given variable and inconsistent results. All our reducing steroid results have been in the normal range,²³ and differences between two extracts of the same urine, or from day to day, have been commoner than as the result of treatment.

These tests suggest a fall in adrenal function when the thyrotoxic patients have been treated with methylthiouracil; the group is small, but the fall in 17-ketosteroids is significant and that in the A.C.T.H. eosinophil depression approaches significance in the small group. Further, when extra thyroid has been given, either to one normal or to nine myxoedema patients on a maintenance thyroid dosage, the opposite trend has usually been seen, though the changes are not significant in these small groups. Thus a lowering of raised thyroid function towards normal levels apparently causes an immediate decrease of adrenal function; and the change observed with the thyrotoxic patients is probably not merely a non-specific effect of the thiouracil. No such non-specific effect of thiouracil on the adrenal has been seen in animals, for with animal experiments it has been observed that the simultaneous administration of thyroxine prevents the adrenal atrophy seen with thiouracil.^{9, 13, 19}

Our results with the few untreated myxoedema patients conform to those already published^{1, 7}—an increase of the lowered ketosteroid excretion and eosinophil depression. Thus our findings suggest that the immediate effect of raising thyroid function is to stimulate the adrenal cortex, and of lowering thyroid function to depress it. The low 17-ketosteroid excretion of thyrotoxicosis suggests that prolonged hyperthyroidism may have a different effect.

Summary

When 10 thyrotoxic patients were tested before and after control with thiouracil 17-ketosteroid secretion fell significantly and eosinophil depression after A.C.T.H. also fell, though not significantly.

When extra thyroid was given to nine myxoedema patients on a basic maintenance dosage and to one normal subject 17-ketosteroid excretion and eosinophil depression after A.C.T.H. rose, but not significantly.

In three untreated myxoedema patients 17-ketosteroid, and eosinophil depression after A.C.T.H., rose slightly following a few weeks of the initial thyroid dosage.

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A TUBERCULIN SURVEY IN STOKE-ON-TRENT

BY

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Tuberculin surveys of the population of the United Kingdom have been performed sporadically, usually on small and selected samples, over the last 30 years or more. Following a decision of the Ministry of Health authorizing the use of B.C.G. vaccine, the Medical Research Council organized a survey on a national scale to estimate the incidence of natural primary tuberculous infection in young people before the results of tuberculin-testing could be materially affected by the widespread use of B.C.G. vaccine.

The M.R.C. report (1952) describes in detail the organization of the survey, and Stoke-on-Trent was one of the 22 areas chosen for the test, which was carried out during the winter months of 1949–50. The present paper is an account of the findings in Stoke, and special attention has been given to the factors peculiar to the district which it is felt had a bearing upon the results obtained.

Present Survey

Stoke is an urban district some 10 miles by 4 in rural surroundings. The density of the population in 1949 was given as 13.05 persons per acre, but this figure is misleading, as a good deal of agricultural land is included in the city's boundary: in the 28 wards of the city it ranges between 4.82 and 37.15 per acre. The area covered by this survey and known collectively as the "Potteries," comprising the townships of Tunstall, Burslem, Hanley, Stoke, Fenton, and Longton, is highly industrialized. Housing is mainly of the small four-roomed terraced type, in which serious overcrowding is common. Among a variety of industries there are two in which the bulk of the population is engaged—pottery manufacture and coal-mining: in 1948, of a total population of 274,500, 56,000 were employed in the former and 15,000 in the latter. Both these occupations are attended by a serious although decreasing risk of pneumoconiosis, often complicated by pulmonary tuberculosis.

About half the people employed in the pottery industry are exposed to dust contamination, and of those who develop silicosis half may be expected sooner or later to become infected with tuberculosis. Approximately 750 cases of silicosis are existent at one time, and about 60 new cases are reported each year. Death from silico-tuberculosis is almost the normal termination of the disease in potters. Pneumoconiosis in miners is less often attended by superimposed open tuberculosis, and death from the combination of the two conditions is less common. There is thus a potential source of infection, especially in potters, which is peculiar to the district. It seemed that this was a factor

worthy of special notice in that the children of parents engaged in these two industries are apparently exposed to more than the average risk of tuberculous infection, as are also those who are themselves employed in them, and the results of an inquiry into this feature of the investigation are given below.

The survey was limited to persons between the ages of 5 and 20 years. Those of 5 to 14 years were all school-children, but from 15 to 20 years they consisted of scholars, potters, and miners. In view of the exposure to silico-tuberculosis mentioned above, and with the approval of the M.R.C., no one otherwise employed was included.

Table I gives the number of persons concerned in the survey and their distribution by occupation and sex.

TABLE I.—Numbers of Population Concerned in the Survey

Age 5-20 Years	Scholars	Potters	Miners	Total
Total concerned	42,791	7,247	895	50,933
No. from which sample was drawn	9,729 (4,873 males, 4,856 females)	1,163 (326 males, 837 females)	254 (253 males, 1 female*)	11,146
No. tuberculin-tested	3,265 (1,602 males, 1,663 females)	495 (98 males, 397 females)	129 (128 males, 1 female*)	3,889

* A typist employed in a colliery office.

The 3,889 who received the tuberculin test represented 7.5% of the total population between the ages of 5 and 20 years, and 34.9% of the number from which the samples were drawn. The consent rate of just over one-third is much lower than the average reported by the M.R.C., and was due mainly to a lack of response among school-children. There was a dearth of young persons in the pottery and mining industries; in the case of potters they were scattered through many factories, and in the time available it was possible to visit only some of the larger of these. A total of 40 schools (out of 178), 11 potteries, and three collieries were visited: these were well dispersed throughout the district, and were representative of the whole. It was considered that the sample of schoolchildren was quite random, and that the potters and miners were a fair cross-section of the population from which they were drawn. In some areas the value of the survey has been enhanced by submitting all positive reactors to examination by mass radiography. Unfortunately no unit was operating in Stoke at the time, and this procedure was not possible.

The method of tuberculin testing described in the M.R.C. report was adhered to in the present survey. All school-children received the initial jelly test, and in negative reactors this was followed by an intradermal injection of 0.1 ml. of 1/100 dilution of old tuberculin (O.T.). The young potters and miners received an initial dose of 0.1 ml. of 1/10,000 dilution of O.T., and the non-reactors had a

similar dose of 1/100 dilution. On several occasions it was noted when reading a second and positive test that the initial jelly test or intradermal test had reacted slightly, although previously negative. The impression was gained that had it been possible to read the jelly test at 96 hours instead of 72 a larger number of positive reactors to the jelly would have been recorded.

Results of the Tuberculin Tests

Table II shows the results of the tuberculin test for each year of age and for the sexes. It will be recalled that between the ages of 5 and 15 years the volunteers consisted of schoolchildren, and above this age young potters and miners were also included. The requirement of the M.R.C. that 250 persons should be tested in each year of age, divided as equally as possible between the sexes, was achieved through the range of 6 to 14 years, but there was a falling off in numbers from 15 years upwards. It will be noted that there was a steady increase in the number of positive reactors from 20.0% at 5 years to 77.2% at 18 years. The figure of 71.0% at 19 years is unreliable owing to the small number tested at that age.

FIG. 1.—Percentage of positive reactors to tuberculin in Stoke-on-Trent.

Fig. 1 expresses the results graphically and demonstrates the difference in positive reaction of the sexes: at no age is this difference significant.

The effect of the prevalence of silico-tuberculosis in the district upon the infection rate was also investigated. It seemed likely that the greatest risk of infection should exist among the children of those in whom the disease mainly occurs, and in Table III the results of the tuberculin test are presented in three groups according to the occupation of the parents—namely, potters' children, miners' children, and "others' children," the latter referring to the children of those otherwise employed. The numbers available for comparison were rather small, and the parents employed in potteries and mines amounted together to little more than half the remainder. Consequently the yearly infection rate varied greatly in the three groups, but in no group was this consistently higher than in the other two, and the

TABLE II.—Number of Volunteers Tuberculin-tested, Showing Percentage of Positive Reactors*

Age in Years	Both Sexes				Males				Females			
	No. Tested	Reaction			No. Tested	Reaction			No. Tested	Reaction		
		+	-	%+		+	-	%+		+	-	%+
5	240	48	192	20.0	119	23	96	19.2	121	25	96	20.6
6	279	52	227	18.6	137	25	112	18.1	142	27	115	19.0
7	291	79	212	27.1	143	36	107	25.1	148	43	105	29.0
8	267	76	291	28.6	123	34	89	27.6	144	42	102	29.1
9	278	95	183	34.1	142	55	87	38.7	136	40	96	29.4
10	310	137	173	44.1	149	66	83	44.2	161	71	90	44.0
11	356	164	192	46.0	186	87	99	46.7	170	77	93	45.2
12	370	172	198	46.4	178	91	87	51.1	192	81	111	42.1
13	397	210	187	52.8	202	115	87	56.9	195	95	100	48.7
14	333	188	145	56.4	170	99	71	58.2	163	89	74	54.6
15	214	127	87	59.3	89	59	30	66.2	125	68	57	54.4
16	164	100	64	60.9	67	44	23	65.6	97	56	41	57.7
17	160	113	47	70.6	72	54	18	75.0	88	59	29	67.0
18	136	105	31	77.2	36	33	3	91.6	100	72	28	72.0
19	94	67	27	71.0	15	11	4	73.3	79	56	23	70.8
	3,889	1,733	2,156	44.5	1,828	832	996	45.5	2,061	901	1,160	43.7

* No person is included in this table who did not complete the test.

TABLE III.—Percentage of Positive Reactors Subdivided According to Occupation of Parents

Age in Years	Potters' Children				Miners' Children				"Others' Children"			
	Total Tested	+	—	%+	Total Tested	+	—	%+	Total Tested	+	—	%+
5	44	12	32	27.1	39	9	30	23.0	157	27	130	17.1
6	56	9	47	16.0	50	8	42	16.0	173	35	138	20.2
7	56	20	36	35.7	38	10	28	26.3	198	49	149	24.7
8	50	8	42	16.0	47	19	28	40.4	169	48	121	28.4
9	50	21	29	42.0	48	16	32	25.0	180	58	122	32.2
10	57	23	34	40.3	65	24	41	36.9	188	90	98	47.8
11	70	35	35	50.0	49	24	25	51.0	238	106	132	44.5
12	71	30	41	42.2	52	24	28	46.1	247	118	129	47.7
13	76	36	40	47.3	49	27	22	59.1	272	147	125	54.0
14	73	42	31	57.5	45	27	18	60.0	215	119	96	55.3
15	37	18	19	48.6	33	19	14	57.5	144	90	54	62.5
16	29	18	11	62.0	37	22	15	59.8	97	59	38	60.8
17	26	20	6	74.6	30	21	9	70.0	104	72	32	69.2
18	20	17	3	85.0	28	22	6	78.5	88	63	25	82.9
19	19	15	4	78.9	28	22	6	78.5	47	30	17	63.8
	734	324	410	44.0	638	294	344	46.0	2,517	1,111	1,406	44.1

average for all the volunteers in each ranged between 44.0% and 46.0%, a difference of 2.0% which is not statistically significant. The conclusion was reached that the occupation of the parent had no important effect upon the incidence of primary infection.

Effect of Environment upon the Results

It was felt that the effect of the conditions at school, workplace, or home should be inquired into, in so far as they might influence the chance of infection, and the schools and places of employment attended by the volunteers were graded according to the quality of their environment and social background. It was thought that where these were found to be of a high standard the risk of infection might be reduced, and the rate of primary infection correspondingly lower.

It was possible to divide the schools conveniently into three classes and nine groups according to their standard of hygiene and the age of the children attending them. Grade A schools were the best type, having modern buildings, and large and airy classrooms with no overcrowding. Facilities for sport were adequate, playing-fields often being attached; but in any case they were surrounded by open country or a residential area of at least the standard of a council house estate. Grade B schools failed to reach the standard of grade A schools in some respects. Sometimes the school itself was of a similar standard, but its environment was of low quality—slum or industrial area—and the means of proper recreation and allied facilities were lacking. Occasionally there was overcrowding. In the other cases the school was of inferior standard, but was well situated in surroundings equivalent to those of the grade A school. Grade C schools failed in every respect to reach the standard of the other two. They were always in old and dirty buildings, ill-lit and ill-ventilated, and were located in a slum or industrial area. There were no facilities for sport, and playgrounds were often unpaved. Overcrowding was frequent, and ablution and w.c. accommodation inadequate.

Broadly speaking, the standard of each school was in accordance with the home conditions of the scholars attending it, so that the better-cared-for children were found at the grade A schools and the more neglected ones at the

schools of inferior grade. There were two exceptions to this observation in that at the two "high schools" visited, one for boys and the other for girls, a uniformly high degree of well-being and smartness was apparent, although the scholars were drawn from all types of district. No cases of gross malnutrition were seen at any school. Table IV gives details of the classification into the nine categories according to age and school attended, together with the percentage of primary infection, and it will be seen that the results for each age group did not differ widely at the three grades of schools. Although the difference is not significant it is of interest that at the grade C schools the lowest degree of infection was recorded instead of the highest, as might have been expected. It must, however, be inferred that the standard of school and home environment had no effect upon the frequency of tuberculous infection.

The 11 potteries visited were classified into three grades in a manner similar to the schools. One factory fell into grade A, seven into grade B, and three into grade C. The grade A factory was a modern well-lit and well-ventilated building in rural surroundings with excellent canteen and medical facilities. A welfare officer was employed and ample provision made for recreation. The grade B factories were in old buildings situated in highly industrialized areas. A welfare officer was employed, but no provision for sport or recreation was made. Canteen and medical facilities were adequate. Grade C factories were smaller buildings situated in highly industrialized areas, poorly equipped with canteen and medical facilities. No official welfare officer was employed, and there were no arrangements for sport or other recreation. In contrast with the schools, the employees at any factory were drawn from all parts of the district, and the factor of home environment was not related to the place of employment. Table V gives the number

TABLE V.—Potters Classified According to Grade of Factory at Which Employed

Grade A Factory			Grade B Factory			Grade C Factory		
No. Tested	No. +	%+	No. Tested	No. +	%+	No. Tested	No. +	%+
157	111	70.7	273	173	63.3	65	46	70.7

TABLE IV.—Scholars Classified According to Age and Grade of School Attended

Grade of School	Infants, 5-6 Years			Juniors, 7-10 Years			Seniors, 11-19 Years		
	No. Tested	No. +	%+	No. Tested	No. +	%+	No. Tested	No. +	%+
A	39	8	20.5	228	79	34.6	637	333	52.5
B	187	36	19.2	421	157	37.2	353	185	52.4
C	295	56	18.9	510	161	31.5	595	288	48.2
	521	100	19.1	1,159	397	34.2	1,585	806	50.8

employed at each type of factory, and it will be seen that the infection rate of 70.7% at grade A potteries coincided with that at the grade C, whereas it was a little lower at grade B factories at 63.3%. The total number of volunteers in each grade was small, but the age group of 15-20 years was common to all three, and the number at each year of age in each grade was proportionate to the total for that grade. A reliable comparison may thus be made, and this indicated that the incidence of positive reactors among young potters was uninfluenced by any difference in their working conditions.

It was not possible to grade the three collieries visited, in a manner comparable to that adopted for the schools and potteries, and in any case the small number of miners concerned would have prevented any accurate conclusions being drawn.

Discussion

The M.R.C. report (1952) provides details of a standardized tuberculin survey in 22 representative areas of England and Wales on mainly unselected samples and has made it possible to compare the findings in different localities with accuracy. Perusal of the report will show that the results have been divided geographically into three areas, referred to as north urban, south urban, and rural areas, Stoke being included in the north urban area.

In Fig. 2 a curve indicating the yearly infection rate in Stoke has been added to the three representing the averages for the areas appearing in the M.R.C. report, and it is at once apparent that the incidence is substantially higher in Stoke at all ages than in the north or south urban areas, and

FIG. 2.—Percentage of positive reactors to tuberculin in the M.R.C. survey with the curve for Stoke-on-Trent superimposed

at most ages is higher than in the rural area also. On further reference to the M.R.C. survey it is found that, of the 22 areas, the positive incidence in Stoke is the seventh highest at 5 to 6 years, the fifth at 9 to 10 years, the fourth at 13 to 14 years, and the second at 17 to 18 years. It is of interest to speculate upon the reason for this high incidence of infection. The part played by milk, always suspect, may be ruled out in this instance, as the annual reports of the public health department for 1945-9 show that the proportion of tested samples of milk containing tubercle bacilli was negligible. The vital statistics recorded in these reports indicate high mortality and morbidity rates for tuberculosis. The mortality rate exceeded that for England and Wales by approximately 10 per 100,000 in 1945, rising to over 15 per 100,000 in 1949. The number of cases on the dispensary register rose from 1,671 in 1945 to 1,939 in 1949, and the number of known sputum-positive cases from 610 to 735 during the same period. The findings of a mass radiographic unit which began work in Stoke in 1952 confirm the high degree of morbidity. In the three months ending September 30, 8,448 persons had been x-rayed, revealing 6.8 cases of active tuberculosis per 1,000 examined. This is high compared with 6.3 per 1,000 for the Birmingham region, and the national figure of 3.5 per 1,000 quoted by the Ministry of Health in June, 1952. Among the Stoke examinees were 2,480 employed at three potteries, and 26 active cases were found, which was 10.5 per 1,000. Half the cases detected in earthenware factories were associated with pneumoconiosis. From this it seems reasonable to assume that infectious cases of silico-tuberculosis must form an important fraction of the whole.

It has already been shown that if the total number of volunteers is broken down into groups corresponding to those who were likely to be in close contact with cases of silico-tuberculosis and those who were not, there is no important difference in the proportion of positive reactors in each group. From this it would seem that all those taking part in the survey were exposed to much the same risk of infection, although this must have been greater in

tuberculous households. One possible explanation of this is that the latter represent numerous small islands of infection scattered throughout the locality, and that the housing congestion combines with the "neighbourly" habits characteristic of the population of an industrial area to encourage exposure to open cases of tuberculosis. The high infection rate noted in schoolchildren may also be attributable to the same cause.

Summary

Stoke-on-Trent was one of 22 areas chosen by the Medical Research Council for inclusion in a national tuberculin survey in 1949, and 3,889 persons of 5-20 years of age were skin-tested.

Pneumoconiosis complicated by infective tuberculosis is prevalent among the many pottery workers (and to a less extent the coal-miners) in the district. The incidence of positive reactors among those whom it seemed were particularly exposed to infection from this source was no higher than in those who were not.

The quality of the environment of home, school, or workplace had no apparent effect upon the infection rate of the volunteers included in the survey.

The primary infection rate in Stoke was higher than the average for the other areas included in the M.R.C. survey, and it is suggested that this may be attributed to the high rate of morbidity from tuberculosis. The fact that no particular group of volunteers showed a greater incidence than the others was considered to be due to the close contact among all classes of persons which resulted from housing congestion and the custom of free social intercourse.

My thanks are due to the officials of the Departments of Health and Education of Stoke-on-Trent, and especially to the senior school medical officer and the members of her staff who assisted directly in the survey. I am grateful to the Federation of Pottery Manufacturers and the local division of the National Coal Board for their co-operation. I am also indebted to Dr. Peter Edwards, who made available the information on mass radiography and has kindly criticized this paper, and to Dr. A. C. Penman, with whom I was associated during the survey of schoolchildren and who has also offered valuable advice.

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In the third number of *Scientific Film Review* there are appraisals of ten medical films: "Anaemia" (E. R. Squibb and Sons) intended for students, general practitioners, and medical societies; "Electromyography of Postural Muscles—Leg and Thigh" (Guy's Hospital) intended for students and postgraduates of physiology and specialists in physical medicine; "Hay Fever" (St. Mary's Hospital Medical College) intended for medical societies and lay people interested in the subject; "The Human Blood Fluke" (Wellcome Film Unit) intended for undergraduate and postgraduate students of tropical medicine and hygiene; "Mitral Valvotomy" (Guy's Hospital) intended for undergraduate and postgraduate students of surgery; "Movements of the Ureter" (Wellcome Film Unit) intended for undergraduates and postgraduates of physiology; "Prevention of Cross-infection—Airborne Infection" (Central Film Library) intended for student nurses, and valuable for medical auxiliaries in contact with hospital patients; "Principles of Penicillin Therapy" (E. R. Squibb and Sons) for undergraduate and graduate students of medicine; "Pronestyl Hydrochloride" (E. R. Squibb and Sons) for anaesthetists and cardiologists; "Rheumatism and Rehabilitation" (Dr. Bach and Edward Langley) for physiotherapists and nurses. The *Review* is obtainable from the British Film Institute, 164, Shaftesbury Avenue, London, W.C.2. Annual subscription 5s., single copies 1s. 6d.