subjects. Usually the vasodilatation lasted for 24 to 60 hours. This is far in excess of that produced by any of the three drugs tried in the same patients. Sometimes, however, the vasodilatation was less well sustained, the blood flow falling to the resting level in six hours or less. It is unlikely that localization of the injected gas to one branch of the main limb artery entirely explains this finding, as there was a generalized distribution of the initial colour changes in the skin of the injected limb on these occasions.

The administration of oxygen has been a relatively safe procedure. The injections are made with the patient horizontal, and the injected limb is held slightly raised to guard against the possibility of gas emboli spreading proximally against the current of arterial blood and causing visceral infarction. The possibility exists that, in patients with degenerative arterial disease, injections may cause local damage to the arterial wall or dislodge material from atheromatous plaques. Care is taken to make each injection at a different site and to use a sharp short-bevel needle, 1 mm. in external diameter, and no such complications have been encountered. Additional precautions include the use of smaller quantities of oxygen than those employed by the Continental authors, and administration at a much slower rate. Hasse *et al.* (1955) consider that injections should not be given to patients with recent acute thrombotic episodes, and that the method should be used with caution in patients with advanced ischaemic lesions in the feet, since in them the injected oxygen may be sufficient to occlude entirely the few patent vessels. The only complication in the present series occurred in such a case.

The patient, a man of 47, suffered from arteriosclerosis and Raynaud's phenomenon with ischaemic changes in the skin of the finger-tips. The resting hand blood flow, despite a warm environment (room temperature 22° C.; plethysmograph temperature 33° C.), was less than 1 ml./100 ml./minute; after injection the usual sequence of colour changes in the skin was noted, but no rise occurred in blood flow. Next morning the forearm was swollen and tender, and attempts to dorsiflex the wrist caused severe pain. The diagnosis was infarction of an extensor muscle. Gradual resolution occurred over the next four days, and there was no residual loss of power. In view of this experience, intra-arterial oxygen was not subsequently given to any case of peripheral vascular disease where the resting blood flow was excessively low, or where a dilator response had not been noted to occur during indirect heating or following the injection of tolazoline intra-arterially.

In two cases the foot blood flow was considerably reduced after intrafemoral injections of oxygen and also of the vasodilator drugs. This paradoxical finding is probably due to a "borrowing" phenomenon, all or most of the available blood in the lower limb being short-circuited through the dilated vessels of the thigh and calf. A similar phenomenon has been noted after lumbar sympathectomy in some patients with severe ischaemia of the feet (Freeman, Leeds, and Gardner, 1947). In such cases intra-arterial vasodilator substances of any variety are clearly contraindicated.

Clinical trials in France (Lemaire, Loeper, and Housset, 1948) and Germany (Ratschow, personal communication, 1955; Hasse *et al.*, 1955) appear to have established intra-arterial oxygen injections as a useful form of therapy in peripheral vascular disease. We hesitate to draw conclusions from our own cases, as our experience in this respect is limited and as the present investigation was designed to obtain objective information concerning the dilator effect of oxygen in patients with peripheral vascular disease rather than to assess its value as a therapeutic agent. However, the present results demonstrate that the vasodilatation induced by intra-arterial oxygen injections is much more prolonged than that following injections of potent vasodilator drugs. It is concluded that in those cases of peripheral vascular disease in which administration of vasodilator drugs by intra-arterial injection is indicated oxygen should be used in preference to other dilator substances.

Summary

The effects of intra-arterial injections of oxygen on the local circulation have been studied in 18 cases of peripheral vascular disease involving upper and lower limbs. In most cases the injections resulted in an increase in blood flow lasting for 24–60 hours. In the same patients injections of tolazoline, hydrallazine, and dilatal caused only relatively transient increases in blood flow.

Provided certain precautions are taken, the intra-arterial injection of oxygen is a safe procedure. It should not, however, be used in patients with very low resting blood flows or in those with recent occlusion of a major vessel.

Occasionally the paradoxical effect of reduction in blood flow through the foot may be observed to follow intrafemoral injection of oxygen, but this effect is also apt to occur with any other potent vasodilator substance.

It is concluded that oxygen should be used in preference to other vasodilators in the treatment of peripheral vascular disease by intra-arterial injections.

We thank Professor G. M. Bull, Dr. T. A. Kean, Dr. H. Millar, Dr. J. F. Pantridge, and Professor H. W. Rodgers for permitting access to their patients. We are grateful to Professor Bull for laboratory accommodation and other facilities.

REFERENCES

- Barcroft, H., and Edholm, O. G. (1943). *J. Physiol. (Lond.)*, **102**, 5.
 Duff, F., Greenfield, A. D. M., and Whelan, R. F. (1953). *Lancet*, **2**, 230.
 Edwards, J. W., Jones, N. B., McConnell, R. B., Pemberton, H. S., and Watson, D. C. (1952). *British Medical Journal*, **2**, 808.
 Freeman, M. E., Leeds, F. M., and Gardner, G. E. (1947). *Ann. Surg.*, **126**, 873.
 Greenfield, A. D. M. (1954). *J. Physiol. (Lond.)*, **123**, 62P.
 Hasse, H. M., Köble, H., and Linker, G. (1955). *Medizinische*, **1**, 380.
 Lemaire, A., Loeper, J., and Housset, E. (1948). *Bull. Acad. nat. Méd. (Paris)*, **132**, 384.
 Roddie, I. C., Shepherd, J. T., and Whelan, R. F. (1956). *J. Physiol. (Lond.)*, **131**, 2P.
 Shepherd, J. T. (1950). *British Medical Journal*, **2**, 1413.
 Singer, R. (1943). *Wien. klin. Wschr.*, **55**, 260.
 Wernitz, W., and Dörken, P. (1954). *Ärzt. Forsch.*, **8**, 308.

PULMONARY TUBERCULOSIS IN NORTH GLASGOW

AN EPIDEMIOLOGICAL STUDY

BY

W. F. TYRRELL, M.B., B.Sc., D.P.H.

AND

J. SMITH, M.B., D.P.H.

Chest Physicians, Ruchill Hospital, Glasgow

Greenwood, in his report to the Health Committee of the League of Nations on the relation of housing to tuberculosis in London, is quoted as stating: "Only by an exact study on a small scale can truth be reached. The massed data of official statistics are too complex to yield any decided answer" (McDougall, 1949).

With this statement in mind we have, during the past year, made a personal detailed investigation into the socio-economic state of nearly all the new significant cases of adult-type pulmonary tuberculosis in patients aged 14 years and upwards arising in the northern area of Glasgow. The 250,000 people in this area are mainly of the working class, and live in what we consider to be a representative sample of the whole of Glasgow in respect of new and old housing. A new case was

regarded as significant if the disease was active and required treatment. Practically all the patients were proved to be excreting the tubercle bacillus from the respiratory tract. For the purpose of the survey we excluded patients with no fixed address, such as those living in common lodging-houses or in lodgings.

While 125 is not a large number of cases, we preferred to investigate a representative sample thoroughly and personally rather than depend on a mass of statistics culled from sources of uncertain dependability and completeness. The aspects of the survey considered here are (1) incidence of cases by age groups, (2) distribution by occupation, (3) frequency of contact history, (4) overcrowding and type of house, (5) household income in relation to age groups and numbers in the household, (6) the results of radiological and tuberculin examination of the household contacts, and (7) birthplace of patients.

Incidence of Cases by Age Groups

The distribution of the cases in age groups is given in Table I. The age distribution is similar to that reported by the Scottish Health Services Council (1951), although in the present survey there is a higher proportion of new active cases in the male age group 55-64.

TABLE I.—Age Incidence

Age groups:	14-24	25-34	35-44	45-54	55-64	65-74	75+
Males ..	18	16	10	6	18	3	1
Females ..	27	14	7	2	1	1	1
Total ..	45	30	17	8	19	4	2

Distribution by Occupation

In the group of 125 patients, 16 were employed in preparation or distribution of foodstuffs; one patient, for example, was a baker's vanman and five were grocers' assistants. The four females shown in Table II as working with children

TABLE II.—Occupations

	Males	Females
Skilled ..	27	12
Unskilled ..	21	11
Apprentices ..	6	11
Food trades ..	5	12
Clerical ..	4	5
Unemployed ..	5	4
Retired ..	2	9
Other occupations ..	2	53
	72	

were a schoolteacher, a primary school dining-room attendant, a receptionist in a children's hairdressing department, and a wardmaid in a children's hospital ward; of these four, only the wardmaid had been previously radiographed. One of our patients, a woman aged 62 (suffering from active cavitation bilateral disease with strongly positive sputum), was engaged in making high-class confectionery (marzipan decoration). Of the 23 married female patients, 13 were attempting to combine the duties of housewife and wage-earner.

Frequency of Contact History

In 56 of the 72 male patients (77.7%), and in 40 of the 53 female patients (75.4%), a history of contact with a tuberculous case was definitely established after close questioning of the patient and family, thorough cross-checking of their statements, and an intensive search of the available records of previously notified cases. A positive contact history was accepted on one or more of the following grounds: (a) Present house contact with an active tuberculous case; (b) past house contact with an active tuberculous case; (c) frequent contact, past or present, with a relative suffering from active pulmonary tuberculosis but not living in the same house; (d) frequent contact with a known case of active pulmonary tuberculosis at work or socially. The figures are given in Table III.

Where a positive contact history was accepted on more than one of the above grounds, only the contact thought to be most significant is included in the four categories in Table III. The number of cases in which multiple contact was established is separately shown in the Table.

TABLE III.—Frequency of Contact History

	Males (72)	Females (53)
(a) Present house contact with active case ..	7	6
(b) Past ..	29	13
(c) Frequent contact with relative, not in same house ..	14	16
(d) " " at work or socially with active case ..	6	5
Total ..	56	40
Total groups a, b, and c ..	50	35
Multiple contact established ..	20	16
Contact established in percentage of total cases ..	77.7	75.4

Overcrowding and Type of House

Table IV gives the number of households overcrowded, applying the standards laid down in the Housing (Scotland) Act, 1950. For the purpose of this Act a person over the age of 10 is regarded as one unit, a child aged 1 to 10 years as half a unit, and a child aged less than 1 year is disregarded.

TABLE IV.—Overcrowding and Type of House (Figures to the Left and Below the Zigzag Line Show the Number of Households Overcrowded)

No. of Units	No. of Apartments				
	1	2	3	4	5
1	2	4			
2	5	10	3	1	
3	4	15	7	4	
4	1	6	12	3	
5	1	2	12	9	1
6		2		6	
7		1	1	4	2
8			1	1	
9				2	3

Households overcrowded, 22 (17.6%).
Households not overcrowded, 103 (82.4%).

In 3 cases out of the 22 overcrowded households the overcrowding was of a voluntary nature—namely, (1) a lodger had been taken in; (2) the overcrowding operated at the week-ends, when an 18-year-old relative stayed in the house; (3) a daughter of the household who had formed a liaison with a married man brought him and their two children to stay with her parents. The overcrowding figures for the households of male patients and of female patients were substantially the same, but overcrowding was found in only 4% of the households of patients over 54 years of age, probably owing to the fact that younger members of the family had left home on marriage or had obtained employment in some other district.

As the assessment of overcrowding according to the Housing (Scotland) Act, 1950, gives no indication of the types of houses in which our patients live, we classified them in the following groups: (a) municipal, further subdivided into (1) tenement type, (2) two-in-a-block, and (3) four-in-a-block; and (b) privately owned tenements which were subdivided according to assessment, after personal inspection of the general state of repair and environmental cleanliness, into good and bad groups. The results are given in Table V, which also shows the sex distribution.

It will be seen in Table V that 52 (41.6%) of the 125 new cases were living in municipal type houses. As such houses comprise approximately 29% of the total houses in the area (personal communication, divisional sanitary inspector), it would appear that there are proportionately more new patients arising in municipal houses than in non-municipal rented houses, as other types of housing in the area are insignificant. An explanation which suggests itself is that

TABLE V.—*Type of Houses*

Municipal			Privately Owned		
	Female	Male		Female	Male
Tenement ..	16	12	Good ..	12	23
2-in-a-block ..	7	10	Bad ..	17	21
4 " " ..	1	6	Total	29	44
Totals ..	24	28			
	52			73	

TABLE VI

	Period Rehoused (Years)						Total
	1	2	3	4	5	5+	
No. of patients ..	5	2	6	5	4	30	52

many of the patients had been recently rehoused by the local authority, and this possibility was investigated. The results are shown in Table VI.

The fact emerges that more than half of these patients had been living in satisfactory (by municipal standards) housing conditions for more than five years, but despite this had contracted tuberculosis. This group comprises a quarter of the cases in our survey, and only one of the 52 families concerned had been rehoused because of previous tuberculosis in the family. A higher proportion of female cases than male cases arose in persons living in municipal tenement houses, as opposed to the block-type of municipal house (66.6% and 42.8% respectively).

When the figures for cases arising in privately owned tenement homes are considered, we find approximately equal numbers in the good and bad types of houses (35 and 38 respectively), and of the 73 new patients living in privately owned tenements, 29 (39.7%) were females and 44 (60.3%) were males. There would thus appear to be a predominance of male cases arising in privately owned tenements.

Household Income

Accurate figures of household income are difficult to obtain because of a natural reticence on the part of the patient and sometimes a suspicion that the information divulged may be used to the patient's financial detriment—for example, in respect of national assistance or income tax. Another difficulty is that wage-earners of the household do not always disclose their true income to the others in the household, and wish to avoid the domestic unpleasantness which the truth would entail. Realizing these difficulties, we postponed close questioning until the confidence of the family had been gained and also gave assurance that any information obtained would be regarded as highly confidential. Care was taken to include in the household income figure all additional sources such as family allowances, pensions, and average overtime earnings. The results of this inquiry are given in Table VII.

This Table shows that household income varied widely from £1 12s. 6d. a week to £48 a week, but by far the greatest number were between £10 and £20. An income of £10 a week for the average household is, in our opinion, the lowest limit of income necessary to avoid undue financial strain, and our analysis shows that 70.4% of our patients were living above this level. In Table VIII we give a breakdown of the household income in relation to age group of

TABLE VII.—*Weekly Household Income (All Sources) (Lowest, £1 12s. 6d.; Highest, £48)*

		Age Groups of Patients				Total
		Males		Females		
		Under 55	Over 55	Under 55	Over 55	
Less than £10	..	18	10	8	1	29.6%
£10-£20	..	25	9	38	2	59.2%
More than £20	..	7	3	4	—	11.2%

the patients and to the average number of units in the house. A person over the age of 10 years is regarded as one unit and a person less than 10 years as a half-unit. It should be pointed out that, whereas in the housing analysis using statutory standards children under 1 year were disregarded, for the financial analysis a child under 1 year is regarded as a half-unit.

Table VIII shows the average income per household unit and also the average number of units per house according to the age groups of the patients. In the age group most

TABLE VIII.—*Income Per Household Unit*

	Age Group						
	14-24	25-34	35-44	45-54	55-64	65-74	75+
No. of families ..	45	30	17	8	19	4	2
" " units ..	212	106½	69	32	69½	8	2
Income per unit ..	£3 16s.	£3 9s.	£2 10s.	£2 19s.	£3 15s.	£3 15s.	£2 10s.
Average No. of units per house	4.6	3	4	3.8	3.6	2	1

prolific of new cases—namely, 14-24—the household income per unit is highest and the number of units per house is at its maximum. This group therefore has an undoubted financial advantage over all other age groups, because, apart from higher income per unit, the finding of a higher number of units per household places them in an additionally advantageous position, as more people are sharing a common roof and household expenses compared with the other age groups. In the patients of the younger age groups, therefore, poverty cannot be accepted as a significant predisposing factor. On the other hand, study of the tables will show that our patients aged 65 years and over are at a financial disadvantage when the average income per unit and the number of units are considered together. The children of these old people have usually left home and no longer contribute to a household, the basic expenses of which (rent, rates, heating, etc.) remain as high as before.

Contact Examination

We endeavoured to persuade all household contacts to submit to x-ray examination and Mantoux-testing with 1:1,000 O.T. The results are shown in Table IX. In addition, many other family and social contacts were examined, but these results are not included.

Of the 21 contacts not Mantoux-tested, seven were patients with pulmonary tuberculosis in whom testing was not considered necessary. One contact was a merchant seaman whom we managed to radiograph, but not Mantoux-test, before he rejoined his ship; 10 were out working all day and refused. Another contact, a lodger, left the household precipitately before testing could be carried out. The remaining two contacts not Mantoux-tested were an 87-year-old incontinent woman whose daughter forbade any examination,

TABLE IX.—*Household Contacts*

Age group:	0-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70	71-75	76-80	80+
No. of contacts in household ..	43	47	40	49	39	30	20	21	29	19	22	17	20	8	7	2	2
" " x-rayed ..	43	47	40	49	38	30	20	21	29	19	22	17	20	8	7	2	1
" " Mantoux-positive (1:1,000) ..	26	36	32	44	35	24	19	21	25	17	16	17	18	7	5	1	—
No. of contacts Mantoux-negative ..	17	11	8	5	1	2	—	—	—	—	4	—	—	—	2	1	1
No. not Mantoux-tested ..	—	—	—	—	3	4	1	—	4	2	2	—	2	—	—	—	1

and a 23-year-old working girl who chose to rest in bed on a Saturday morning rather than have any test carried out. These latter two were also the only household contacts not radiographed out of a total of 414. Of the group, therefore, 94.6% were Mantoux-tested and 99.5% radiographed.

As a result of the x-ray examination of these 412 household contacts 21 (5.7%) were discovered to have active pulmonary tuberculosis and a further 31 (6.8%) had tuberculous disease, probably quiescent or inactive.

As one may confidently expect that a proportion of the 31 cases classified as quiescent or inactive will break down in the future, continued observation will swell the total of active cases detected at an early stage as a result of the survey.

Racial Factors

In view of the fact that Glasgow has a large number of citizens who were born in Ireland and the Scottish Highlands, we thought it would be interesting to ascertain what proportion of the patients in our group came into this category. Only four patients (0.8%) were born in Ireland and four (0.8%) in the Scottish Highlands.

The 1951 census gives the number of persons living in Glasgow and born in Ireland as 34,475, which is approximately 3% of the city's population. The corresponding figure for persons born in the Scottish Highlands and Western Isles is 19,680, approximately 2% of the population. It would therefore appear unlikely that there is any special prevalence of tuberculosis in North Glasgow among persons of Irish or Highland birth.

Discussion and Conclusions

If the figures given above are a fair reflection of the position in the area surveyed, and if we accept Greenwood's dictum quoted in the opening paragraph, we reach some conclusions which may be at variance with generally accepted concepts of tuberculosis epidemiology. Bradbury (1933), in a frequently quoted Tyneside study, found that the triad of factors particularly associated with pulmonary tuberculosis were poverty, overcrowding, and Irish nationality, but the figures in this survey do not suggest that these factors are of appreciable importance in Glasgow. Stein (1950), in Edinburgh, also suggested a highly significant relation between tuberculosis morbidity and overcrowding, as did Macgregor (1926) in Glasgow. McKinlay (1947), however, was critical of the older views on the association between tuberculosis and housing conditions, as he could find statistically no significant correlation between tuberculosis and overcrowding in either town or rural areas. Lockhart (1949), too, in Stirling, found no greater incidence in overcrowded houses, but suggested that this may have been the result of a vigorous policy of rehousing tuberculous families.

Our figures would suggest that Lockhart's surmise is incorrect, as only one of our 52 tuberculous families in municipal houses had been rehoused because of previous infection. It would also appear that the rehousing of overcrowded families affords them no obvious protection against the development of the disease, especially when it is considered that more than half our municipally housed families had been rehoused for more than five years. Perhaps the most striking result, however, of this investigation is that we could demonstrate a definite contact history in 77.6% of the male cases and 75.4% of the female cases. This should be compared with the figure of 40% obtained by Lloyd and Macpherson (1936) in their survey of 1,000 patients aged 15-25. These authors also quoted percentages of 41 in France and 36 in Leeds. The differences between these figures and ours is even more striking when we consider the London County Council report of 1937, which emphasizes that contact history is more frequent in young adults than in patients over the age of 40 years. Semple (1955) stated that in Liverpool one in twelve of new patients gave a history of contact with a known case, and Clarke (1952) states that in perhaps two-thirds of all cases of pulmonary tuberculosis there is no family history.

If the discrepancy in these figures from different areas is not accounted for by the relative intensity of the contact investigations then it would seem that the epidemiology of the disease varies so much from area to area that case-finding schemes profitable in one part of the country may be much less so in others. We consider it noteworthy also that the contact history in our series was of a familial nature in 88.5% of cases. This very high proportion has strengthened our conviction that in the detection of new cases of tuberculosis the emphasis should continue to be laid on full and relentless investigation of all familial contacts, whether living in the household or elsewhere. In this connexion it is important to investigate all such contacts regardless of their age, as in at least two of our patients, aged 55 and 56 years, the probability of their having been infected by younger members of their families is suggested by study of serial x-ray films. This emphasis on household and familial examination is justified by the incidence of 57 per 1,000 active cases found in a total of 412 contacts examined, which may be contrasted with the usual incidence of 5 per 1,000 in mass radiography surveys in the same area (Dr. T. Miller, Director Mass Radiography, personal communication) and which underlines the dictum that the most profitable yield of previously unknown cases is obtained by examination of the familial contacts.

The results of tuberculin-testing show that between the ages of 31 and 50 years all our household contacts were Mantoux-positive. Above 50 years 11% were negative reactors. This is an interesting finding which is at present being further investigated.

An extremely disconcerting fact which emerged was that 20 out of our 125 new patients were working in food trades or with children. It is difficult to avoid the conclusion that periodical x-ray examination of such persons is highly desirable, and the fact that the employee is in one of the older age groups should not be considered an adequate excuse for failure in this respect. School authorities have already attempted with varying success to implement this policy with regard to full-time employees. We suggest that this be extended as a condition of employment of part-time workers such as our patient, who was serving meals to primary-school children.

This work has given us some general impressions which we feel may be of value to other workers in the field. For example, we find that visits by the chest physician to the homes of new patients give the health visitor a feeling of greater interest and encouragement, with the added advantage that such visits serve to reinforce, and occasionally redirect, her activities to the best advantage. We also found that home visits made in the evening were most productive in eliciting information and in establishing rapport with the members of the household. Moreover, at such times recalcitrant contacts were found to be in a more amenable state of mind and willing to discuss the reason for their reluctance to be examined. As our figures show, this reluctance could usually be overcome as a result of our methods, which, however, sometimes involved a considerable number of visits.

An easing of the situation in obtaining the co-operation of tuberculosis contacts would be achieved by facilities for having x-ray examination carried out in the evening, as it is unreasonable to expect a working man or woman to lose a half-day's wages in conforming to a recommendation which is as much in the public interest as his own. Our firm impression is that such visitation is as useful to the chest physician as to the patient, since the domestic conditions which are important in this social disease cannot be visualized accurately otherwise, and help in treatment planning and management of the patient is thereby obtained.

If there is any tendency, as is sometimes suggested, for the modern chest physician to devote his energies too much to purely clinical activities it is not in the best interests of tuberculosis control. The tuberculosis situation cannot be viewed complacently until the incidence rate for new cases, which, so far, in most urban areas has shown only a negli-

gible or moderate decline, decreases in the same marked manner as mortality. Far from the volume of work in the tuberculosis field becoming less, a marked expansion in effort is necessary, with as much emphasis placed on prevention as on treatment. Plans for the detection of tuberculosis must be based overwhelmingly on examination of the household contacts, and it must be a long-term surveillance, especially as our figures of familial contact history would appear to support the theory that inherited susceptibility to tuberculosis is a major factor in the development of disease in the adult.

Summary

The results of an intensive investigation of the sociological and epidemiological features of 125 new cases of pulmonary tuberculosis in North Glasgow are given.

Overcrowding, poverty, and Irish nationality were found not to be significant factors.

The results of x-ray examination of 412 out of 414 household contacts are given with the results of tuberculin-testing of the majority, including adults. A reason for the increased incidence of tuberculosis in older males is suggested.

Figures show that the rehousing of families confers no obvious advantage in preventing the onset of tuberculosis.

The results of contact history examination showed a possible source of infection in a very high percentage, about double those in previous surveys. The contact history was of a familial nature in nearly 90%, and a suggestion was made for the better control of the disease on this basis.

Compulsory x-ray examination of food-trade employees and persons working with children is advocated.

It is a pleasure to thank Dr. A. W. Lees, consultant chest physician, Ruchill Hospital, for his interest and advice in this work, and also our medical, nursing, and clerical colleagues in the public health department.

REFERENCES

- Bradbury, F. C. S. (1933). *Causal Factors in Tuberculosis*. N.A.P.T.
 Clarke, B. R. (1952). *Causes and Prevention of Tuberculosis*, p. 88. Edinburgh.
 Lloyd, W. E., and Macpherson, A. M. (1936). *British Medical Journal*, 2, 1130.
 Lockhart, R. (1949). *Hlth Bull. (Edinb.)*, 7, 76.
 McDougall, J. B. (1949). *Tuberculosis: A Global Study in Social Pathology*, p. 357. Edinburgh.
 Macgregor, A. S. M. (1926). Report of the Medical Officer of Health, Glasgow.
 McKinlay, P. L. (1947). *Hlth Bull. (Edinb.)*, 5, 37.
 Scottish Health Services Council (1951). *Report of Committee on Tuberculosis*, p. 19. Edinburgh.
 Semple, A. (1955). *Lancet*, 2, 34.
 Stein, L. (1950). *Brit. J. soc. Med.*, 4, 143.

"In spite of the very real advances which have been made in the understanding and management of cerebral palsy during the last few years it is still unfortunately true that mitigation and alleviation of the result of the handicap are all that can be offered to-day," states the Annual Report of the British Council for the Welfare of Spastics for 1955-6. To mitigate the sufferings of 30 severely handicapped young adult spastics the Council established Ponds, a home which completed its first year in 1956. Although it would be premature to assess results there, the Warden, Dr. C. D. S. AGASSIZ, believes that practically every spastic admitted has improved socially and physically to some extent. The council regard Ponds as a long-term pioneer experiment to find out what can be achieved with spastics likely to need permanent care, and hope that it may eventually develop into a model on which local authorities may base their own schemes.

DEVELOPMENTAL SPEECH ANOMALIES IN APPARENTLY NORMAL CHILDREN

BY

C. H. M. WALKER, M.D., M.R.C.P.Ed., D.C.H.

Senior Medical Registrar

AND

P. R. LANGUTH, L.C.S.T.

Speech Therapist

From the Hospital for Sick Children, Great Ormond Street, London, W.C.1

The aetiology of speech anomalies in children is often obscure. Particularly is this so when there is no physical handicap, such as cerebral palsy, cleft-palate, or deafness, and when the mental capacity is normal. The indications for treating delayed onset of speech, arrested speech development, and subsequent dyslalia are poorly defined. In view of the scarcity of information in the literature a study of these particular aspects of the problem was planned. On completion of the study, Morley *et al.* (1955) described 72 cases, seen over a six-year period, in which similar disorders of speech were observed.

Material

The cases were selected from children who within the previous five years had attended the medical outpatient department and speech clinics of the Hospital for Sick Children, Great Ormond Street, London. At the outset, 57 children were regarded as physically normal and of average intelligence, though on re-examination doubt was cast on the intelligence in 10 cases. The intelligence quotient (I.Q.) was estimated in seven of these, and two were found to score below 80, the level accepted by MacMeeken (1942) as the lower limit of normality in a study on schoolchildren. These two and the three children whose I.Q. could not be estimated were omitted from the study. Those selected showed no evidence of deafness or neuromuscular abnormality, and it was possible to confirm this by re-examination in 43 of them. Of the children who could not attend this research clinic, further information was obtained by questionnaire in four and the original notes were adequate for some parts of the analysis in 10. In 14 cases where there was some doubt about the effects of the speech abnormality on schooling, a report was obtained from the schoolteacher. Progress reports of five children who had been referred elsewhere for treatment were received from the speech therapists of other clinics. Of the original 57 cases, then, 52 (34 males, 18 females) were included in the analysis.

Normal Speech Development

One or two special points concerning the normal development of speech are worthy of reiteration. It is now generally understood that infants first have a realization of the importance of speech at about 9 months of age (Sheridan, 1945). What is less often appreciated is that the babbling which occurs much earlier (Sheridan, 1945; Schantz-Hansen, 1952; Van Riper, 1954) is of considerable significance and plays an important part in assessing subsequent speech abnormality.

During the course of normal development the child goes through phases of "echolalia," "perseveration," "lispering," and other mild articulatory difficulties. For example, "s," "sh," "th," and "r" are among the last to be learned, along with the tricky consonant combinations such as "pl," "thr," and "sk."

Knowledge of this nature is valuable in estimating the stage at which the development of speech becomes abnormal or arrested. A careful estimation of the child's present and