosis will require continued study over a period of years to determine the long-term influence of this Campaign. While it is inappropriate to indulge in speculation as to the outcome, it is proper to comment on some of the hopes upon which this operation was conceived and some of the limitations of its long-term effects.

One of the principal long-term objectives was to reduce the pool of infection by bringing under control a large proportion of the active cases of tuberculosis in the community and by preventing future additions to it by placing under medical supervision a large number of those presenting suspicious X-ray findings - the latter being regarded as a group at exceptional morbidity risk. The successful accomplishment of this task was dependent upon the more effective exploitation of chemotherapeutic control both as an agent of treatment and of future prevention. While the examination of whole populations, or substantial proportions of them, on only one occasion must be followed by the development of new cases, the evidence already quoted supported the view that the attack rate was relatively low among older persons, especially women. The reduction in the infection rate consequent upon the success of the above measures would enable the more effective exploitation of B.C.G. vaccination among children and promote a more rapid fall in incidence of disease among the younger sections of the population. The other effect which it was hoped to achieve was the substantial reduction in the incidence of new disease especially among older persons. On the assumption that a single examination would usually be sufficient to detect most of the significant tuberculosis among them, future additions to tuberculosis morbidity would be likely to be substantially less among those whose chest radiographs had been shown to be clear.

The influence of a programme of case-finding of this kind on the future incidence of tuberculosis is severely limited by a number of factors. In spite of the exceptional public response, at least one-third of the adults resident in the twenty-two survey areas failed to co-operate. What evidence there is (Fletcher et al., 1959) suggests that the prevalence of new disease among these people is as high, if not higher, than among those who supported the Campaign. It has therefore become a matter of special concern, since the completion of the surveys, to achieve the examination of these individuals through the routine diagnostic and case-finding programme. Nor did the Campaign encourage the attendance of school children as the yield of tuberculosis among them is low and because unnecessary exposure to radiation had to be avoided (this latter view has been confirmed in the report, Radiological Hazards to Patients, 1959). Case-finding among this group of the population is carried out by subjecting to X-ray examination only those who react to the tuberculin skin test. This programme is being actively pursued in conjunction with the arrangements for protective vaccination. The Campaign must also have been defective in missing a proportion of significant cases of tuberculosis through observer-failure since the initial film interpretation employed only single readers. This deficiency was recognised at the outset and the chest physicians were asked to re-scrutinise the films at leisure and to communicate with the patient's general practitioner

in the event of the later identification of a case missed on the first reading. Again, the Campaign could have no effect on the attack rate among those whose chest radiographs were regarded as normal at the time of attendance during one of the surveys. From the available evidence, however, the attack rate would be likely to be substantially lower among those with normal X-ray findings compared with those presenting abnormal radiological appearances and would be expected to become progressively less with advancing age. A further source of loss was provided by those who defaulted when invited to attend for clinical consultation following the identification of a significant abnormality. During 1958, 29, or two per cent., of the 1,262 active cases and 164, or nearly six per cent., of the 2,083 observation cases had failed to co-operate with the clinical services by the end of the follow-up period. Special measures were adopted in the survey areas to obtain the co-operation of these patients and the final figure was probably a great deal less. Finally, the Campaign can have had no influence on the incidence of new disease among those already infected. When the programme was planned there was evidence (Palmer and Shaw, 1953) that the bulk of new cases occurring among children and adolescents came from those initially known to react to the tuberculin skin test. This observation was in contrast with the findings of Daniels et al. (1948) and the substantial evidence, reviewed by these authors, in favour of a higher morbidity among

negative tuberculin reactors. The latter observations were made, however, among nurses and others exposed to special risk, while those of Palmer and Shaw embraced whole populations of children and young persons living under normal conditions in areas of high and average tuberculosis prevalence. The finding of a higher attack rate among those known to have been previously infected, especially among adolescents producing large reactions to the tuberculin skin test, has been confirmed by follow-up studies carried out by Palmer et al. (1957), Palmer et al. (1958), the Medical Research Council (1956 and 1959), Groth-Petersen et al. (1959) and other workers. The X-ray Campaign in Scotland could have no influence on the future attack rate among persons previously infected.

In conclusion, it should be emphasised that this Campaign was planned as a tuberculosis case-finding operation and not as an instrument of epidemiological inquiry. It is abundantly clear from the experience gained that no additional information could have been collected from those attending the X-ray centres without substantially increasing the cost and labour involved and without interfering with the rapid and convenient examination of the public. It is more than likely that any attempt to employ more than the simplest examination and recording procedures would have so interfered with the main purpose, which was to examine as many people as possible in the shortest time, that the response would have been seriously affected. Further, the massive amount of work

which fell on the public health and the clinical services during and after each of the X-ray surveys made it necessary to employ only the simplest follow-up records. It was in these ways that the Scottish Campaign differed from the surveys in Denmark (Groth-Petersen et al., 1959), Rhondda Fach (Cochrane et al., 1952 and 1955), Annandale (Cochrane et al., 1957) and Dumfries (Cochrane et al., 1959), all of which were designed as epidemiological studies and carried out at a tempo of operation appropriate to this objective. That it is possible, however, to engage in important epidemiological inquiry during a Campaign of this kind has been demonstrated by the Supplementary Survey in Edinburgh. Apart from this special study, carried out as a parallel inquiry, care had to be taken to avoid any elaboration of the basic procedure which might have detracted from the operational efficiency of the surveys. After the commencement of the Campaign a study was made of the work being carried out under the Danish programme and a tuberculosis index was established in Edinburgh to observe the future trends of the disease in that City. This index contains information relating to all those examined during the survey and permits the study, against this background, of all new patients identified by the diagnostic services in the future. It is hoped that valuable information will be obtained about groups of the population at more than average risk of developing tuberculosis.

SUMMARY

SUMMARY

This thesis presents an appreciation of the technical planning, execution and results of a programme of chest X-ray surveys carried out in 22 areas of high tuberculosis prevalence in Scotland during 1957 and 1958, with the object of finding and bringing under control a high proportion of the previously undisclosed reservoir of cases, reducing the pool of infection and contributing to the more rapid decline in the future incidence of this disease. This Campaign was unique in that each of the mass radiography surveys which it comprised was carried out within a few weeks, using a concentration of medical and publicity services not previously employed in a health programme of this kind. Moreover, it attracted a greater measure of public support than any of the local chest X-ray surveys which had previously been attempted, with the exception of those carried out over long periods using the individual rather than the community approach. This operation has demonstrated the practicability and the immediate profitability of the community approach to tuberculosis case-finding by the employment of the national resources of the clinical, radiological and publicity services in a series of chest X-ray surveys designed to examine whole adult populations at a tempo of operation not previously thought possible.

The population in the areas selected for survey comprised about two-thirds of that in the whole country. During the two

years 1,844,268 persons were X-rayed. Of these 1,639,957 were adults resident in the defined areas, representing a response rate of 68 per cent. The response rate in the 15 urban areas was 75 per cent., and in the four Scottish Cities, 76 per cent. The number of adults examined represented 43 per cent. of the adult population of Scotland. The relatively poor attendance in the County areas is attributed to the fact that the dispersal of the population made it impossible, using this method of operation, to provide a service which was convenient to those living in isolated places. The difference in the level of co-operation between younger and older persons can be explained by the incidence of illness and infirmity among the latter. In some places the response was adversely affected by the fact that non-residents took up too much of the available X-ray time. It seems likely that, in surveys of this kind, the provision of too much X-ray unit cover may have as detrimental an effect on the response as too little.

The principal technical fault in the Campaign was the failure to employ dual photofluorographic film interpretation, but reference is made to the method suggested to overcome this deficiency which, on the basis of previous evidence, might have been responsible for the loss of about 10 per cent. of the significant cases. This deficiency could not have been obviated in any other way with the resources available. This method of

community survey is unsuitable for epidemiological inquiry without considerable interference with its effective operation and because, at the tempo of work required, neither staff or equipment are likely to be available for special studies.

The Campaign produced 12,094 new cases of tuberculosis, of whom 4,328, or 2.35 per 1000, were regarded as suffering from active disease. In addition 7,776, or 4.26 per 1000 persons examined, presented evidence of tuberculosis requiring observation. Nearly two-thirds of the 4,033 active cases and the 7,267 observation cases discovered among residents were found in Glasgow and four-fifths in the four Scottish Cities. The rates for active cases varied between 0.26 and 3.69 and, for observation cases, from 0.14 to 10.37 per 1000 persons examined. A study of the associations between the survey yield of tuberculosis and the rates of notification, registration and death during the pre-Campaign period revealed a significant positive correlation only between the aggregate of the active and observation survey case rates and the notification rates in the different areas. Reference is made to the inaccuracy of the arbitrary clinical separation into active and observation categories.

The considerable success of this method of tuberculosis case-finding is illustrated by the fact that the yield of new cases during the four weeks of each survey amounted to a substantial proportion of the annual number expected from the routine

diagnostic services at the pre-Campaign rates. This advantage was substantially greater among the older than the younger sections of the community.

The results of this Campaign are regarded as an outstanding success in terms of public response and tuberculosis identification. The possible influence of this work on the future incidence of tuberculosis is discussed.

Only a very brief reference has been made to the yield of non-tuberculous diseases during the Campaign since the operation was designed as part of a national tuberculosis case-finding programme and the follow-up of persons presenting evidence of non-tuberculous pulmonary disease was not required with the same accuracy. These results, while of considerable interest, cannot be regarded with the same confidence. They are, however, the subject of separate study.

GLOSSARY OF TERMS

GLOSSARY OF TERMS

Active tuberculosis. Tuberculosis found to be infectious or to require treatment or some modification in the patient's way of life. Included in the yield of active cases from the X-ray Campaign were all cases classified as active (Code 24), those with accompanying pneumoconiosis (Code 23) and those in whom the condition was a tuberculous pleural effusion without radiographic lung involvement (Code 26).

Adult. A person of 15 years of age or over.

Attendance. Number of persons attending for miniature film examination. Regarded as equivalent to the number of miniature films taken.

Confirmed tuberculosis. Respiratory tuberculosis found during the X-ray surveys and confirmed by the demonstration of tubercle bacilli.

Confirmed notification. Active tuberculosis notified to the Medical Officer of Health in which the diagnosis has been confirmed by the chest physician on clinical but not necessarily on bacteriological grounds.

Defaulter. A person failing to attend for a large film or for clinical examination after being X-rayed at a mass radiography unit.

Defined area. Local health authority area selected for mass X-ray survey.

Defined population. Adults resident in the defined areas. Also referred to as the eligible population.

Final diagnosis. Clinical diagnosis following a minimum period of three months follow-up.

Infection level. Proportion of children reacting to the tuberculin skin test at 13 years of age.

Intimation. A procedure used in Scotland to facilitate the reporting of clinical, radiological, bacteriological and other details of patients suffering from tuberculosis, by the appropriate consultant, to the Medical Officer of Health.

Registered cases of tuberculosis. The number of persons known to be suffering from, or under supervision for, tuberculosis and registered by the local health authority.

Response. Persons belonging to the defined population, examined in the defined area. Expressed as the number or as a percentage of the defined population.

Recall centre. A centre established in a survey area by the mass radiography service for the radiographic examination of those recalled.

Significant radiological abnormality. A radiological abnormality identified by the mass radiography service, regarded as constituting a potential or actual health hazard.

Significant tuberculosis. Radiological evidence of respiratory tuberculosis, other than the presence of a few calcified spots or an obliteration of the costo-phrenic sinus. This term is also used to denote the sum of the active and observation survey yield based on clinical assessment after three months.

Tuberculosis requiring observation. Cases presenting radiological evidence of tuberculosis not regarded as active but which present more emphatic evidence of disease than a few calcified spots in the lung or an obliteration of the costo-phrenic sinus (Code 25). Statutory notification is not required for such patients.

X-ray Campaign. The complete programme of mass radiography surveys.

X-ray centre. A centre established for photofluorographic examination of the general public.

X-ray survey. A community X-ray survey carried out with the object of examining a total community (excluding children).
Synonomous terms: Mass chest X-ray survey, mass radiography survey, community X-ray survey, mass X-ray survey.

X-ray unit cover. Number of X-ray units employed per 10,000 of the adult-resident population.

X-ray unit performance. Average number of persons X-rayed per unit week by the mass radiography units engaged in each survey.

Yield. Abnormal cases discovered as the result of an X-ray survey. Expressed as a number or rate per 1000 persons examined.

REFERENCES

REFERENCES

ANDERSON, R.J. (1955),
Amer. Rev. Tuberc. 71. 406.

BAUER, H.J. and GENTZ, C. (1953),
Acta. Tuberc. Scand. 29. 22.

BRITISH TUBERCULOSIS ASSOCIATION (1959),
Tubercle (Lond.). 40. 317.

CLAYSON, C., FREW, H., MCINTOSH, D.G., MCWHIRTER, J.G., MCKINLAY, P.L. and STEIN, L. (1955),
Brit. J. Tuberc., April 1955.

COCHRAN, J.B., CLAYSON, C. and FLETCHER, W.B. (1957),
Brit. Med. J. 2. 185.

COCHRAN, J.B., FLETCHER, W.B. and CLAYSON, C. (1959),
Brit. Med. J. 2. 1.

COCHRANE, A.L., COX, J.G. and JARMAN, T.F. (1952),
Brit. Med. J. 2. 843.

COCHRANE, A.L., COX, J.G. and JARMAN, T.F. (1955),
Brit. Med. J. 1. 371.

COCHRANE, A.L., JARMAN, T.F., MIALL, W.E. and CARPENTER, R.G. (1956),
Thorax. 11. 141.

COCHRANE, A.L. (1954),
Brit. Med. Bull. 10. 91.

CODE OF PRACTICE FOR THE PROTECTION OF PERSONS EXPOSED TO IONIZING RADIATIONS (1957). H.M.S.O.

DEPARTMENT OF HEALTH FOR SCOTLAND (1959), Circular 21/59.

DANIELS, M., RIDEHALGH, F. and SPRINGETT, R.V. (1948), Report on the Prophit Tuberculosis Survey 1935-44.

ELEY, A. and PAXTON, T.G. (1956), Lancet. 1. 511.

FLETCHER, W.B., MAIR, J.M., SKLAROFF, S.A. and WILLIAMSON, J. (1959), Tubercle (Lond.). 40. 82.

GROTH-PETERSEN, E., LØVGREEN, A. and THILLEMAN, J. (1952), Act. Tuberc. Scand. 26. 13.

GROTH-PETERSEN, E. and MØLLER, A.V. (1955), Bull. Wld. Hlth. Org. 12. 247.

GROTH-PETERSEN, E., KNUDSEN, J. and WILBEK, E. (1959), Bull. Wld. Hlth. Org. 21. 5.

GLASGOW'S X-RAY CAMPAIGN AGAINST TUBERCULOSIS (1958), Glasgow Corporation.

HANSEN, O.G. (1955), Mass Chest Surveys in Norway. Wld. Hlth. Org. Europe. 84/17.

HEAF, F.R.G. (1951), Lancet. 2. 151.

HILL, A. BRADFORD (1951),
The Application of Scientific Methods to Industrial and Service Medicine. Medical Research Council. H.M.S.O.

HOLM, S., NIELSEN, H., MØLLER, A.V. and WINGE, K. (1954),
Act. Tuberc. Scand. 30. 63.

MANCHESTER REGIONAL HOSPITAL BOARD (1954),
Lancet. 2. 1172.

MANCHESTER REGIONAL HOSPITAL BOARD (1954),
Personal communication.
Report on mass radiography Campaign in the City of Salford.

MACGREGOR, I.M. (1955),
Health Bulletin of the Chief Medical Officer, Department of Health for Scotland. 13. 1.

MACGREGOR, I.M. (1957),
Health Bulletin of the Chief Medical Officer, Department of Health for Scotland. 15. 1.

MEDICAL RESEARCH COUNCIL (1953),
Report of the sub-committee on mass miniature radiography. M.R.C. 53/687.

MEDICAL RESEARCH COUNCIL (1956),
Brit. Med. J. 1. 413.

MEDICAL RESEARCH COUNCIL (1959),
Brit. Med. J. 2. 379.

NEWCASTLE REGIONAL HOSPITAL BOARD (1955),
Personal communication.
Report of a combined mass radiography and tuberculin survey in Blyth.

PAYNE, H.M., ENTERLINE, P. and HEUCK, J. (1953),
Amer. Rev. Tuberc. 66. 548.

PALMER, C.E. (1953),
Amer. Rev. Tuberc. 68. 678.

PALMER, C.E. and SHAW, L.W. (1953),
Amer. Rev. Tuberc. 68. 467.

PALMER, C.E., KROHN, E.F., MANOS, N.E. and EDWARDS, L.B. (1956),
Public Health Rep. (U.S. Public Health Service), 71. 7.

PALMER, C.E., JABLON, S. and EDWARDS, P.Q. (1957),
Amer. Rev. Tuberc. 76. 517.

PALMER, C.E., SHAW, L.W. and COMSTOCK, G.W. (1958),
Amer. Rev. Tuberc. 77. 877.

POLLOCK, T.M., SUTHERLAND, I. and HART, P. D'ARCY (1959),
Tubercle (Lond.). 40. 336.

RADIOLOGICAL HAZARDS TO PATIENTS (1959),
Interim report of the Adrian Committee. H.M.S.O.

RIDDERVOLT, E. (1958),
Personal communication.

SEMPLE, A. and HUGHES, T.L. (1959),
Personal communication.
Report on the mass radiography Campaign in Liverpool.

SEILER, H.E., WELSTEAD, A.G. and WILLIAMSON, J. (1958),
Tubercle (Lond.). 39. 339.

SPRINGETT, R.V. (1951),
Brit. Med. J. 2. 144.

SMITH, J. (1959),
Brit. Med. J. 1. 1448.

STRADDLING, P. and JOHNSTON, R.N. (1955),
Lancet. 1.1247.

UNITED STATES PUBLIC HEALTH SERVICE (1953),
Community-wide chest X-ray survey data.

WEGELIUS, C. (1958),
Personal communication.

WUNDERLY, H. (1953),
Personal communication.
Report of a mass radiography survey in Broken Hill, Australia.

APPENDICES

COMMUNITY CHEST X-RAY SURVEYS

SCOTLAND 1953-1956

Areas surveyed, X-ray provision, response and tuberculosis yield

Area	Dates	Period (Weeks)	X-ray Units	Unit Weeks	Adult Population 1951 Census	Adults X-rayed$^{\phi}$		Yield of New Cases of Tuberculosis			
						Number	Per Cent Adult Population	Active		Observation	
								Number	Rate/1000$^{\#}$	Number	Rate/1000$^{\#}$
1953											
Greenock Burgh	15 Sep - 3 Oct	3	2	6	56,000	12,962	23.1	58	4.3	93	6.9
1954											
Edinburgh City (Pilton)	10 May - 15 Jne	4	2	8	19,000x	11,131	58.6	39	3.5	88	8.0
Coatbridge and Airdrie Burghs	24 May - 23 Jne	5	2	10	55,000	12,522	22.8	21	1.7	54	4.3
Fife County (Kelty/Lochgelly)	2 Aug - 28 Aug	4	2	8	20,000x	11,613	58.1	19	1.6	74	6.4
Paisley Burgh	26 Sep - 6 Nov	6	3	18	70,000	17,084	24.4	32	1.9	91	5.3
Kirkcaldy Burgh	8 Nov - 4 Dec	4	2	8	37,000	11,617	31.4	14	1.2	64	5.5
Rutherglen Burgh	29 Nov - 24 Dec	(1 (4	1) 1)	5	19,000	2,648	13.9	4	1.4	10	3.6
1955											
Edinburgh City (Central Leith)	7 Mar - 22 Mar	3	2	6	17,000x	12,822	75.4	27	2.1	50	3.9
Dumbarton Burgh	28 Mar - 23 Apl	4	2	8	17,000	10,039	59.1	28	2.6	66	6.2
Dundee City (Hilltown/Hawkhill)	18 Apl - 14 May	4	2	8	19,000x	15,117	79.6	41	2.7	213	13.8
Glasgow City (E.P.H. Div.)	6 Jne - 2 Jly	4	3	12	166,000x	11,628	7.0	56	4.5	125	10.0
Fife County (Cowdenbeath/Wemyss)	1 Aug - 17 Sep	7	3	21	48,000x	26,842	55.9	38	1.3	194	6.9
Motherwell and Wishaw Burgh	14 Nov - 3 Dec	3	3	9	52,000	20,548	39.5	51	2.4	110	5.2
1956											
Clydebank Burgh	12 Mar - 29 Mar	3	4	12	32,000	16,925	52.9	11	0.9	40	3.6
Falkirk Burgh	9 Apl - 21 Apl	2	4	8	28,000	7,885	28.2	9	1.1	31	3.8
Stirling County	23 Apl - 15 May	3	4	12	39,000x	17,921	46.0	17	0.9	44	2.4
Fife County (West)	4 Jne - 30 Jne	4	4	16	35,000x	18,243	52.1	20	1.0	102	5.5
Edinburgh City (South and East)	3 Sep - 29 Sep	4	4	16	99,000x	28,104	28.4	64	2.2	97	3.3
Hamilton Burgh	5 Nov - 24 Nov	3	3	9	30,000	14,380	47.9	19	1.3	95	6.5
TOTAL 1953-56		75	-	200	858,000	280,031	32.6	568	2.0	1,641	5.7

x Estimate. ϕ Includes non-residents. $\#$ Rates per 1000 examined (all ages) including non-residents.

RESPIRATORY TUBERCULOSIS

MEAN ANNUAL CONFIRMED NOTIFICATION AND DEATH RATES IN SCOTLAND 1952-56

Rates, in descending order, per 100,000 based on estimated population, 1954

Area	Confirmed Notifications	
GLASGOW		190
West Lothian		154
EDINBURGH		152
DUNDEE		148
Renfrew County	114)	
Greenock	207)	
Paisley	125)	146
Port Glasgow	217)	
Lanark County	139)	
Airdrie	116)	
Coatbridge	119)	
Hamilton	112)	140
Motherwell/Wishaw	173)	
Ruthergien	169)	
Midlothian County		120
ABERDEEN		114
Dunbarton County	98)	
Clydebank Burgh	104)	114
Dumbarton Burgh	195)	
Ross & Cromarty County		113
Clackmannan County		106
Fife County	95)	
Dunfermline	77)	97
Kirkcaldy	120)	
Stirling County	90)	
Falkirk	110)	95
Stirling Burgh	100)	
Dumfries County	72)	
Dumfries Burgh	127)	88
Argyll County		88

Area	Confirmed Notifications	
Kirkcudbright County		86
Angus County	76)	
Arbroath	121)	85
Inverness County	80)	
Inverness Burgh	92)	83
Moray & Nairn County		81
Caithness County		78
Bute County		74
Perth & Kinross County	73)	
Perth Burgh	95)	73
East Lothian County		73
Ayr County	70)	
Ayr Burgh	86)	72
Kilmarnock Burgh	70)	
Selkirk County		70
Sutherland County		63
Peebles County		61
Wigtown County		59
Zetland County		49
Orkney County		47
Berwick County		41
Banff County		40
Aberdeen County		38
Kincardine County		36
Roxburgh		34
SCOTLAND		126

Area	Deaths	
GLASGOW		35
Renfrew County	19)	
Greenock	34)	27
Paisley	31)	
Port Glasgow	39)	
Lanark County	22)	
Airdrie	17)	
Coatbridge	23)	23
Hamilton	33)	
Motherwell/Wishaw	22)	
Rutherglen	30)	
Dunbarton County	18)	
Clydebank	24)	21
Dumbarton Burgh	30)	
Argyll County		20
Ross & Cromarty County		19
DUNDEE		18
EDINBURGH		18
Inverness County	17)	
Inverness Burgh	16)	16
Bute County		16
Caithness County		15
Angus County	12)	
Arbroath	21)	14
Roxburgh County		14
Ayr County	12)	
Ayr Burgh	23)	14
Kilmarnock	14)	
Kirkcudbright County		13
Stirling County	12)	
Falkirk	19)	13
Stirling Burgh	10)	

Area	Deaths	
Perth & Kinross County	9)	
Perth Burgh	19)	12
West Lothian County		12
Clackmannan County		12
ABERDEEN		12
Fife County	11)	
Dunfermline	12)	12
Kirkcaldy	19)	
Sutherland County		11
Dumfries County	9)	
Dumfries Burgh	15)	11
Banff County		10
Orkney County		9
Aberdeen County		9
East Lothian County		9
Midlothian County		8
Selkirk County		7
Zetland County		7
Moray & Nairn County		7
Berwick County		7
Peebles County		6
Wigtown County		6
Kincardine County		4
SCOTLAND		20

RESPIRATORY TUBERCULOSIS

Areas in which the highest proportion of Scottish notifications and deaths occurred during the quinquennium 1952-56, with population and rates per 100,000

		Population (all ages) (1954)			Mean Annual Confirmed Notifications (1952-56)				Mean Annual Deaths (1952-56)			
		Number	Per Cent		Rate		Per Cent		Rate		Per Cent	
Glasgow City ¤	1	1,083,417	-	21.1	-	190	-	31.9	-	35	-	37.1
Lanark County	8, 18	315,470	6.2		139		6.8		22		6.8	
Airdrie Burgh¤	17	31,769	0.6		116		0.6		17		0.5	
Coatbridge Burgh¤	16	49,627	1.0		119		0.9		23		1.1	
Hamilton Burgh¤		40,734	0.8	10.5	112	140	0.7	11.5	33	23	1.3	11.9
Motherwell/Wishaw Burgh¤	19	69,401	1.4		173		1.9		22		1.5	
Rutherglen Burgh¤	13	24,414	0.5		169		0.6		30		0.7	
Edinburgh City¤	11	469,297	-	9.2	-	152	-	11.0	-	18	-	8.0
Renfrew County	14	134,083	2.6		114		2.4		19		2.5	
Greenock Burgh¤	12	77,533	1.5	6.4	207	146	2.5	7.5	34	27	2.6	8.9
Paisley Burgh¤	15	94,530	1.9		125		1.8		31		2.9	
Port Glasgow Burgh	7	22,657	0.4		217		0.8		39		0.9	
Fife County¤	6	217,428	4.2		95		3.2		11		2.2	
Dunfermline Burgh		45,052	0.9	6.1	77	97	0.5	4.6	12	12	0.5	4.7
Kirkcaldy Burgh¤		50,520	1.0		120		0.9		19		1.0	
Dundee City¤	22	176,784	-	3.5	-	148	-	4.1	-	18	-	3.0
Ayr County		240,512	4.7		70		2.6		12		2.8	
Ayr Burgh	4	42,920	0.8	6.3	86	72	0.6	3.7	23	14	1.0	4.4
Kilmarnock Burgh	5	42,981	0.8		70		0.5		14		0.6	
Aberdeen City	10	185,725	-	3.6	-	114	-	3.3	-	12	-	2.2
Dunbarton County	20	95,573	1.9		98		1.5		18		1.6	
Dumbarton Burgh¤	21	24,946	0.5	3.3	195	114	0.8	3.1	30	21	0.7	3.4
Clydebank Burgh¤		47,306	0.9		104		0.8		24		1.1	
Stirling County¤		125,142	2.4		90		1.7		12		1.5	
Falkirk Burgh¤		37,216	0.7	3.6	110	95	0.6	2.7	19	13	0.7	2.5
Stirling Burgh		26,836	0.5		100		0.4		10		0.3	
West Lothian County	3	90,875	-	1.8	-	154	-	2.2	-	12	-	1.1
Midlothian County	9	103,741	-	2.3	-	120	-	1.9	-	8	-	0.8
TOTAL		3,966,489	-	77	-	142	-	88	-	23	-	87
SURVEY AREAS$^{\phi}$		3,223,212	-	63	-	154	-	77	-	25	-	77
SCOTLAND		5,123,336	-	100	-	126	-	100	-	20	-	100

¤ Areas included in the 1953-56 survey programme (in whole or part)

ϕ Includes Perth Burgh and adjusted for Fife County

1-22. Survey numbers of areas included in 1957-58 programme

TWO YEAR MASS RADIOGRAPHY CAMPAIGN

Areas included in the 1957-58 Programme

Population, morbidity and mortality rates, survey dates and allocation of X-ray unit time

Survey Area	Adult Population 1951 Census	Mean annual rates per 100,000 (all ages) 1952-56		Survey Dates	Allocation of X-ray units and time				Examinations required per unit week ⧺
		Deaths	Confirmed notifications		Weeks	Units	Unit Weeks		
							Number	Per 10,000 adults	
1957 Surveys									
1. Glasgow City	819,420	35	190	11 Mch - 13 Apl	5	36.4	182	2.22	2,251
2. Perth Burgh	31,382	19	95	29 Apl - 11 May	2	4	8	2.55	1,961
3. West Lothian County	64,465	12	154	29 Apl - 25 May	4	4	16	2.48	2,015
4. Ayr Burgh	32,842	23	86	20 May - 15 June	4	2	8	2.44	2,053
5. Kilmarnock Burgh	32,010	14	70	20 May - 15 June	4	2	8	2.50	2,001
6. Fife County (Part)	48,648x	11ϕ	95ϕ	27 May - 29 June	5	2	10	2.06	2,433
7. Port Glasgow	14,704	39	217	17 Jne - 29 June	2	3	6	4.08	1,225
8. Lanark County (Part)	111,700	22ϕ	139ϕ	2 Sep - 5 Oct	5	5	25	2,24	2,234
9. Midlothian County	73,440	8	120	2 Sep - 5 Oct	5	3	15	2.04	2,448
10. Aberdeen City	140,297	12	114	28 Oct - 30 Nov	5	7	35	2.49	2,004
TOTAL	1,368,908	-	-	11 Mch - 30 Nov	41	-	313	2.29	2,187
1958 Surveys									
11. Edinburgh City	365,136	18	152	3 Mch - 29 Mch	4	27	108	3.03	1,690
12. Greenock Burgh	55,940	34	207	14 Apl - 10 May	4	4	16	2.86	1,748
13. Rutherglen Burgh	18,752	30	169	28 Apl - 10 May	5	2	4	2.13	2,344
14. Renfrew County	101,519	19	114	12 May - 14 Jne	2	5	25	2.46	2,030
15. Paisley Burgh	70,444	31	125	12 May - 14 Jne	5	3	15	2.13	2,348
16. Coatbridge Burgh	33,506	23	119	16 Jne - 5 Jly	3	3	9	2.69	1,861
17. Airdrie Burgh	21,909	17	116	16 Jne - 5 Jly	3	2	6	2.74	1,826
18. Lanark County (Part)	119,215	22ϕ	139ϕ	1 Sep - 4 Oct ≠	2/3	6/4	24	2.01	2,484
19. Motherwell/Wishaw Burgh	50,074	22	173	15 Sep - 4 Oct	3	4	12	2.40	2,086
20. Dunbarton County	72,847	18	98	6 Oct - 1 Nov	4	4	16	2.20	2,276
21. Dumbarton Burgh	17,343	30	195	20 Oct - 1 Nov	2	2	4	2.31	2,168
22. Dundee City	134,447	18	148	10 Nov - 6 Dec	4	8	32	2.38	2,101
TOTAL	1,061,132	-	-	3 Mch - 6 Dec	44	-	271	2.55	1,958
TOTAL 1957-58	2,430,040	25	154	-	85	-	584	2.40	2,081

x Estimate by Medical Officer of Health

ϕ Rates for whole county area

⧺ Miniature film examinations required to X-ray 50 per cent of adults resident in the Survey areas. Recalls (5 per cent) to be examined within this allocation.

≠ Carried out in two parts

Two-year Mass Radiography Campaign

Administrative Arrangements

DEPARTMENT OF HEALTH FOR SCOTLAND

Policy and Finance
Planning of the national programme
Co-ordination of services
Deployment of mass radiography teams
Staff service conditions
Records and statistics
Servicing of equipment
Deployment of national hospital resources
Technical standards
Printing and stationery

SCOTTISH INFORMATION OFFICE

National publicity
Preparation and supply of advertising material
- Booklets for voluntary workers
- Banners
- Posters

Advice and assistance to local authorities

CAMPAIGN TECHNICAL ADVISORY COMMITTEE

REGIONAL HOSPITAL BOARDS

Implementation of local survey programmes
Accommodation and welfare of staff
Staff reinforcements (technical and clerical)
Records
Supplies
Local transport
Disposal of patients

SURVEY TECHNICAL COMMITTEES

LOCAL HEALTH AUTHORITIES

Selection and adaptation of Unit Sites
Publicity (Publicity Committees)

Letters to householders	Films ¤
Household canvasing	Public meetings
Leaflets	Speakers ¤
Posters and banners	Press conferences
Window displays & stickers	Prizes
X-ray badges	Publication of Unit programmes

Organisation of Voluntary workers
(Ward committees, British Red Cross Society, Women's Voluntary Services, Church Organisations, Youth Organisations, individual volunteers.) for home visiting and duties as X-ray Unit hostesses.

¤ Films, speakers and some publicity material supplied by the Scottish Council for Health Education. All film material rented from the National Association for the Prevention of Tuberculosis and some of the posters purchased from this source.

APPENDIX 6

MASS RADIOGRAPHY CARD

(not to scale)

Front

Initial Visit Date	/ M.R. Number		Survey No.
Surname	Mr. Mrs. Miss	Code	Survey Group
Christian Name(s)			Area Code
Address			Age
			History Code
Doctor's Name ..... Address	History		
Report on Small Film	Further X-ray required: L.F.	Other	Significant Abnormality No Significant Abnormality Card Completed Date / /59

Back

Recall Date	Date of Birth / /	If History Recorded - Name and Address (if different)	
Occupation			Code
Industry, School, etc.			Code
Contact	M.R. Result	Method	Code
Report on Large Film		Diagnosis	Code
		Disposal	Code
	Final Result (Chest Clinic)	Diagnosis	Code
		Disposal	Code
	Defaulter		Code

TWO YEAR MASS RADIOGRAPHY CAMPAIGN

DIAGNOSIS CODES

Code	Diagnosis
1	Congenital abnormalities of the Bony Thorax and Soft Tissues:- depressed sternum — wedge vertebrae spina bifida
2	Acquired abnormalities of the Bony Thorax and Soft Tissues:- fractures — tuberculosis malformations due to Polio — Paget's disease osteo-chondritis — actinomycosis
3	Tumours of the Bony Thorax (primary and secondary):- osteo-chondromata — sarcomata chondromata — reticulosis fibromata
4	Congenital malformations of the lungs:- lobar malformations — hamartomas accessory lobes — haemangiomas ectopic segments — arterio-venous aneurysms
5	Bacterial and virus lung infections:- lung abscess and pneumonitis (exclude infections secondary to malignancy aspiration and chemical pneumonias)
6	Other infections of the lungs:- hydatid disease — fungus infection syphilis — histoplasmosis
7	Bronchiectasis
8	Honeycomb lung
9	Emphysema:- hypertrophic — bullous obstructive — interstitial
10	Pulmonary fibrosis - non-tuberculous:- asthma bronchitis post-infective fibrosis secondary to pneumonitis, suppurative and chemical pneumonias (oil, achalasia, fumes, etc.)
11	Pneumoconiosis
12	Spontaneous pneumothorax
13	Benign tumours of the lungs and mediastinum:- pulmonary fibromas — substernal thyroid endotheliomas — mediastinal cysts neurofibromas
14	Carcinoma or other malignant disease of the lung and mediastinum
15	Metastases in the lung and mediastinum
16	Enlarged mediastinal and bronchial glands - non-tuberculous:- reticuloses glandular fever other causes
17	Sarcoidosis and collagenous diseases:- glandular and pulmonary
18	Pleural thickening or calcification - non-tuberculous:- sequelae of empyema haemothorax, etc.
19	Abnormalities of the diaphragm and oesophagus - congenital and acquired:- hernia — oesophageal strictures cardiospasm — diverticula
20	Congenital abnormalities of heart and vessels:- abnormal venous drainage — right-sided aorta dextrocardia
21	Acquired abnormalities of heart and vessels:- aneurysms haemosiderosis
22	Miscellaneous:- empyema F.B. in lung
23	Pneumoconiosis with tuberculosis
24	Pulmonary tuberculosis. Active
25	Pulmonary tuberculosis. Of doubtful activity but requiring observation
26	Tuberculous pleural effusion without demonstrable pulmonary lesion
27	Tuberculosis - inactive and healed - primary
28	Tuberculosis - inactive and healed - post primary
29	No abnormality detected)
	) Chest Clinic diagnosis only
30	Not yet diagnosed)

TWO YEAR MASS RADIOGRAPHY CAMPAIGN

SCOTLAND 1957-58

Numbers Examined and Response in each Survey

Survey Area	TOTAL EXAMINATIONS		RESIDENTS EXAMINED				Non-residents Examined all ages	Per cent resident adult population examined	
	All ages	Per Unit/week	Adults		All ages				
			Number	Per cent of all examinations	Number	Per cent of all examinations	No.	1951 Census	1957 Estimate
1957 Surveys									
1. Glasgow City	714,915	3,928	622,349	87.1	641,815	89.8	73,100	75.95	77.62
2. Perth Burgh	28,358	3,545	21,536	75.9	22,301	78.6	6,057	68.63	70.38
3. West Lothian County	37,341	2,334	33,970	91.0	35,484	95.0	1,857	52.69	51.27
4. Ayr Burgh	30,556	3,820	21,204	69.4	21,641	70.8	8,915	64.56	63.61
5. Kilmarnock Burgh	31,790	3,974	22,688	71.0	23,212	73.0	8,578	70.88	67.59
6. Fife County (Part)	27,096	2,710	26,037	97.0	26,851	99.2	245	-	53.52 Ø
7. Port Glasgow Burgh	12,815	2,136	10,788	84.2	11,379	88.8	1,436	73.37	67.87
8. Lanark County (Part)	48,390	1,936	45,742	94.5	47,759	98.7	631	-	40.95 Ø
9. Midlothian County	29,540	1,969	27,163	92.0	28,750	97.3	790	36.99	35.34
10. Aberdeen City	125,598	3,589	106,430	84.7	110,601	88.1	14,997	75.86	75.13
TOTAL	1,086,399	3,471	937,907	86.3	969,793	89.3	116,606	68.51	69.01
1958 Surveys									
11. Edinburgh City	295,037	2,732	276,749	93.8	280,663	95.1	14,374	77.79	76.99
12. Greenock Burgh	48,093	3,006	43,978	91.4	46,086	95.8	2,007	78.62	78.31
13. Rutherglen Burgh	14,673	3,668	11,784	80.3	12,593	85.8	2,080	62.84	63.30
14. Renfrew County	44,062	1,762	40,901	92.8	43,062	97.7	1,000	40.29	39.80
15. Paisley Burgh	48,655	3,244	44,244	90.9	46,347	95.3	2,308	62.81	61.76
16. Coatbridge Burgh	24,058	2,673	21,848	90.8	22,756	94.6	1,302	65.20	60.29
17. Airdrie Burgh	15,038	2,506	14,048	93.4	14,763	98.2	275	64.11	59.67
18. Lanark County (Part)	59,761	2,490	56,841	95.1	59,180	99.0	581	-	47.69 Ø
19. Motherwell/Wishaw Burgh	37,675	3,139	34,158	90.7	35,615	94.5	2,060	68.22	65.16
20. Dunbarton County	38,658	2,416	36,049	93.3	37,571	97.2	1,087	49.48	49.77
21. Dumbarton Burgh	13,691	3,423	12,777	93.3	13,253	96.8	438	73.67	68.59
22. Dundee City	118,468	3,702	108,673	91.7	112,350	94.8	6,118	80.83	80.85
TOTAL	757,869	2,797	702,050	92.6	724,237	95.6	33,630	66.16	65.89
TOTAL 1957-58	1,844,268	3,158	1,639,957	88.9	1,694,030	91.9	150,236	67.49	67.63

Ø Based on population estimate by Medical Officer of Health

TWO YEAR MASS RADIOGRAPHY CAMPAIGN

SCOTLAND 1957-58

Numbers Examined in Age and Sex Groups in each Survey 1957-58

	NUMBER OF RESIDENTS EXAMINED															Total Examined - Residents and Non-Residents
	MALES							FEMALES							BOTH SEXES		
	-14	15-	25-	35-	45-	60+	Adults	-14	15-	25-	35-	45-	60+	Adults	All Ages	Adults	
1957 Surveys																	
1. Glasgow City	9,816	58,716	58,953	55,329	71,700	37,059	281,875	9,650	70,854	64,431	66,257	88,065	50,690	340,474	641,815	622,349	714,915
2. Perth Burgh	404	1,714	1,933	2,014	2,553	1,300	9,524	361	2,168	2,316	2,415	3,181	1,921	12,012	22,301	21,536	28,358
3. West Lothian County	748	3,411	3,360	3,367	3,976	1,570	15,634	766	4,285	4,044	3,955	4,334	1,659	18,286	35,484	33,970	37,341
4. Ayr Burgh	186	1,799	1,837	1,909	2,503	1,248	9,297	251	3,473	2,269	2,309	3,128	1,716	11,907	21,641	21,204	30,556
5. Kilmarnock Burgh	248	2,006	2,216	2,155	2,615	1,230	10,224	276	2,590	2,493	2,576	3,192	1,606	12,464	23,212	22,688	31,790
6. Fife County (Part)	346	2,683	2,054	2,299	3,118	1,600	11,765	468	2,561	2,461	2,826	4,058	2,366	14,272	26,851	26,037	27,096
7. Port Glasgow Burgh	272	1,255	1,100	1,037	1,106	592	5,091	319	1,424	1,289	1,199	1,156	626	5,697	11,379	10,788	12,815
8. Lanark County (Part)	1,071	4,574	4,204	4,394	5,415	2,797	21,404	946	5,069	5,148	5,410	5,812	2,865	24,338	47,759	45,742	48,390
9. Midlothian County	824	2,679	2,844	2,938	3,001	1,233	12,700	763	3,067	3,474	3,366	3,260	1,292	14,463	28,750	27,163	29,540
10. Aberdeen City	2,056	9,676	9,408	9,268	12,600	6,441	47,399	2,115	11,708	10,939	10,929	16,105	9,330	59,031	110,601	106,430	125,598
TOTAL	15,971	88,513	87,909	84,710	108,587	55,070	424,963	15,915	106,199	98,864	101,242	132,291	74,071	512,944	969,793	937,907	1,086,399
1958 Surveys																	
11. Edinburgh City	2,188	22,963	22,985	23,264	34,052	20,922	124,294	1,726	26,221	24,397	27,076	42,740	31,906	152,455	280,663	276,749	295,037
12. Greenock Burgh	1,045	4,677	4,153	3,996	5,082	2,913	20,821	1,063	5,165	4,308	4,570	5,621	3,490	23,157	46,086	43,978	48,093
13. Rutherglen Burgh	436	942	891	918	1,319	783	4,853	373	1,216	1,179	1,348	1,957	1,230	6,931	12,593	11,784	14,673
14. Renfrew County	1,118	3,493	3,380	3,575	4,453	2,544	17,452	1,043	4,307	4,559	4,966	6,116	3,484	23,449	43,062	40,901	44,062
15. Paisley Burgh	1,046	4,365	3,890	3,704	4,808	2,563	19,330	1,075	5,236	4,483	4,901	6,462	3,829	24,914	46,347	44,244	48,655
16. Coatbridge Burgh	453	2,630	2,249	1,883	2,378	1,347	10,487	455	2,743	2,473	2,275	2,559	1,311	11,361	22,756	21,848	24,058
17. Airdrie Burgh	381	1,479	1,193	1,205	1,509	826	6,213	334	1,928	1,539	1,593	1,851	923	7,835	14,763	14,048	15,038
18. Lanark County (Part)	1,178	5,342	5,056	5,206	6,276	3,527	25,408	1,161	6,071	6,682	6,691	7,709	4,277	31,433	59,180	56,841	59,761
19. Motherwell/Wishaw Burgh	780	3,395	3,253	3,027	3,878	2,289	15,846	677	3,846	3,695	3,640	4,662	2,465	18,312	35,615	34,158	37,675
20. Dunbarton County	728	3,217	2,809	3,133	4,070	2,214	15,459	794	3,851	3,747	4,304	5,434	3,210	20,590	37,571	36,049	38,658
21. Dumbarton Burgh	272	1,268	1,215	1,213	1,352	713	5,761	204	1,534	1,406	1,433	1,646	997	7,016	13,253	12,777	13,691
22. Dundee City	1,888	9,963	9,861	9,356	12,639	7,125	48,955	1,789	11,236	10,512	10,694	15,883	11,382	59,718	112,350	108,673	118,468
TOTAL	11,513	63,734	60,935	60,480	81,816	47,766	314,879	10,676	73,354	68,980	73,491	102,640	68,504	387,171	724,239	702,050	757,869
TOTAL 1957-58	27,484	152,247	148,844	145,190	190,403	102,836	739,842	26,591	179,553	167,844	174,733	234,931	142,575	900,115	1,694,032	1,639,957	1,844,268

Age "not stated" in 801 cases - all of which are included in the totals

TWO YEAR MASS RADIOGRAPHY CAMPAIGN

SCOTLAND 1957-58

Residents Examined as a per cent of the 1951 Census Population in Age and Sex Groups

	PER CENT RESIDENTS EXAMINED															
	MALES							FEMALES							BOTH SEXES	
	-14	15-	25-	35-	45-	60+	Adults	-14	15-	25-	35-	45-	60+	Adults	All Ages	Adults
1957 SURVEYS																
1. Glasgow City	7.2	78.2	76.5	71.9	78.3	60.6	73.8	7.2	81.6	78.4	79.9	83.1	63.7	77.8	58.90	75.95
2. Perth Burgh	8.8	70.4	71.2	68.4	72.8	51.1	67.3	8.0	75.0	76.7	76.2	75.3	48.9	69.7	55.08	68.63
3. West Lothian County	6.1	56.0	50.2	51.2	54.0	31.2	49.4	6.5	63.7	59.9	62.3	58.3	30.6	55.9	40.05	52.69
4. Ayr Burgh	3.8	67.2	66.4	63.6	68.5	48.0	63.0	5.4	72.7	75.3	67.0	70.7	44.9	64.6	50.07	64.56
5. Kilmarnock Burgh	4.9	73.3	74.6	68.9	72.8	51.0	68.9	5.5	82.4	76.9	76.2	75.8	50.2	72.7	55.11	70.88 ϕ
6. Fife County (Part)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	53.52 ϕ
7. Port Glasgow Burgh	7.7	83.2	70.3	73.3	74.4	58.3	72.8	9.4	81.4	75.6	80.5	73.7	52.2	73.9	52.64	73.57
8. Lanark County (Part)																
9. Midlothian County	6.3	37.1	36.5	40.2	37.6	20.6	35.0	6.1	43.4	45.2	47.0	39.2	18.7	38.9	29.05	36.99
10. Aberdeen City	9.6	81.1	77.8	74.1	82.3	62.4	76.3	10.1	77.9	79.9	75.9	84.2	58.7	75.5	60.53	75.86
1958 SURVEYS																
11. Edinburgh City	4.2	78.8	74.7	71.0	84.3	71.8	76.6	3.4	77.4	72.0	72.0	84.0	71.3	75.2	60.13	75.79
12. Greenock Burgh	10.2	88.2	75.8	75.9	84.4	64.8	78.4	10.6	84.8	75.7	84.6	83.7	63.7	78.8	60.41	78.62
13. Rutherglen Burgh	16.1	65.9	55.8	52.4	63.3	47.6	57.1	13.7	67.1	67.8	69.4	75.4	57.0	67.6	52.66	62.84
14. Renfrew County	6.9	43.4	39.5	38.3	37.1	31.2	37.8	6.8	45.6	47.5	47.0	43.9	30.1	42.3	32.37	40.29
15. Paisley Burgh	8.9	69.9	60.5	55.6	62.3	49.1	59.9	9.2	75.1	64.0	66.8	68.9	51.4	65.3	49.46	62.81
16. Coatbridge Burgh	6.3	78.3	65.6	60.7	65.6	50.3	64.8	6.6	70.3	66.3	69.3	66.5	51.5	65.6	47.86	65.20
17. Airdrie Burgh	8.9	72.4	55.1	56.6	62.4	49.6	59.6	8.1	77.9	64.5	73.9	68.2	52.4	68.2	48.70	64.11
18. Lanark County (Part) ¤	5.2	44.4	41.8	44.2	45.7	35.3	42.7	5.1	44.7	49.4	53.9	48.6	34.2	46.4	34.04	44.64
19. Motherwell/Wishaw Burgh	8.5	76.4	66.9	62.7	67.2	56.6	66.1	7.6	73.4	70.4	71.3	76.8	55.4	70.1	52.26	68.21
20. Dunbarton County	6.3	50.3	40.8	44.1	49.6	37.9	44.8	6.5	56.2	53.5	58.6	57.4	39.2	53.7	39.17	49.49
21. Dumbarton Burgh	8.4	81.0	72.1	72.9	71.5	52.5	70.6	6.5	85.8	73.2	86.0	77.7	59.2	76.4	55.92	73.67
22. Dundee City	8.6	87.1	83.1	80.0	88.6	71.4	82.6	8.5	82.7	80.7	78.9	85.5	69.2	79.4	63.35	80.83

¤ 1957/58 surveys combined. Response rates based on population of whole county.

ϕ Based on population estimate by Medical Officer of Health.

TWO YEAR MASS RADIOGRAPHY CAMPAIGN

SCOTLAND 1957-58

Yield of New and Previously Known Cases of Respiratory Tuberculosis in individual Survey Areas

Numbers and rates per 1000 Examined

Survey Area	Yield of Respiratory Tuberculosis among Residents											
	New Cases									Previously Known Significant Cases		
	Active		Observation		Significant			Confirmed bacteriologically				
	No.	Rate	No.	Rate	No.	Rate	Per cent Active	No.	Rate	No.	Rate	Per cent of significant yield
1957 SURVEYS												
1. Glasgow City	2,369	3.69	4,142	6.45	6,511	10.14	36.4	523	0.81	1,087	1.69	14.3
2. Perth Burgh	25	1.12	134	6.01	159	7.13	15.7	5	0.22	14	0.63	8.1
3. West Lothian County	56	1.58	159	4.48	215	6.06	26.0	17	0.48	4	0.11	1.8
4. Ayr Burgh	32	1.48	17	0.79	49	2.26	65.3	16	0.74	NA	-	-
5. Kilmarnock Burgh	33	1.42	47	2.02	80	3.45	41.3	23	0.99	NA	-	-
6. Fife County (Part)	7	0.26	35	1.30	42	1.56	16.7	3	0.11	7	0.26	14.3
7. Port Glasgow Burgh	17	1.49	118	10.37	135	11.86	12.6	5	0.44	50	4.39	27.0
8. Lanark County (Part)	76	1.59	115	2.41	191	4.00	39.8	22	0.46	75	1.57	28.2
9. Midlothian County	37	1.29	126	4.38	163	5.67	22.7	18	0.63	31	1.08	16.0
10. Aberdeen City	162	1.46	364	3.29	526	4.76	30.8	72	0.65	33	0.30	5.9
TOTAL	2,814	2.90	5,257	5.42	8,071	8.32	34.9	704	0.73	1,301*	1.34*	16.4*
1958 SURVEYS												
11. Edinburgh City	473	1.69	1,325	4.72	1,798	6.41	26.3	194	0.69	72	0.26	3.9
12. Greenock Burgh	76	1.65	88	1.91	164	3.56	46.3	12	0.26	8	0.17	4.7
13. Rutherglen Burgh	23	1.83	34	2.70	57	4.53	40.4	5	0.40	18	1.43	24.0
14. Renfrew County	64	1.49	96	2.23	160	3.72	40.0	11	0.26	51	1.18	24.2
15. Paisley Burgh	74	1.60	41	0.88	115	2.48	64.3	34	0.52	18	0.39	13.5
16. Coatbridge Burgh	27	1.19	52	2.29	79	3.47	34.2	12	0.53	91	4.00	56.9
17. Airdrie Burgh	16	1.08	2	0.14	18	1.22	88.9	7	0.47	5	0.34	21.7
18. Lanark County (Part)	84	1.42	86	1.45	170	2.87	49.4	25	0.42	48	0.81	22.0
19. Motherwell/Wishaw Burgh	48	1.35	26	0.73	74	3.08	64.9	15	0.42	7	0.20	8.6
20. Dunbarton County	58	1.54	55	1.46	113	3.01	51.3	16	0.43	6	0.16	5.0
21. Dumbarton Burgh	17	1.28	5	0.38	22	1.66	77.3	6	0.16	4	0.30	15.4
22. Dundee City	259	2.31	200	1.78	459	4.09	56.4	90	0.68	70	0.62	13.2
TOTAL	1,219	1.68	2,010	2.78	3,229	4.46	37.8	427	0.59	398	0.55	11.0
TOTAL 1957-58	4,033	2.38	7,267	4.29	11,300	6.67	35.7	1,131	0.67	1,699*	1.03*	15.2*

* Excluding Ayr and Kilmarnock

TWO YEAR MASS RADIOGRAPHY CAMPAIGN

SCOTLAND 1957-58

Persons Found Suffering from Active Respiratory Tuberculosis
Numbers and Rates per 1000 Examined in Age and Sex Groups

Residents and Non-Residents

1957 SURVEYS

/New Cases Only/

Survey Area		MALE RESIDENTS							FEMALE RESIDENTS							BOTH SEXES - ALL AGES		
		-14	15-	25-	35-	45-	60+	All Ages	-14	15-	25-	35-	45-	60+	All Ages	Residents	Non-Residents	Grand Total
1. Glasgow City	No.	22	201	208	218	478	260	1,387	10	285	242	215	162	67	982	2,369	196	2,565
	Rate	2.24	3.42	3.53	3.94	6.67	7.02	4.76	1.04	4.02	3.76	3.24	1.84	1.32	2.81	3.69	2.68	3.59
2. Perth Burgh	No.	-	2	5	3	6	3	19	-	-	3	2	1	-	6	25	2	27
	Rate	-	1.17	2.59	1.49	2.35	2.31	1.91	-	-	1.30	0.83	0.31	-	0.48	1.12	-	0.95
3. West Lothian County	No.	1	5	5	5	5	-	21	-	14	9	7	5	-	35	56	-	56[x]
	Rate	1.34	1.47	1.49	1.49	1.26	-	1.28	-	3.27	2.23	1.77	1.15	-	1.84	1.58	-	-
4. Ayr Burgh	No.	-	3	3	3	5	4	18	-	5	3	5	1	-	14	32	24	56
	Rate	-	1.67	1.63	1.57	2.00	3.21	1.90	-	2.02	1.32	2.17	0.32	-	1.15	1.48	2.69	1.83
5. Kilmarnock Burgh	No.	-	4	5	4	4	2	19	-	2	5	4	3	-	14	33	14	47
	Rate	-	1.99	2.26	1.86	1.53	1.63	1.81	-	0.77	2.01	1.55	0.94	-	1.10	1.42	1.63	1.48
6. Fife County (Part)	No.	-	-	-	1	-	1	2	-	3	-	2	-	-	5	7	-	7[x]
	Rate	-	-	-	0.43	-	0.63	0.17	-	1.17	-	0.71	-	-	0.34	0.26	-	-
7. Port Glasgow Burgh	No.	-	1	1	2	2	3	9	-	2	2	3	1	-	8	17	-	17
	Rate	-	0.80	0.91	1.93	1.81	5.07	1.68	-	1.40	1.55	2.50	0.87	-	1.33	1.49	-	1.33
8. Lanark County (Part)	No.	1	10	7	7	10	6	41	2	12	8	6	3	4	35	76	-	76[x]
	Rate	0.93	2.19	1.67	1.59	1.85	2.15	1.82	2.11	2.37	1.55	1.11	0.52	1.40	1.38	1.59	-	-
9. Midlothian County	No.	-	6	9	3	3	4	25	-	5	3	3	1	-	12	37	-	37[x]
	Rate	-	2.24	3.16	1.02	1.00	3.24	1.85	-	1.63	0.86	0.89	0.31	-	0.79	1.29	-	-
10. Aberdeen City	No.	1	6	16	21	30	17	91	1	19	14	13	19	5	71	162	16	178
	Rate	0.49	0.62	1.70	2.27	2.38	2.64	1.84	0.47	1.62	1.28	1.19	1.18	0.54	1.16	1.46	1.07	1.42
TOTAL 1957 SURVEYS	No.	25	238	259	267	543	300	1,632	13	347	289	260	196	76	1,182	2,814	252[ø]	3,066[ø]
	Rate	1.57	2.69	2.95	3.15	5.00	5.45	3.70	0.82	3.27	2.92	2.57	1.48	1.03	2.24	2.90	2.31	2.84

x Excluding non-residents.

ø Excludes non-residents in four surveys.

Age not stated in one case (Glasgow).

TWO YEAR MASS RADIOGRAPHY CAMPAIGN

SCOTLAND 1957-58

Persons Found Suffering from Active Respiratory Tuberculosis
Numbers and Rates per 1000 Examined in Age and Sex Groups

Residents and Non-Residents

1958 SURVEYS

/New Cases Only/

Survey Area		MALE RESIDENTS							FEMALE RESIDENTS							BOTH SEXES - ALL AGES		
		-14	15-	25-	35-	45-	60+	All Ages	-14	15-	25-	35-	45-	60+	All Ages	Residents	Non-Residents	Grand Total
11. Edinburgh City	No.	-	19	40	56	103	90	308	-	37	35	45	30	18	165	473	14	487
	Rate	-	0.83	1.74	2.41	3.02	4.30	2.44	-	1.41	1.43	1.66	0.70	0.56	1.07	1.69	0.97	1.65
12. Greenock Burgh	No.	-	5	9	7	10	14	45	1	14	6	2	8	-	31	76	1	77
	Rate	-	1.07	2.17	1.75	1.97	4.81	2.06	0.94	2.71	1.39	0.44	1.42	-	1.28	1.65	0.50	1.60
13. Rutherglen Burgh	No.	-	4	-	-	4	8	16	-	3	2	-	-	2	7	23	2	25
	Rate	-	4.25	-	-	3.03	10.22	3.03	-	2.47	1.70	-	-	1.63	0.96	1.83	0.96	1.70
14. Renfrew County	No.	-	6	5	6	9	9	35	2	5	5	9	7	1	29	64	1	65
	Rate	-	1.72	1.48	1.68	2.02	3.54	1.88	1.92	1.16	1.10	1.81	1.14	0.29	1.18	1.49	1.00	1.48
15. Paisley Burgh	No.	-	8	7	7	15	11	48	-	5	8	9	3	1	26	74	5	79
	Rate	-	1.83	1.80	1.89	3.12	4.29	2.36	-	0.95	1.78	1.84	0.46	0.26	1.00	1.60	2.17	1.62
16. Coatbridge Burgh	No.	-	1	2	6	4	2	15	-	8	2	1	1	-	12	27	1	28
	Rate	-	0.38	0.89	3.19	1.68	1.48	1.37	-	2.92	0.81	0.44	0.39	-	1.02	1.19	0.77	1.16
17. Airdrie Burgh	No.	-	-	2	1	3	3	9	-	1	2	4	-	-	7	16	0	16
	Rate	-	-	1.68	0.83	1.99	3.63	1.36	-	0.52	1.30	2.51	-	-	0.86	1.08	-	1.06
18. Lanark County (Part)	No.	-	7	9	12	13	5	46	-	11	11	8	6	2	38	84	2	86
	Rate	-	1.31	1.78	2.31	2.07	1.42	1.73	-	1.81	1.65	1.20	0.78	0.47	1.17	1.42	3.44	1.44
19. Motherwell/Wishaw Burgh	No.	-	4	6	6	5	7	28	1	6	8	2	2	1	20	48	2	50
	Rate	-	1.18	1.84	1.98	1.29	3.06	1.68	1.48	1.56	2.17	0.55	0.43	0.41	1.05	1.35	0.97	1.33
20. Dunbarton County	No.	1	6	8	5	10	8	38	-	5	7	6	1	1	20	58	7	65
	Rate	1.37	1.87	2.85	1.60	2.46	3.61	2.35	-	1.30	1.87	1.39	0.18	0.31	0.94	1.54	6.44	1.68
21. Dumbarton Burgh	No.	-	5	-	-	3	4	12	1	2	2	-	-	-	5	17	2	19
	Rate	-	3.94	-	-	2.22	5.61	1.99	4.90	1.30	1.42	-	-	-	0.69	1.28	4.57	1.39
22. Dundee City	No.	-	19	25	26	39	43	152	1	19	19	27	30	11	107	259	6	265
	Rate	-	1.91	2.54	2.78	3.09	6.04	2.99	0.56	1.69	1.81	2.52	1.89	0.97	1.74	2.31	0.98	2.24
TOTAL 1958 SURVEYS	No.	1	84	113	132	218	204	752	6	116	107	113	88	37	467	1,219	43	1,262
	Rate	0.09	1.32	1.85	2.18	2.66	4.27	2.30	0.56	1.58	1.55	1.54	0.86	0.54	1.17	1.68	1.28	1.67
TOTAL 1957-58	No.	26	322	372	399	761	504	2,384	19	463	396	373	284	113	1,649	4,033	295ϕ	4,328ϕ
	Rate	0.95	2.11	2.50	2.75	4.00	4.90	3.22	0.72	2.34	2.36	2.13	1.21	0.79	1.83	2.38	2.07	2.35

ϕ Excludes non-residents in four 1957 Surveys

TWO YEAR MASS RADIOGRAPHY CAMPAIGN

SCOTLAND 1957-58

Persons Presenting Radiological Evidence of Respiratory Tuberculosis of Doubtful Activity Requiring Observation
Numbers and Rates per 1000 Examined in Age and Sex Groups
Residents and Non-Residents
1957 SURVEYS

/New Cases Only/

Survey Area		MALE RESIDENTS							FEMALE RESIDENTS							BOTH SEXES		
		-14	15-	25-	35-	45-	60+	All Ages	-14	15-	25-	35-	45-	60+	All Ages	Residents	Non-Residents	Grand Total
1. Glasgow City	No.	10	161	334	413	910	530	2,358	12	234	446	447	459	185	1,784	4,142	346	4,488
	Rate	1.02	2.74	5.67	7.46	12.69	14.30	8.08	1.24	3.30	6.92	6.75	5.21	3.65	5.10	6.45	4.73	6.28
2. Perth Burgh	No.	-	2	7	18	21	18	66	1	6	16	15	23	7	68	134	-	134*
	Rate	-	1.17	3.62	8.94	8.23	13.85	6.65	2.77	2.77	6.91	6.21	7.23	3.64	5.50	6.01	-	-
3. West Lothian County	No.	-	5	11	19	40	31	106	-	6	12	11	12	12	53	159	-	159*
	Rate	-	1.47	3.27	5.64	10.06	19.75	6.45	-	1.40	2.97	2.78	2.77	7.23	2.78	4.48	-	-
4. Ayr Burgh	No.	-	-	2	2	4	2	10	-	-	2	2	3	-	7	17	10	27
	Rate	-	-	1.09	1.05	1.60	1.60	1.05	-	-	0.88	0.87	0.96	-	0.58	0.79	1.12	0.88
5. Kilmarnock Burgh	No.	-	2	6	7	7	4	26	-	2	7	6	2	4	21	47	18	65
	Rate	-	1.00	2.71	3.25	2.68	3.25	2.48	-	0.77	2.81	2.33	0.63	2.49	1.65	2.02	2.10	2.04
6. Fife County (Part)	No.	-	-	2	4	7	3	16	-	3	4	6	4	2	19	35	-	35*
	Rate	-	-	9.74	1.74	2.25	1.88	1.32	-	1.17	1.63	2.12	0.99	0.85	1.29	1.30	-	-
7. Port Glasgow Burgh	No.	1	7	12	18	24	9	71	-	6	12	14	9	6	47	118	18	136
	Rate	3.68	5.58	10.91	17.35	21.70	15.20	13.24	-	4.21	9.31	11.68	7.79	9.58	7.81	10.37	12.53	10.61
8. Lanark County (Part)	No.	2	11	13	15	25	9	75	-	2	13	16	8	1	40	115	-	115*
	Rate	1.87	2.40	3.09	3.41	4.62	3.22	3.34	-	0.39	2.53	2.96	1.38	0.35	1.58	2.41	-	-
9. Midlothian County	No.	-	5	6	15	24	31	81	-	2	6	14	14	9	45	126	-	126*
	Rate	-	1.87	2.11	5.11	8.00	25.14	5.99	-	0.65	1.73	4.16	4.29	6.97	2.96	4.38	-	-
10. Aberdeen City	No.	1	7	22	38	75	47	190	-	10	31	34	63	36	174	364	34	398
	Rate	0.49	0.72	2.34	4.10	5.95	7.30	3.84	-	0.85	2.83	3.11	3.91	3.86	2.83	3.29	2.27	3.17
TOTAL 1957 SURVEYS	No.	14	200	415	549	1,137	684	2,999	13	271	549	565	597	262	2,258	5,257	426ϕ	5,683
	Rate	0.89	2.26	4.72	6.48	10.47	12.42	6.80	0.83	2.55	5.55	5.58	4.51	3.54	4.27	5.42	4.14	5.30

* Excluding non-residents. ϕ Excludes non-residents in five surveys. Age not stated in one case (Glasgow)

TWO YEAR MASS RADIOGRAPHY CAMPAIGN

SCOTLAND 1957-58

Persons Presenting Radiological Evidence of Respiratory Tuberculosis of Doubtful Activity Requiring Observation
Numbers and Rates per 1000 Examined in Age and Sex Groups
Residents and Non-Residents
1958 SURVEYS

/New Cases Only/

Survey Area		MALE RESIDENTS							FEMALE RESIDENTS							BOTH SEXES - ALL AGES		
		-14	15-	25-	35-	45-	60+	All Ages	-14	15-	25-	35-	45-	60+	All Ages	Residents	Non-Residents	Grand Total
11. Edinburgh City	No.	-	35	73	130	314	268	820	-	26	75	109	165	130	505	1,325	17	1,342
	Rate	-	1.52	3.18	5.59	9.22	12.81	6.48	-	0.99	3.07	4.03	3.86	4.07	3.28	4.72	1.18	4.55
12. Greenock Burgh	No.	-	4	7	8	11	18	48	2	6	12	10	9	1	40	88	4	92
	Rate	-	0.86	1.69	2.00	2.16	6.18	2.20	1.88	1.18	2.79	2.19	1.60	0.29	1.65	1.91	1.59	1.51
13. Rutherglen Burgh	No.	1	1	2	5	7	2	18	-	2	3	5	3	3	16	34	10	44
	Rate	2.29	1.06	2.24	5.45	5.31	2.55	3.40	-	1.64	2.54	3.71	1.55	2.44	2.19	2.70	4.81	3.00
14. Renfrew County	No.	-	8	9	6	20	7	50	-	3	10	18	11	4	46	96	0	96
	Rate	-	2.29	2.66	1.68	4.49	2.75	2.63	-	0.70	2.19	3.62	1.80	1.15	1.88	2.23	-	2.18
15. Paisley Burgh	No.	-	2	4	2	6	10	24	-	1	6	4	2	4	17	41	3	44
	Rate	-	0.46	1.03	0.54	1.25	3.90	1.18	-	0.19	1.34	0.82	0.31	1.04	0.65	0.88	1.30	0.90
16. Coatbridge Burgh	No.	-	4	4	13	8	6	35	-	3	7	6	1	-	17	52	6	58
	Rate	-	1.52	1.78	6.90	3.36	4.45	3.20	-	0.09	2.83	2.04	0.39	-	1.44	2.29	4.60	2.41
17. Airdrie Burgh	No.	-	1	1	-	-	-	2	-	-	-	-	-	-	-	2	1	3
	Rate	-	0.68	0.84	-	-	-	0.30	-	-	-	-	-	-	-	0.14	3.64	0.20
18. Lanark County (Part)	No.	1	3	11	10	12	8	45	-	4	10	7	13	7	41	86	0	86
	Rate	0.85	0.56	2.18	1.92	1.91	2.27	1.69	-	0.66	1.50	1.05	1.69	1.64	1.26	1.45	-	1.44
19. Motherwell/Wishaw Burgh	No.	-	1	3	1	2	8	15	-	3	1	2	3	2	11	26	1	27
	Rate	-	0.29	0.92	0.33	0.52	3.49	0.90	-	0.78	0.27	0.55	0.64	0.81	0.58	0.73	0.49	0.72
20. Dunbarton County	No.	-	2	2	7	11	8	30	-	4	2	3	12	4	25	55	25	80
	Rate	-	0.62	0.71	2.23	2.70	3.61	1.85	-	1.04	0.53	0.70	2.21	1.25	1.17	1.46	23.00	2.07
21. Dumbarton Burgh	No.	-	1	-	1	-	1	3	-	1	-	-	1	-	2	5	0	5
	Rate	-	0.79	-	0.82	-	1.40	0.50	-	0.65	-	-	0.61	-	0.28	0.38	-	0.37
22. Dundee City	No.	-	3	9	23	43	37	115	1	4	11	14	25	30	85	200	6	206
	Rate	-	0.30	0.91	2.46	3.40	5.19	2.26	0.56	0.36	1.05	1.31	1.57	2.64	1.38	1.78	0.98	1.74
TOTAL 1958 SURVEYS	No.	2	65	125	206	434	373	1,205	3	57	137	178	245	185	805	2,010	73	2,083
	Rate	0.17	1.02	2.05	3.41	5.30	7.81	3.40	0.28	0.78	1.99	2.42	2.39	2.7	2.02	2.78	2.17	2.75
TOTAL 1957-58 SURVEYS	No.	16	265	540	755	1,571	1,057	4,204	16	328	686	743	842	447	3,063	7,267	499ϕ	7,766ϕ
	Rate	0.58	1.74	3.63	5.20	8.25	10.28	5.48	0.61	1.83	4.09	4.25	3.58	3.14	3.31	4.29	3.66	4.26

ϕ Excludes non-residents in five 1957 Surveys.

TWO YEAR MASS RADIOGRAPHY CAMPAIGN

SCOTLAND 1957-58

Respiratory Tuberculosis - Survey yields compared with notifications, death and registration rates and tuberculin response in the survey areas

Survey Areas	Tuberculosis Survey Yield 1957-58 (New Cases among residents) Rates per 1000 examined			Notifications per 1000 population 1952-56	Deaths per 1000 population 1952-56	Registered Cases per 1000 population 1954-56	Tuberculin positive school children≠ 1954-56 Per Cent
	Active	Observation	Significant				
1. Glasgow City	3.69	6.45	10.14	1.90	0.35	12.74	28
2. Perth Burgh	1.12	6.01	7.13	0.95	0.19	13.28	18
3. West Lothian County	1.58	4.48	6.06	1.54	0.12	9.83	22
4. Ayr Burgh	1.48	0.79	2.26	0.86	0.23	6.94	18
5. Kilmarnock Burgh	1.42	2.02	3.45	0.70	0.14	6.00	12
6. Fife County	0.26	1.30	1.56	0.95ϕ	0.11ϕ	6.83	28ϕ
7. Port Glasgow Burgh	1.49	10.37	11.86	2.17	0.39	13.51	28
8. Lanark County*	1.59	2.41	4.00	1.39ϕ	0.22ϕ	10.85	-
9. Midlothian County	1.29	4.38	5.67	1.20	0.08	8.44	42
10. Aberdeen City	1.46	3.29	4.76	1.14	0.12	9.72	53
11. Edinburgh City	1.69	4.72	6.41	1.52	0.18	10.42	21
12. Greenock Burgh	1.65	1.91	3.56	2.07	0.34	17.00	37
13. Rutherglen Burgh	1.83	2.70	4.53	1.69	0.30	15.69	-
14. Renfrew County	1.49	2.23	3.72	1.14	0.19	8.26	29
15. Paisley Burgh	1.60	0.88	2.48	1.25	0.31	9.98	52 (1955)
16. Coatbridge Burgh	1.19	2.29	3.47	1.19	0.23	10.82	23
17. Airdrie Burgh	1.08	0.14	1.22	1.16	0.17	7.65	28
18. Lanark County*	1.42	1.45	2.87	1.39ϕ	0.22ϕ	10.85	-
19. Motherwell/Wishaw Burgh	1.35	0.73	3.08	1.73	0.22	11.44	32
20. Dunbarton County	1.54	1.46	3.01	0.98	0.18	8.46	24
21. Dumbarton Burgh	1.28	0.38	1.66	0.95	0.30	9.05	21
22. Dundee City	2.31	1.78	4.09	1.48	0.18	13.19	35

* Composite rates for Lanark County (1957-58) - 1.50 (active) 1.88 (observation) and 3.38 (significant).

ϕ Whole county. ≠ 13 years of age.

TWO YEAR MASS RADIOGRAPHY CAMPAIGN

SCOTLAND 1957-58

Degree of association (r) between various indices of tuberculosis prevalence and the yield of active and significant cases from the Mass X-ray Surveys

		Infection Level	Death Rate	Registration Rate	Notification Rate	Significant Survey Yield
Number of Surveys		18	20	20	20	20
Standard Error		0.243	0.229	0.229	0.229	0.229
Tuberculosis Survey Yield	Active	+ 0.373	+ 0.371	+ 0.335	+ 0.453	+ 0.494
	Significant	- 0.046	+ 0.295	+ 0.412	+ 0.568	
Notification Rate		+ 0.269	+ 0.586	+ 0.769		
Registration Rate		+ 0.260	+ 0.587			
Death Rate		+ 0.002				

Infection Level : Percentage of School children (13 years) reacting to the tuberculin skin test (mean 1954-56).

Registration rate: Number of persons registered as suffering from, or under supervision for, respiratory tuberculosis (1954-56) per 1000 population.

Death Rate : Average annual death rate from respiratory tuberculosis (1952-56).

Notification Rate: Average annual rate of confirmed notifications of respiratory tuberculosis (1952-56).

Active Yield : Number of Cases of active tuberculosis from Survey areas per 1000 residents examined.

Significant Yield: Number of Cases of active tuberculosis and patients requiring observation per 1000 residents examined in the Survey areas.

APPENDIX 18

TWO YEAR MASS RADIOGRAPHY CAMPAIGN
SCOTLAND 1957-58

ATTENDANCES, RECALLS AND DISPOSAL OF PATIENTS

Residents and non-residents
Numbers and rates per 1000 examined

	ATTENDANCES	RECALLS FOR LARGE FILM		Referred to Chest Physicians		Referred to General Practitioners		Tuberculosis cases Admitted to Hospital	
		Number	Rate	Number	Rate	Number	Rate	Number	Rate
1957 SURVEYS									
1. Glasgow City	714,915	30,506	42.7	13,863	19.4	7,806	9.9	974	1.4
2. Perth Burgh	28,358	915	32.3	310	10.9			19	0.9
3. West Lothian County	37,341	1,510	40.4	465	12.5			32	0.9
4. Ayr Burgh	30,556	826	27.0	199	6.5	92	3.0	13	0.6
5. Kilmarnock Burgh	31,790	909	28.6	428	13.5			28	1.2
6. Fife County	27,096	858	31.7	271	10.0	63	2.3	5	0.2
7. Port Glasgow Burgh	12,815	480	21.0	200	8.8			10	0.9
8. Lanark County	48,390	2,234	46.2	904	18.7			43	0.9
9. Midlothian County	29,540	1,093	37.0	465	15.7			19	0.7
10. Aberdeen City	125,598	4,683	37.3	1,698	13.5	763	6.1	58	0.5
TOTAL 1957	1,086,399	44,014	40.5	18,803	17.3			1,201	1.1
11. Edinburgh City	295,037	10,455	35.4	3,654	12.4	2,144	7.3	259	0.9
12. Greenock Burgh	48,093	1,713	35.6	666	13.8	321	6.7	73	1.5
13. Rutherglen Burgh	14,673	526	35.8	197	13.4	94	6.4	17	1.2
14. Renfrew County	44,062	1,679	38.1	811	18.4	404	9.2	34	0.8
15. Paisley Burgh	48,655	1,822	37.4	778	16.2	236	4.9	58	1.2
16. Coatbridge Burgh	24,058	844	35.1	402	16.7	172	7.1	48	2.0
17. Airdrie Burgh	15,038	655	43.6	108	7.2	145	9.6	6	0.4
18. Lanark County	59,761	2,548	42.6	760	12.7	741	12.3	57	1.0
19. Motherwell/Wishaw Burgh	37,675	1,295	34.4	624	16.6	312	5.7	33	0.9
20. Dunbarton County	38,658	1,613	41.7	721	18.7	256	6.6	46	1.2
21. Dumbarton Burgh	13,691	484	35.4	220	16.1	83	6.1	14	1.0
22. Dundee City	118,468	4,349	36.7	1,480	15.6	646	5.5	164	1.4
TOTAL 1958	757,869	27,983	36.9	10,425	13.8	5,455	7.2	809	1.1

TWO YEAR MASS RADIOGRAPHY CAMPAIGN

SCOTLAND 1957-58

Active tuberculosis survey yield compared with the average annual number of confirmed notifications of respiratory tuberculosis during 1952-56

	Survey Period weeks	Survey yield (residents)		Average annual notifications (1952-56)		Period required to produce notifications equivalent to survey yield≠ (weeks)
		Number	Per cent. of annual notifications	Number	Number expected during survey period≠	
1957 Surveys						
1. Glasgow City	5	2,369	115	2,058	198	60
2. Perth Burgh	2	25	64	39	2	33
3. West Lothian County	4	56	40	140	11	21
4. Ayr Burgh	4	32	86	37	3	45
5. Kilmarnock Burgh	4	33	110	30	2	57
6. Fife County (Part) ϕ	-	(7)				
7. Port Glasgow Burgh	2	17	35	49	2	18
8. Lanark County (Part) ¤	5	(76)				
9. Midlothian County	5	37	30	125	12	16
10. Aberdeen City	5	162	76	212	20	40
1958 Surveys						
11. Edinburgh City	4	473	66	712	55	35
12. Greenock Burgh	4	76	48	160	12	25
13. Rutherglen Burgh	2	23	56	41	2	29
14. Renfrew County	5	64	42	153	15	22
15. Paisley Burgh	5	74	63	118	11	33
16. Coatbridge Burgh	3	27	46	59	3	24
17. Airdrie Burgh	3	16	43	37	2	22
18. Lanark County (Part)¤	5	160	36	439	84	19
19. Motherwell/Wishaw Burgh	3	48	40	120	7	21
20. Dunbarton County	4	58	62	94	7	32
21. Dumbarton Burgh	2	17	35	49	2	18
22. Dundee City	4	259	99	262	20	51

¤ Both Lanark County surveys aggregated under survey 18.
ϕ Only part of area surveyed in 1957.
≠ At mean 1952-56 rates of notification.

TWO YEAR MASS RADIOGRAPHY CAMPAIGN

SCOTLAND 1957-58

Survey Yield of Active Respiratory Tuberculosis in the Four Scottish Cities
Compared with the Average Annual Confirmed Notifications 1954-56

Rate per 1000

AGE GROUPS	GLASGOW				ABERDEEN				EDINBURGH				DUNDEE			
	Average annual confirmed notifications 1954-56		Active survey yield 1957 (5 weeks)		Average annual confirmed notifications 1954-56		Active survey yield 1957 (5 weeks)		Average annual confirmed notifications 1954-56		Active survey yield 1958 (4 weeks)		Average annual confirmed notifications 1954-56		Active survey yield 1958 (4 weeks)	
	No.	Rate per 1000 population	No.	Rate per 1000 examined	No.	Rate per 1000 population	No.	Rate per 1000 examined	No.	Rate per 1000 population	No.	Rate per 1000 examined	No.	Rate per 1000 population	No.	Rate per 1000 examined
Males																
-14	74	0.54	22	2.24	13	0.61	1	0.49	48	0.93	-	-	16	0.73	-	-
15-	269	3.58	201	3.42	21	1.76	6	0.62	69	2.36	19	0.83	30	2.62	19	1.91
25-	177	2.30	208	3.53	20	1.65	16	1.70	59	1.92	40	1.74	23	1.94	25	2.54
35-	150	1.95	218	3.94	16	1.28	21	2.27	53	1.62	56	2.41	20	1.71	26	2.78
45-54	180	2.70	-	-	15	1.34	-	-	66	2.25	-	-	20	1.93	-	-
45-59	-	-	478	6.67	-	-	30	2.38	-	-	103	3.02	-	-	39	3.09
55-64	133	2.92	-	-	19	2.56	-	-	54	2.66	-	-	13	1.84	-	-
60+	-	-	260	7.02	-	-	17	2.64	-	-	90	4.30	-	-	43	6.04
65+	61	1.51	-	-	9	1.28	-	-	27	1.35	-	-	9	1.32	-	-
All Ages	1044	2.01	1387	4.76	113	1.35	91	1.84	376	1.76	308	2.44	131	1.61	152	2.99
Females																
-14	84	0.63	10	1.04	10	0.48	1	0.47	44	0.88	-	-	20	0.95	1	0.56
15-	383	4.41	285	4.02	22	1.46	19	1.62	108	3.19	37	1.41	43	3.16	19	1.69
25-	208	2.53	242	3.76	31	2.26	14	1.28	69	2.04	35	1.43	29	2.23	19	1.81
35-	98	1.18	215	3.24	11	0.76	13	1.19	46	1.22	45	1.66	9	0.66	27	2.52
45-54	47	0.63	-	-	5	0.37	-	-	21	0.59	-	-	9	0.69	-	-
45-59	-	-	162	1.84	-	-	19	1.18	-	-	30	0.70	-	-	30	1.89
55-64	26	0.46	-	-	3	0.29	-	-	9	0.31	-	-	5	0.48	-	-
60+	-	-	67	1.32	-	-	5	0.54	-	-	18	0.56	-	-	11	0.97
65+	17	0.32	-	-	3	0.27	-	-	9	0.27	-	-	4	0.35	-	-
All Ages	863	1.51	981	2.80	85	0.857	71	1.16	306	1.21	165	1.07	119	1.24	107	1.74

TWO YEAR MASS RADIOGRAPHY CAMPAIGN

SCOTLAND 1957-58

Actual and expected respiratory tuberculosis notifications (confirmed) in the Cities and the Burgh and County aggregates

Survey areas		Number of respiratory tuberculosis notifications								
		Estimated annual rate of fall during 1951-56 ≠ (Per Cent)	1951-3	1952-4	1953-5	1954-6	1956	1957	1958	1959
GLASGOW	Actual	5.44	2257	2185	2111	1906	1732	3771	1225	
	Expected			2134	2018	1908	1804	1706	1613	1525
ABERDEEN	Actual	4.85	229	226	215	197	190	306	99	
	Expected			218	207	197	187	178	169	161
EDINBURGH	Actual	10.39x	716	773	745	680	603	418	694	
	Expected				693	621	556	498	446	400
DUNDEE	Actual	4.46	296	278	272	258	219	235	426	
	Expected			283	270	258	246	235	225	215
BURGHS	Actual	12.93	962	839	733	635	552	588	632	
	Expected			838	730	636	554	483	421	367
COUNTIES ϕ	Actual	6.98	1096	1015	960	882	833	964	692	
	Expected			1019	948	882	820	763	710	660
SURVEY AREAS	Actual	6.43	5557	5316	5036	4548	4129	6282	3768	
	Expected			5196	4858	4542	4247	3971	3713	3472
NON SURVEY AREAS	Actual	8.67	1799	1651	1524	1370	1296	1229	1092	
	Expected			1643	1501	1371	1252	1143	1044	953

≠ Average annual reduction over the triennia around 1952, 1953, 1954 and 1955

x Expected notifications calculated over the period 1952-57 owing to irregularities in earlier data.

ϕ Fife County included with Non-Survey areas since only part covered.

TWO YEAR MASS RADIOGRAPHY CAMPAIGN

SCOTLAND 1957-58

Abnormalities discovered during 22 Chest X-ray Surveys 1957-58
Residents, non-residents and previously known cases

Code No.	Disease Group	1957 (1)		1958 (2)	
		Number	Rate Per 1000	Number	Rate Per 1000
1-3	Abnormalities of bony Thorax	140	0.13	207	0.27
5-6	Lung infections	784	0.72	353	0.47
7-10	Bronchiectasis Honeycomb lung Emphysema Fibrosis	2,548	2.34	2,408	3.18
11	Pneumoconiosis	1,474	1.36	1,055	1.39
13	Tumours - benign	321	0.30	287	0.38
14-15	Tumours - malignant	463	0.43	283	0.37
17	Sarcoid	61	0.06	35	0.05
18	Pleural thickening	645	0.59	655	0.86
19	Abnormalities of Oesophagus and diaphragm	464	0.43	614	0.81
20-21	Cardiac abnormalities	1,821	1.67	2,517	3.32
23-26	Tuberculosis - significant	10,171	9.36	3,764	4.97
27-28	Tuberculosis - healed	5,467	5.03	5,973	7.64
4, 12, 16, 22	Other conditions	633	0.58	270	0.36
29	Not yet diagnosed	122	0.11	74	0.10
30	No significant abnormality (3)	-	-	296	0.39

(1) Mass Radiography service radiological diagnosis (except for code numbers 23-26 where final diagnosis was available).

(2) "Final" diagnosis - after three months only among cases of pulmonary disease referred to chest clinics.

(3) No significant abnormality detected at clinical consultation.

SCOTLAND 1957-58

Response and tuberculosis yield among adults, standardised for age and sex in the survey areas

Rates per 1000 persons

	Response rates		Yield of new cases of tuberculosis (Adults)			
			Active		Observation	
	Crude	Standardised	Crude	Standardised	Crude	Standardised
Glasgow City	75.95	75.95	3.76	3.76	6.62	6.62
Perth Burgh	68.63	69.35	1.16	1.16	6.18	6.02
West Lothian County	52.69	52.47	1.61	1.51	4.68	5.03
Ayr Burgh	64.56	65.13	1.51	1.52	0.80	0.80
Kilmarnock Burgh	70.88	70.97	1.45	1.44	2.07	2.06
Fife County (Part)	-	-	0.27	0.28	1.34	1.35
Port Glasgow Burgh	73.37	72.73	1.58	1.56	10.85	11.08
Lanark County (Part)	-	-	1.60	1.58	2.47	2.39
Midlothian County	36.99	37.12	1.36	1.32	4.64	5.12
Aberdeen City	75.86	76.10	1.50	1.51	3.41	3.37
Edinburgh City	77.79	76.18	1.71	1.69	4.79	4.50
Greenock Burgh	78.62	78.75	1.71	1.68	1.96	1.94
Rutherglen Burgh	62.84	63.05	1.95	2.11	2.80	2.83
Renfrew County	40.29	40.71	1.52	1.52	2.35	2.34
Paisley Burgh	62.81	62.98	1.67	1.70	0.93	0.94
Coatbridge Burgh	65.20	64.84	1.24	1.20	2.38	2.15
Airdrie Burgh	64.11	63.92	1.14	1.14	0.14	0.14
Lanark County (Part)	44.42	44.64	1.48	1.48	1.50	1.50
Motherwell/Wishaw Burgh	68.22	68.28	1.38	1.35	0.76	0.74
Dunbarton County	49.48	49.44	1.58	1.63	1.53	1.51
Dumbarton Burgh	73.67	73.88	1.25	1.35	0.39	0.39
Dundee City	80.83	81.15	2.37	2.38	1.83	1.76