TUBERCULOSIS IN CHILDREN OF SCHOOL AGE.

THESIS

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AUTHOR'S PREFACE.

The outbreak of the Great War has completely disorganised the work of school medical inspection as well as the efficient supervision of tubercular children by tuberculosis officers. This interruption has particularly affected the area referred to in this thesis, the author and tuberculosis officer having been absent serving in the army at home and abroad for a considerable period.

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TUBERCULOSIS IN SCHOOL CHILDREN.

Introduction.-

It is generally acknowledged by all authorities that the most widespread of all diseases affecting civilized man and domestic animals is tuberculosis. So prevalent is the disease that most authorities further agree upon the unavoidability of the infection.

Unlike pneumonia, the history of tuberculosis as a recognised distinct disease does not go further back than the time of Laennec - a 100 years ago. The former disease was recognised even in the time of Hippocrates, the latter although more widespread is of much later recognition. It was Laennec who first called attention to the similarity between scrofula and consumption.

In 1843 Klencke made the discovery that the injection of tuberculous material into the veins of rabbits produced a multiplication of the tubercules in the injected animal. Then came Villemin's inoculation experiments in 1865, when

he demonstrated the infectious character of tuberculosis, whether derived from human sources or from the tubercular nodules on the pleurae of cattle. The inability to distinguish between tubercular and non-tubercular lesions raised a strong impression against the existence of any infection in the former. In 1873, Armanni, and then Cohnheim and Salomonsen demonstrated in more convincing experiments than Villemin's the infective nature of tubercle. These workers inoculated the cornea and anterior chamber of the eye of rabbits with tubercular material, and demonstrated the gradual deposition of tubercles in the iris and the lymphatic glands, followed by general tuberculosis in the animal inoculated. They, however, did not determine the nature of the poison which was capable of setting up these morbid changes.

Koch in 1882 made his great discovery of the bacillus of tubercle, revealing the presence of the organism, after having overcome apparently unsurmountable difficulties, not only in the diseased tissue but also successfully cultivated it on solidified blood serum. Since the discovery by Koch in March 1882 the investigation of tuberculosis has been and is receiving widespread attention.

It is, however, only during the last 12 years that the great frequency of tubercular lesions among children has been revealed, up till then it was generally believed

that not more than 20 per cent of all children dying from all causes showed tubercular deposits present.

The following figures (quoted by Eric Pritchard, Tuberculosis in Children, Practitioner, Jan. 1913) show the astonishing high incidence of the disease among children as revealed by more recent and more careful investigators:-

1905, Harbitz showed that of all children in Christiania who died, 42% had foci of tuberculosis.

1905, Hamburger and Sluka's figures for Vienna are 40%.

1909, By means of the tuberculin test Hamburger and Monti have demonstrated a tuberculosis incidence as high as 20% among school children in Vienna during their 3rd. year, 70% in children between the 7th. and 8th year, and 90% in children of 14 years of age.

These figures have been confirmed by other investigators and Pritchard (Ibid.) particularly mentions the conclusions of Mantoun and Lemaire in Paris.

We are justified then as a result of these figures in concluding that tuberculosis is practically universal among children of school age. The tubercular lesion may be latent or evident; in the former case the evidence can only be obtained by subsequent post mortem examination, where lesions have been healed and in the past gave rise to symptoms too indefinite to diagnose, or else the evidence is established

by the tuberculin test intra vitam.

The death rate from all forms of tuberculosis among children is greatest during the first five years of life, to be more precise it is enormously high during the first few months of life; according to Hamburger and Monti, quoted by Pritchard, ibid, the mortality rate among such tubercular infected children is 100%, at the end of the first year 50%, at the end of the second year 20%, and gradually diminishes until after the fourth year it is so low as 2%.

The mortality in England and Wales at several ages from all causes and from Tuberculous diseases during 1907 and 1909 is as follows:-

use of death	Deaths under 1 year of age per 1,000 births.	Death rate per 1,000 living.						
		Age 1 - 5	Age 5 - 10	Age 10-15	Age 15-20	Age 20-25	Age 35 & up	All ages
07.								
ll causes	117.62	17.74	3.39	1.98	2.80	3.51	26.36	15.11
hthisis	0.4	0.29	0.16	0.26	0.84	1.26	1.84	1.15
ther forms) f tubercu-) osis.)	4.14	1.62	0.50	0.29	0.24	0.20	0.18	0.47
08.								
ll causes	120.43	16.18	3.25	1.92	2.66	3.45	25.72	14.80
hthisis	0.36	0.27	0.16	0.27	0.81	1.27	1.79	1.12
ther forms) f tubercu-) osis.)	4.29	1.66	0.49	0.28	0.23	0.19	0.17	0.47
09.								
ll causes	108.73	15.98	3.31	1.96	2.73	3.38	26.5	14.62
hthisis	0.29	0.23	0.15	0.27	0.80	1.22	1.74	1.09
ther forms) f tubercu-) osis.)	3.71	1.57	0.46	0.31	0.25	0.18	0.17	0.45

The incidence rate is almost a contrast to the mortality rate, starting at zero the incidence rate rises to 90% at the age of 14. Once the period of infancy - after the third year- is passed there is developed in the child a degree of immunity. Respecting this degree of immunity there is even yet divergence of opinion, for instance, Dr. Robert Jones of Liverpool in his article on "Tuberculous Diseases of Bones and Joints" in The Practitioner for February 1913, states, "Children under 15 possess a very high degree of natural immunity"; while Dr. Eric Pritchard in the same periodical points to the absence of reaction in children as a sign of inactive defence. In children then after the third year, we are compelled by statistics to admit that the period of extreme danger from infection is passed; and a point we must quickly determine is, whether a mild infection from a well diluted bovine source can be responsible for this degree of protection noticeable during the first two decades of life. The question was investigated by the Royal Commissioners on Tuberculosis by experiments on calves with bovine and human tubercle bacilli, in some of the animals inoculated some considerable degree of resistance was gradually obtained, in other animals no resistance was produced. The general trend of opinion points at present to such a mild infection in later childhood from a well diluted source as being of some protective value until about the fifteenth year.

The seat of tuberculosis in childhood is admitted on all hands to be most commonly in the lymphatic system, inhaled or swallowed, air or food borne, human or bovine in origin the infection is sooner or later arrested in the well developed lymp glands of the child. Their arrest here is not accompanied by those constitutional symptoms we are accustomed to observe in cases of other infections, where the bacterial inroad is met by antibacterial and antitoxic products in the body and made manifest by elevation of temperature and other well known symptoms. It is a mechanical arrest, followed by the production of tubercular growths at that site. Sewall (Journal Amer. Medic. Assoc. 1911 Sept) refers to the more frequent occurrence of tuberculosis in cervical glands than in the tonsils - although he found four per cent of all enlarged tonsils removed by him were tuberculous HI, which he explains by the ability with which the tubercle bacilli can travel to the glands without injuring the tonsils.

The lymphatic system in childhood is well developed, and it is this preponderance of lymphatic tissue in children as compared with the amount of similar tissue in adults which has brought present authorities to regard tuberculosis in children as essentially a disease of the lymphatic system.

In infants the glands arrest the infection for only a

very short time, there is apparently no tendency to repair in the affected tissues. Tubercular growth is rapid and along with it we notice rapid softening or caseation without the characteristic enclosure of the lesion by means of fibrosis and calcification. The infant has not yet learned the processes which give immunity from the invading bacilli and their toxins, apparently the only obstruction to the more rapid spread of the bacilli is the mechanical arrest in the lymphatic glands, and this as already shown is only temporary. As a rule there is by this time some interference with the passage of the lymph stream of the adjacent organs, the functions of these organs are obstructed first by the occlusion of the lymphatic passages draining the organ and later by a spread of the infection towards it from those infected glands.

By this time of course, other glands have become affected so that before there may be evidence of any disease in one particular area the child may be riddled with tubercles; enhibiting symptoms of meningitis, broncho-pheumonia, intestinal catarrh and ulceration, and perhaps only now revealing serious constitutional disease for the first time.

In later years, especially after the third year, the system has learned the processes of bacteriolysis and now we find with increased incidence rate a gradual increased immunity. The disease is still, however, an affection principally of the lymphatic system, the infection now is held in the

glands thus forming the primary focus of the disease. The younger the child the less likely are the glands to retain the tubercular bacilli in them, the latter passing on after more or less interruption to the other tissues. The affection known as "Hilus disease" for instance, is an involvement of the bronchial lymphatic glands by the tubercular invasion whence the process passes to the base of one or both lungs through the lymphatic vessels, giving rise in that area to massive consolidation with fairly evident physical signs. In the older child the disease does not so readily spread to other structures and the infection is retained in the glands, and exhibited by the enlargement of these latter. All palpable areas where lymphatic glands are easily examined should consequently be examined, whenever there is any reason, however slight, for suspecting tubercular infection. Eric Pritchard emphasises the importance of the diagnostic significance of swollen glands in the axilla, the tumefication of which cannot be explained on other grounds.

Evidence of tubercular disease is, of course, not to be regarded as conclusive from enlargement of lymphatic glands alone, cervical glands are frequently found enlarged from scalp trouble, submaxillary from dentition causes and so on; still we have every reason for regarding with suspicion all enlarged glands from whatever cause arising, because impairment of these structures by any agent predisposes them to

subsequent tubercular infection.

From what has been written it is clear that there are in children two well marked forms of the disease, corresponding to some extent with the age of the child, and merging one into the other rather than being sharply divided. The one form, where the disease affects infants, meets with no obstruction from the host, affecting primarily the lymphatic system and spreading quickly through the whole of that system into other structures. Then another form met with in older children where there is some amount of immunity from the disease, and where the infection is retained for some time in the glands. In the latter form we can further recognise two stages, that stage where the disease is occult or manifest in the lymphatic glands, and the second stage where the disease has overstepped them and appears in any other part of the body.

II.

Tubercular infection may appear after having traversed the lymphatic glands in more distant parts, the manner in which this occurs we are not yet decided upon, yet from collecting data obtained from various sources we can assume that the bacilli spread through the blood stream. They enter the blood stream by way of the mucous membranes, which they can traverse without leaving any local lesion (Ludwig Hektoen, Klebs Tuberculosis 1909, p.61) the mucous lining of the ali-

mentary canal, respiratory passages, etc., or the bacilli may pass indirectly into the blood vessels through the lymphatic channels and thoracic duct. And if the number of these bacilli is large, such as we may expect when a softened tubercular mass has given an accidental entry into the blood stream, then there may result general miliary tuberculosis.

To enable these bacilli to find resting places, where they may flourish at the expense of the host, after having entered the blood stream, there are several influences at work. To begin with there is the mechanical obstruction and slowness of the blood stream in the smaller arterioles; the effect of trauma upon the invaded part - the classical experiment of producing inflammatory changes in the leg of a dog while the part is being frequently struck and the animal fed on putrid meat is well known - is an undoubted assistance to tubercular invasion of that part; then again there is the effect of previous injury or impairment of vitality through former lesions produced by other infections. Other influences of course are known producing general or local defective immunity to the invading bacilli, these will be referred to later.

The tubercular infection may now appear in one or other or several of these forms:-

1. Surgical Tuberculosis.
2. Medical Tuberculosis. a. Manifest.
   b. Occult.

Surgical Tuberculosis. Under this division we include tuberculous disease of lymphatic glands, bones, joints, skin, etc.

Medical Tuberculosis. a. Manifest, as disease of the lungs, pleura, peritoneum, brain, meinges, etc.

b. Occult, as miliary tuberculosis, without exhibiting any signs or symptoms revealing the existence or even the localities of the infection.

In the present thesis the author desires to give a general account of the whole subject of Tuberculosis in School Children. It is an interesting study to him as a general practitioner in one of the black counties of Wales - Pembrokeshire; black from the high mortality rate from this disease, and more particularly is the subject one of interest seeing that he is occupied as Medical Examiner of School Children for East Pembrokeshire. In Wales great interest in tuberculosis is being taken by the general public, this interest has been aroused through the recent crusade against the "Great White Plague". A crusade which has at its head the King Edward VII Welsh Memorial, with its very huge funds. In connection with this Memorial there are medical lecturers who visit all towns and villages in the Principality, a travelling tuberculosis museum with demonstrators also accompanies the lecturer. Already the fruits of these demonstrations and lessons is to be seen in better lighting of houses,

open and larger windows; knowledge of the infectious nature of tuberculosis is gaining ground, and isolation of the infected persons and disinfection of their sputa, clothes, etc., is becoming generally practised. In addition there is in the country a large army of tuberculosis medical officers with Dr. Marcus Paterson - chief medical officer of the Welsh Memorial - at their head, who all contribute to the spread of knowledge respecting the infection and assist in its prevention, notification, isolation, disinfection and treatment.

DIAGNOSIS.

The great point in the diagnosis of tubercular diseases is to ascertain if the disease is active or latent (or occult). In order to determine this there are various methods of diagnosis in addition to those signs and symptoms we are accustomed to observe in active tuberculosis, such as fever, wasting, etc. These methods shall be divided into five classes and described each in detail afterwards. They are:-

1. Injection of Old Tuberculin.
2. Cutaneous tests - von Pirquet, Moro, Woodcock.
3. Complement fixation test.
4. Opsonic index.
5. Regional diagnosis.

1. The injection of Old Tuberculin. Koch in 1889 - 1901 brought to general notice a substance called by him "Tuberculin"

which he described as possessing curative processes in tuberculous diseases (Muir & Ritchie, Bacteriology, p.249 et seq.) Briefly described, this Tuberculin, or Old Tuberculin, and also as T. A. (Tuberculin Alt) was made by growing a human strain of the tubercle bacillus in glycerine-veal broth, then evaporating the culture to one-tenth its bulk, and filtering through porous porcelain. The filtrate is practically a glycerin solution of the soluble toxins produced by the organisms, these toxins are endotonius and exotonius, the glycerine being present as a preservative. This Old Tuberculin is a syrupy, transparent, amber-coloured liquid. As first used by Koch this agent was found harmful; Kirchow especially attacking its use; the injection of the toxins, according to Virchow, liberated dead and living bacilli from the tuberculous focus through the necrotic action set up around that part. It must be noted, however, that Virchow then attacked the method and results of those days, the views of Virchow today are much modified, indeed Carnac Wilkinson states, "Too few are familiar with the subsequent interpretations of Virchow's investigations, which amounted to a virtual recantation." (Practitioner, January 1913, "Tuberculin & Tuberculosis, p. 153.) In our own country it is remembered that the late Professor MacCall Anderson of Glasgow spoke with approval in a clinical lecture of the results he had obtained in Lupus from Old Tuberculin and referred to in

the Brit. Jour. of Dermat, Sept. 1905.

The present revival in the use of Old Tuberculin is due to several causes, chief among which are, greater knowledge of its uses and contraindications, the stimulation received from the researches and writings of Sir Almroth E. Wright, its great use in ophthalmic and cutaneous diagnostic reactions, and last but not least more careful and smaller dosage. This revival in the use of Old Tuberculin is more as a diagnostic agent than therapeutic, other forms of tuberculin being prefered on the whole than T.A. in the latter department.

Before describing the manner of use in the form of injection, it would be as well to describe two other forms of Old Tuberculin. One is Perlsucht Tuberculin, also known as Koch's Old Tuberculin, and P.T. This product is precisely similar to the other - Old Tuberculin - only that the bacilli come from a bovine rather than a human source. It is similarly prepared and similarly used, some consider it milder in action. Recently there seems to have arisen a preference for the human product in pulmonary tuberculosis and for the bovine in other tubercular lesions. The second form is known as Albumen-Free Tuberculin, in short Tuberculin A.F. This is obtained from the human type of Tubercle Bacillus, which has been cultivated for three weeks on a nutrient medium consisting of inorganic salts and citrates, and of which the sole

nutrient constituent is Asparagin. The tuberculin is prepared in the same manner as T.A., by killing the bacilli by heat, evaporating the culture to one-tenth its volume, and finally filtering off the bacterial residue. It is then a mixture, like T.A., of exotoxins and endotoxins of the bacilli. It is employed for diagnostic and curative purposes in the same manner as T.A., but the advantage that is claimed for it over the latter is that being free from protein matter there is no danger of the production of anaphylactic symptoms. Deal reports excellent results from tuberculin A.F., which he calls tuberculinum purum, in seventeen cases treated with this product (Med.Rec. 1910, Nov.26) Dr. Arthur Tatham too calls particular attention to this agent in the diagnosis of early cases of pulmonary tuberculosis ("Diagnosis & Early Treatment", Tatham Practitioner, January 1913, p. 44)

The result of injecting Old Tuberculin in any of the three forms described is to produce in the tuberculous person a reaction. This reaction is due to, "A heightened susceptibility on the part of the tuberculous to the poisons of the tubercle bacillus." The reaction according to Clive Riviere ("The diagnostic and therapeutic use of Tuberculin &c in Infancy & Childhood", Tuberculosis, Kelynack, 1908) consists in (1) A general disturbance, as malaise nausea, pains in the head and limbs, accompanied by a rise of temperature of at least 0.5°C, or 0.9°F.

(2) A local change, the result of active hyperaemia of the tuberculous focus.

The original dose used by Koch was 1 milligram, but the modern method is that advocated by Bandelieu & Roepke and consists of an initial injection of 2/10 milligram, or 0.2 c.c. of the 1:1,000 dilution (made with 0.5% phenol in sterilised distilled water). If no rise in temperature takes place, a second injection is given, this time of 1 c.c. of the 1:1,000, and if this has no effect, 0.5 c.c. of 1:100 is then administered. Absence of reaction after this third injection is regarded as absolute proof that the patient is free from tuberculosis. In children half doses are recommended beginning with 1/10 milligrame (Comby: "Ophthalmo-reaction tuberculleuse chez les enfants", Bull. et Mem. Soc. Med. des Hôp de Paris, vol. xxiv, page 766, 1907). The usual method is to make the injection at night, to take the temperature in the morning, and then every two hours. An interval of a few days is permitted between each injection.

Respecting the value of the test we have to note certain drawbacks. It is not applicable in the presence of fever, a temperature above 98.6°F. in the axilla or 99°F. in the month is generally regarded as a contraindication (Clive Rivière, Kelynack's Tuberculosis, 1908, p.282) Seeing that the susceptability to the poison increases with each dose even healthy persons may react to large quantities (0.5 c.c. of 1:100

dilution). A method used by French physicians, (Claisse, Bezançon, Labbe. "L'emploi de la tuberculine pour le diagnostic de la tuberculose", Bull. et Mem. Soc. Med. des Hôp. de Paris, vol. xxiv, pp. 689, 700 & 703, 1907) to exclude the reaction in healthy persons, is to inject a small dose (2/10 milligramme) at intervals of three or four days up to four injections. It has been stated that reactions in apparently healthy people is due to latent or obsolete tubercle. Again there are tuberculous patients where no reaction is obtainable, these are mainly persons undergoing treatment with tuberculin and those suffering from very evident advanced pulmonary tuberculosis. Rotch and Floyd (Journ. of Am. Med. Assoc. vol. xlix, p. 633, 1907) have used the method widely and have obtained a positive reaction in 95% of tuberculous cases. They come to the conclusion that a negative result does not exclude tuberculosis, though it affords strong evidence against it. Clive Rivière (loc. cit.) quoting Schick, states that he attaches considerable importance in diagnosis to swelling and pain among children at the point of injection of the tuberculin. While some authors have observed no ill effects from the use of Old Tuberculin as a diagnostic agent, others again report instances of collapse with restlessness in healthy infants after doses of 3/10 to 5/10 milligramme. Seeing that Claisse, Bezancon, and Labbe obtain satisfactory information from doses of 2/10 milligrammes in adults there is very little

reason for the employment of such doses as 3/10 and 5/10 milligrammes in infants. It is very interesting to note that no reaction was obtained even with 5 centigrammes in new-born babies, including those born of tuberculous mothers, by Schreiber and Epstein (Kelynach's Tuberculoses, 1908, p. 283.)

The use of Koch's Old Tuberculin, or of the other similar forms of it, has not apparently been used in school children as a diagnostic agent to any great extent. Indeed in the present state of our knowledge, with other methods more applicable, its use is hardly to be recommended in that department. It is possible of course that where children suspected to be tuberculous can be kept in a suitable institution, then its use may be advocated. In hospital therefore, where children are under constant observation, its use is, in suitable cases and in suitable doses, apparently quite safe and valuable.

More recent inquiry into the facts regarding the diagnosis of Tubercular disease by subcutaneous injection of Tuberculin are on the whole unsatisfactory, unless used with considerable skill. Clive Rivière quotes certain well known experiments (Modern Methods in the Diagnosis of Phthisis, Lancet, Aug. 30, 1913) by Franz, on Bosnian soldiers showing 61% reacted to doses of only 3 mg., whereas after a year's stay in Vienna, 76% gave positive reactions; Beck, among 2,137 convalescents, found 54% react to injections of 1, 5, or 10 mg., Frankel

obtained similar results; Dr. Hammon of Johns Hopkins university is stated by Clive Rivière (loc. cit.) to find about 60% of all individuals react, whether they are suspected of having tuberculosis or not. This authority in the same contribution states that a positive febrile reaction to tuberculin gives little evidence either way in the diagnosis of phthisis.

Tuberculin subcutaneous injections in diagnosis are of use when attention is mainly paid to the "Negative febrile reaction" and "The Positive focal reaction."

The negative febrile reaction is of very definite value excluding active disease, and this alone makes the test of considerable value in properly selected cases.

The focal reaction shows itself in symptoms and in the appearance or increase of physical signs whether to percussion or auscultation or both; in phthisis it is of distinct value in not only pointing to the presence of a tuberculous process but in definitely indicating its presence in the lung. Even here again a great deal depends upon the individual factor, the observer may not possess the necessary skill to ascertain these increased focal signs and symptoms, and he may be so obsessed with the

presence of tuberculosis as to imagine its presence.

The general opinion of the profession respecting the subcutaneous use of tuberculin in the diagnosis of tuberculosis at present is:-

To avoid its use always in febrile cases.

To repeat rather than increase the dose where the reaction obtained is doubtful.

To use it only when the diagnosis cannot be made by other means by those with special knowledge and skill kept quite up to date.

Used in this way tuberculin would be used in only a few selected cases with no risk. In the hands of experts of course statistics have shown the harmlessness of the test, Bardelier and Roepke (quoted by Clive Rivière loc. cit.) have given ten to twelve thousand injections without any evidence of harm.

2. Cutaneous tests.

There are three well known cutaneous tests, Von Pirquet's, Moro's, and Woodcock's, and if the conjunction is included we can add another, this latter test is Calmette's, and will be considered after the others are described.

Von Pirquet's test is usually obtained by vaccinating the skin with old tuberculin; the skin of the inside of arm having been scratched with a needle (just in the same way as vaccination is carried out) in two places, a drop of 25% tuberculin is rubbed in to the scratches, at the same time another control scratch is made with saline solution. In a tuberculous patient the scratches containing tuberculin become reddened, and as a rule a papule forms over each mark and less often even vesicles form. The reaction generally occurs within twenty-four hours but it may not appear for a few days. The author has seen one case of pleurisy with effusion in an otherwise healthy young athlete with a bad tubercular family history react to the test very markedly after six days. In cases of advanced tubercular mischief the reaction is feeble or absent. The test is really too delicate a method for general use, as it proves too much; it is of most use in children during the first year or two.

The great majority of children, at any rate in towns, become infected with tubercle before they grow up, and henceforward give the Von Pirquet reaction, although the disease is latent; up to the age of two years quiescent

or obsolescent tubercle is rare and a positive reaction points to active disease. After this age the patient will react with latent or arrested disease, and this latency or arrest is so common as to make the test of little clinical value.

Thursfield (Practitioner, Oct. 1913) describes four varieties of reactions:-

a. The ordinary form in which the inflammation appears within twelve hours.

b. The ephemiral form in which the maximum is reached in twelve and has disappeared in twelve to twenty-four hours more.

c. The lasting reaction which does not reach its height until the expiration of two or three days.

d. The delayed reaction which does not appear for two or three days and lasts many days in a desultory fashion.

Dr. Lapage (Brit. Jour. Child Dis., Vol. IX., Nov. and Dec. 1912) has tested 1000 children below fourteen years of age, and finds, judging by the reaction, the infection of tuberculosis increases with age, so that 60% have been infected between five and fourteen years of age. Then of 445 children not reacting, Dr. Lapage

considered 35 were certainly tuberculous, in 122 he failed to find any clinical evidence of infection. In 555 cases not giving a positive reaction, he regarded as clinically tuberculous 156, and 57 as clinically without tuberculosis. Dr. Lapage concludes that a negative result after two trials is sufficient evidence of absence of tuberculosis, and a positive reaction only points to the child having been infected, it does not indicate active disease, nor that the illness from which the child is suffering at the time is necessarily tubercular. The same investigator has compared his results with those obtained by Dr. Bythell's X-ray photographs, and finds the two methods in agreement; he concludes by stating that of children attending hospital between the ages of five and fourteen at least 60% have been infected with tuberculosis.

The same point has been investigated by Dr. ~~Allen~~ Alan Brown (Pediatrics, Vol. XX., May, 1913, p. 321) in the service of Emmet Holt at the New York Babies' Hospital. He examined 650 cases and obtained a positive result in 124; in 89 of which the result was confirmed by autopsy, or by finding the tubercle bacillus, a percentage of over 70%. The percentage of positive results is much more than Dr. Lapage obtained for the same ages - under two years. Dr. Allen Brown concludes that a positive reaction

at this age is indicative of the presence of an active and generalised tuberculosis, and is of bad prognosis.

Reference at this stage can be made to a later development of the Von Pirquet reaction, which has been described as the "Quantitative Cutaneous Test." Clive Riviere (Modern Methods in the Diagnosis of Phthisis, B. Med. Jour., August 30th, 1913), in describing the method states that it is most conveniently applied after the method of Ellerman and Erlandsen, where four scarifications are made simultaneously on the skin, which are treated with four dilutions of tuberculin, rising in strength of dilution with geometrical progression. As a result of this papules develop whose diameter is said to rise in arithmetical progression, from lowest to highest. From the size of these papules and the difference in size between them, there can be calculated the lowest dilution of tuberculin to which a particular patient will react, and the reciprocal of this represents his sensitiveness. Thus, a patient with a sensitiveness of 100 reacts to 1% tuberculin, and a patient with a reaction to 1/1000 tuberculin has a sensitiveness of 1000. Errors of technique occur, such as difference in absorbtion of tuberculin owing to differences in depth of the scratches, quantity of tuberculin left on the skin, and the time it is allowed to dry on, etc. To

the above four scarifications, Clive Riviere is accustomed to add a fifth control one, this is below the lowest of the four and avoids errors of reaction due to traumatism. Skin sensitiveness, like general sensitiveness to subcutaneous tuberculin, is generally higher in active disease than in the presence of an obsolete or healed focus. The figure 100 is usually put as sensitiveness above which active disease is usually found, figures below this are generally said to indicate its absence. The above investigator, quoting the figures of Hamman and Wolman, found 16% of the non-tuberculous sensitive to 1% tuberculin, and 44% of cases of incipient tuberculosis negative to 1% tuberculin, that is with a sensitiveness below 100, which does not support this method.

These figures coincide with the experience of Clive Riviere, who states (loc. cit.) in his own words, "I do not think it wise to pin much faith to its findings at present. At the same time there is value in the test at the further ends of the scale - a very high sensitiveness on the one hand as evidence of disease, and a very low one on the other, in the absence of any other explanation as evidence of its absence."

Moro's test. This is to-day, to all appearance seldom used. It is like Woodcock's test, a modification

of Pirquet's, and like the latter these two tests are too delicate. Moro rubs into the skin an ointment composed of equal parts of old tuberculin and lanolin, the part is then left uncovered for ten minutes; If tuberculosis be present a positive reaction usually occurs, which is known by the appearance of a papular or pustular exanthem which disappears in a few days, the reaction generally takes twelve to thirty-six hours to appear (Lancet II., 1909, p. 1443, and Lancet I., 1910, p. 73.)

Woodcock's test is apparently even less practised than Moro's, both avoid the scarification of Pirquet. In this modification two blisters are raised on the back, a water dressing is left over them for two days to lessen any hyperaemia. pure new tuberculin is now applied to one of the small blisters, and allowed to dry. The sensitised area in a positive subject becomes rosy red in twenty-four hours with a blush around, the negative cases may become rosy red but have no blush, at the same time the control blister remains comparatively pale. (Med. Ann., 1909, p. 604, Tuberculosis, E. E. Maddox.)

Calmette's ophthalmic reaction was a few years ago very largely used, but although Pirquet's results are more in error than Calmette's (Percival Hay, quoted by E. E. Maddox, Med. Ann. 1909, p. 603.), yet the ophthalmic reaction to-day is rarely used. Its use is

not advisable, on account of the risk of setting up a severe and even locally dangerous inflammation (Carr, in Diseases of Children, 1913, Garrod, Batten and Thursfield). The conjunctival reaction owes it origin to Wolff-Eisner, who was led to study the application of tuberculin to the eye from his observations on its hypersensitiveness to pollen in hay fever. Wolff-Eisner used a 10% solution of old tuberculin (T.A.), but Calmette used a modification, fearing that the glycerine andbouillon derivatives might irritate the eye. The latter precipitated the tuberculin with alcohol, dried it, and made with it a 1% solution in distilled water or normal saline. The test is now made with 0.5% of old tuberculin in aqueous solution, the lower lid is drawn down, the patient meanwhile looking upwards, a drop of the solution now falls into the lower sac; the lid is held for half a minute to prevent the escape of the fluid. The other eye is used as a control. In a few hours itching and smarting of the inner canthus is felt, provided the case is tuberculous, congestion of the there is vascular engorgement and lachrymation. The reaction is at its height in six to ten hours, and as a rule, there is not much discomfort. The Calmette test is of great value; its chief and undeniable disadvantage is the risk of damage to the eye.

3. Complement Fixation Test.

During his investigations upon the nature of the defensive mechanisms of the body, Bordet found that two substances were concerned in bactericidal action; one, in fresh serum and is in its nature thermolabile - destroyed by heating to 55°C., and another in immune serum which is thermostabile in character. The thermolabile body is known as the complement. The thermostabile body is also known as the amboceptor or immune body. The amboceptor is a specific substance being related to its own specific poison, bacterium or its toxin; for example, a mixture of fresh serum with inactivated ante-cholera serum being bactericidal to cholera vibrios only.

The same investigator also pointed out, that the phenomenon following the inoculation of one species of animal with red blood corpuscles from another species present many analogies to the anteraction in the case of cholera vibrios in the blood. For this reason, and its convenient nature so much work has been done on haemolytic sera.

Thursfiedd in "Diseases of Children" by Garrod, Batten & Thursfield, 1913, p.17, describes the test very clearly as follows:-

"An animal immunised by repeated small doses of bacteria or bacterial toxins, owes its immunity to the interaction of three substances.

1. The antigen, i.e. the substance injected (e.g. bacterial vaccine).
2. The immune body, also called the amboceptor or copula, produced by the action of the antigen on the tissues.
3. The complement, a substance normally present in blood serum.

The amboceptor forms a link between antigen and complement, thus neutralising the effect of the antigen. The amboceptor is specific, combining only with its related antigen; the complement however is not specific and can interact with any amboceptor and its related antigen".

The whole process can be compared with a key, a lock which the key fits and the hand which turns the key in the lock; the key is the antigen, the lock which it fits and to which it is related therefore is the amboceptor, any hand will turn the key which is compared to the complement. As has already been stated, the amboceptor is thermostabile, the complement is thermolabile. It is evident then that a mixture of amboceptor and complement can be freed of its complement by heating

to 55°C. Such destruction of the complement in a serum is known as "Inactivating"the serum.

The complement is said to be "fixed" when there has been interaction between antigen amboceptor and complement. When there is present only antigen and amboceptor the system is known as "Incomplete".

These facts have been used to devise a test which is of wide application, and has especially been adapted in the diagnosis of Syphilis, where it is known as the "Wasserman reaction test". Briefly the method of procedure is as follows:-

A rabbit is injected with the corpuscles of a sheep (antigen), an immune body is formed in the rabbit's serum (amboceptor). Place in a test tube a suspension of sheep's corpuscles in mormal saline solution, and bring into contact with it some of the rabbit's serum, haemolysis occurs in the test tube, there is an interaction between the antigen (sheep's corpuscles), the immune body or amboceptor (formed in the rabbit's serum) and the complement (normally present in the serum).

Now make an incomplete haemolytic system as follows:- Heat some of the rabbit's serum to 55°C, the complement is inactivated but the amboceptor being thermostabile is still present, when the inactivated rabbit's serum is now brought into contact with the suspended sheep's corpuscles

no haemolysis occurs. This incomplete mixture is placed on one side and a second mixture is made as follows:-

(1), Syphilitic antigen, e.g. an amulsion of the liver of a syphilitic fetus.

(2), Inactivated serum from a patien suffering or suspected to be suffering from syphilis (amboceptor).

(3), Fresh guinea pig serum (complement).

Suppose that the specific immune body or amboceptor related to the antigen is present in (2) , it will then link up (3) and (1). If the amboceptor is absent or the person has no syphilis there will be no interaction, the complement will be left free in the mixture.

Let it be granted that the complement is left free in the mixture, and that it is added to the incomplete haemolytic serum set apart as above described, haemolysis will take place, which shows absence of syphilitic amboceptor in the patient's blood.

Let it be now supposed that haemolysis does not occur, then there is no free complement, what complement was present in the guinea pig's serum has been taken up by the syphilitic amboceptor to interact or link it to the antigen, proving that the patient is really syphilitic.

This is the principle of the serum-diagnosis of Wasserman for syphilis, but as has already been stated

the reaction is of wide application. Chevassu (Presse Med. 1912, 173) discusses the value of the "Antigen Reaction". He found the nethod in advance of any at present in use, he examined the value of the method in 44 cases, with controlled reactions, obtaining exact results in 37 cases, unverified in 4, and inexact in 3. So that nine times out of ten the method was exact. The method will give in a day the key to a problem which may now take weeks to decide. The disadvantage of the method is its complexity and it can be undertaken only by laboratory workers. Its chief value is in renal tuberculosis, when the antigen method applied to the separated urines from each ureter would assist in ascertaining the condition of the opposite kidney where operation on the one is under consideration.

Commenting on the Antigen Reaction, in the diagnosis of tuberculosis, Francis D. Boyd (Medical Annual 1913, p.528) states,"It is only fair to state that so far British pathologists have not confirmed results obtained by Continental workers. Most positive results have been got by 'short cut' methods, which in the present state of our knowledge must be regarded with suspicion."

4. The Opsonic Index Test.

This improtant test was first discovered by Sir Almroth Wright, and like the Compelment Fixation test

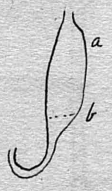
is a laboratory method, is of wide application, but has been especially applied to diagnosis and the treatment of tuberculosis by tuberculin. More than anything else it has been due to Wright's discovery that the wider use in recent years of vaccines has arisen. It is for this reason and not for its clinical importance that reference is here made to it. The author can well recollect carrying out the various steps in the test in the Pathological Department of Trinity College, Dublin, when the complications, the dexterity and skill required, together with the fallacies depending on the personal factor of the examiner made it evidently an unsuitable clinical test. Thursfield (loc.cit.) sums up his opinion of the test in these words,"Much controversy has taken place on this subject, but, without entering into the argument, it may be briefly stated that, in the writer's opinion, the fallacies in connection with this test are so numerous and so little appreciated, that the test is of slight value to the clinician". Moss (Johns Hop. Hos. Bull. July 1907) found that even if 300 Leucocytes are counted there is still an error of 10% .

Rivière and Morland in their recent work on "Tuberculin Treatment", state "Both of us have used it as a guide to specific treatment, and have learned much from it of dosage and interval, but having applied the know-

ledge so gained, regard it no longer as an indispensable guide". This is in the author's opinion a t rse and truthful statement of the value of the opsoninic index, it is more useful as a guide to treatment by vaccines than in the department of diagnosis. The author is also of opinion from his own small knowledge of the technique that the test whenever used should be carried out by the same skilful worker, and not by different workers.

Metchnikoff ignores the important properties of blood serum in his "Phagocytic theory of immunity", and it was left to A.E.Wright to demonstrate the existence in blood plasma of substances possessing the power of preparing bacteria for phagocytic action. It is these substances in the blood plasma which are called opsonins. (ὀψωνέω).

Briefly the technique of the process is as follows:-



Blood is collected in a pipette shaped as shown in the diagram, the ends are sealed, and the tail hooked by its curved end to a centrifuge. On centrifuging the corpuscles collect at a, and the tube is broken with a file at b, the serum is drawn off by a pipette.

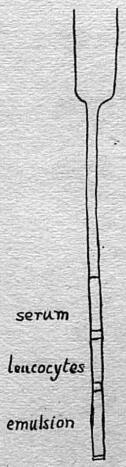
Next serum free corpuscles are collected by allowing some of the patient's blood to drop into a 1% solution of sodium citrate in normal saline. The citrate prevents coagulation. The mixture is centrifuged well and the

supernatant fluid is decanted off; more sale is added, again centrifuged, and repeated once more. After this second washing the upper layer is found rich in leucocytes, and is employed as "washed leucocytes".

Then an emulsion of the organism is made by grinding a loop-full of dead bacilli (for tubercle bacilli) in an agate mortar with salt solution, and then centrifuging.

We now have three preparations, blood serum, washed leucocytes, and bacterial emulsion.

Now comes one of the most delicate operations, for the tyro, where equal quantities of each of these preparations are drawn up into a tube, surmounted with a rubber nipple and its other end drawn out into a long capillary stem.



A mark is made on the glass stem about 4 m. or $\frac{1}{4}$" from the end with a greased pencil, or better still with a hair dipped in Brunswick black (Jeans and Sellards, Johns Hop. Hosp. Bull. Aug., 1907). The rubber nipple is lightly compressed, the end of the capillary stem is inserted into the prepared serum, and some of the serum is drawn up until it reaches the mark on the stem; a slight bell of air is now drawn in by slightly relaxing the pressure on the nipple. Then leucocytes, then a bell of air, and finally the bacillary emulsion.

The contents are now squeezed out on to a glass slide,

well mixed and re-aspirated into the capillary tube.

Another control capillary tube is prepared with normal serum instead of pathological serum and used as the control.

Both tubes are now sealed and incubated for fifteen minutes at 37°C. Films are then made from each tube and stained as usual. The number of bacteria in 20 or 30 cells is counted and an average struck for each of the films. The ratio of the number ingested in the preparation with the patient's serum to the other, stated as unity, gives the opsonic index of the patient's blood.

These are tests then which do not depend upon the seat of the infection, but are applicable in all cases of tuberculosis - unless there are contraindications in some particular case. There still remain for consideration a few other methods of diagnosis which are not generally serviceable, as are the above methods, but which are of great assistance in certain seats of affection.

They are:-

1. The examination of the sputum for tubercle bacilli
2. X-ray examination.
3. Laboratory methods.

1. The frequent absence of sputum in children is the chief reason for the more general use of this method in adults than in children. L. Emmet Holt (Pulmonary Tuberculosis in Infancy & Childhood, Kelynack's Tuberculosis,

1908) manages to obtain sputum from his cases by "Exciting a cough by irritating the pharynx, and catching the sputum brought into view upon a piece of muslin in the jaws of an artery forceps". Time, patience, and repeated examinations are necessary, he states to obtain the sputum satisfactorily. "During nineteen months at the New York Babies' Hospital the same authority observed 67 cases of pulmonary tuberculosis, 52% of these were under 2 years of age, and 15% under 6 months; tubercle bacilli were found in the sputum of over 80%, although in more than half of them the disease was not advanced judging by the symptoms and physical signs. Holt's observations further reveal the presence of tubercle bacilli in the sputum of 52% of cases of tubercular meningitis in the New York Babies' Hospital, although in many cases there were no pulmonary symptoms, or these were so slight as to be readily overlooked. In describing the symptoms of Pulmonary Tuberculosis in early life in the same contribution, Holt states, "The symptoms lead no one to suspect from them in most cases the nature of the disease. Such cases are only recognised by finding tubercle bacilli in the sputum."

The author has obtained assistance in diagnosis from the absence and presence of tubercle in the sputum of children of all ages in very severe cases of pertussis complicated by extreme wasting, exhaustion and broncho-

pneumonic signs of long duration. During the present year, 1913, some of the schools in East Pembrokeshire were closed in consequence of a virulent epidemic of measles, followed by another equally virulent one of whooping cough. Among the worse cases of whooping cough were three children, who were, or had been recently suffering from, active tubercular disease outside the chest. The author was of opinion, from the very grave condition of the emaciated children, that the chest organs had become infected; sputum was several times collected by Emmet Holt's method, the vomit he carefully rejected, and no tubercle bacilli were seen. The ultimate rapid recovery of these children confirmed the author's feeling, from the absence of tubercle bacilli, of the absence of serious tubercular lung infection. The acute symptoms and physical signs were of such long duration, in one case nearly a month and in another five weeks, and these continued with such severity, as to exclude broncho-pneumonia, and suggest empyema or tubercular trouble. Empyema was excluded by carefully examining the children and by needle exploration, so that extensive tubercular disease might otherwise have seemed clinically positive.

The author has in a few instances derived much assistance in excluding phthisis in doubtful early cases of whooping-cough among adults, and older children, from

an examination of the sputum on several occasions. Last September (1913) when examining school children in East Pembrokeshire, the author was shown two sisters, aged 11 and 14 respectively, presented as special cases by the school teacher, and suspected as cases of early whooping cough. Both were pale, anaemic, with slight frequent cough, no expectoration had been noticed by the teachers. In both sisters parts of the left lung, in the axillary region, were dull on percussion, with moist and dry râles more generally spread over the same lung. Neither had rise of temperature. The sputum was obtained without any trouble from the older girl, and from the younger by Emmet Holt's on the first occasion and naturally afterwards, the sputa were frequently examined and tubercle bacilli were found in each case. They have both been under treatment ever since and are under the supervision of the County Tuberculosis Medical Officer, and are reported by him to be making satisfactory progress.

The author does not consider it possible to obtain sputum in all cases, but after observing the results obtained in the case of babies at the New York Babies' Hospital by Emmet Holt, and from his own use of the same method, he is of opinion that, where the school Medical Officer is also the medical attendant upon the children or can win the support of the medical attendant,

and diligence and patience are used, the obtaining of satisfactory samples of sputum is by no means difficult in the majority of children of school age.

In Pembrokeshire samples of sputum are sent to the Tuberculosis Medical Officer, who sends them to the pathologist of the Welsh Tuberculosis Memorial to Edward VII. So that there is no trouble, nor expense, nor indeed excuse for neglecting this important method of diagnosis. In the author's own practice he follows the method taught him at the pathological laboratory of Trinity College, Dublin. A portion of sputum - preferably the first morning's expectoration - is chosen, containing if possible some of the small yellowish masses, this is placed between two clean slides and well mixed and broken up, a cover glass film from this is taken, dried in the air and fixed by passing film upwards in a bunsen flame. The cover glass is now placed on the edge of a strip of metal about half an inch wide and a few inches long, with one edge or corner projecting over the metal strip. A few drops of carbol fuschin are dropped on the cover slide to well cover the film, care being taken not to let it run on the metal. Hold the metal strip well above a bunsen flame, so that the solution steams for five minutes, boiling must be avoided. The cover slip is now removed, the carbol fusehin is dried off with filter paper,

wash well in several changes of water, and then place it in a 25% solution of hydrochloric acid for ten seconds. Wash well in methylated alcohol until no more red colour comes away and rinse in water; then holding the cover glass film upwards drop on it some aqueous solution of methylene blue and allow it to stain for thirty seconds. Drain off the surplus stain with filter-paper, wash in water rapidly, dry with filter paper by holding it by the finger and thumb well above a flame. The tubercle bacilli will be stained red the other parts of the film and micro-organisms being coloured blue. The film can be mounted if desired in liquid paraffin, which can be used instead of cedar-wood oil for oil immersion. For estimating the time the pulse rate can be counted.

2. X-Ray Examination. This method has now attained an established position in the diagnosis of early pulmonary tuberculosis and of early deposits of tubercle in bone. The author remembers seeing in the X-ray department of Trinity College, Dublin, an X-ray photograph of an early tubercular deposit in the end of one of the long bones of the lower limb of a foetus, which was confirmed by examination after birth. It is in the department of early pulmonary tuberculosis that the method has been most useful. Reginald Morton (Brit-Med. Journ., Oct.11th 1913) writes, "It is not too much to hope that this

position will be greatly strengthened in the future". Lawson, writing in the Practitioner (January, 1913) in a contribution on "X-rays in the diagnosis of lung diseases" states, "Experience has not only substantiated those claims which were set up sixteen years ago, but it has exalted and glorified them, until now it may truthfully be said that the consultant, who, in the diagnosis of a difficult and obscure lung condition, has not brought to his aid the service of X-rays, has failed alike in his duty to himself and to his patient.

The radiologist in making an examination of the chest for pulmonary disease notes among others the following important points:-

1. Opacity, local or general, and the effect produced thereon by deep inspiration.
2. Movements of the diaphragm and ribs.
3. The size and position of the heart.
4. The presence of the shadows of enlarged bronchial glands with striae radiating therefrom into the lungs.
5. The presence of tuberculous foci.

("The present position of the X-ray diagnosis of pulmonary tuberculosis", by E. Reginald Morton delivered in the section of Electrotherapeutics of the British Medical Association and published in the Brit. Med. Journal, Oct. 11. 1913.)

Opacity. It is generally agreed that the presence of more or less opaque areas in the lungs, which do not illuminate on deep inspiration, as well as the surrounding parts, is very suggestive of tuberculous infiltration. The sign is of great delicacy and can be observed only at the screen examination. On the contrary it must not be overlooked that cavity formation reveals itself often by an abnormally light area on the screen; on the other hand an old chronic thick-walled cavity will appear as a dense dark ring enclosing a bright clear space (Lawson loc.cit)

Movements of the diaphragm and ribs:- At one time limitation of the movements of the diaphragm was regarded as pathognomonic of tuberculosis, at present we are not disposed to go so far as this. Free movement is presumptive evidence against tuberculosis, and vice versa, but more than this cannot be claimed.

The Heart:- A large proportion of cases of tuberculous invasion of the lungs have a relatively small and centrally placed heart; it is so common that it must be more than a coincidence.

The Presence of Enlarged Bronchial Glands with striae radiating therefrom:- It is doubtful if there is complete agreement on this point (Morton, loc. cit.) That many children and practically all adults living in towns have them and that most of the latter at least are

not the subjects of pulmonary tuberculosis sufficiently proves that their presence cannot be accepted as positive evidence of anything in particular. All we can claim with any certainty is that, while the chest showing enlarged glands and striae on one or both sides may be tuberculous, it is not necessarily so. Frequently one of these striae will be found to run through or end in a tiny round or oval shadow - a tuberculous focus.

These small tuberculous foci scattered through the network of fine striae are probably the most characteristic appearance we get, and the most positive evidence we have of tuberculous disease of the lungs (Morton loc. cit.)

Referring to the use of X-rays in the diagnosis of tuberculous disease of the chest Sir Clifford Allbutt sums up his opinion thus (Practit. January, 1913) "It is not for me to say at what measure of certainty an interpreter of these phenomena may arrive, but an expert is not always at hand. For the rest of us, I think, are as yet far from the hope that our methods of physical examination laborious and fallible as they may be, will be superseded by the screen." In the same journal (p.289) Eric Pritchard referring to children writes, "Evidence of skiagram, distinct in advanced cases, unreliable in recent cases."

3.Laboratory Methods: These are daily increasing in number and a passing reference only is necessary to a few of the more important. The examination of the blood for tubercle bacilli, is a very recent method of diagnosis. Rosenburger (N. York Med. Jour., June 19, 1909) believes, as a result of his observations, that the presence of the tubercle bacillus in the blood is an almost infallible test of tuberculosis, and contended that the tubercle bacillus could almost invariably be demonstrated in the blood of tuberculous patients. Hewat & Sutherland (Brit. Med. Jour., Oct. 16, 1909) do not accept Rosenburger's conclusion and hold that at no stage of localised pulmonary tuberculosis is the bacillus demonstrable in the blood. At present it is better to keep an open mind on the matter, and in the words of Clive Riviere (Modern Methods in the Diagnosis of Phthisis, B.M.J., Aug. 30. 1913), "The examination of the blood for tubercle bacilli, has hardly yet reached the stage of practical utility, though it may do so in the near future."

The examination of the sputum for albumin has been shown by Nathan Raw (B.M.Jour., 1911, ii, 1470) to be an addition to the diagnosis of tuberculosis before any physical signs appear in the lungs. His method is to mix 5 c. cm. of the sputum with 20 c. cm of physiological salt

solution in a test-tube; add five or six drops of acetic acid, and shake up the whole then filter; the filtrate is then tested for albumin by heat or by the cold nitric acid test. Fullarton (Glasg. Med. Jour., 1912, ii, 8) found albumin absent in 50% of phthisical patients and 86% of non-phthisical patients; he concluded that where much albumin is present in a case of bronchial catarrh not due to acute bronchitis with fever, or pneumonia, or bronchiectasis, then tuberculosis should be suspected. The examination for albumin according to Clive Riviere (loc. cit.) assists in differentiating between bronchial and pulmonary sputum.

The cytological count of the sputum has also been brought to the notice of the profession as an aid to diagnosis. Wolff-Eisner, quoted by Clive Riviere (loc. cit.) has shown that a large preponderance of mononuclear cells (lymphocytes) occurs in early phthisis, and may focus suspicion on a case before the tubercle bacilli have been discovered.

The same authority has called attention to Much's discovery of a granular form of tubercle bacillus, which does not retain the stain in Z. Nielsen's method and requires a modification of Gram's staining to demonstrate its presence. Roepke found 12% failures to the acid-fast method with positive results in all these to Much's method,

and he thinks both must be used where certainty is required.

It only requires to mention one more recent method of sputum examination to practically complete the laboratory methods in use. The anti-formin method (15 per cent liq. sodae hydrat. and liq. sodae chlorinatae, equal parts) of sputum examination. It has immensely facilitated the technique of sputum examination for tubercle bacilli. There are various modifications; one, in which acetone-antiformin is used does not require the use of a centrifuge and is described in the B.M.Journ. 1911, ii, 596.

The Utility Of The Above Methods Of Diagnosis. It is not so much in discovering tubercular disease in a child attending school, as in determining the presence of active disease that these methods affect us. The author has referred already in considering in particular each of the methods to this matter, but it is now necessary to refer to them in general so far as they aid in discovering active tubercular disease.

The greatest assistance in the use of the subcutaneous test is to be found in the "Negative febrile reaction" and the "Positive focal reaction"; but the test cannot be conducted during the course of the ordinary school medical examination. It is true, as the author has quoted above, Bandelieu and Roepke have given ten

to twelve thousand injections of tuberculin without any evident harm, but they are experts. In addition the test can only be safely used in cases which are a-febrile, a casual examination of the temperature during the school inspection would be insufficient to determine the presence or absence of fever. The consent of the parents should be obtained, and most often the parents in agricultural rural areas are unable to be present. Finally the child during the usual period of reaction must be watched in order to determine whether there has been a general or focal reaction, and this is in a widely scattered thinly populated area impracticable. The same objections to some extent apply in the cutaneous tests, and these do not differentiate between active and inactive tuberculosis, being of greatest use in confirming absence of tubercular disease in very young children, who would be too young to attend school, where there has been no reaction after repeated tests. As the author has already stated the ophthalmic reaction is practically obsolete; then again the complement-fixation and opsonic index tests are only suited for those with the necessary technical knowledge and skill. The other laboratory tests cannot be utilised in the course of the ordinary school medical inspection, but are very useful where ordinary methods of examination are insufficient and where the children can remain under the observation of such as are skilled in this department.

The Diagnosis of active tubercular disease in school children by the medical inspector is on the whole dependent upon the investigation of the family and personal history, and a close and thorough examination of the child's signs and symptoms. The school medical officer should not in the present state of our knowledge be expected to proceed further, if he is in any way uncertain or suspicious respecting the presence of active tubercular disease, then he should inform the child's parents and at the same time the family medical attendant of his suspicions. The family medical attendant can if he thinks it desirable utilise any of the methods of diagnosis described above, and in Wales he is given greatassistance in this matter by a richly endowed Memorial with an army of tuberculosis medical officers and nurses. In the county of Pembrokeshire all teachers are given cards upon which the family history and personal history of the child has to be filled, and when the child enters school as a new comer the card is presented to the doctor at the medical inspection. Under the system which the county medical officer of health has introduced every child is examined within a year after its admission. If the family and personal history are satisfactory as well as the child's physical and mental condition he is examined again in Standard two and a year before leaving

school, All defective children are examined until the defect is removed, or until he is considered physically satisfactory, but all children coming from families and houses infected with tuberculosis are kept under constant observation, and repeatedly examined, irrespective of their freedom from any signs or symptoms.

The importance of the family history in the diagnosis of active tuberculosis is universally accepted, in consequence of an hereditary transmission of an enfeebled physical condition and of the greater risk of infection. Ashby & Wright (Diseases of Children, p. 234) state, "In making a diagnosis the family and personal history is of great importance; if other children or older members of the family have died of tubercular disease, the probabilities in a doubtful case will naturally be in favour of tubercle." We also find the importance of family and personal history when we consider the question of predisposition; e.g. in Kelynack's Tuberculosis of Infancy and Childhood it is thus written, "As a practical measure it would be well if the offspring of all tuberculous parents were dealt with as predisposed subjects." L.G.C.Money in "Riches & Money", 3rd edit., p.160, London, 1906, writing on the same matter states, "It is well not to forget that of the 1,200,000 added annually

to the population of the United Kingdom, one-quarter to one-third are born into conditions of want and squalor." Emmet Holt of New York in his contribution to Kelynack's Tuberculosis, 1908, also points out the importance of the family history in the diagnosis of tubercular disease in these words, "It has been my custom to consider as probably tuberculous every infant who has been for any length of time in contact with a tuberculous parent or other tuberculous member of a household." The Chief Medical Officer to the Board of Education in his Annual Report for 1913 (p.74) has extracted the following portion respecting the question of diagnosis in tubercular disease from the report of Dr. Raffle of South Shields, "The points I personally lay stress on are loss of weight, winter cough, night sweats, and a family history of tuberculosis."

The Personal History of The Child. To my mind the knowledge of those complaints which predisposes the child to tuberculous infection is of much importance to the school medical officer. Every child entering school for the first time, or coming from a school outside the authority of the Pembrokeshire county council, has its personal and family history summarised on the medical inspection card by the head teacher. Whipham (Medical Diseases of Children, London, 1912, p. 125) states, "The infection

may be acquired by way of the intestinal tract or it may gain an entrance through some local condition, such as enlarged tonsils, adenoids, any lesion of the mouth or nasopharynx, or chronic otitis media.

A predisposition to tuberculosis or glandular enlargement favours its onset, and a previousattack of one of the infectious fevers, especially measles or scarlet fever, often act as the exciting cause." The same writer (loc. cit.p.21) states, "Tuberculous children further have a history of being delicate from birth." A number of children are described by parents as having at some time of their life been 'delicate'. No amount of questioning will definitely clear up this vague pathological condition, and in these it is wise for the medical examiner to recollect the possibility of tubercular disease which healed or became latent. In the Annual Report to the Board of Education, 1911, p.70, the Chief Medical Officer refers to this matter, he states, "The fact that such slight infections are known to occur and to heal unrecognised, makes it probable that a certain number of children who may be apparently healthy or may be suffering from general delicacy or 'debility' have somewhere in their bodies a focus of tuberculosis," and to this he later adds, "If there is already a previous infection or even a predisposition, the disease may at any time become active or be contracted afresh."

The author here desires especially to draw attention to the group of children who are classed in school reports as suffering from "defective nutrition". In Pembrokeshire about 12% of the children suffer from poor nutrition which the chief medical officer attributes to:-

1. Unsuitable food.
2. Insanitary homes.
3. Insufficient sleep.
4. Disease (especially decayed teeth and adenoids)

The author has however more closely investigated the causes of mal-nutrition and finds that quite an appreciable number of these children live in homes where one or more members of the family are tubercular, and is very inclined to regard the mal-nutrition as evidence of tubercular infection. So much is this the case that the author's percentage of mal-nutrition is lower and the percentage of tubercular children or suspected tubercular children is correspondingly higher than that of the other medical officers. Reference is made to malnutrition later in the thesis.

The signs and symptoms of active tubercular disease in school children depend entirely upon the seat of mischief, surgical tuberculosis, as it is termed, seldom gives much diagnostic trouble to the medical examiner. The intra-thoracic form is the one he is chiefly interested in from the standpoint of diagnosis. Judging

from the Annual Reports of the Chief Medical Officer to the Board of Education, it is evident that whole time school medical officers are not sufficiently acquainted with the pathology of tuberculosis in children of school age. They are not sufficiently mindful of the fact that in children the infection is by way of the lymphatic system, and in children it is essentially a disease of the lymphatic glands, that the type of intra-thoracic disease noticed in children is not what obtains in adults, and that children may be very seriously affected with tubercular deposits without there being any apparent signs or symptoms. A glance over these Annual Reports will reveal such statements as, "my first procedure is to decide that the child has definite symptoms of ill health," or "he further considers that unless the apices and bases of the lower lobes of the lungs are most carefully examined in children the examination is valueless." Medical men in general practice are aware that to wait for definite symptoms is to wait for disaster. Eric Pritchard (Tuberculosis in Children", Pract. January 1913) calls attention to this frequent absence of symptoms, he states, "Infants may literally be riddled with tubercles, and older children may have extreme involvement of the mediastinal or peritoneal glands, without the exhibition of any serious impairment of health or constitutional symptoms. Wasting is by no means an essential feature until the disease is very far

advanced." The author has relatively frequently noticed in private practice cases of tubercular disease in children of evidently advanced type without any physical signs. It is by no means uncommon to find children with advanced phthisis where the physical signs are exactly like those of bronchitis, yet the sputum is on examination laden with tubercle bacilli.

Hogarth (Medical Inspection of Schools, London, 1909, p.268) states, in reference to the difficulty of early diagnosis of active tubercular disease, that, "The only safe rule is to treat all children of the well known strumous or scrofulous constitution as if they had an unrevealed form of tuberculosis."

The Symptoms of Active Tuberculosis in School Children

These vary in degree very much as can be understood and depend upon the virulence of the infection and region attacked, but most frequently we observe whenever there is active mischief such symptoms as:-

1. Pallor, amounting to anaemia is seldom observed, except of course in bone or joint affection with early loss of sleep, or in advanced disease. Authors frequently mention this symptom as common, but the author is emphatically of opinion that it is not so common in early cases, he is more suspicious of those bright looking children whose rosey congested cheeks carry a false impression of good health. The author can recall several such rosey-cheeked

children in Pembrokeshire and Carmarthenshire who have undoubted latent or mildly active tuberculosis, some have later in life died from phthisis or general tuberculosis.

2. Lassitude, physical rather than mental, together with poor morning appetite, depression of spirits alternating with extreme buoyancy. Tubercular children do not readily join in games but are more gentle and refined in their nature, frequently they are the most brilliant scholars in their standard. "Those whom the Gods love die young" is not without its foundation of fact.

3. Dry cough, with some persistance, unaccompanied by much in the way of physical signs is a frequent symptoms in intra-thoracic disease. The author has reason for regarding such a symptom in older children - if it is accompanied by a frequent pain in the side of the chest - as almost pathognomonic of phthisis. The examiner should keep in mind the possibility of whooping-cough in those cases of persistent dry cough where the physical signs are our of proportion to the subjective symptoms.

4. Elevation of Temperature, It is not often that the school medical officer notices this. The author has good reason for accepting this as an early sign of frequent occurrence in private practice, and for that reason regards the symptom as one which the school doctor should not overlook. W.T.Cummins (Kelynack's Tuberculosis, 1908,

p. 21) states, "As is well recognised irregularity and elevation of the temperature is often the earliest and most suggestive indication of a developing tuberculosis in children." The author was asked to examine a lad of eleven years of age, two years ago in whom the only symptom was an elevation of temperature with the usual accompanying symptoms of fever, which condition persisted for several weeks; a Widal's test proved negative but the boy reacted to a cutaneous tuberculin test at home and later in a sanatorium, later he developed a persistent dry cough with a few dry rales. The boy was treated at a sanatorium for several months, and even after his return active exercise invariably caused an increased temperature. He was never pale and never developed any physical signs, apart from a few dry râles and increased temperature.

The author has at the same time met with other cases where there has been no fever.

5. Night-sweats, are common in many children's ailments and for that reason the author does not lay much store on this symptom when it occurs in young children, but in others who are older the author agrees with the observations of others and their conclusion in regarding the symptom as an important one in early intrathoracic disease. Eric Pritchard (loc. cit.) states, "A child, twelve years of age, who regularly suffers from profuse perspiration at night, with beads of cold sweat showing on the face and

forehead, is probably actually tuberculous or at least a candidate for tuberculosis." The author again feels it his duty to refer to the possibility of overlooking whooping-cough in such case as described by Dr. Pritchard for the above description is an excellent pen picture of an isolated case of whooping cough without the characteristic symptoms in a girl of fourteen, who quickly recovered after the whooping cough subsided from a nightly recurrence of copious cold perspiration.

Regional Diagnosis. The well known methods which have been described with the personal and family history of the child, as well as the symptoms mentioned, are all of use in determining if, in a general way, the child is suffering from tuberculosis or not. They do not determine conclusively if the disease is in a latent or active state, nor indeed the actual seat of the disease. These most important points can of course only be investigated by a detailed and careful regional diagnosis. For the sake of clearness and convenience the author has divided the diagnosis of regional tuberculosis into three great classes:-

1. The Diagnosis of Intra-thoracic tuberculous glands.
2. The Diagnosis of Surgical tuberculosis.
3. The Diagnosis of Miliary tuberculosis.

1. Intra-thoracic tuberculous glands. As has already been stated by the author precedence of place must be given to X-ray examinations for determining the presence

or absence of such glands. Reference has already been made to the want of complete agreement upon the significance of opacities in X-ray photographs of children in this neighbourhood of the chest, but it is only the authors duty to make mention of the observations of A.G.L.Reade and F.G.Caley (Lancet, 1912, ii, 1501). These writers specially emphasise the value of X-rays in the diagnosis of tuberculosis of the mediastinal glands and tuberculosis commencing at the pulmonary root, and in spite of the prevalent impression above referred to in this thesis these writers are convinced of their importance. They examined a series of control children of about the same age, who were in good bodily health, and failed to give a positive von-Pirquet reaction, and in them no opacities were seen. The shadows seen in those who react positively to the test consisted of either linear striation corresponding to the larger bronchi, or of an indefinite mottling, or showed a more definite circumscribed outline.

In a scattered thinly populated rural district like Pembrokeshire and West Carmarthenshire the great difficulty in X-ray work is its impracticability. The local profession owes a debt to one of its members - Mr. Brook of Swansea - for his recent demonstrations upon the utilisation of X-rays in country work. The author is in a position to state that so far as Pembrokeshire is concerned we shall soon have such an outfit provided for local use

by the Welsh Memorial Association. Until then it will be impossible to make any remarks upon its utility in local school examination work.

The methods we are therefore up to now compelled to follow in school medical work in order to arrive at our conclusion, although not conclusive, in respect to intra-thoracic glandular tubercular infection depend almost altogether upon pressure symptoms and signs and other evidences of spreading to the lungs. These signs and symptoms are :-

a. Subjective. Although common at the outset of the invasion ofthese glands, they are not sufficiently distinctive to be conclusive. Yet the author is of opinion that the existence of such symptoms should be made known to the medical examiner, for in children they may easily escape notice during the medical inspection, and that the chest of such a child should be examined in detail. As suspicious and suggestive symptoms Zabel (Munich, Med. Woch. 1912, 2664.) mentions catarrh, pyrexia especially after exercise, asthenia, tachycardia, cough, pain, dysphagia, and dyspnoea. Dysphagia was only noticed by Zabel once, he mentions the presence of a dry irritative cough in 80 per cent of the cases due to pressure of these glands, an attempt at swallowing being very apt to provoke it, and it may be impossible to distinguish it from whooping-cough. Unfortunately the author has

however in a number of school children found no symptoms caused by early implication of these glands, and none of those enumerated by Zabel were brought to his notice nor observed by him until there were evidences of spreading to the lung. Perkins (Med. Ann. 1914, p. 163), writing on this subject, is also of opinion that symptoms caused by pressure of glandular masses on vessels and bronchi are rare, and he explains this rareity by the small size of the affected glands and because the glands most frequently affected are the inferior tracheo-bronchial lymphatic glands, which he states are not in a position to produce pressure symptoms.

b. Objective signs. In school medical inspection it is the utilisation of these signs after all which have proved themselves the most reliable and practicable in determining the presence of intra-thoracic glandular infection.

Inspection as may be expected has not given the author any material assistance, limited chest movement he has not observed to be of any value, the boy who had the best developed and largest movement of his chest in the Narberth Non-Provided School during the medical inspection in 1914 was found to be infected with tubercular cervical glands and such signs as to lead to the conclusion that the intra-thoracic glands were also affected.

Enlargement of the superficial veins in the upper third of the chest, especially when unilateral - on the

right, and radiating from the coracoid process to the sternal end of the second intercostal space, does occur occasionally, as also do other phenomena as difference between the two radial pulses, and laryngeal paralysis, but they must not be expected for as a matter of fact the glands most often affected intra-thoracically are not in a position to produce these signs.

Percussion over the thoracic wall is without doubt the most serviceable method of examination in the mind of the author, provided it is carefully carried out. The medical examiner must however bear in mind the areas of the chest which are most frequently affected in young and older children. This method of examination for intra-thoracic tubercular disease in children seems to have won considerable weight in the mind of Dr. Eicholtz, one of the medical officers to the Board of Education. The author following the advice of this authority has paid very considerable attention to this means of ascertaining the presence of tubercular deposits. The author is aware that this is not the opinion of all. Perkins (loc. cit.) as a result of his investigations concludes that percussion of the thoracic wall only gives results in tumours of large size. The author is unable to verify his cases by post mortem examinations or X-ray photographs, and is therefore unable to say whether such cases as he has discovered by percussion are cases of large medium or small

sized tubercular enlargement. Two papers referring to this important means of diagnosis, read by Dr. D.B.Lees and Dr. Clive Riviere on the Diagnosis Of Chronic Pulmonary Tuberculosis In Childhood at the British Medical Association in July 1914, point out very clearly the great assistance obtained in establishing a diagnosis of chronic pulmonary tuberculosis in children by careful percussion. "It appears to me," said Dr. Lees "therefore, that careful and accurate percussion is of primary importance in the diagnosis of early pulmonary tuberculosis, both in the child and in the adult, and that it is capable of detecting the disease at a much earlier period than is possible by any other method of investigation." The author regards such a statement from so high an authority after what he has discovered for himself in his school examinations and general practice, conclusive in regarding percussion in this department as of the very greatest importance. Dr. Clive Riviere confirms this in his paper just referred to. He there said, "Two notable additions to our clinical armamentarium now enable us to discover disease at a far earlier stage. Of these the first is the widespread recognition of gentle percussion, and the second is the introduction of the Roentgen rays into medicine." The same authority at the same time pointed out a fact hitherto unrecorded,

that interscapular impairment as an early sign of tuberculosis of tracheo-bronchial glands occurs on the right side only. Most observers have noticed the greater frequency of dulness in the right as compared with the left interscapular region, but we have to thank Dr. Riviere for the above new point. He explains this apparent anomaly on anatomical and pathological grounds thus." I may say that evidence is collecting to point to pressure on the right pulmonary artery where it passes in front of the bifurcation glands as the causation of these right sided signs. The bifurcation glands are those most commonly tuberculous of all the thoracic group; they show the most extreme changes, and hence are probably the first to suffer."

Percussion over the spinous processes is regarded by some as of very great assistance in ascertaining intra-thoracic glandular enlargement and no doubt is in some hands proving itself a very useful means of diagnosis. Perkins (loc. cit.) quoting from Koranyi mentions that enlarged bronchial glands give diminished resonance over the fifth and sixth thoracic spines with an increased sense of resistance, and in children dullness is found over the third dorsal vertebra, and positive results are obtained by this means in 40 per cent of the cases. When

All this is amply the opinions or premises of others. There is no evidence of personal observation of the author to confirm or refute.

it is recalled that the bifurcation of the trachea normally lies between the ages of eight and fifteen between the first and third dorsal spinous processes the existence of dullness below this area would lead one to suspect enlargement of the inferior tracheo-bronchial glands, which have been mentioned as those most often affected in early cases. The author is now investigating this method but so far the results have not been encouraging, but as the number of cases have been so few the author has no desire to draw any conclusion, for theoretically the method is an excellent one.

Increased vocal resonance and whispering pectoriloquy over the vertebral spines. This is a method introduced by D'Espine and referred to by Eric Pritchard as a common sign of intra-thoracic glandular infection (Pract. 1913, i, 280) and mentioned by Perkins (loc. cit.) as being, according to Zabel and others, by far the most reliable sign of the presence of such enlarged bronchial glands, being nearly always present, certain in its results, and simple to carry out. The chest-piece of the stethoscope is applied over the vertebral spinous process from the seventh cervical downwards, the child meanwhile speaking or whispering some word like "thirty-three". In healthy children the sudden cessation of the tracheal vocal quality is very striking,

but where there are enlarged glands present the tracheal quality is heard below this "vertebra prominens", reaching sometimes below the level of the scapular spines to the fifth vertebral spine. Zabel calls particular attention to the point that it is the tracheal quality of the voice which must be observed and not mere loud conduction of the ordinary tone. Zabel gives the limits at which the tracheal tone is to be considered pathognomonic in young children at the seventh cervical vertebra; in children of eight years at the first dorsal; of twelve at the second dorsal; and in children of fifteen years at the third dorsal vertebra, corresponding to the natural descent of the bifurcation of the trachea with the increasing age of the child, in the fork of which bifurcation the enlarged glands lie. He and many others give D'Espine's sign the first place in the diagnosis of the enlarged bronchial glands of childhood, not even excluding X-rays from this comparison, he has found and proved it positive even when radiography has failed. The author has put the method to the test in several cases and has received much assistance from it, in the case of the boy, already referred to at Narberth Non-Provided School whose age is thirteen the tracheal quality is quite distinct down to the interval between fourth and fifth spine. The same was noticed in

the case of two sisters aged nine and twelve respectively at the Llandissilis Council School, chest symptoms were entirely absent in the younger child, but the older girl had had a dry persistent short cough for several weeks. In the younger girl there is definite dullnes over the right interscapular space, and on auscultation over the dorsal spines there is undoubted conduction of the tracheal quality of the whisper downwards; the older girl on percussion reveals slight dulness on percussion over the right interscapular space, below the level of the spines of the scapular and reaching over towards the left interscapular space to the left axillary region, auscultation reveals diminished respiratory murmur over the same area as compared to the corresponding area of the other side, and over the base of the left lung and apex of the lower lobe of the same lung there are moist rales which are very distinct during deep inspiration after an effort at coughing. Since this date both girls have been isolated and treated for intra-thoracic tuberculosis by the family medical attendant together with the tuberculosis medical officer, and both have confirmed my diagnoses, which were:- Tubercular disease of the intra-thoracic glands in the younger and in the older phthisis in addition. Although the physical signs over the dorsal spines have

been regarded by some observers as almost pre-eminent, the author together with the tuberculosis medical officer for Pembrokeshire have certainly not such an exalted opinion of these methods; we have both examined a large number of children, some of whom are undoubtedly tubercular, and we do not regard these methods so satisfactory as careful percussion over the interscapular area.

The existence of signs and symptoms of tubercular disease spreading to the chest organs from the infected lymphatic glands of itself reveals the presence of tubercular disease in the chest, and further reveals the important knowledge of active disease. Such signs are generally inseparable from the signs and symptoms of phthisis or general tubercular disease, and as such are described in detail below the author will refer to them later.

2.. The Diagnosis of Surgical Tuberculosis.

The detection in the course of medical inspection in schools of tubercular disease in bone, skin, joints and the more superficial lymphatic glands will not on the whole give the medical officer much trouble. This has certainly been the experience of the author and his colleagues in Pembrokeshire.

The number of cases of tubercular disease, apart from the intra-thoracic forms, observed in children in

the Pembrokeshire day schools (not including Pembroke-Dock) during the year 1913 was fifteen, of these ten were girls. It must of course be pointed out that these numbers refer only to such children as were attending school during the medical examiners' visits, consequently a number of cases - especially of surgical tuberculosis - are missed. The number of children who are at present known to be suffering from surgical tuberculosis while actually attending school in the area of the county of Pembroke just referred to during the year 1913 is:-

	Boys	Girls	Total
Cervical glands	1	3	4
Spine	3	1	4
Bones and joints	3	4	7
Abdominal	0	2	2
	7	10	17

The forms of surgical tubercular disease which the author discovered during the years 1912 and 1913 among children attending school in his area of inspection were:-

Tuberculosis of elbow joint. One case was found; the right joint was affected, the patient was a girl of fourteen years of age, there was a definite history of trauma three months previously, the symptoms present were slight effusion

and limitation of movements for about a month, with pain on extension. The diagnosis was confirmed by the family medical attendant, and treated accordingly by fixation and rest. The result is quite satisfactory.

Tuberculosis of knee-joint. Two cases were found. The one is a boy, aged ten, the disease started four years ago, for the last eight to ten months there have been no active symptoms present at all, and child's general health is excellent. Two cicatrices are present over the front of inner side of femur, discharge ceased nearly a year ago. There is much deformity, the joint is flexed and very slight movement is present. The parents do not desire any surgical interference to remove or lessen the deformity. It is very doubtful if the boy received any medical treatment at all. He lives two miles away from school and journeys to and fro on donkey-back. The other case is a girl, aged six years, there is active disease, the joint is kept flexed, there were three sinuses, discharging pus, apparently in connection with the femur, several members of the family have died from phthisis, a general examination revealed enlarged tubercular cervical glands and one old cicatrix of a former tubercular abscess in connection with cervical lymphatic glands. The child was excluded fromschool and treated by her

medical attendant.

Tuberculosis of cervical vertebrae. One case only has been discovered, a boy aged six was found with a history of injury immediately antecedent to the disease, the usual signs of early disease were observed, he was excluded from school and has been under medical care for several months and has returned to school again. There is now considerable deformity and as disease is latent the boy is allowed to continue school attendance under the supervision of the school nurse. The author on enquiry has discovered that the parents practically refused the assistance of the Welsh Memorial Tuberculosis Medical Officer, so that the great deformity is no doubt due to inefficient treatment.

Tuberculosis of dorsal vertebrae. One case was found, a girl aged fourteen, five foot eight inches tall in spite of the curvature of the spine. The disease after having been quiescent for four years has again become active, when previously ill the girl was treated at Great Ormond Street, London. The renewed activity is in the opinion of the author due to over-work on a farm with general weakness produced by excessive growth. The girl is now undergoing treatment at an institution.

Tuberculosis of cervical lymphatic glands. This

form of tuberculosis is, contrary to general opinion, not at all common among the children in my district. During 1912 and 1913 the author has only observed three definite cases of tuberculosis of these glands. Enlarged glands due to decayed teeth, adenoids, infected tonsils skin affections &c. are not included. Tubercular lymphatic glands in the neck are however very common in this part of Wales in young people of both sexes after school age. Two of the cases noticed were boys; one aged seven years was treated at home after being excluded by the author from school, he is now well; the other boy is aged twelve years, he has intra-thoracic disease as well, and has been placed under the supervision of the Welsh Memorial tuberculosis medical officer. On enquiry the author is informed that the boy is making very satisfactory progress and will soon be able to resume school attendance. The third case was a girl aged fourteen years, about leaving school, an abscess was in course of formation. She was excluded and placed under the care of the local tuberculosis medical officer and made very rapid recovery after simple incision and drainage.

"Note on the element of trauma in the above cases of surgical tuberculosis of school children. It will be observed that a definite history of traumatism is present in three out of five of the above cases where the joints

and bones were affected with tuberculosis. In one of these the disease followed immediately upon the receipt of injury; the disease followed after a brief interval of a few weeks in another; and in the third case traumatism in the form of over-strain at farm-work was largely responsible for the renewed activity of the tuberculous process in the dorsal vertebrae."

3. The Diagnosis Of Acute General Miliary Tuberculosis.

We mean by the term acute general miliary tuberculosis the fairly regular distribution of numerous small, grey, or greyish-red nodules, about the size of a millet seed, and approximately at the same degree of development in the organs of the body. The disease is as a rule acute and terminates fatally in two or three weeks.

The author desires to refer briefly to the etiology of the disease before dealing with the diagnosis of this form of tubercular disease, for a clearer conception of the difficulties encountered can be better appreciated after a brief reference to those pathological processes leading up to the general infection. It is generally accepted that blood vessel tubercles are of great importance in the production of the disease; these may be the result of encroachment on the walls of the blood vessels from

a neighbouring focus, or the bacilli may be brought directly into the blood vessel wall by the vasa-vasorum. The thoracic duct can be similarly affected, and it is interesting to learn that Astley Cooper first discovered tuberculosis of the thoracic duct in 1878 (Stilling, Virchow Archiv Vol lxxxviii, p. 118) A peripheral tubercular process may encroach upon the thoracic duct and break down into its lumens or the bacilli may enter the duct from such areas as the pleura or peritoneum, in which cases there are no lymphatic glands to intercept the progress of the bacilli (Brasch, quoted by Cornet, Lowenthal's Pract. Sect. on Tuberculoses, 1904, p. 636). We are also acquainted with other paths of entry for the tubercle bacilli into the blood stream, for example erosions into the pulmonary vein or the aorta from a pulmonary tubercular cavity has been discovered. Children are more frequently affected by acute general miliary tuberculosis than adults, and it has been suggested that they are more predisposed to this form of tuberculosis for these reasons. The circulation in childhood is quicker and does not favour thrombotic changes as the slower circulation in adults, the lymph channels in children are broader and more permeable, acute infectious fevers produce swelling and maceration of lymphatic glands, and in childhood traumatism is more frequent than in adult life.

The symptoms and physical signs:- The symptoms of miliary tuberculosis are partially the result of the local formation of tubercles and partially the result of toxic action, and of these the symptoms produced by the latter cause show themselves first. The process is similar to that seen in embolism (Cornet, Lowenthal's Pract. 1904, p. 656), the cheesy mass breaks up however and its constituent parts are carried deeper into the tissues.

Fever is one of the most frequent general symptoms and as a rule high, frequently persistent and exhibiting remissions, sometimes fever is almost absent, but it often resembles the fever of typhoid fever. The pulse is generally very rapid, 130 to 150; the blood pressure is low, the pulse feels soft, but is not so frequently dicrotic like the pulse is in typhoid fever.

In the respiratory organs we observe marked acceleration in breathing with dyspnoea, a severe distressing cough is very common, scanty frothy sputum tinged with blood is the rule. Signs of profuse catarrh of the lungs are generally found, percussion reveals nothing as a rule, but the disproportion between the extreme dyspnoeic symptoms and auscultatory signs cannot but fail to attract attention.

The nervous system would of course be affected by

the liberation of toxins and the deposition of nodules and the disturbances produced may be due to one or both of these factors. Headache, vertigo, restless sleep, delirium, semi-coma, stupor, and coma; muscular exhaustion and tremors are noticed together with those symptoms characteristic of meningitis, such as irregular pulse, contraction of the neck muscles, vomiting, &c.

The eye. Tubercles of the choroid are very important diagnostic phenomena. Finlayson in his Clinical Manual (Ed. iii, p. 179) calls attention to the "Shining Miliary tubercles occasionally seen in the choroid in cases of tuberculosis and tubercular meningitis." Their diagnostic importance used to be considered very high, but they are much rarer than generally thought. In addition "The restlessness and irritability of children suffering from tuberculosis often render it impossible to make a thorough ophthalmoscopic examination", (Ashby & Wright's Diseases of Children, 4th Edit., p. 233) Their diagnostic importance was first pointed out by Cohnheim (Ueber Tuberculose der Chorioidea, Virchow Arch., Bd xxxix, p. 49)

The discovery of the tubercle bacilli in the blood is of very little assistance, like choroidal tubercles their presence is an haphazard occurrence, similarly the presence of tubercle bacilli in the urine as is Proebsting's case (Ashby & Wright, iv Edit., p. 233) is too precarious a source of information. The sputum may

reveal the presence of tubercle bacilli if the chest or air passages are affected. Widal's serum reaction would help to eliminate typhoidal or paratyphoidal infection where they must be excluded. Lumbar puncture is in the author's opinion a very useful procedure, the exclusion of cerebro-spinal fever is called for in nearly all cases of the meningeal type, the normal fluid contains no cellular elements; the lymphocytes of tubercular meningitis and the polymorphs of cerebro-spinal fever, then the presence of tubercle bacilli in a high percentage of the former (Mc. Arthur, "Tuberculosis of the brain and meninges", Kleb's Tuberculosis, 1909) and the meninogocci in the latter, are all of much assistance. A marked leucocytosis in an examination of the blood would suggest suppurative rather than tubercular infection, an increase in the lymphocytic count would suggest the latter.

Other general symptoms are lost appetite, constipation, dry brown cracked tongue, rarely diarrhoea is seen, emaciation, scanty urine with abundance of phosphates and urates.

There are three great leading types of acute general miliary tuberculosis, the typhoidal, the pulmonary, and the meningeal form.

a. The typhoidal form. "In this variety the general symptoms are those of an infectious disease without

localising symptoms, closely resembling enteric fever", (Butler, Diagnosis of Internal Medicine, 2nd. Edit., 1905, p. 787) This form predominates in children and young people owing to the more rapid absorption of the toxins as explained above, the pulmonary form is commonest in older persons. In the typhoidal form there is an initial stage which is marked by malaise, headache, lost appetite, weakness, epistaxis with an irregular intermitting fever, the intermissions occurring in the mornings. The pulse and breathing rate are accelerated and dyspnoea is very common. Dullness of the intellect with marked disturbances of consciousness develops. According to Cornet (loc. cit.) there is marked enlargement of the spleen, but Butler (loc. cit.) says that "A slightly enlarged spleen is more likely a sign of acute tuberculosis than an easily palpable hard spleen."

The pulmonary form. - The ordinary signs and symptoms of lung disease predominate; dyspnoea and cyanosis are very noticeable. The physical signs are those of bronchitis of the smaller tubes, and the want of proportion between the severe symptoms and the scanty physical signs at once attract observation.

The meningeal form:- The irritation of the brain set up by the liberation of the tubercle bacilli into the blood stream may cloud the symptoms in other organs. Severe headache is common, and this may be so intense

as to be the only complaint made by the patient, it may be followed by delirium, and in children convulsions with rigidity of the spinal muscles is commonly noticed. The author had under his care a school boy, aged fourteen years, who was suffering from iliac abscess and spinal caries, during the treatment the abscess gradually diminished and all the symptoms pointed to recovery, the only treatment adopted was rest in bed, open air and liberal diet. About four months after the boy had been under treatment he suddenly complained of intense headache, the pulse was not appreciably altered but temperature quickly rose to 105, the headache continued for three days, but on the third day stupor with increasing unconsciousness set in; along with these symptoms rigidity of the spinal muscles in the neck, irregular pulse and temperature together with irritability of the facial muscles on each side were marked features. Coma supervened and the boy died in about fourteen days after the onset of the intense headache. The only physical signs found in the lungs were those commonly found in passive congestion of those organs towards the end of his illness. Cornet (loc. cit.) very aptly describes the temperature and pulse as "rather characterised by their instability". Cheyne-Stokes breathing is commonly seen if the patient is unconscious or asleep. The usual signs and symptoms

are those of meningeal disease, and if the patient survives them he passes as a rule into the typhoid state.

The duration of the disease as well as its usual sudden onset and serious initial symptoms are all reasons why the disease is seldom met with in the course of school medical examiners. Now that open air schools are being established and school medical officers are brought more intimately in contact with children actually suffering from tubercular disease the possibility of acute miliary tuberculosis must be always kept in mind. The annual reports of the chief medical advis[illegible] to the Board of Education contains no reference at all to acute miliary tuberculosis.

TREATMENT.

A. Prophylactic.

The first official act pronouncing tuberculosis a contagious disease, giving directions for the disinfection of apartments, furniture, and personal effects used by a consumptive and prescribing punishment on the part of the physician for failing to notify cases of consumption to the authorities, was the royal decree issued in Naples, Sept. 20, 1782 (Adolphus Knopf, "Public neasures in the prophylaxis of tuberculosis", Kleb's Tuberculosis, 1909) It was the French, says Osler in the same treatise, who awoke to the fact that in the fight against tuberculosis organisation was the first essential. France had its first "Congres pour l'etude de la Tuberculose chez l'homme et chez les animaux" in 1898. An international congress on tuberculosis was held in Paris in 1905, in Washington in 1908, and in 1911 at the invitation of the Italian Government the international congress met in Rome. At these congresses all the great questions of diagnosis cure, and administrative control are discussed. The administrative activity shown in Great Britain and Ireland is only part of a world-wide movement organised for one end. "The policy of the governing bodies, therefore, cannot any longer be regarded as the hasty and indiscreet application of abstract ideas to a practical problem; it

is a well-considered policy of skilled statesmen, moving slowly and deliberately in response to ascertained social demands," Health & Disease, by W.L.Mackenzie, London.

It is as well here to point out the national importance of the fight against tubercular infection. Taking the year 1908, as an example, we find that there were 520,426 deaths registered in England and Wales, and that the population of England and Wales for the same year - based upon the census of 1901 - was 17,071,524 males and 18,277,256 females, a total of 35,348,780. On examining these figures still further we find that 107 deaths in every 1,000 are caused by tuberculosis in various forms. Diseases of the heart contributed 96 to the thousand deaths. Then follow diseases of the respiratory system with a contribution of 89 to the 1,000 deaths. Diseases of the nervous system contributed 64; cancer and other malignant diseases 63; old age contributed also 63. The great death dealing diseases are tuberculosis, diseases of the heart and blood vessels and diseases of the respiratory organs (Mackenzie, Health & Disease, Williams & Norgate, London.)

In a contribution to the Practitioner Jan. 1913, Sir John Moore writing on Tuberculosis in Ireland, refers to a paper on "The prevalence and distribution of phthisis and other diseases of the respiratory organs in Ireland",

showed that in the decennial period, 1871 to 1880, pulmonary consumption, considered as a single disease, was the most potent cause of death in Ireland, constituting the cause of more than one-tenth of all the deaths registered during the decade. Referring to Wales, including and excluding Monmouthshire, Latham and Garland (Conquest of Consumption, Latham & Garland, 1911) give the total number of deaths for the year 1908 as 36,861 (C. Monmouthshire) and 30,719 (ex. Monmouthshire) and of these 3,754 and 3,280 respectively died from tuberculosis, equal to 101.9 deaths from tuberculosis in 1,000 deaths from all causes. Cornet (Nothnagel's Practice, Eng. Edit. p. 497, 1904) describes how in Prussia alone from 1875 to 1894 the total number of deaths from tuberculosis amounted to 1,669,587, equal to the population of Berlin, and equivalent to 80,000 a year. He further goes on to show how the death-rate from tuberculosis is among those, principally, who are about to make a return to the family and thus to the country for the outlay made on them during childhood and youth. Furthermore the disease being a protracted one, unlike acute lobar pneumonia, typhoid fever, &c, and its treatment costly, is a loss to the home and the nation of great importance.

Before considering various methods of prophylaxis

it is as well to enquire briefly as to whether the death rate from tubercular infection shows a decrease corresponding with the efforts towards its elimination. It is not practicable to ascertain how much we can attribute to the application of general principles, cleanliness, improved sanitation, and general increased well being, and to the application of special precautions against the particular organism of tuberculosis. There is no dividing line between the two. The application of these general principles, we know, have reduced the death-rate and incidence of all infectious diseases, by eradicating one we go a long way to eradicate others, with the disappearance of typhus fever we note the diminution in typhoid fever, diphtheria and acute lobar pneumonia; and a corresponding decrease in tuberculosis follows as a logical conclusion and a practical fact. It is generally admitted by authorities that the diminution in tuberculosis is due to the application in a general manner of the principles referred to. Douglas Powell and Hartley (Diseases of the Lungs &c., 1911) are of opinion that the decline in the tu berculosis mortality of the last 60 years has been dependent mainly upon improvement in general hygiene, increased well-being, and cleanliness. Leslie Mackenzie (loc. cit.) admits that general sanitation has contributed much, if under "general sanitation" we include the draining of soils, the sewering of towns,

the improvement in houses, the increase in cleanliness of habit, and most of all the steady, remorseless, systmatic campaign against infection of every form. Glaister (loc.cit.) has called attention to one important fact respecting tuberculosis, its relation to men and animals living under domestic conditions, and refers to tuberculosis being susceptible to the influences of improved sanitation generally, and that it has now come to be recognised (according to Glaister) that the important factors in the development of tuberculosis are, not so much the condition of the soil or altitude of a place, as the intimate home life of a people and the conditions of their environment, employment and consanguinity.

What diminution in the death-rate from tuberculosis has there been of late years? Osler (Historical Sketch, Kleb's Tuberculosis, 1909) gives the following encouraging information, "The death-rate has fallen steadily in the past sixty years from 38.8 per 10,000 in the quinquennial period 1838 to 1842 to 12.1 per 10,000 in the quinquennial period 1901 to 1905. This is an extra-ordinary record and justifies the hope that tuberculosis may ultimately come within the category of such diseases as leprosy, typhus fever, and malaria, which have been practically abolished. Theodore Dyce Acland ("On the education of the public in relation to the prevention of tuberculosis", The Practitioner, Jan. 1913) states,

"The mortality rate from tuberculosis in England and Wales has diminished, during the last fifty years by more than fifty per cent. It may reasonably be assumed that the incidence of the disease has diminished in proportion."

Glaister (Public Health and Tuberculosis, The Practitioner, January, 1913) gives the following tables showing the mortality per million persons living in England and Wales and Scotland from tuberculosis (all forms) and from phthisis from 1871 till 1900.

		1861-70	1871-80	1881-90	1891-1900
England & Wales	Tuberculosis (All forms)	3.239	2.862	2.429	2.010
Scotland		3.620	3.470	2.750	2.370
England & Wales	Phthisis	2.545	2.190	1.775	1.391
Scotland		2.560	2.390	2.000	1.690

Glaister mentions too that in Scotland the death-rate from phthisis during the years 1855-1894 had fallen by fully one half, and in England and Wales by about two thirds, compared with previous death rates. Referring to the Prussian statistics between 1876 and 1897 Cornet (loc. cit.) points out the steady decline since the year 1889 and emphasises the fact that, "The frequency of tuberculosis

has fallen to about two-thirds of what it previously was". Every treatise on tuberculosis carries in its pages the same message with respect to the reduction in the mortality and incidence of tuberculosis.

Since Koch's discovery of the bacillus of tuberculosis in 1882 there has grown on all sides a reasonable demand for a direct attack upon that particular organism. Not satisfied with the diminution in the mortality and incidence of tuberculosis by the general methods referred to for the improvement of health at large and consequently diminish or eradicate all infections, we see today national and international efforts directed towards the annihilation of the bacillus of tuberculosis. The campaign against the organism is now in full swing in these islands and the attack has already been attended by a considerable measure of success. Mr. Asquith, as Prime Minister, speaking at the fifth annual conference of the National Association for the Prevention of Consumption on Aug. 4. 1913, said, "Allowing for the increase of population, the number of deaths in 1911 would, had the death-rate of 1871 to 1880 been continued, have been about 103,000. Therefore 50,000 lives were saved in the course of one single year. During 1907 there was a growing feeling manifested in favour of notification in Great Britain, New York had had compulsory notification

for ten years, in Norway there had also been for some years the same compulsory notification, and Edinburgh, Bolton and Sheffield have adopted compulsory notification, while Bradford, Brighton, Leeds and Liverpool have started with voluntary notification. During 1908 a great advance was made by the Local Government Board, which issued an Order dated Dec. 18, 1908, to operate on the first day of 1909 for the provision of the notification to Medical Officers of Health to Sanitary Authorities of cases of pulmonary tuberculosis occurring among the inmates of Poor Law Institutions, or amongst persons under the care of the District Medical Officers, and for the taking of certain measures in such cases. The year 1911 saw completed the system of compulsory notification of pulmonary tuberculosis, it also saw the completion of the Final Report of the Royal Commission on Tuberculosis. In 1912 we saw produced the New General Order of the English Local Government Board, known as the Public Health (Tuberculosis) Regulations, 1912, which came into force on Feb. 1, 1913, and making compulsory the notification of all forms of tuberculosis. In the meantime the National Insurance Act of 1911 has come into operation with its so called "sanatorium" benefit which has such far reaching opportunities for the future. On Feb. 20, 1912, it was announced that the Chancellor of the Exchequer had appointed a Departmental Committee

"to report at an early date upon the considerations of general policy in respect of the problem of tuberculosis in the United Kingdom, in its preventive, curative, and other aspects, which should guide the Government and local bodies in making or aiding provision for the treatment of tuberculosis in sanatoria, or other institutions or otherwise." Two reports were published, an important interim report in April 1912, and a final report in March 1913. Already in Wales a great campaign initiated by Mr. David Davies, M.P. for Montgomeryshire, has taken root and flourished, the campaign in Wales was raised as a memorial to King Edward VII. It was readily accepted by the Welsh people as a most fitting memorial and the support the movement received came from all classes of the community. Referring to the Welsh memorial Latham & Garland (loc. cit.) said, "The Welsh campaign bids fair to be the most comprehensive one that has yet been waged against the disease, and is one which merits every encouragement." The Welsh memorial to King Edward VII has grown to such importance that it is now practically a national institution very closely affiliated to the National Insurance Authority (Wales).

The author would now desire to call attention to certain particular aspects of the great campaign towards the eradication of tuberculosis, and wishes especially to refer to "Sanatorium Benefit" and the co-operation

of the medical inspector of schools and the tuberculosis officer, with particular reference to the methods adopted in the author's neighbourhood - East Pembrokeshire.

The National Insurance Act of 1911 is wide-reaching in its application, it being estimated that some fifteen million persons (approximately one-third of the population) come within the scope of its compulsory provisions and quite a large number who have and will take advantage of the permission given them to insure under the Act voluntarily (Social Progress Year Book for 1913-14). One of the benefits provided by the Act is already referred to above as "Sanatorium benefit", that is "Treatment in Sanatoria or other institutions or otherwise, when suffering from tuberculosis or such other diseases as the Local Government Board with the approval of the Treasury may appoint." The provision being made wide enough to cover any kind of treatment for all forms of tuberculosis or other appointed diseases chiefly by (1) sanatoria, hospitals, or other residential institutions, (2) Tuberculosis dispensaries or other non-residential institutions, (3) the patient's home. The most important of these provisions, so far as they affect the school medical officer, is the tuberculosis dispensary. "It is the pivot upon which the scheme of detection, prevention and treatment must revolve." (Priestly, loc. cit.) The dispensary can, when properly worked, become the chief information

bureau and through its means the home conditions can be ascertained, and by getting into touch with "contacts" of cases attending the dispensary an early introduction to the "infects" is obtainable. This is apparently the most practicable means of finding out those early cases of tuberculosis for whom effective treatment can do so much.

The co-operation of the tuberculosis officer and the medical inspector of schools is evidently a most important desideratum. Von Pirquet (Kleb's Tuberculosis) says, "If it is true that the majority of people are infected during childhood, it must be concluded that the most useful revelations about the incipient stages of tuberculosis are to be expected from the investigations of pediatricians. The whole pathology of adults demonstrates only chronic processes or reinfections or terminal stages of the disease, the beginning of which must be referred to childhood." It is not for the author to express any opinion upon Von Pirquet's conclusions but his experience generally has after careful consideration of his own cases brought him to respect very greatly these views. The tuberculosis officer having had brought to his notice cases of tuberculosis should be compelled to bring to the notice of the school medical officer, directly or indirectly, the names of all school children and the schools they attend living in the infected homes,

or likely in his opinion to require tuberculosis supervision. At present in the author's district such information is only obtained from the school authorities and it is evident that some cases are overlooked. Of course in rural areas where the school authorities are more intimately acquainted with the families of the children, for that certainly obtains in Pembrokeshire, such loopholes of escape are more limited than in industrial rural districts and towns. The introduction of the system of employing as school nurses the village nurses and district nurses employed in the school area has assisted greatly in bridging the gaps between the home and the tuberculosis officer on the one side and the home and school medical officer on the other side. All children who attend school cannot be subjected to a detailed chest examination, as Hogarth (Medical Inspection of Schools, p. 162) very wisely states, "It is mere waste of time to percuss and auscultate systematically the lungs and heart of every child," it being much more productive of good in the author's opinion to confine such detailed examination to such children as come under the above description and those who for some reason require the same care. The school medical officer too should not take upon himself the work of the tuberculosis officer in diagnosing too readily the presence of tuberculosis

- active or latent - where a provisional diagnosis of tuberculosis is all that is required. One has only to read the extracts from the reports of school medical officers as published in the Annual Reports of the Chief Medical Officer of the Board of Education to note much want of compatibility with each other and with what the author has himself observed. It would be much wiser if school medical officers were to bear in mind Hogarth's advice, "Minute technical research does not suit the purposes of school hygiene, especially when the use of instruments would be necessary to ascertain all the clinical details." Having therefore from his observations formed a provisional working diagnosis of tuberculosis it is the wiser plan for the child to be transferred to the tuberculosis expert in the tuberculosis dispensary for a more complete and detailed examination before making the diagnosis conclusive. The methods used by the author, as well as others used elsewhere, for the examination of such children as he concludes require an examination for tuberculosis in more or less detail are given above. The statistics of the school medical officer should separate those finally diagnosed as tubercular from those regarded as suspicious. One has only to look at the tables on tuberculosis in the returns of school medical officers as published in the Annual Reports of

the Chief Medical Officer of the Board of Education to note the great disparity which obtains all over the country. It must not be inferred, from this that the methods used are wrong, but that there is not existing that uniformity of method which the author has striven to reveal in his thesis. The closer co-operation between the tuberculosis officer and school medical officer will materially add to our knowledge of the modes of infection, of the signs of definite infection, and will keep under constant supervision those "leavers" who were under the observation of the school medical officer and might otherwise get outside "the net which is being drawn more closely round tuberculous suspects". In truth we have here in our possession a co-operation of incredible value. In his own district the author has had every assistance from his colleague the tuberculosis officer, and cannot too highly express his indebtedness to him for his help and suggestions respecting the children they have mutually had under their observation.

It has been the custom in Pembrokeshire for several years to examine each year the following groups of children:- (a) new admissions, these may be children who are commencing on their school career or those who have just come from a school outside the author's area of supervision (b) children likely to leave after twelve months from the

date of examination; (c) children in an intermediate standard - usually standard two; (d) special cases presented by the parents, teachers, or school nurse; (e) children who were found defective on previous visits are re-examined in order to make observations on results of treatment; (f) children regarded as "suspects" or "contacts" of tuberculosis. Three visits at least are made during the year to each school by the school medical officer, between these visits the school nurse - who is as stated the district or parish nurse - pays her calls in school and where necessary at the homes of the scholars. An "after care committee" of ladies has been established in some areas and they too give some assistance, more especially in promoting cleanliness, although so far in the rural areas the author has not found the "after care ladies" of material help. School children found defective are given every facility for the relief of the defect, and where the defect leaves open an entrance route for tubercular infection - especially in "contacts" - these remedial agents are employed with the least delay. It has not been sufficiently brought home to the general public in the popular lectures and literature on tuberculosis that the natural barrier between the tubercle germ and the body tissues is a whole and healthy skin and a whole and healthy lining to the respiratory and

digestive tracts. Exclusion from school of children suspected or known to be suffering from tuberculosis is left on the whole to the tuberculosis officer or medical practitioner in attendance on the child. At the visits to the schools the medical inspector should ever keep a vigilant eye or ear for evidences of probable sources of infection among the teaching staff. The author has more than once been able to bring to the notice of the chief school medical officer and the tuberculosis officer such cases, in one teacher it was found that there was free expectoration which was reported to contain tubercle bacilli in large numbers.

Cleanliness is everywhere regarded as of prime importance in the prophylaxis of tuberculosis. The matter is now receiving considerable attention in the author's area, and already a very marked improvement in this respect is to be observed. Out of a total of 1607 children examined during 1914 it was found that the percentage suffering from uncleanliness was 5.5; the preceding year the percentage was over 8. The report of the chief school nurse of the county for the year reads, "It is satisfactory to report that there is a marked improvement in the state of the children in regard to cleanliness. Most of them are a credit to their parents." The influence of our training of school children in habits of

cleanliness has its influence on the home-life and must quickly have its effect upon thetuberculosis rate. "Tuberculosis," says Ransome (A Campaign against Consumption, Cambridge, 1915) "is a filth disease." "Cleanliness should be the key-note of the nursing and education of the child from the cradle up", says Cornet (Prophylaxis, Eng. Edit. Nothnagel's Practice.)

Malnutrition is a process which has a very important bearing upon the prophylactic treatment of tuberculosis in school children. In Pembrokeshire all badly nourished children are regarded as potential victims of tuberculosis and are cared for as if they were tuberculous (Annual Report of School Medical Officer to the Pembrokeshire Education Committee, 1914). In endeavouring to estimate the child's nutrition or malnutrition we have to follow the able advice of the Chief Medical Officer to the Board of Education (Annual Report of Chief Medical Officer to the Board of Education, 1912), "We must think not only of bulk and weight, but of ratio of stature to weight, of the general appearance and 'substance' of the body and of its carriage and bearing; of the firmness of the tissues; of the presence of subcutaneous fat; of the condition and process of development of the muscular system &c." It is left to the medical officer to form for himself his standard of nutrition which can only be acquired

after long and wide experience, consequently the author attaches little weight to malnutrition statistics and is inclined to think that the marked difference in the statistics in different areas is very largely due to the varying standards of the school medical officers in different areas. In the county of Pembrokeshire we find that the percentage of malnutrition varies from 9 to 17, and we are certainly of opinion here that the difference in the percentages is due to different standards adopted by the different medical examiners. Malnutrition influences tuberculosis in two ways. Firstly, it prepares the child for tuberculous infection by reducing its physical condition, and when with this is coupled the fact that "On the whole a poorly nourished child suggests a poor home", we see how important is this influence. Secondly, malnutrition inhibits the attempt to eliminate the organism from the system or else circumscribe its growth by means of the vital energies.

Education in Practical Hygiene by means of practical teaching in general hygiene in order to make children familiar with a healthy way of living is one of the weapons in the prevention of tuberculosis which the Chief Medical Officer to the Board of Education points out in his Annual Reports. Such instruction of the children should be accompanied by making schools and classrooms

conform to modern standards of hygiene. Ransome especially has called attention to the great influence of light and drainage as well as avoidance of overcrowding upon the incidence of tuberculosis, (Ransome, A Campaign Against Consumption, Cambridge, 1915). The travelling lecturers of the Welsh National Memorial for the Prevention of Tuberculosis have frequently visited the schools and by means of lantern demonstrations and exhibitions done much to enlighten the older children and their parents on the subject. The influence too of the school inspection upon the latter, especially in respect to the effect of adenoids upon children in restricting chest development and causing other important defects, in the case of teeth, the preservation of a healthy external covering and an internal lining to the air and food passages, the choice of occupations, and many other matters all add greatly in the weight of the preventive attack upon tuberculosis. The high standard of cleanliness and hygiene measures found generally in public elementary schools find their counter part in public meeting rooms, churches and chapels. The clergy have been slow to cultivate the present day requirements in respect to the practice of hygienic matters, they are generally much more attentive to the rigid adherence to certain style of architecture than they are to the proper sanitary construction and

ventilation of their buildings. Bishop Fano in his Italian diocese has asked his clergy and lay helpers to comply with certain regulations with a view to diminishing the risk of infection from tuberculosis by members of the congregation, by those attending confessional boxes and partakers of the Holy Sacrament. There is to be seen today even in remote mountain small holdings a wholesome and wholesale dread of the infection of tuberculosis throughout the area in which the author practises, and as a result of the crusade meat, milk and other dairy products are given the attention they never before received.

B. Curative Measures.

It very rarely falls to the lot of the school medical officer to deal with this aspect of the question, the only cases which he sees at all in school are those suffering from early tubercular disease of the glands of the neck or chest or surgical cases which are or have been receiving treatment at home or in institutions. School children in the author's area quickly come under the observation of the tuberculosis officer if there is any suspicion of tubercular infection about them, he it is therefore who almost invariably undertakes the supervision of the child's treatment. Now that tuberculosis officers are getting more in touch with educational

requirements we do not now see about here that long absence from school or places of instruction which used to obtain in most tubercular children.

There are two curative measures of recent formation which the author desires to call attention to in his thesis, these are:-

1. The out-of-door or playground classes, these are a feature of rural Pembrokeshire today although we have such a heavy rain fall. In the play-ground of Mynachlog-ddu Council School the rain gauge shewed a depth of 76.31 of rain in inches in 1912. As is well known such districts are cold and draughty and by no means tempting to open air classes. Where such classes are a feature of the school life there is little reason for the prolonged absence from school of non infective tubercular children who are under the supervision and are given their consent for attending school by the tuberculosis officer.

2. Sanatorium and day open-air schools. Hogarth (Med. Inspection of Schools, London, 1909) called attention to, "A crying necessity for the establishment of a large number of small residential convalescent schools for tubercular children." Today there are quite a number of schools with an open air classroom or class rooms, in some localities there have been established open air residential schools of recovery for non-tuberculous or non-infective

tuberculous children, and in certain localities residental sanatorium schools. All of which may be approved by the Board of Education. It is not very generally known that the Finance Act of 1911 made available a sum of 1,500,000 £, for the provision of sanatoria and other institutions for the treatment of tuberculosis in the United Kingdom. Of this amount £100,000 was ear-marked as capital grants for providing sanatorium schools for children. The distribution of these grants rests with the Local Government Board. By agreement with them the Board of Education approve the plans and carefully consider the arrangements made for the education of the children.

We have in Pembrokeshire fully availed ourselves of the out-of-door method of instruction but have not so far any of the institutions of a residential nature for children referred to in the latter subdivision. It has been the custom of the Education Committee of the County of Pembroke to send their tubercular children to such institutions as the tuberculosis officer chooses, these are usually but not generally in Wales.

Summary and Conclusions.

Chiefly as a result of tuberculin tests it is shown that in civilised countries tuberculosis is practically universal among children of school age; the death rate among tuberculous infected children is enormously high during the first few months of life, diminishes to 50 per cent at the end of the first year, and is as low as 2 per cent at the end of the fourth year.

There are two well marked forms of the disease corresponding to some extent with the age of the child to be observed in children. The one form is seen in infants and meeting no obstruction from the host attacks first the lymphatic system and then quickly passes through the whole system. The other form is met with in older children, children of school age, where some degree of immunity has been established, and the disease is arrested for some time in the lymphatic glands.

The method of entrance of the tubercle bacillus is yet a matter of dispute, it is admitted that the bronchial glands are more often affected than the mesenteric, the bacillus may gain entrance through the respiratory passages, the alimentary canal, or skin, at present the inhalation theory seems to be the more commonly accepted route of invasion. Parrot Law, viz., that enlargement of the lymphatic glands in the tracheal bifurcation

implies pre-existing disease of the lung, has recently been confirmed by Anthony Ghon (The Primary Lung Focus of Tuberculosis in Children, London, 1916)

The bovine and human bacillus are sources of trouble, the former is considered by some when well diluted to confer on the patient some degree of immunity from the latter, the latter form is the commoner type of bacillus in the tubercular lesions of children, the former being responsible for some of the surgical tubercular lesions. The elimination of tuberculosis must include both sources, human and bovine, as the agents of infection.

In the diagnosis of tubercular disease in children an effort must be made to determine if the disease is active or latent, the tuberculin tests and laboratory methods alone cannot do this. The school medical officer has on the whole to confine himself to symptoms and physical signs, and where available an X ray report. Laboratory methods should, like the tuberculin tests, be left to the specialist. There is a confusion respecting the physical signs to be sought for, this is chiefly due to an appreciation of the pathology of tuberculosis in school children, auscultation is given too important a place in school medical examiners' reports. Percussion of the enlarged consolidated glands in the chest should

be the chief method employed. D'Espine's whispering sign and Clive Riviere's area of dulness in the right inter-scapular area might be kept in mind. The school medical officer should always recognise his own limits and not take upon himself the work of the tuberculosis medical officer; cases of tubercular disease in children not being regarded as absolute without the latter's examinations being completed. Above all it must be clearly understood that the signs and symptoms caused by pressure of glandular masses on vessels and bronchi are rare, and that the glands most frequently seen affected are the inferior tracheo-bronchial lymphatic glands which are not in a position anatomically to produce pressure symptoms.

Too much must not be expected from the family history, the child's health history and symptoms, above all the medical examiner must not be so obsessed by the disease as to allow only one interpretation to the symptoms and history facts presented to his notice.

Surgical tuberculosis can give little trouble to the school medical officer, the cases which can come under his observation must be few and are sure to be under the observation of the tuberculosis officials or private practitioner. Likewise acute miliary tuberculosis can scarcely affect the work ofthe school medical examiner its chief interests lie in its association with former

tubercular deposits and its diagnostic relationship with cerebro-spinal fever.

The prophylactic measures which have been taken generally against tuberculosis, directly and indirectly have reduced the incidence and mortality rate at so satisfactory a speed as to call forth for its complete elimination. Formerly the attack was against all infections but the high prevalence of tuberculosis has called for special effort against this particular infection. In Wales there has been formed the Welsh Tuberculosis Memorial as a practical means of commemoration of the reign of Edward VII. Its huge funds have been further enriched by the "Sanatorium benefit" and other government grants. The aim of the Memorial is to eliminate and undertake the treatment of tuberculosis in Wales and Monmouthshire. The school medical inspection is closely associated with the work of tuberculosis prevention, its usefulness can be still further increased by avoiding overlapping with the tuberculosis authorities and utilising in a greater degree the special knowledge of the tuberculosis medical officer.

The curative measures scarcely effect the school medical officer apart from the encouragement and supervision of arrangements for the formation of open air

classes; the disposal of the tuberculous child is largely a matter for the tuberculosis officer, the private practitioner and parents, suitable sanatorium schools approved of by the Board of Education are being widely established; an effort should be made to avoid the mental crippling of the tuberculous child by long absence from school.

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