THE PREVENTION OF TUBERCULOSIS

IN CHILDREN OF SCHOOL AGE

a Thesis submitted for the Degree of
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by

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The Prevention of Tuberculosis

in Children of School Age

Section I

Introduction
"In our endeavour to find methods to prevent" tuberculosis," Pottenger (1) writes, "we must give the" "period of childhood much more attention than it has" "been wont to receive; for it is not only possible, but" "probable, that the seeds which ripen into full-fledged" "cases of tuberculosis in later life were in many cases" "implanted in the tissues during the period of childhood," "remaining there until a favourable time appeared for" their activity."

There is no doubt that, among the many duties which the school medical officer is called upon to perform, the early detection of tuberculosis in the child is by no means the least important. Constantly in contact with children between the ages of four and fourteen, he has opportunities, not only for making himself perfectly acquainted with the healthy conditions of a child, but also for studying those deviations from the normal that suggest early infection by tuberculosis, which are not given to medical men in other branches of the profession. It must, indeed, be the experience of many school medical officers, that rarely does a day pass, in which some child during an examination is not suspected of, or found to be, suffering from tuberculosis in one form or other of its manifestations.

Statistics are available from many sources to show the frequency and the ubiquitous nature of the infection.
infection. These are obtained from a study of
(a) the records of post-mortem examinations of
individuals dead from all causes;
(b) the records of the morbidity of the infection
and (c) the mortality records.

After making an examination of 500 bodies of
children, of ages varying from infancy to fourteen years,
brought to the Pathological Institute at Munich, Oskar
Müller (2) concluded that 150, that is 30 per cent, had
succumbed to tuberculosis.

Baurgarten, quoted by Felix Wolff, (3) found 3
out of every 4 bodies, — those who died of tuberculosis
not being included, — that is 75%, showed the presence
of healed tuberculous lesions.

Bollinger's (4) examinations proved that 40% to
50% of all bodies exhibited traces of the disease.

Emil Schlenker (5) in his paper of 1893 gave the
results of others as to the prevalency of tuberculosis.
Thus Babes in Budapest found evidence of tuberculosis
in about half of all the children who had died of
various diseases, — in 1887 out of 93 corpses 65 were
found to show signs of tuberculosis, although only 10
or 11 were said to have died as a result of it.
Again, at the "Congress fur innere Medicin" in 1893,
Wolff gave the following numbers:— among adults 40%
to 50%; among children 60% to 70%. About 30% of the
adults and 40% of the children showed "latent"
tuberculosis.
tuberculosis. Further Hanau found 66 out of 100 unselected bodies to be tuberculous; of 61 cases without active and evident tuberculosis, he found "latent" tuberculosis in 44% of them.

In 1906 Burkhardt (6) dealt with 1,452 cases. Of these 190 were children; and of these 36% were tuberculous. Out of this 36%, 18% had died of tuberculosis. Of 1,262 adults, only 113, i.e. 9% showed no tuberculosis; 91% showed the presence of the infection.

Hamburger and Sluka (7) in Vienna have dealt with 401 cases of children between infancy and fourteen years of age and found 40% were tuberculous. In children from one to fifteen years of age, they found 55% tuberculous. These authors also quote the following authorities in respect of postmortem examinations on children, who have died of injuries, operations, or acute infections:-

Councilman, Boston, in 230 cases, found 16% tuberculous; Baginsky, Berlin, in 806 found 18%; Heller, Kiel, in 714 found 20%; Ganghofner, Prague, in 973, found 24%; and Hamburger and Sluka, Vienna, in 150 found 31%.

Taking all children under fifteen years of age submitted to postmortem examination, Harbitz (8), in Christiania, found tuberculous lesions in 42.5%; and Comby (9), in Paris, 38.5%.

Still (10) reports 769 postmortem examinations upon /
upon children under twelve years of age, in which 369, or 35%, were tuberculous.

Hand (11), in reporting to the Pathological Society of Philadelphia, showed statistics of sections held at the Children's Hospital for ten years. Of 332 autopsies made, 115 or 34.3% showed tuberculosis.

Tuberculous infection was found by Naegeli (12) of Zurich to the extent of 33% in children between the ages of five and fourteen on whom post-mortem examinations were made.

According to Hamburger the frequency of infection by tuberculosis as demonstrated in the dead body rises from about 15% in the first year of life to as much as 70% between the eleventh and twelfth; and at the age of puberty upwards of 90% of the poorer population of the large towns have been infected with the bacillus of tuberculosis.

Eastwood and Griffith (13), in a report to the Local Government Board in 1914, stated that in the dead bodies of 150 children (unselected hospital cases) 62.7% showed evidence of tuberculous infection.

Philip (14) quotes Rheinhart of Berne, who in 1917 found that 96% of bodies which "came consecutively to post-mortem examination" at the Berne Pathological Institution manifested tuberculous infection. 32% of these cases showed "evidence of progressive tuberculosis within the system" and in 64% there was evidence of healed tuberculosis.

Koplik /
Koplik (15) quotes Ghou, who carried out a series of autopsies in which tuberculous infections were found to be present in different age groups to the following extent:

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 3 months</td>
<td>4%</td>
</tr>
<tr>
<td>4 - 6 months</td>
<td>18%</td>
</tr>
<tr>
<td>7 - 12 months</td>
<td>33%</td>
</tr>
<tr>
<td>2 years</td>
<td>40%</td>
</tr>
<tr>
<td>5 years</td>
<td>56%</td>
</tr>
<tr>
<td>11 years - 14 years</td>
<td>70%</td>
</tr>
</tbody>
</table>

Although there is considerable variation in the percentages of tuberculous infection amongst children as shown by the results of post-mortem examinations carried out by different authorities, the figures are sufficient to indicate how prevalent and how frequent such infection is. The lowest estimate is 30%, whilst the highest is between 60% and 70%.

It is at present impossible to ascertain the actual amount of tuberculous infection amongst children, but that it is extensive may be judged from the returns quoted in the Annual Report of the Chief Medical Officer of the Board of Education, 1915 (16). Particulars are given of the number of children found to be suffering from tuberculosis in certain educational areas in England and Wales during 1915, along with percentages of tuberculosis among children in 1911, 1912, 1913, 1914, and 1915. For all these years, however, the same areas have not been used for the purposes of compiling statistics, nor the same number of children examined, so...
6
that the results in each case are not strictly comparable.

<table>
<thead>
<tr>
<th>1915</th>
<th>Percentage of Tuberculosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1914</td>
</tr>
<tr>
<td>Routine Cases</td>
<td>52</td>
</tr>
<tr>
<td>Special Cases only</td>
<td>19</td>
</tr>
</tbody>
</table>

These figures give but a rough estimate of the extent of manifest infection amongst children of school age, for it must be admitted that many early cases with few physical signs escape the notice of general practitioners and school medical officers. Nor do the figures account for those children in whom the disease is present, probably active and unrecognised by present diagnostic methods, nor for those in whom infection has occurred but is occult and in the meantime unrecognisable.

J. E. Squire and Annie Gowdey (17) found only 0.47% of cases of pulmonary tuberculosis among 1,670 children; or if cases with doubtful signs were included, 1.3%.

We know, then, that very approximately one child out of every two hundred exhibits the signs and symptoms of the disease. Reliable figures in regard to the frequency /
frequency of the infection amongst children can only be obtained when our knowledge and experience in the diagnosis of tuberculosis has considerably increased, and when the work of general practitioners, school medical officers, and clinical tuberculosis officers is efficiently co-ordinated. Only then will fewer cases escape the meshes of the net.

The number of cases (all ages) of tuberculosis, notified in the year 1918, amounted to 92,000.

The mortality from tuberculosis is responsible for one-tenth of the death rate at all ages for all causes.

Up to 1913 the mortality among children and young people continued generally to decrease, and the death rate from all forms of tuberculosis among children under fifteen years of age was greatest during the first five years of life.

The mortality from pulmonary tuberculosis was lowest between the ages of five and ten years, and showed a steady increase during the age periods ten to fifteen and fifteen to twenty, the increase being particularly marked during the fifteen to twenty age period.

On the other hand the mortality from other forms of tuberculosis declines after five years of age.

Since 1913, however, - that is during the period of the great war, - the tuberculosis death rate/
rate between the ages of five and fifteen has steadily risen.

In 1917, there were 5,397 deaths from tuberculosis of children in this age group. Again, dealing with the same age group, the mortality for all forms of tuberculosis in 1913-14 was 569 per million (age group five to ten) and 564 per million (age group ten to fifteen), whilst in 1917 it had risen to 678 and 733 per million respectively.

The following table (18) indicates the decline in the death-rate from tuberculosis at ages one to five years, and the rise at ages five to fifteen.

<table>
<thead>
<tr>
<th>England and Wales</th>
<th>Death Rate per 1,000/ from all forms of tuberculosis</th>
<th>living</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ages 1 - 5</td>
<td>Ages 5 - 10</td>
</tr>
<tr>
<td>1913</td>
<td>1.65</td>
<td>0.59</td>
</tr>
<tr>
<td>1914</td>
<td>1.49</td>
<td>0.56</td>
</tr>
<tr>
<td>1915</td>
<td>1.73</td>
<td>0.61</td>
</tr>
<tr>
<td>1916</td>
<td>1.56</td>
<td>0.64</td>
</tr>
<tr>
<td>1917</td>
<td>1.56</td>
<td>0.68</td>
</tr>
<tr>
<td>1918</td>
<td>1.47</td>
<td>0.68</td>
</tr>
</tbody>
</table>

Infancy, therefore, is a condition of extreme susceptibility to tuberculous infection accompanied by no inconsiderable danger. The immature tissues of the child are in some ways prone to the attacks of the bacillus. However as age increases more children suffer from tuberculous lesions and decreasing numbers die from their results. Once the period of /
of infancy has been passed it appears that some protective agencies are at work, notably during the first two decades of life.

Behring and Römer (19) have shown that the only strain of tubercle bacilli which they found produce complete immunity in cattle was the human strain (typus humanus). It is not unreasonable to suppose that the converse also is true and that a well diluted bovine infection, in addition to an increased natural resistance on the part of the body tissues, is a potent factor in causing the marked decrease in mortality during the first decade of life.

Tuberculosis has a distinct preference for the lymphatic tissues, since in the child, at any rate, the most common seats for tuberculosis infiltration are undoubtedly the lymphatic glands of the abdomen and thorax. In children tuberculous infection of the lungs, bones and joints, and other parts of the body, appears to be nearly always secondary to disease of, or infection through, the lymphatic glands.

In early years the lymph glands are well developed and form the main defence against the tubercle bacillus by a mechanical process of arrest and filtration.

But localisation of the bacilli in the lymph glands of infants appears rarely to take place, and the bacilli readily gain access to the larger lymphatic vessels; and Calmette (20) considers that death /
death takes place either with a general atrophy or by the breaking down of tubercles into the lungs, or into the venous system, producing thereby a tuberculous broncho-pneumonia, or the final stage of miliary tuberculosis. In older children the tubercle bacilli do not penetrate so easily through, or beyond, the lymph glands draining the site of invasion. The localisation of the bacilli in the lymph glands thus forms in children over one year of age the primary focus of infection from the clinical standpoint.

The glands may be the only tissues involved; but after encapsulation caseation may take place with a consequent spread to other tissues where secondary infection ensues with the development of the appropriate physical signs.

It is possible to distinguish two definite stages of the disease, a primary stage in which the lymph glands are the foci, and a secondary stage when the disease has overcome the glands and has spread to appear in any other parts of the body tissues.

Tuberculous adenitis almost always develops slowly and painlessly during the course of weeks, months, or even years. So in the primary stage of the disease we have to deal with two clinical conditions, namely, one in which there are definite signs and symptoms to indicate that certain lymphatic structures are affected, and the other, where the enlargement of the glands has given rise to signs and symptoms which are not /
not yet appreciable by our present clinical methods.

The disease as it affects the human subject may be graphically represented thus:

<table>
<thead>
<tr>
<th>Primary Stage</th>
<th>Secondary Stages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuberculous Adenitis</td>
<td>I. Surgical Tuberculosis</td>
</tr>
<tr>
<td>(a) Manifest, or</td>
<td>(a) Bones</td>
</tr>
<tr>
<td>(b) Occult</td>
<td>(b) Joints</td>
</tr>
<tr>
<td></td>
<td>(c) Skin, etc.</td>
</tr>
<tr>
<td>II. Medical Tuberculosis</td>
<td></td>
</tr>
<tr>
<td>(a) Lung, pleura, etc.</td>
<td></td>
</tr>
<tr>
<td>(b) Peritoneum</td>
<td></td>
</tr>
<tr>
<td>(c) Miliary Tuberculosis</td>
<td></td>
</tr>
</tbody>
</table>

From the prophylactic point of view it is a matter of importance that the routes of entrance of the tubercle bacilli should be determined in order that the source and nature of the infection be ascertained.

Koplik (21) has defined the portals of entry as Aerogencus (inhalation), Enterogencus (alimentary), dermogencus (through a breath in the cuticle), and hereditary or congenital. The last two methods are regarded at present as of relatively small importance; whilst with respect to the comparative significance of the first two modes there now exists considerable difference of opinion among investigators. Koplik considers that infection by inhalation is commonest not /
not only in the adult but in the child. Herbert Koch in 133 cases could with certainty trace the source in 50 infants to be a direct infection of the lung tissues through the sputum of the father or mother; and Jennig states that 55% of his cases of tuberculosis occurred in families in whom tuberculosis was prevalent.

Studies (22) begun by Kayserling in Berlin and continued by Miller of New York, Floyd and Bowditch of Boston, and Lowman of Cleveland, have proved that from 20% to 55%, especially of the children, of families of consumptives, in whom all the members have been thoroughly examined, are tuberculous. The City statistics of Berlin show that 70% of all new cases of phthisis reported can be directly traced to some previous case.

Holt (23) as a result of his own observations is of the opinion that tuberculosis in infants and young children is much more frequently acquired through contact with tuberculous patients than in any other way.

Cobbett (24) brings evidence in support of the contention that the lungs are the most important portal of entry. Repeating some experiments originally conducted by Harth and Hermann and using the bacillus prodigiosus, he showed that this organism could be demonstrated in the lungs of a guinea-pig killed so soon after the commencement of exposure to a fine spray of liquid containing the bacilli that no time was allowed to elapse for the absorption of the bacilli /
bacilli into the lymphatics and thence to the lungs. Cobbett also quotes Findel, who, using guinea-pigs, found that 63 bacilli inhaled constantly caused tuberculosis.

Other evidence in favour of infection by inhalation is found in the occurrence of tuberculosis in infancy in countries where artificial feeding is unknown. Gaultley (25) gives the instance, in this respect, of Japan, where children are suckled for two or three years, where the cattle are not known to suffer from tuberculosis, and where cow's milk is little used for infants; yet tuberculosis in children is as common as in other countries. Tuberculosis is prevalent in China, although artificial feeding of infants is not practised. And in India and Egypt, where infants are breast fed for two or three years, tuberculosis of the glands and peritoneum is rare.

It is generally admitted that invasion by the tubercle bacillus through the alimentary tract can take place either by -

(1) the ingestion of food containing either the human or bovine type of the organism, or

(2) by the accidental entrance of bacilli into the mouth and thence to the alimentary canal, or

(3) by the tonsil, - the tonsils being considered part of the alimentary tract.

There is no doubt that the ingestion of the bovine type of the bacillus, principally in milk, is
the cause of a very considerable amount of tuberculosis in children. Fowler (26) considers that tuberculous milk is responsible for about one quarter of the cases of the disease in childhood. The British Royal Commission on Tuberculosis (27) expressed the opinion that "there can be no doubt but that, in a certain" "number of cases, the tuberculosis occurring in the" "human subject, especially in children, is the direct" "result of the introduction into the human body of the" "bacillus of bovine tuberculosis."

As a result of experiment on animals, Calmette (28) concludes, among other things, that the bacilli may penetrate the walls of the alimentary canal, both in youth and in adult life, without leaving any visible lesions; and that the so-called primary pulmonary tuberculosis is intestinal in origin.

V. Behring (29) considered as a result of many investigations that there was experimental support for the view that the origin of epidemiological tuberculosis in man is a primary intestinal infection in very early infancy; but the point whether the bacilli gain access to the body through feeding or through inspiration is left undecided.

Nathan Paw (30) considers that human tubercle bacilli produce tuberculous ulceration of the intestine, tuberculosis of the abdominal glands, and pulmonary tuberculosis; whilst the bovine type produces tuberculosis of the mesenteries, tuberculous peritonitis,
peritonitis, tuberculous glands, tuberculous lesions of bones and joints, tuberculous meningitis, acute miliary tuberculosis and probably lupus.

Koch thought that, in children, tuberculosis of intestinal origin was rare.

Professor Simms Woodhead (31) produced much evidence in support of the preponderance of intestinal infection which is in agreement with the opinion of Sidney Martin (32).

The quotation of figures to indicate the percentage of cases infected with the bovine bacillus is a common method of argument in support of infection through the intestine, the assumption being that the bacillus enters through the intestinal mucous membrane. Thus for example, German observers state that while 10% of the adult cases suffer from bovine infection, no less than 50% of children do. A similar figure for cases of tuberculous peritonitis were reported by the Royal Commission on Tuberculosis and Bovand found the bovine organism in 70% of the cases suffering from abdominal tuberculosis. It is an argument which loses very considerable weight if it is admitted that pulmonary infection can take place whilst feeding.

The tonsil by virtue of its extremely exposed position is a not uncommon portal of entry. Dieudonne (33) of Warzburg found tubercle bacilli to be very frequently present in the nasal secretion, and in the dust /
dust on the hands of children varying in age from 9 months to 3½ years.

The tonsils are not unfrequently the seat of what appears to be primary tuberculosis, often showing the presence of scars, giant cells and other changes attributable to tuberculosis. Dieulafoy (34), Latham, and other workers have demonstrated by the inoculation of guinea-pigs the presence of tuberculosis in tonsils. But tubercle bacilli may remain for varying periods lodged in the tonsillar crypts without causing actual disease in the tonsils. Latham's work precluded this possibility whilst carrying out his experiments.

The tonsil may like other lymph glands become overwhelmed by invading tubercle bacilli and may thus become an avenue for infection elsewhere in the body.

Carmichael (35) examined a series of tonsils removed in the out-patient department at the Royal Hospital for Sick Children, Edinburgh, from children with degrees of lymphatic enlargement varying from "a small pea to a marble, or pigeon's egg". Out of 14, 7 cases were found on section to be tuberculous.

Holden (36), in reviewing shortly the occurrence of the types of tubercle bacilli as met with in the human subject, presents an enlightening summary completed from various monographs but chiefly from Cobbett's "Causes of Tuberculosis". As a result of direct examinations of the lung, no bovine bacilli were found in the case of 24 adults, and only four out of 65 children/
children showed the bovine types. The sputa of 936 cases exhibited the bovine bacillus in 4 cases. Bovine types were found to constitute about 50% of the cases of primary abdominal tuberculosis. Tuberculous cervical adenitis was caused in 75% of cases by the bovine type of bacillus, that is, the glands which drain the oral and pharyngeal cavities. This figure is for early life, but it is found to drop to 50% in adolescence—a figure similar to that quoted for primary abdominal affections. It is the bronchial glands, however, that show the great preponderance of the human type, and these are the glands which are known to receive their lymph supply from the lungs.

Tuberculosis of the bones and joints has been shown by Fraser of Edinburgh in a series of cases to be due to bovine tubercle bacilli in 58%, and in children under four years of age in 78%.

The evidence is ample to indicate that the two main routes of infection are by way of the lungs, partly inhalation whilst breathing, and partly, though to a less extent, inhalation of infected food materials, and by way of the alimentary canal through the ingestion of infected food, or the swallowing of infected dust, or infected oral or nasal secretions. It is equally certain also that the bovine as well as the human type of the organism is responsible for the disease in the human subject, but whichever be the route of infection, and whichever be the type of bacillus responsible for the
the lesions, this fact remains clearly demonstrated, namely, that childhood constitutes the great age period of infection.

Metchnikoff has said in 1912 that "we have to" "recognise the fact that in his environment man" "encounters tubercle bacilli of very different degrees" "of virulence. It is during childhood that the" "contagion of these bacilli is established".

After a period of five years during which one's attention, as a medical officer, has been directed entirely to the prevention and the detection of disease in the adult subject, it is a striking contrast on returning to life under civil conditions to have to deal with these matters as they affect the child; and there is no subject which in this respect has impressed me so strongly as the obvious need which at present exists for the establishment of a definite, clearly defined policy for the prevention of tuberculosis, the discovery of its existence at the earliest possible moment after infection, and the initiation of adequate means of segregation of active infective cases, and of the immediate treatment of early cases of the disease.

In my own experience, particularly during the few months in which I have resumed my work as a medical officer of health, hardly a day passes, which does not bring to my notice some child or children in whom there is /
is grave suspicion of the beginnings of the disease. A mother says that her child is not so "bonny" as he used to be, is not gaining weight, or, perhaps, is even becoming thinner, is becoming irritable, and does not have the same relish for his food as once he did. To you, the boy, or girl, looks pale, usually bright and intelligent; his skin appears to have a translucent appearance and there are the blue tracings of the veins on the chest wall underneath; but physical signs in the abdomen and chest give no hint of tuberculous involvement of the tissues.

Repeatedly I have asked myself if our present clinical methods are sufficiently far developed to enable us to ascertain the presence of early tuberculous lesions in the child. If they are not, and I believe they are not, then the school medical officer has before him a unique field of study from which should be gleaned material invaluable to the improvement and perfecting of the clinical methods for the diagnosis of early tuberculous disease, or even infection, in childhood. There is no medical man who should be more expert in the appreciation of the physical signs of the healthy child, and by the development of this sense, by the utilisation of every opportunity, the school medical officer should be able the better to detect those slight deflections which may in the end point to early tuberculous invasion.

But the selection of the tuberculous individual
is only one portion of the subject. Prevention and treatment are equally important. The broad lines of treatment and prevention are obvious, yet it is a fact that they are in the main ineffectively co-ordinated and ill-organised.

It is, therefore, my desire to review the whole subject of tuberculosis, particularly from the administrative standpoint, as it affects the child of school age, for it is then, as has been abundantly proved, that the seeds are chiefly sown.
The Prevention of Tuberculosis

in Children of School Age

Section II  

Diagnosis
There seems to be little doubt that the majority of people are infected during childhood and that this age period is the one in which beginnings of the disease are to be looked for. After the first year of life the disease must, in the great majority of cases, be in a latent condition, and since tuberculosis can with certainty be arrested provided the disease is sufficiently early recognised, it is a matter of first importance that the latent state should become recognisable to the clinician. It is in regard to occult tuberculosis that the difficulties of the clinician arise, for whilst suspicion is frequently aroused, its conversion into terms of certainty is with our present knowledge impossible. Here it should be stated that the word "latent" is an ambiguous term, but it is convenient to use it, provided it is clearly defined. I take the term to mean a condition of tuberculosis which is undoubtedly active but not as yet appreciable by our present clinical methods.

We do not know, for instance, if there are any discernible symptoms immediately following upon the entrance of the tubercle bacillus into the body. Yet it is reasonable to presume that after a period of incubation there should be some symptoms of malaise and rise of temperature. No doubt such occur, but are so slight, and unaccompanied by other appreciable signs, that they pass unnoticed, or are considered unworthy of remark on the part of the patient.
patient.

And so with the enlargement of the lymph glands. Symptoms of their enlargement only become recognised when they assert themselves as mechanical obstacles.

There are many methods of diagnosis, and they may with convenience be allocated to two main classes, - those which claim to indicate the presence of the disease within the body, and those which have particular reference to the presence of the disease in a particular part of the body.

In the first of these classes is the employment of old tuberculin, either by subcutaneous injection, by scarification of the epidermis, or by application to the conjunctiva; and the examination of the blood serum of the suspected patient by the complement fixation test and the estimation of the opsonic index. It is proposed to give a brief account of each of these methods.

(1) **The subcutaneous injection of old Tuberculin.**

It is advisable to have the patient in bed for a period of forty-eight hours preceding the injection as well as during the period occupied by the test. Throughout this time the temperature should be taken every four hours and carefully recorded. If the temperature during the forty-eight hours previous to the time arranged for the first injection keeps below 99°F (F.), the first dose is given. The susceptibility of the individual to tuberculin rises with each injection, whether /
whether he be tuberculous or healthy, so it is important to find a dose which will cause a reaction in the infected person and not in the healthy.

There is considerable difference of opinion as to the best doses, - those which will not produce any reaction in a healthy person. - Koch originally recommended an initial dose of 1 mgm., but this dose has since been considerably modified. Roepke commences with $\frac{2}{10}$ths mgm. For children half doses are given, and $\cdot 0001$ cc. is the customary initial dose.

The site of the injection is immaterial. It is frequently given in the flank or the scapular region. Intramuscular injection is less painful than hypodermic.

The test shows itself in a "reaction", which is (1) a general disturbance, such as pains in head and limbs, nausea, and malaise accompanied by a rise of temperature of at least $1^\circ$ or more within twenty-four hours after the injection, and (2) a local change in which there is an active hyperaemia at the site of injection.

If no reaction follows the administration of the initial dose further doses of $\cdot 0002$ cc., $\cdot 0005$ cc., and finally $\cdot 001$ cc., are given at intervals of forty-eight hours.

Horden (37) says "If a slight reaction (i.e. a rise of temperature of less than $1^\circ$) follows the first dose, the same interval (48 hours) is allowed to elapse, and a dose of the same size is administered a second time. If /
If a response to a second dose of the same size is more marked than was the response to the first dose, it constitutes a reaction of great delicacy."

During the reaction the glands in cervical adenitis may enlarge and become tender, diarrhoea may appear in cases of tuberculous peritonitis, and, in phthisis the cough and sputum may be temporarily increased.

There are contra-indications for the use of old tuberculin as a diagnostic aid, e.g. in febrile and acute cases, uncompensated heart disease, epilepsy, nephritis, and where the temperature is over 99°F.

Clive Rivière (38) considers the test a useful one in children, and quotes in support Binswanger who, after verification by autopsy, found the reaction to be correct in 41 cases out of 42 (i.e. 16 positive and 25 negative). Rotch and Floyd in America have used the test widely and obtained a positive result in 95% of tuberculous cases.

In view of the great care which is required in carrying out the test, the close observation demanded on the part of the physician, and the necessity of retaining the patient in bed during the test, it is not a method of practical value to the tuberculosis officer or the school medical officer, who has to examine in a day so many cases of suspected tuberculosis. It is a method eminently suitable for use in an institution or by a medical practitioner who has the time to attend to the essential details of the method.

(3) The cutaneous reaction. This was introduced by /
by von Pirquet in 1907 and consists in a skin "vaccination" with a solution of old tuberculin. It is convenient to have three solutions, namely, a 25% solution of old tuberculin (human) in glycerine with a little carabolic acid and a similar solution of bovine tuberculin, and a control solution of glycerine, water, and carabolic acid, in three separate glass bottles, which are fitted with droppers.

The skin of the forearm is cleaned with ether, and a small drop of each reagent placed on it about half an inch apart, the control being placed at the distal end. The skin is lightly abraded through the drops, and the excess of fluid dried off with cotton wool after a lapse of five minutes. A dry gauze dressing should then be lightly applied.

The test is considered to be positive if from 24 to 48 hours a zone of light pinky redness, about half an inch in width and accompanied by swelling, appears at the tuberculin sites. Finally a papule usually forms. If the reaction is very violent vesicles may form.

The test is most reliable in infants, or children under two years of age, and von Pirquet found 88% of the tuberculous to react, and 12% give no reaction. The latter were mostly suffering from miliary tuberculosis or cachexia. 16% of the apparently healthy give positive results. As the child becomes older the test becomes correspondingly less reliable. Arloing (39) does not accept it as a specific test.

From /
From the practical point of view it is an extremely convenient form of diagnosis, and it is exceedingly unfortunate that its application to the school child should have been found unreliable. In the very early case, where the symptoms are few and, as is the rule, unconvincing, a positive result would not necessarily infer the presence of the disease in an actively latent condition, but merely indicate that infection had occurred without necessarily any concurrent pathological conditions. It is a test, then, which does not assist materially in detecting with certainty the beginnings of active tuberculosis in the school child.

There are modifications of von Pirquet's cutaneous reaction. Woodcock blisters the skin instead of scarifying, and then applies tuberculin to the site prepared by moving the raised epidermis. The positive reaction is said to be clearly marked. Moro uses an ointment which is composed of equal parts of old tuberculin and lanoline, and which is applied by rubbing into the skin. The appearance of a papular or pustular rash within 48 hours constitutes a positive reaction.

(3) The ophthalmo-tuberculin reaction. Wolff-Eisner first observed the conjunctival re-action after using the stronger solutions of tuberculin (10%) and Calmette modified and clinically applied the test. The former used a 10% solution, whilst the latter applied a 1% solution, and this is the one which is generally accepted as being the most practicable. A drop or two of /
of a 1% solution of dry tuberculin (alcohol precipitate) in sterile water is dropped into the conjunctival sac; the lids of the eye being held apart to allow the fluid to diffuse on the eye-ball. The opposite eye is not interfered with and remains as the control. In positive cases the reaction may be observed to begin about five or six hours after the instillation. It is well marked in twenty-four hours, which is the best time to consider its presence. In the healthy man there is little result, perhaps only a very slight injection of the conjunctivae. In the tuberculous there is a marked congestion of the palpebral conjunctiva which is bright red and more or less intensely oedematous. This is particularly marked at the inner cauthus. Lachrymation takes place and strings of muco-pus are seen in the palpebral sac. The inflammation persists, although gradually diminishing, for several days.

The effect of strong doses, even in the healthy can be very severe, and Comby (40) on this account recommends the use of a 0.5% solution.

Cohn and Eisen, quoted by Rivière (41), obtained 50% of positive results among advanced cases of tuberculosis, and from 78.9% (Eisen) to 93% (Cohn) among earlier cases. Different observers have shown considerable percentages of positive results in what appeared to be non-tuberculous cases. Comby considers his results in their application to children to be satisfactory.

The test should not be used where there exists already /
already some form of ocular disease or where there is a strumous diathesis.

Like the cutaneous reaction of von Pirquet it is a test which is simple to apply and requires no delicate attention, but it is not in the main a reliable test. The positive results obtained in cases which are apparently non-tuberculous require investigation and decision can only be arrived at after extensive post-mortem examination. It is not a test which under its present conditions will in any way assist in the selection of the detection of early tuberculosis in the child of school age. At the most a positive result should encourage the clinician to examine the suspected case more closely; but that is all.

(4) The complement fixation test, as applied to tuberculosis is still in the early stages of development. Apparently it has the same disadvantages as von Pirquet's cutaneous reaction in that the large majority of adults will show some trace of infection. Dudgeon (42) and some fellow workers have described the results of their efforts in attempting to estimate the strength of the immune sera which gave positive reactions by using definite dilutions of sera and antigens. They divided into three groups the cases which reacted.

(a) In those cases undergoing treatment other than by tuberculin injections, 66 out of 102 reacted.
(b) Every case was positive where there was treatment by tuberculin.
(c) /
(c) In "arrested" cases, living ordinary lives under healthy conditions, 14 reacted out of 18.

They conclude their remarks by stating - "Our" results have incited us to undertake a much more "elaborate investigation on this subject, but not" especially from the point of view of the diagnosis "of tuberculosis. We consider that much may be" learnt from a comparison of results obtained from "time to time in individual cases, and intend to" investigate the effects of treatment upon the" reaction, and especially in how far clinical" phenomena and the strength of the immune sera," "as tested by titration methods, are intimately" related."

The suggestion appears to be that the scope of this test is confined to the estimation of prognosis and the effect of treatment. At any rate at the moment it is of little use as a diagnostic aid, and of no practical value when comparatively large numbers of suspected cases of tuberculosis require to be dealt with. It requires a delicacy and a skill which the average clinician could not hope to develop without the expenditure of much time.

(5) As a diagnostic agent the estimation of the opsonic index is considered to be entirely useless and has been generally abandoned.

The physical signs of tuberculosis in early life vary in many respects. They will vary in accordance with the distribution of the lesions and the irregular course of
of the disease as it is so frequently observed in children.
It is a noteworthy fact that the signs may be very slight
even when the lungs are extensively involved. More
frequently than not the physical signs are not characteristic.
The child may appear anaemic and in bad health, mothers
often refer to this as "ailing". The facies may have a
puffy appearance; on the chest over its upper part in
front may be seen small dilated veins, whilst comment
has been made regarding the presence of a downy growth
of hair in the interscapular region. Children often
have a delicate appearance; in many cases the child is
good looking with clean cut features, good eyes, long
eyelashes. The hair may be lustreless and dry, and
the skin of the trunk dry.

A slight fever of an irregular character is
suggestive as a symptom, but it is difficult to
ascertain unless the patient can be relied upon to
take his own temperature at frequent intervals during
the day. A history of progressive ill health
accompanied by lassitude or langour and wasting is in
the majority of cases obtained and is to my mind one of
great value. Anorexia, described by the parent as
"picking at his food" is another symptom, whilst there
may be a dry troublesome "hacking" cough.

None of these signs or symptoms in itself is
characteristic of the early stages of the disease,
but taken collectively they may be considered as
extremely suggestive and prompt the observer to make
an /
an exhaustive examination.

The careful inquiry into the family history of the child is of considerable importance in tuberculosis. There is the possibility although the evidence in this respect is conflicting, that a lessened resistance to tuberculosis is inherited and that such susceptible individuals will be more likely to contract infection.

In addition it is possible often to elicit a history of illness the result of one of the infectious diseases, notably influenza, measles, whooping cough, and sometimes diphtheria, which is coincident to, or slightly precedes, the time when the child was first observed to be declining. That meningeal and glandular tuberculosis may follow exanthematous diseases is well known.

Turning now to the regional diagnosis of tuberculosis it is necessary to review the clinical methods which are in use as they are applicable to the different regions of the body of the child. It is clearly a duty to ascertain if the early stages of the disease are present as indicated by the presence of enlarged lymph glands. Diagnosis is much less difficult when the glands affected are situated in a part of the body which lends itself to palpation, such as the neck, the axillae, the groins, and to some extent the mesenteries. But where the glands are enclosed within a bony structure, such as the thorax, palpation as a clinical aid is out of the /
the question.

(1) The diagnosis of intrathoracic tuberculous adenitis.

Almost invariably the "bronchial" glands are found to be involved at postmortem examinations on tuberculous children. The intrathoracic glands can be anatomically separated into three groups, (a) the hilum group, situated at the root of each lung and following the bronchus into the pulmonary tissue, (b) the bronchial group, associated with the main bronchi, and (c) the tracheo-bronchial group, found at the bifurcation of the trachea.

Usually the glands on both sides are involved, but those on the right show the greater number of lesions.

Still's account of the physical signs is extremely valuable, and the majority of them I have relied upon in my endeavour to ascertain the presence of diseased glands and with a view to the selection of those children who, at least, show signs of suspected tuberculous disease and who in my opinion should be placed in the hands of the tuberculosis officer for out door, as opposed to institutional, treatment.

1. The cough may have a curious clanging, sometimes paroxysmal character, not unlike that of whooping cough, and an inspiratory stridor, due most likely to pressure of the glands on the trachea.

2. There may be an impairment of the percussion notes in the first and second interspaces close to the manubrium, and of one
manubrium, and of one or other or both sides of the interscapular area behind.

The impairment may be very slight and careful percussion is required. In front the sign is of more value when found on the right side, whilst behind it is usually on the right. Behind the impairment is more often definitely dull.

3. The entry of air into some part of the lung may be heard to be deficient. I have observed this sign in the chest of a child, in whom no other physical signs were discernible, and who was apparently healthy.

4. Increased resistance or pressure over the manubrium sterni has been described. The normal resilience is well marked in the earlier half of childhood, and the skilled hand, it is said, may detect a variation.

5. Enlargement of the veins on the anterior wall of the chest. It is usually most noticeable in the second space where one large vein is seen passing inwards from the region of the coracoid process to the inner end of the second space. This sign is chiefly of value when confined to one side.

6. By palpating in the hollow at the root of the neck, deeply behind the manubrium, it may be possible to distinguish the upper rounded portion of an enlarged gland.

7. Eustace Smith (43) in 1875 described a sign which has now become associated with his name. It
is a sign, however, which may be obtained in purely anaemic children. If the head of the child is fully retracted a systolic murmur may sometimes be heard over the sternum immediately below the clavicle.

8. Lastly there is d'Espine's sign. This is a whispered bronchophony found in the interscapular space. The normal change in the voice is said to occur between the seventh cervical vertebral and first dorsal vertebral spines. The sign is positive if the whisper is heard in the interscapular space below the seventh cervical spine. I have selected well nourished, and what appeared to me to be healthy children, and in several cases have been able to appreciate the whisper as low as the third dorsal vertebral spine.

Koplik (44) states that, according to some, the diagnosis of enlarged lymph glands in the mediastinum is revealed by pressure symptoms, at the root of the lung by d'Espine's sign, dullness in the interscapular space, pertussis-like an expiratory cough, and bronchophonic voice or whisper.

Pressure of glands on the bronchi would give dyspnoea or cough, on the large veins a nervous congestion and cyanosis or oedema of the lungs, on the recurrent laryngeal nerves asthma or laryngo-spasm, and on the oesophagus, dysphagia.

In regard to the physical signs which suggest the spread of the disease from its primary localisation in the bronchial /
bronchial glands to the chest we are again in a difficulty in our efforts to recognise this at its commencement. Percussion and auscultation show less than the full extent of the involvement. The very slight differences are of most value and should be looked for. Thus the mere suggestion of flattening above the clavicle, and the slight limitation of movement are important points in inspection. In the child palpation is not of great value and an estimation by vocal fremitus does not help, unless at the bases of the lung in front or behind when it may be useful in calling attention to the presence of small areas of consolidation.

Differences in the percussion note are of great value, and here actual dullness is not considered so much as the short highly pitched note. Light percussion is essential and the percussion of the clavicle should not be neglected.

Auscultation is recognised as a delicate, if not accurate, method of diagnosis. Slight alterations of the respiratory murmur must be listened for. Bronchial breathing is not an early sign. Early alterations may be found in a roughening of the inspiratory phase, a feeble form of breathing, an interrupted inspiratory phase, the "cogwheel" type of breathing, or a harsh inspiratory phase with prolonged expiration. Unless the breath sounds of the healthy child have been appreciated and retained these slight variations which suggest disease will pass unheard. It is here then that the school medical /
medical officer's training is of infinite value, and given the opportunity for assisting the tuberculosis officer, his opinion should be allowed considerable weight. Vocal resonance is also a very useful aid for it will produce evidence of commencing consolidation sooner than will percussion.

Râles should invariably be searched for, and particular note should be made in regard to whether they are persistent or not. Their persistence is of high significance. When they first appear they are usually dry crackles and are scanty and isolated.

In regard to radioscopy and radiography, Turban (45) expresses the opinion that "the scanty" "and uncertain signs of tuberculosis of the" "bronchial glands obtained by percussion and" "auscultation, supplemented by the X-ray appearances" "may render diagnosis possible - at any rate in children" "and in cases where the enlargement extends in some" "degree to the right of the spine." There is little doubt that the use of the Roentgen rays is of great assistance in the diagnosis of enlarged thoracic glands and pulmonary tuberculosis, but two things are essential, a good apparatus, and a radiographer who is not only skilled but experienced.

Holden (46) says that X-rays are deceptive as a basis for early diagnosis, and they must always be used in conjunction with physical signs. If this is true it is /
is disappointing, since enlargement of the intrathoracic glands may be very marked and need not on that account be responsible for the production of physical signs.

The school medical officer or the tuberculous officer cannot be expected, in addition to their main duties, to become expert in this specialised work, and until a skilled radiologist, with particular experience in intrathoracic radioscopy, is readily available for consultation, much practical assistance from this method of diagnosis cannot be looked for.

The diagnosis of surgical tuberculosis, and by that is meant tuberculosis of bones, joints, glands and skin, is generally an easy matter. In this, as in other forms of the disease, successful treatment depends almost entirely on early recognition of the presence of the disease.

The invasion of the bone tissue by the tubercule bacilli is a slow process. Constitutional symptoms are usually absent. Gradual swelling without the accompaniment of pain or the usual signs of inflammation is the outstanding diagnostic feature. The early symptoms and signs are notoriously slight and are for this reason apt to be overlooked. It is a matter of great importance in diagnosis to remember the pathological fact that the cancellous tissue is by far more prone to be the seat of the disease than the compact tissue.

There seems to be no characteristic early symptoms or /
or signs of the invasion of joints by tuberculosis. There may be in the first instance simply a slight impairment of movement or a slight swelling. Probably pain due to involvement of the periosteum or the more sensitive joint structures is the first complaint made by the patient. Yet such pain may be but slight and considered to be simply "growing" pain, or a manifestation of rheumatism. Constitutional symptoms in the main are absent. The clinician must be alive to these possibilities and where there is, as in bone affections, the least doubt, resort must be made to other diagnostic agencies, X-ray, inoculation tests, von Erquet's cuti-reaction, etc., or the search for other foci.

Tuberculous adenitis develops slowly and painlessly unless a mixed infection is present. The general health may not be much affected if the disease is not well marked. It may be taken as a wise maxim that chronic glandular enlargement, in the absence of any other obvious cause, should be strongly suspected as tuberculous in origin.

In the neck the glands most frequently affected are those in the submaxillary region and those lying along the jugular veins. In the abdomen, wherever nodules are felt, faecal masses, of course, being excluded, the diagnosis of tuberculosis may with confidence be made.

These forms of glandular tuberculosis are found comparatively /
comparatively frequently in the course of routine medical inspection of schools, and I make an invariable practice of examining with great care the abdomen of a child who exhibits those signs of failing health which have already been enumerated.

Tuberculosis of the skin is not a frequent manifestation of the disease among children of school age. Authorities quote Lupus as being the most common form of tuberculosis of the skin. One case only has come before me in the course of my work, in which the thigh was extensively affected.

Of miliary tuberculosis there are four distinct clinical types: general miliary tuberculosis, acute tuberculous pneumonia, tuberculous broncho-pneumonia and what is called tuberculous fever.

These are conditions which are rarely met with by the school medical officer. They are essentially acute conditions for the treatment of which the services of a medical practitioner are called upon. However it is important to remember that miliary tuberculosis may be mistaken for typhoid fever, but a careful record of the temperature will be of assistance as well as the fact that in miliary tuberculosis, where the lungs are affected, there will be a predominance of pulmonary symptoms.

There is little in the first week to assist in distinguishing /
distinguishing between acute tuberculous pneumonia and the pneumonia due to the pneumococcus. The finding of the causative organism in the sputum or in the faeces is in the majority of cases the only certain method of diagnosis.

Hyslop Thomson (47) considers that tuberculous bronchopneumonia is a more frequent occurrence in children than is generally supposed. The tuberculous nature of the disease should always be suspected if the course of the disease is unduly prolonged.

The condition of acute tuberculous fever is obtained where the signs of localised infection are marked by the intensity of the systemic intoxication. Tubercle bacilli are invariably present in the sputum and diagnosis can in this way be made.
The Prevention of Tuberculosis

in Children of School Age

Section III

Prophylaxis
To no disease can the hackneyed saying "Prevention is better than Cure" be applied with more appropriateness and truth than to tuberculosis. The prevention of tuberculosis is an enormous problem and one which demands the fullest attention and activity of the state. The discovery by Koch in 1882 of the causative organism eventually indicated the nature of attack which was necessary to combat the progress of the disease, and civilised communities to a greater or less extent have accordingly organised themselves to fight and conquer tuberculosis.

It has been considered desirable here to review briefly the anti-tuberculosis campaign as it is conducted by different civilised communities and to discuss the measures which have been evolved for the prevention of the disease in children, more particularly those of school age.

The anti-tuberculosis movement in Switzerland is in the main almost entirely conducted through the efforts of voluntary bodies. The State assists but little, except in the discreet provision of grants-in-aid. There is, however, a central body on commission which co-ordinates the work of the associations in the different areas.

Tuberculosis dispensaries have been established in the larger towns. There are Sanatoria to accommodate those
those suffering from different forms of the disease, as well as hospitals or institutions which are devoted to the care of delicate children. Delicate children, for example, those who are rickety or scrofulous, are sent to different establishments at the seaside. Sick and feeble children of poor circumstances are provided with annual holidays at various homes and institutions in the mountains. The majority of the larger towns have been provided with baby clinics, crèches, and milk depôts.

In Denmark the State takes a very active part in the campaign. There are many hospitals for tuberculous subjects in all stages and forms of the disease, and hospitals for the delicate, scrofulous individuals - including children, and institutions for delicate children at the seaside. Provided the conditions of the State are fulfilled in regard to the conduct of these hospitals or institutions, the State undertakes to grant substantial financial assistance. One very important sociological fact is worthy of notice in regard to the campaign in Denmark. Many of the hospitals, in addition to grants-in-aid, are supported by Friendly Societies, and it is the right of a patient to have his treatment in the sanatorium paid for, and his family supported, without the loss of citizenship.

Assistance is also given by the State to tuberculosis dispensaries and other associations which assist patients in their homes. Grants are also /
also available to assist in the eradication of the disease from cattle.

In Sweden the campaign against tuberculosis is of comparatively recent origin. The State figures apparently but little, and the work is carried out for the most part by the Municipal authorities and voluntary associations. It is interesting to note that efforts of a very practical nature have been made to prevent the infection of healthy children by their infected parents, by congregating the families in large buildings under the supervision of doctors and nurses. The children are not permitted to associate with their parents at night. Children of consumptive parents are removed in many cases from their homes to other surroundings. Suitable homes are found for boarding out such healthy children. There are tuberculosis dispensaries in the larger towns and elementary school children are examined with a view to the discovery of tuberculous infection. Efforts are made to prevent tuberculous milk from reaching children, and special farms have been established for the purpose of supplying non-infected milk.

In most of the towns of large size milk depôts have been established, and in some of these provision is made for nursing mothers and babies. A vigorous campaign for education is also being carried out by means of lectures, school instruction, and the distribution /
distribution of literature. As in other communities there are hospitals, but few provide for children, who in the vast majority of cases, require to be nursed at home. Surgical tuberculosis is treated in ordinary hospitals. Recently, however, seaside sanatoria and holiday colonies have been erected and established.

In Norway the province of the medical officer of health is recognised, and the compulsory notification of certain forms of the disease is required by the state. There are sanatoria and nursing homes, whilst special accommodation has been arranged for in connection with general hospitals in the larger towns. Seaside sanatoria exist for the reception of scrofulous but not tuberculous children. In one the children receive instruction in ordinary school subjects.

The German government has been active in sanctioning the establishment of anti-tuberculosis dispensaries, which are also "bureaux" of information. All immediate contacts of the infected person are examined for early signs of the disease, so that treatment, if necessary, may commence at once. The sick and their relatives are instructed in regard to prevention, and the proper care of children. The patients are dealt with in hospitals, sanatoria or similar institutions. The actual establishment of these "bureaux" was generally carried out by the municipal authorities.

The State, too, has combined with voluntary associations and local authorities with a view to providing /
providing mothers with instruction in regard to baby nourishment.

Curable cases are sent to sanatoria; advanced cases are dealt with in asylums, hospitals, or homes for invalids. There are marine stations, seaside hospitals, and holiday centres for children.

Tuberculosis is notifiable compulsorily in Germany, but there is no power to remove the patient to an appropriate institution, whilst in most of the states the disease was only notifiable at death the result of a pulmonary or a laryngeal affection. School medical inspection is in being and the existence of separate classes and schools for delicate children is recorded.

The State in France is apparently inert as a force in the anti-tuberculosis campaign. There is no system of compulsory notification. Private enterprise is entirely at the back of the campaign. There are crèches and milk dépôts. An "Oeuvre de Preservation de l'Enfance contre la Tuberculose" which owes its origin to Professor Grancher, arranges for the disposition in the country districts of children having infected parents. Branches of the League carry out its work in many of the large towns. School colonies also exist in the hills and at the seaside for the accommodation and building up of poorly nourished children. Woodland sanatoria have been established for the cure of tuberculous children, and marine sanatoria afford accommodation.
accommodation for both the delicate and the tuberculous child. Propaganda is also used, for example, literature, popular lectures, and the instruction of children in the laws of health. Medical inspection at schools is also carried out.

As a community New York City, U.S.A., is extremely far advanced in its anti-tuberculosis methods. The State as represented by the Board of Health is a virile force, autocratic where necessary, but always willing to co-operate to the full with voluntary agencies, which are undertaking their work satisfactorily. Compulsory notification of the disease has long been in force, and compulsory removal to, and retention in, hospitals of cases which are a danger to the public health are carried out by the Board of Health.

The milk supply is supervised and pasteurisation is carried out on the large scale. School children are medically inspected. Tuberculosis dispensaries have been established each of them providing for specified areas. A central bureau co-ordinates the work of the district dispensaries, and all admissions to, and discharges from, hospitals pass through it.

There is a good supply of hospitals, and separate institutions exist for the segregation of cases of advanced pulmonary tuberculosis. There are sanatoria for hopeful cases; a hospital for incipient tuberculosis, and what are called children's "preventoriums" in which /
which children with no definite or open lesions from tuberculous families are cared for.

Open air schools are in vogue for tuberculous children, for those who are poorly nourished, and for crippled children. There are special sea-side institutions for children suffering from surgical tuberculosis, and a State hospital for crippled children. Voluntary associations assist needy tuberculous families in obtaining the necessities of life. Premises vacated by the decease or removal of cases of pulmonary tuberculosis are disinfected and where necessary renovated. Lastly a wide educational campaign is conducted in connection with many of the voluntary associations.

As in other countries, so also in Britain, the campaign against tuberculosis was initiated as a result of charitable and voluntary effort. But within comparatively recent years the State has become conscious of its responsibilities and has introduced itself as a guiding and co-ordinating influence. It has provided for England and Wales Public Health (Tuberculosis) Regulations, 1908 and 1913, and Public Health (Tuberculosis in Hospitals) Regulations 1911; for Scotland, a Public Health Act, 1897, and a Public Health Amendment Act, 1907, and Local Government Board Circulars, 1906 and 1908; for Ireland a Tuberculosis Prevention Act, 1906. The National
National Insurance Act of 1911 provides means for expert diagnosis of Tuberculosis by establishing dispensaries and tuberculosis officers, and assists in the provision of treatment either at sanatoria, for which grants-in-aid are available, or at home - the "domiciliary" treatment. The Milk and Dairies (Consolidation) Act, 1915, and "The Tuberculosis Order of 1913 are extremely important and far reaching measures in the prevention of the spread of the disease through the medium of milk.

In general the scheme for anti-tuberculosis work is almost perfect in its comprehension. The health of the child is cared for during its intra-uterine life by encouraging expectant mothers to present themselves before skilled obstetricians at ante-natal clinics. The mother may receive attention at maternity hospitals or hostels in regard to parturition, whilst by means of maternity and infant welfare centres the mother receives advice and assistance in the nursing, rearing, and feeding of her child, by specially equipped doctors and nurses, and her home circumstances are improved, if necessary, through the agency of valuable voluntary organisations. Children, until they reach school age, and if the parents so desire, may come under the influence of these centres. Creches are available in which mothers, whose circumstances require that they must earn a living, may leave their children to be tended and cared for during the working hours.
Nursery schools have been established, in which children, varying in age from three years to five or even six, may be placed, particularly those whose home conditions are unsatisfactory and whose health is suffering in consequence.

When the child reaches the age of five or six years it comes automatically into the province of the local education authority, which provides hygienic schools, medical inspection, medical treatment, open air schools and classes, special schools for physically defective children, organised physical training, and in necessitous cases milk and even meals. The education authority also arranges schools for mothers, and for the teaching of mother craft, nursery schools, and day nurseries. The treatment of dental disease is carried out. Provision is made for school journeys, holiday schools and camps, and various combined remedial and educational institutions.

The Education Act of 1918 extends the medical services as employed in regard to elementary school children, to those of older years attending secondary schools, continuation classes or other similar institutions, and at the same time amends the Employment of Children Act, 1903, whereby the employment of children under twelve years of age is prohibited, and of children over that age considerably restricted and modified.

Whilst all these provisions above enumerated have not been framed with a view directly to prevent tuberculosis, there is no doubt they play a very definite /
definite part in the campaign.

In addition to the efforts which are made to improve the conditions of child life there are other wider measures. During at least the last five and twenty years sanitary authorities have advanced rapidly in their endeavours to secure improvement of sanitary and hygienic conditions, by more industrious inspection of unhealthy areas, and the enforcement of the requirements of the Housing Acts and other reformatory measures.

Efforts are also made by means of lectures, exhibitions, and travelling caravans, to increase the knowledge of the people in regard to tuberculosis, and in general to raise their standard of education.

Notification of all forms of tuberculosis was enforced only so recently as 1911, and isolation of advanced open cases of the disease is arranged for, but compulsory removal has not yet been insisted upon. Sanatoria were recognised as being the chief factors in the cure of the condition, and opportunities for this expensive form of treatment were extended to the masses by the National Insurance Act, of 1911. In close association with the Sanatoria are the industrial colonies where tuberculous patients discharged with the disease arrested from Sanatoria may be educated in forms of livelihood which necessitate out door occupations. Lastly and most important of all preventive organizations is the anti-tuberculous dispensary.
dispensary. The product of Edinburgh, the result of the ingenuity and insistence of its originator, Sir R. W. Philip, it is the centre round which all anti-tuberculosis movement revolves, and its principles have been adopted by every civilised community in which anti-tuberculosis warfare exists. That then is a brief survey of the many forces that are in operation in this country for the purpose of quelling and mastering the disease. The Ministry of Health Act of 1919 is now in operation and will co-ordinate in time the activities of the many different organisations at work.

My purpose, however, is to concentrate attention on prophylaxis in so far as it concerns children of school age. There are but two sources of infection, that of human origin, and that which is associated with cattle. The ideal preventive measures would be, although they seem at the moment impracticable, in the former case, following the analogy of leprosy, the rigid and absolute segregation and isolation of all tuberculous individuals, and in the latter case the destruction of all infected cattle. The one, however, interferes with the liberty of the subject, a British birthright, and the other would entail the expenditure of an enormous amount of money in compensation.

Less effective but more practical measures must therefore be adopted and these may for the sake of /
of convenience be considered as falling under four distinct headings -

(1) the steps which are taken to eliminate unhealthy environmental conditions,

(2) the methods adopted to fortify the child and increase his resisting powers,

(3) measures for the reduction and prevention of infection, and

(4) the adoption of the most effective forms of treatment for children suffering from the disease.

In some cases certain detailed measures may be classed under more than one of the above headings.

It is not possible here to consider minutely the questions of water supply, sewerage, sewage disposal, filth removal, cleaning, paving, and the drying of the ground on which houses are built; nor those relating to house accommodation, and allied conditions, namely, increase of light, and air, increase of breathing space, diminution of overcrowding, removal of house dampness, white washing of interiors, closet accommodation, etc. These have the almost daily attention of the medical officer of health and his sanitary inspectors, and although progress is slow it is none the less definite and affects directly the prevention of tuberculosis amongst children by presenting to them an improved and better sanitary environment.

So also any reforms which tend directly to improve the conditions of adult life will, though indirectly /
indirectly, have a beneficial effect upon the children. And in this respect may be mentioned the work which is done by voluntary bodies in their efforts to better the people socially by the diffusion of a knowledge of health and instruction and assistance in its practical application. Then there is factory and workshop legislation whereby the conditions of industrial workers are improved, and the provision in congested communities of large open air spaces.

In all localities where the campaign against tuberculosis has any pretensions of being organised there are three officials whose activities are directed against the ravages of this disease,—the medical officer of health, the school medical officer and the tuberculosis officer.

Officer of Health

The Medical, by virtue of his office receives notification of known cases occurring in his district. This knowledge permits him to arrange for the proper isolation of the case at home or, in default of that, its removal to an isolation hospital. Unfortunately amongst the poorer classes effective isolation at home is not possible and accommodation at infectious diseases hospitals far from adequate to meet the demands of open and advanced cases of the disease. In too many instances a source of infection is not dealt with and is permitted to exist. Until accommodation for isolation is fully available and until compulsory removal is insisted upon very /
very little active preventive work can be undertaken. Notification, however, serves another purpose and from the point of view of children an extremely important one, for it permits the discovery of contacts of the disease. On receipt of a notification the Medical Officer of Health informs the Tuberculosis Officer, in the first place; and also arranges for the infected house to be visited by a sanitary inspector or a health visitor. Amongst other things it is the duty of either of those officials to note particularly the names of all persons, other than the patient, living in the house. This information is then available for the tuberculosis officer, who should immediately take steps to examine the contacts, and particularly the child contacts. The school medical officer should also receive this information so that he can arrange to have such children placed under observation and presented to the teachers concerned as being children suitable for special care and observation in school.

The discovery of "contacts" then is a most essential factor in the prevention of tuberculosis, and it is incumbent upon the medical practitioner, the school medical officer, and the tuberculosis officer to take especial care in the examination of all contacts, not least those of school age and under.

Where, for any reason, a case of infective tuberculosis is not removed from his home, and particularly where the home conditions are such as to /
to preclude efficient isolation, it should be possible to remove children directly associated with the case to some institution until such time as infection in the home no longer exists. This is a matter which should receive the urgent consideration of local governing authorities.

Notification to be effective must be prompt. In tuberculosis more than in any other infectious disease there is frequently delayed notification. This may be due to neglect on the part of the parent to consult the doctor, or to difficulty on the part of the doctor in making up his mind in regard to the condition of his patient, and preferring to await the presence of tubercle bacilli in the discharges. The former case can only be met by education of the public with reference to the disease, The latter condition should be easy of remedy. The medical man should be acquainted with the signs and symptoms which are suggestive of tuberculous infection. The assistance of the tuberculosis officer is always available; whilst notification can at all times be provisional.

There is another point arising out of the notification of tuberculosis which presents considerable administrative difficulty, namely disinfection. Disinfection under ordinary circumstances takes place immediately a case has died, or has been removed from the occupied house, or has ceased to be infectious. In tuberculosis the periods in any of these cases may be
be protracted and the question of disinfection may, consequently, be forgotten. Systematic "following up" by the tuberculosis nurses would obviate this difficulty. Again, and under similar circumstances, the patient may change his address. It is essential that the local authority should be aware of any change, since the vacated premises must be disinfected and the new address known. Such a possibility suggests the necessity on the part of the local authority of keeping in constant touch, either by means of sanitary inspectors, health visitors, or tuberculosis nurses, with all infective domiciliary cases.

The state must be considered as having failed in its duty so long as it continues to permit the possibility of children becoming infected in massive doses by being in contact with "open" human cases, for prevention can only be adequately obtained either by the removal of the infecting agent from the vicinity of the children, or, on the other hand, by the removal to a place of safety of the children from the infecting agent.

Legislation framed with a view to the prevention of tuberculosis caused by the bovine type of the bacillus gives local authorities great assistance in their efforts to eradicate the disease. The most recent measures are embodied in "The Milk and Dairies (Consolidation) Act, 1915", and "The Tuberculosis Order of
of 1913'. Under this Act the sale of milk from tuberculous cows is prohibited. It permits of steps being taken to discover the source of origin of tuberculous milk and the medical officer for a county or county borough has power to stop the supply of milk from a dairy if he considers the consumption of such milk is causing, or is likely to cause, tuberculosis. The Order allows of action being taken in regard to cattle, for the purpose of more accurate diagnosis of the disease in cattle by the employment of a veterinary surgeon, the application of the tuberculin test, and the examination of discharges. Further the local authority may, if satisfied that the disease is present in an animal, make arrangements for slaughter and subsequent compensation. The time, therefore, should not be now far distant when it would be reasonable to expect local authorities to appoint full time veterinary officers, so that the authorities might be provided with independent opinion. This officer would require to be skilled in the early diagnosis of tuberculosis in cattle, and it does not seem impractical to suggest in this connection the establishment of a hospital farm in which diseased animals could be segregated and where veterinary surgeons could receive training in the early diagnosis of the disease.

There is another important matter which may easily become overlooked and that is the fate of milk which has been condemned as being unfit for human consumption/
consumption on account of its being infected with tuberculosis of the bovine tuni. Frequently it will be found that such milk is fed to calves and pigs, thus causing infection in these animals. It is of the utmost importance to make certain that such milk is destroyed or, at least, sterilized or pasteurised before being given to such susceptible animals.

The child having attained the age of five or six years now leaves the particular sphere of influence of the Medical Officer of Health. It has for the most part been cared for through the activities of the infant welfare statutory committee of the local authority and has been assisted in a variety of ways to avoid or resist tuberculous infection. The child then enters the sphere of the local education authority. Here it is that a vast amount of efficient preventive work can be undertaken.

It may be truly asserted that children of school age, that is between the ages of five or six years and fourteen to sixteen years, are for the most part under direct medical supervision in an efficiently controlled local authority or education authority. In the first place, during their ten years of school life children are subjected to at least three searching medical examinations, when they enter school, when they reach the age of eight or nine years, and when they become due to leave school at the conclusion of their elementary education.
education.

In the County Borough of Croydon no fewer than 300 children are so examined each week, and I make it a definite duty to select at these examinations all children whom in the slightest degree I suspect to be suffering from early tuberculosis. Any child who exhibits anaemia and is stated by its parents to show signs of anorexia is subjected to further more careful examination. Nearly all the children whose cases are referred to in the appendix were selected in the first instance on account of these two symptoms.

These medical examinations constitute one means of discovery of the early tuberculous case. But in addition teachers in the schools are requested to bring to the notice of the school medical officer any child who appears anaemic and ill-nourished. Health visitors or school nurses are similarly instructed in regard to any such child whom they discover in the course of their district work, whilst school attendance officers render extremely valuable assistance in a similar manner. Social welfare committees whose areas of activity extend round different schools are also instrumental in bringing such children to the notice of the school medical officer.

However the case may be discovered it is invariably examined thoroughly for the presence of the disease. It is clear, therefore, that a school medical officer ought to be skilled in the early diagnosis of tuberculosis.
culosis in children. It is impossible to refer all suspected cases to the tuberculosis officer, whose hands are already over full with adults. In this connection, however, there appears to be a distinct administrative advantage in the existence of the closest "liaison" between the school medical officer and the tuberculosis officer. The school medical staff of a county borough could examine all suspected cases at the tuberculosis dispensary, and be able thereby to have at the same time on the spot the opinion of the tuberculosis officer, and thus save delay and waste of valuable time both in respect of the patient and the doctor.

All suspected cases considered to be tuberculous after a thorough examination are accepted by the tuberculosis officer for treatment or disposal; and all suspected cases which are not thought to be suffering from early tuberculous disease are kept under observation by the school medical officers.

This latter class is dealt with in the following ways. The child may be given milk in school. The milk is supplied daily by the dairyman to the school and the child receives a pint on two occasions each day. There is no doubt that this measure is fully justified. After two or three months' supply of this food, marked improvement in the child's condition is noticeable, - an increase in weight, less anorexia, and a decrease in pallor. In Croydon the supply of milk in school to children is recognised as a definite prophylactic measure.
measure.

In addition to the supply of milk, there ought to be the provision at least of open air classes. Croydon, like many other authorities, have not yet appreciated their value and necessity. Yet it has been possible unofficially with the assistance of a far-seeing head-teacher to establish such a class and the results so far have been admirable. There are no great difficulties in the formation of open air classes. Covered areas exist in nearly all playgrounds whilst canvas wind-screens can easily be attached without much expenditure of public money.

But the needs of the ailing child alone in this respect should not only be considered, and it should be the duty of every education authority, when the erection of new public elementary schools are contemplated, to make certain that the plans provide for open air classes for all the pupils.

Malnutrition and tuberculosis in children are closely associated whichever be the cause, or whichever the effect. The Education (Provision of Meals) Act 1906 allows local education authorities to assist in improving the bodily condition of necessitous children. The meals are served in school to selected children, usually those brought forward by the school teachers. Yet this Act is a most valuable asset not only to the School Medical Officer but also the tuberculosis officer in their efforts to war.
war against the disease, and these officials ought undoubtedly to make every use of its provisions.

These then are the measures best suited to deal with the potential case and prevent the development in the child of tuberculosis, - medical supervision at school, provision of milk at school, the provision of meals at school, and the provision of open air, or playground classes. Drugs are unnecessary when these means are, as they should be, available.

When considering the disposal of those children in whom tuberculosis is considered to be present the question of exclusion from attendance at school at once arises. Early tuberculosis in children, even early pulmonary tuberculosis, is seldom a source of danger to other individuals. A good practical rule is to exclude the child from school only if the home conditions are better than those which exist at school. Children so excluded will lose at once the benefits of free or cheap meals and of the provision of milk.

The early case of tuberculosis, glandular or even pulmonary, may attend school and should of course have similar benefits to those received by the potential case. But medical supervision must necessarily be more exacting. Medical examination must be more frequent and records of progress must be carefully and systematically kept. All cases showing no improvement, or but slight improvement, should again be /
be submitted to the tuberculosis officer for his advice.

Some local authorities have arranged for day open air schools for the purpose of accommodating early, incipient, and doubtful cases. It would be wiser, perhaps, to fill such institutions with the purely phthisical children, so that those who at any time might become infectious, might be segregated for a portion of each day. To keep the child under the best conditions, the school day should be a long one. Good medical supervision is essential, and medical examinations frequent. A trained nurse would require to visit daily to take temperatures, estimate haemoglobin content, and to weigh the children. Records would be necessary. Night sleeping accommodation could be arranged for those whose homes are bad, and the children could be permitted to return home daily for a few hours. School work would be modified in accordance with the physical condition. There are a few such day open air schools in England, but none as yet have been established in the County Borough of Croydon.

The next step in the disposal of tuberculous children is to find residential accommodation. Cases for such institutions are carefully selected by the tuberculosis officer, for this selection is essentially his duty. There are two distinct types of residential sanatoria, one accepting usually incipient cases of pulmonary tuberculosis, the other dealing entirely with the surgical form of the disease. Only those children who /
who are likely to benefit permanently, and who would probably fail to improve by non-institutional treatment on account of home conditions, should be selected for institutional treatment. Protracted residence is necessary and for that reason, if for no other, education should be continued at the sanatoria. Education also seems to have a definite therapeutic value, in that it brightens the monotony of the children's daily existence and provides something to which they look forward with genuine pleasure.

Special residential sanatoria for surgical tuberculosis are required, since this form of the disease needs for its treatment the presence of a skilled surgeon, and extensive and elaborate equipment and appliances. If the best results are to be obtained, and these to a great extent are measured by the amount of consequent crippling, cases of surgical tuberculosis must in the first place be diagnosed early and in the second be subjected to a thorough treatment continued until arrest of the disease is definitely effected.

The accommodation available for tuberculous children is deplorably inadequate. There is rarely any difficulty in selecting cases for open air schools, play-ground classes, schools for physically defective children, or residential sanatoria, but there is infinite difficulty in finding institutions immediately to admit the cases. Thus the vast majority of
of the children are either on waiting lists or are relegated to sanatoria for adults, infirmaries, or general hospitals, or more frequently have to remain at home, where conditions are unsatisfactory and treatment intermittent and almost useless.

The local school medical service loses direct supervision of a child transferred to a residential institution, but it has a very important function to perform immediately a child is discharged and returns to its home to resume its regular school life. And this is what is termed "after care". It should be considered an essential part of the preventive measures, that a child so discharged from a sanatorium should be assisted step by step to meet the sterner conditions of life at home. So from a sanatorium a child should always next be placed in a day open air school (night residential) for a period, then to a carefully conducted open air school or class, and finally be permitted to sit alongside his healthy fellows in the ordinary classes of the elementary schools. Even then the child should be under observation by being medically examined at least four times each year and by being "followed up" at home by the school nurse to ensure that his parents are providing him with the best hygienic conditions that it is possible for the home to supply.

"Tuberculosis must be sought for in the household and in the community", (48). This the County Borough of Groydon attempts to do to the utmost and with /
with marked success, but it is not encouraging to realise that from the lack of suitable accommodation the best that can be done for the discovered potential or actual cases is but little more than domiciliary treatment and the help which an active but overworked dispensary can render.

Enough has now been written to indicate how vital it is to have perfect co-ordination of, and co-operation in, the work of the medical officer of health, the school medical officer, and the tuberculosis officer respectively. Strictly the Medical Officer of Health is the co-ordinating influence. The School Medical Officer and the Tuberculosis Officer are essentially clinicians. Through the activities of all three, and in addition, of course, the medical practitioners, efforts are made to find all cases, early and late, of tuberculosis, and to discover and deal with 'nests' of the disease.

The Medical Officer of Health receives information by notification from medical practitioners, general hospitals, infirmaries and poor-law institutions, and should in turn inform the Tuberculosis Officer and the School Medical Officer so that contacts can be controlled and examined, and child "contacts" kept under observation during their school years.

The Tuberculosis Officer collects information in regard to all cases of the disease, or suspected cases of the disease, from the Medical Officer of Health.
Health and the School Medical Officer and other sources. His is the department through which all such cases ought to pass; it is first the sorting office and then the disposal centre.

The School Medical Officer is the greatest searcher of all. It is he who will discover the greatest number of early or potential cases and it is through him that the greatest amount of preventive work can be done.

The Medical Officer of Health by virtue of his position must direct the campaign against tuberculosis. The School Medical Officer and the Tuberculosis Officer should be, therefore, subordinate to him, but only in the administrative sense. Clinically these two officers are independent and to carry out their duties efficiently should be untrammeled by administrative routine.

In Croydon there are the three in one. The Medical Officer of Health is also the School Medical Officer and the Tuberculosis Officer. But the work is de-centralised, and except for questions of policy and administration the two latter officers are separate entities.

Indirectly the School Medical Service undertakes much valuable preventive work. At the medical inspections children who are underclad, or who are deficient of proper footgear, are noted and efforts are made either to force the parents concerned to remedy such defects, or to provide assistance in these respects through "care committees" and voluntary organisations. Malnutrition is /
is noted and steps taken to improve by milk and free meals the bodily condition of ill-nourished or under-weighted children. Tonsils, which are enlarged, have been shown by some workers to be infected by tubercle bacilli, and so to be the cause of secondary infection of the glands of the neck. An enormous amount of work is done each year in enucleating enlarged tonsils. So also with adenoids, whose presence in the course of time markedly impairs the vitality of children so affected; these are removed in large numbers. Cases of bronchitis, however slight, are excluded from school, since it is believed that bronchitis in children is an infectious condition, and one which prepares the soil for the better activities of the tubercle bacillus.

All these are measures of no mean importance in the prevention of tuberculosis amongst children of school age.

We are a long way still from the time when we can hope to prevent the entrance of the tubercle bacillus to the human body, but in the school medical service, we have a most powerful means, if properly and intelligently used, in preventing the results of infection and in searching for and curing the early cases of the disease.
The Prevention of Tuberculosis in Children of School Age

Section IV

Treatment
The nature of the treatment of tuberculosis is easily defined. It is at once the method adopted to increase the resistance of the child. This resistance can be attained by attending to the general hygiene, by administering drugs, and if approved by the administration of tuberculin.

Every effort is made to improve the environment of the tuberculous child. And on this ground the Medical Officer of Health, the School Medical Officer, and the Tuberculosis Officer in common meet, the one with his sanitary inspectors and disinfecting organisation, etc., the other with the school nurses and care committees attending to the clothing, and feeding of the child and as far as possible the education of the parents, and the last by the tuberculosis nurses who visit frequently and provide professional help whenever necessary. There is no need to dilate on the necessity for fresh air, proper food in the form of a highly nitrogenous diet, and suitable clothing, for directions for the care of tuberculous children can be found in all modern textbooks on medicine.

It is a difficult matter to exhort parents to give their children at least a tepid sponge over the body every morning. Yet it is a practice which is invaluable.
invaluable in assisting the child to resist the vagaries of our climate. The application of the tepid sponge, and the subsequent brisk rub with a towel should be an essential part of the treatment of early tuberculosis in the child.

All defects from which the child is suffering and which can be remedied, should be given medical or surgical attention, as the case may be, without delay. In this respect the repair of dental caries is an important matter. The child should be given a clean mouth, and sound teeth with which properly to masticate his food. Here the School Dental Officer steps in and accomplishes much valuable work. It is a regrettable fact, however, that the average lower class parent does not yet realise the necessity for dental repair and considers it useless when applied to the decayed teeth of the first dentition. I am definitely of the opinion that all tuberculous children, and even those suspected cases should be given the opportunity whenever necessary of having dental treatment at the hands of the School Dental Officer.

Enlarged tonsils and adenoids should be removed by surgeons skilled in this operation. I have had to make this qualification for recently I have digitally examined the throats of children who have but a few weeks previously undergone operation for removal of adenoid growth, and I have found in several cases considerable growth still existent. Not only as an essential /
essential part of the after treatment of this condition, but in order to improve poorly or malformed chests and to oxygenate the anaemic child, breathing exercises carefully carried out both at school and at home are very necessary adjuncts in the treatment of the early tuberculous child.

Drug treatment includes the treatment of special conditions, such, for example, as bronchitis, anaemia, and anorexia; as well as that employed to improve the general body condition. The anaemia will lessen proportionately as the health improves, but the Syrupus Ferri Phosphatis Compositus is agreeable to the child's palate and is readily accepted and has no doubt a therapeutic value in this condition.

It is well to recollect that the best stimulant for a jaded appetite in a young person is a life in the open air. The health visitor should make it always a special duty during her domiciliary visits to encourage without remission the parents to arrange that the child has every opportunity of fresh air both at night when asleep and through the day. In addition a simple mixture of sodium bicarbonate, tincture of rhubarb, and infusion of gentian is of value, whilst nux vomica can be given with advantage if the tongue is furred.

Recent work by the Medical Research Committee (49) has shown the necessity of providing infants and young children with food containing the "fat soluble growth factor" which is contained in certain fats. If this is /
is true for the prevention of wasting diseases, it must equally be true for the treatment of a disease in which wasting is not an uncommon symptom.

Milk and butter contain this special food factor and are its best sources. Margarines made from animal fats are valuable, but those made from vegetable oils are not apparently satisfactory and should not be used. The motto is "butter for the children", but where the quantity is insufficient or entirely lacking, as it must necessarily be to the poorer classes, on account of the exorbitant price, cod liver oil or other fish oils and eggs make satisfactory substitutes.

Milk and cod liver oil are therefore extremely important agents not only in the prevention, but also in the treatment of tuberculosis in the young subject, and they should form a definite integral part of the treatment supplied by a tuberculosis dispensary.

Children will accept cod liver oil the better if it is combined with malt in the proportion of one part of oil and three parts of malt. The dose is one or two teaspoonfuls thrice daily. If the children are attending school the cod liver oil and malt mixture is best given during school hours. It is a matter for practical and even economical consideration since if the mixture is supplied in bulk to the children's homes, it is not by any means an uncommon experience to find the other members of the family enjoying the patient's medicine applied to bread.
bread in-lieu of margarine or butter. Care has to be taken to avoid causing gastric disturbance and where oil is not accepted by the child or only accepted at the expense of the discomfort of nausea, it should be omitted.

Along with a proper hygienic surrounding, with fresh air, sunshine, and an adequate diet containing not only nitrogenous materials but also these fats to which reference has already been made, and in addition to any drug treatment which may be called for, the other all important factor in assisting the "arrest" of the disease must never be neglected, namely rest. Rest is strictly a fundamental principle in the repair of tuberculous tissue. It is at once called for whenever pyrexia, even of small degree is present, and no tuberculous child, or a child in whom the disease is suspected, should be allowed to exercise to the extent of experiencing fatigue. The question of rest is one part of the treatment which is so difficult of control in the early, and domiciliary case. Until such time as proper residential accommodation becomes available for the early tuberculous child, this important essential in the treatment will continue to be neglected.

It seems to be admitted by those who have used tuberculin that tuberculous adenitis is one of the most suitable forms of the disease for the application of this remedy. It also seems true that in early tuberculosis the glands are the first structures which become infected/
infected, consequently tuberculin ought to have consideration as a remedy for the disease in its beginnings.

Raw (50) says "we must always expect to get" "better results in localized deposits of tubercle, such" "as glands, bones, and joints", and he is of the opinion that tuberculous peritonitis and tuberculosis of the mesentery respond very quickly to tuberculin.

Tuberculin does not appear to be, in the true sense of the word, a remedy. There is no evidence, I am aware of, to show that it kills the tubercle bacilli. But it undoubtedly produces an immunity, which may be short and fleeting, and in doing so at the same time limits the spread of, and localizes, the disease.

Every variety of tuberculin has its adherents. Sahli (51) considers that little difference exists between many of the tuberculins. T. R. and E. E. are the two forms commonly used in treatment.

The dose, and the intervals between the administration of each dose, are of importance. If the tuberculin is being administered in a tuberculosis dispensary or an out-patient department of a hospital, the method of rapidly increasing the doses, for the purpose of obtaining a reaction, is unadvisable, since the patient should be kept in bed for about twenty-four hours both preceding and following the administration. For out-patient work, then, it is better to rely on the small dose given at proper intervals. Anaphylaxis may
may develop in about ten days, whereas the immunizing effect is manifested in from two to five days, so seven days is a convenient period to allow to elapse between each injection. The initial dose should be a small one - one ten thousandth part of a milligram. Each week the dose is increased by $\frac{1}{10,000}$ m.g., continuing for 10 weeks provided no reaction has followed. In out-patients the object must be to avoid marked reaction, and subsequent dosage will depend upon the individual and his response to tuberculin, a matter requiring careful study. In addition to the reaction itself the general body condition and the weight must receive careful attention. It is considered to be a safe rule that if the weight is increasing, the injections may continue.

Tuberculin is usually administered by hypodermic injection in the upper arm, the flank, or interscapular region. Occasionally redness, tenderness, and some induration may occur. Latham has shown that, with certain precautions, tuberculin can be effectively given by the month.

The emulsion of B. E. must be used in a freshly prepared condition. Much of its potency may be lost in a fortnight and excessive and unexpected reactions may occur on proceeding to the use if a fresh preparation.

Klebs (52) says that the majority of physicians who give tuberculin hold that it should be administered, even /
even in incipient cases, over a period of at least six months. After a period of remission of three to six months a second and shorter course should be given. If given over too long a period, there is a danger of hypersusceptibility occurring. At any rate it is necessary to treat every case individually, and no rule of thumb can be dogmatically applied.

In the County Borough of Croydon tuberculin is not used at the dispensary. Out-patients receive cod liver oil and malt and frequently syrupus ferri phosphatis compositus, and other symptoms as they arise receive appropriate treatment. 1914 was the first year in which the dispensary in Croydon was in full working order, and no tuberculin was then used. During the war the work lost its necessary individuality, and this year it is returning to its normal state, when tuberculin will be given fair and considered trial. Meanwhile the results without its use have not been unsatisfactory, and if by thorough search all early cases of tuberculosis in children are discovered, it is reasonable to expect that by the development and the use of measures already to our hands for the care of such children, arrest of the disease will be more rapid and the use of tuberculin and drugs unnecessary.
The Prevention of Tuberculosis

in Children of School Age

Section V

Conclusions
Tuberculosis is an infectious disease which is readily and frequently contracted by children living in civilised communities.

So far as can be ascertained at present about one child in every two hundred is suffering from the disease.

The morbidity rate will be found to be considerably higher when our knowledge of the signs and symptoms of tuberculosis in its early stages is increased.

The death rate from tuberculosis is higher in infants than in children of older years, but the death rate in children between the ages of five and fifteen is definitely increasing.

The earliest manifestation of infection by tuberculosis in the child over one year of age is an enlargement of the lymphatic glands.

The diagnosis of occult tuberculosis, for example, the enlargement of the mediastinal glands, is of great difficulty, although a combination of certain physical signs provides strong presumptive evidence of their enlargement.

Little practical assistance in diagnosis is given by old tuberculin, von Pirquet's cuti-reaction or its modifications, or the complement fixation test, and none at all by the estimation of the opsonic index.

The application of the Roentgen rays in the hands of an expert radiographer appears to provide considerable assistance, but it is a method which must /
must be used in conjunction with physical signs.

Anaemia and anorexia are two extremely suggestive signs and symptoms of the disease in its beginnings.

It is necessary to continue to improve the social condition under which the lower and middle classes live and work so that children may be born into hygienic surroundings.

Infants as far as possible should be breast-fed and on weaning should be supplied with milk which does not contain the bacillus of tuberculosis.

Cattle should be examined by expert veterinary surgeons skilled in the early diagnosis of the disease as it is manifested in cattle. All infected cattle should be segregated or killed. No milk from infected cattle should be distributed for human consumption or fed to animals.

All human cases of tuberculosis in whose discharges the causative organism is present should be isolated. At all events no children should be permitted to come in intimate contact with such cases.

To prevent the consumption of the flesh of animals infected with tuberculosis the inspection of meat by specially skilled sanitary inspectors must be strictly maintained.

The search for the presence of tuberculous individuals in the community must be indefatigable.

So that the searching may be effective it is essential that the searchers be skilled in the early diagnosis /
diagnosis of the disease.

The medical practitioner, the tuberculosis officer, the school medical officer, and the medical officer appointed for infant welfare work are the four individuals on whom the onus of searching is placed; it is through their activities that the great number of early cases will be discovered.

Opportunity should be given to these different medical men to become experienced in the early diagnosis of tuberculosis.

The school medical service provides one of the most efficient means of assisting in the prevention of tuberculosis.

The health of the vast majority of children of school age is in the care to a large extent of the local education authority and children are thereby subjected to frequent medical examination, with the result that the beginnings of disease are early observed and remedial action promptly taken.

Fresh air is a definite factor in preventing tuberculosis and this is given as far as possible by the establishment of open air classes and schools, holiday homes for the more necessitous children, and holiday camps.

Adequate feeding is also an important preventive factor. Milk and meals in school are essential for the under weighted child, the ailing child, the child from the poverty-stricken home, the suspected tuberculous child,
child, and the child in whom the disease has commenced. Such children must at once be placed under conditions where there is a sufficiency of light, fresh air, and good food containing those fats which have the "fat soluble growth factor".

Such children must be under the constant observation of the school medical service, by the doctors and the school nurses, and must be particularly cared for by the teachers in the schools.

The discovery and subsequent examination of all "contacts" of any case of tuberculosis are of the utmost importance amongst preventive measures. Such children should be dealt with in a way similar to those who are underweighted, etc.

There must be the closest co-operation between the school medical officer and the tuberculosis officer; the school medical officer and the medical officer of health; the medical officer of health and the tuberculosis officer. The activities of all three must be co-ordinated by the medical officer of health.

As infant and child welfare work develops, the medical officer in charge of this work must have his work similarly co-ordinated.

Notification of the disease, to be of any value, must be prompt. It is generally too late to await the presence of the tubercle bacillus in the discharges. Medical practitioners and others must have more time for /
for post-graduate study in the recognition of tuberculosis in its early stages.

Early cases of tuberculosis must be given institutional treatment where the home conditions are unsatisfactory. Institutional treatment must be available for every suitable case as soon as it is diagnosed. More accommodation for early tuberculous children is urgently required.

For economic and therapeutic reasons institutional treatment should be combined with elementary education, supplied in modified curricula.

Institutional treatment must be continued until the disease is definitely arrested.

The child, discharged from such an institution, must be allowed to return to the ordinary conditions of life by gradual degrees. For this purpose residential open air schools, day open air schools, and finally open air classes are the necessary steps.

When the child has been returned to its home "after care"must be continued by constant medical supervision in the school and by frequent visitation to the home by the school nurse.

To assist the tuberculous child's return to health and to diminish the possibility of infection of other children, all defects, such as dental caries, hypertrophied tonsils, and adenoid growths, should be promptly repaired or removed. The school medical service performs valuable work in this respect.

Drug /
Drug treatment is not essential in the cure of the disease.

Cod liver oil forms a valuable substitute for butter, and supplies the necessary fat in which the diet received by the child in its home is so frequently deficient.

The administration of tuberculin is of great assistance in early cases of the disease, but it is impracticable and probably unsatisfactory under domiciliary conditions. Tuberculin is of the greatest value when the child is under institutional care.

Fresh air, good food, exercise short of fatigue, and rest, all under medical supervision, are the four great determining factors in the cure of the disease.
The Prevention of Tuberculosis

in Children of School Age

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27. Royal Commission on Tuberculosis, Second Report.

28. Calmette - "Transactions of the Pasteur Institute" - Lille.

29. v. Behring - "Suppression of Tuberculosis".

31. "Channels of Infection in Tuberculosis".
32. Report of Royal Commission on Tuberculosis, 1895, Appendix, page 9, et seq.
34. Klebs - "Tuberculosis".
42. Dudgeon - Emery L. I. 1911, 564.
44. Koplik - "Diseases of Children".
45. Turban - "The Diagnosis of Tuberculosis of the" "Lungs with special reference to the Early" "Stages". /
"Stages".


47. Hyslop Thomson - "Consumption in General Practice".


52. Klebs - "Tuberculosis".
The Prevention of Tuberculosis

in Children of School Age

Appendix
The following are cases of children who have been selected at the routine medical inspection held in the elementary schools in Croydon. The majority of them are children whose parents would not have considered it necessary to obtain medical advice in regard to the children's conditions. The medical inspection at the schools was the means of bringing these children under medical observation.

They are typical of perhaps the most common manifestation of early tuberculosis in school children and form the type of case which is constantly being sought for throughout the schools.

Whilst not all have been definitely diagnosed as tuberculous they have invariably kept under observation according to the methods detailed in the text of this thesis.

Case I. 23/9/19.

W. E., male, aet. 12 years.

Family History:— None of tuberculosis.

Previous Diseases:— Measles, Pertussis.

History of present disease:— Cough, nasal discharge.

Physical Condition:— Cough, slight sputum, dyspepsia, night sweating.

Weight:— 4 stone 11\(\frac{1}{2}\) lbs.

Glands in neck enlarged. Chest good. /
good. Expansion fair.
Home: Clean, poor locality, not separate bed, windows open.

Case II. 23/9/19.
T. G. C., male, aet. 3 years.
Family History: Tuberculosis on maternal and paternal sides.
Previous Diseases: Tuberculosis of mesenteries.
Bronchitis. Pertussis. Pneumonia.
Present Condition: No cough, sputum, or dyspnoea.
Slight night sweats. Appetite varies.
Weight: 2 stone 4½ lbs.
Chest and expansion good. Rather thin.

Case III. 23/9/19.
J. C. D., male, aet. 6 years.
Family History: None of tuberculosis.
Previous Diseases: Measles, Pertussis, Influenza. Pneumonia.
Present Condition: Chest asymmetrical, expansion fair, delicate aspect, fingers clubbed, no glands enlarged, at base of left lung bronchial breathing and increased vocal resonance.
Case IV. 23/10/19.

C. C., female, aet. 8 years.

Family History: None of tuberculosis.

Previous Diseases: Measles. Pertussis.

History of Present Diseases: "Falling off".

Swelling of glands in neck. Frequent "colda".


Case V. 18/10/19.

G. W. D., male, aet. 8 years.

Family History: Father suffering from phthisis.

Previous Disease: Measles.

History of Present Disease: Cough and enlargement of glands of neck.


Generalised bronchitis but not acute. Definite dullness of interscapular region. Bronchial breathing and impaired resonance at right apex posteriorly.

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Case VI. /
Case VI. 22/10/19.
C. G., male, aet. 12 4/12 years.
Family History:— None of tuberculosis.
Previous Diseases:— Measles. Pneumonia.
Present Condition:— No cough. Sputum and slight
dyspnoea. Marked night sweats. Fair
appetite. Weight:— 5 stone 3 3/4 lbs.
Only sign in chest a marked d'Espine's sign.

Case VII. 5/11/19.
R. B., male, aet. 7 3/4 years.
Family History:— Tuberculosis on mother's side.
Previous Disease:— Measles.
Present Condition:— Slight cough and sputum.
Dyspnoea. Night sweats marked. Weight:—
3 stone 10 1/2 lbs. Harsh prolonged
expiration heard in both lungs posteriorly.
Glands in the posterior triangles of the
neck enlarged. d'Espine's sign marked.

Case VIII. 28/11/19.
B. C., female, aet. 8 years.
Family History:— Tuberculosis on mother's side.
Previous Diseases:— Measles, Pertussis.
History of Present Disease:— Indigestion. Night
sweats. Losing Weight.
Present Condition:— Night sweats marked. Poor
appetite. Chest thin and expansion poor.
Strumous /
Strumous aspect. Pin-head glands in the anterior triangles of neck.

Case IX. 14/11/19.

R. D., male, aet. 6½ years.
Family History:—Tuberculosis on mother's side.
Previous Disease:—Frequent colds.
History of Present Disease:—Rarely without cough.
Present Condition:—Marked cough. Poor appetite.
Impaired resonance at right apex posteriorly.
Harsh expiration. No crepitations.

Case X. 14/11/19.

F. F., female, aet. 5⁷/₁₂ years.
Family History:—None of tuberculosis.
Previous Diseases:—Measles. Pertussis. Scarlet Fever.
Weight:—3 stone 4½ lbs. Chest and expansion fair. Hectic appearance. At right apex—anteriorly prolonged expiration, some crepitations, and slight impairment of percussion note; posteriorly similar signs with bronchial breathing in addition.

Case XI. 7/11/19.

F. G., male, aet. 13½ years.
Family /
Family History:— Tuberculosis on father's side.

Previous Diseases:— Measles. Pneumonia.

History of Present Condition:— Has had "chest trouble" every year.


Case XII. 24/12/19.

M. E., female, aet. 10½ years.

Family History:— Tuberculosis on mother's side.

Previous Diseases:— Measles. Pertussis. Influenza.


Case XIII. 7/1/20.

E. C., male, aet 12 years.

Family History:— Tuberculosis on mother's side.

Previous /
Previous Diseases - Measles, Pertussis.


Case XIV. 14/1/30.

E. D., male, aet. 7½ years.

Family History: - Brother and sister have pulmonary tuberculosis.

Previous Diseases: - Measles, Pertussis, Bronchitis.


Case XV. /
Case XV. 16/1/20.
G. B., male, aet. 8\(\frac{10}{12}\) years.

Family History:- None of tuberculosis.

Previous Diseases:- Frequent "colds".

Present Condition:- Cough. Weight 3 stone 4\(\frac{3}{4}\) lbs.


Appearance hectic. d'Espine's sign well marked. Breath sounds harsh, and rhonci present at right apex posteriorly.

Case XVI. 18/9/19.

J. M., female, aet. 12 years.

Family History:- Mother died of tuberculosis.

One brother and one sister suffering from tuberculosis.

Previous Disease:- Measles.

Present Condition:- "Ailing" for six weeks.

Chest fairly well developed. Expansion fair.

No cough. Weight 4 stone 5\(\frac{1}{2}\) lbs.

At right apex both anteriorly and posteriorly, impaired percussion note and râles.

Case XVII. 26/9/19.

W. J., male, aet. 12 years.

Family History:- None of tuberculosis.

Previous Disease:- Measles.

Present Condition:- Slight cough. Greenish coloured /

Case XVIII. 3/10/19.

G. W. H., male, aet. 7 years.
Family History:– None of tuberculosis.
Previous Diseases:– Measles. Pertussis. Scarlet Fever.

Case XIX. 14/10/19.

L. J., female, aet. 6 years.
Family History:– Tuberculosis on mother's side. Mother at present suffering from phthisis.
Previous Diseases:– Measles. Tuberculous mesentery.
Present Condition:– Marked cough. Dyspnoea when /

Case XX. 21/11/19.
R. T., male, aet. 6\(\frac{2}{3}\) years.
Family History:— Tuberculosis on mother's side.
Mother at present suffering from phthisis.
Previous Diseases:— Measles. Asthma. Bronchitis Pneumonia on four occasions.

Case XXI. 19/11/19.
G. M., male, aet. 13 years.
Family History:— Unobtainable.
7½ lbs. Pleuritic signs over lower portions of lungs, anteriorly and posteriorly.

Case XXII. 5/12/19.

C. S., female, aet. 8½ years.

Family History:—Tuberculosis on mother's side.

Previous Diseases:—Measles. Pertussis. Pneumonia.

Present Condition:—"Hacking" cough. Poor appetite. Langour. Evening rise of temperature to about 100°F. Weight:—3 stone 13 lbs.

Enlarged glands in left anterior triangle of neck. Right apex anteriorly impaired percussion note and harsh expiration, similar signs posteriorly with occasional râles in addition. d'Espine's sign well marked.

Case XXIII. 12/12/19.

A. H. T., female, aet. 4½ years.

Family History:—Tuberculosis on both sides.

Previous Diseases:—Influenza. Bronchitis.


Case XXIV. 12/12/19.

E. W., /
E. W., female, aet. $7\frac{1}{12}$ years.

Family History:— None of tuberculosis.

Previous Diseases:— Measles. Pertussis. "Colds".


Case XXV. 13/12/19.

H. T., male, aet. 6 years.

Family History:— Tuberculosis on mother's side.

Previous Diseases:— Measles. Pertussis. Anaemia.

Present Condition:— Cough night and morning.


Pallor. Ill-nourished. Dyspepsia.

Weight:— 3 stone 9$\frac{1}{2}$ lbs. Poorly clad chest. Poor expansion. Delicate aspect.

Clubbed fingers. Right apex anteriorly and posteriorly, impaired percussion note, increase of vocal resonance, harsh breathing with prolonged expiration.

Case XXVI. 13/12/19.

L. H., male, 4 years. /
L. H., male, aet. 4 years.
Family History:—Tuberculosis on mother's side.
Previous Diseases:—None.
Present Condition:—Slight night sweating.
   Fairly good appetite. Weight:—2 stone 3½ lbs.
   Rise of temperature at night to 99°F.
   Veins showing on anterior chest wall.

Case XXVII. 17/1/30.
R. W., male, aet. 7 years.
Family History:—Tuberculosis on mother's side.
Present Condition:—Slight cough. Has had night sweats. Weight:—3 stone 12½ lbs.

Case XXVIII. 17/1/30.
E. O., male, aet. 7½ years.
Family History:—None of tuberculosis.
Previous Diseases:—Measles. Pertussis. Mumps.
Present Condition:—Fairly good appetite.
   Weight 3 stone 6 lbs. Chest well formed with/
with good expansion. Pallor. d'Espine's sign well marked. Posteriorly at the right apex the breath sounds are faint.