TABLE OF LABORATORY INVESTIGATIONS.
Flexner Cases.

Date.	Patient's Initials.	Specimen.	Result.
1930.			
Feb. 5	A. G.	Faeces	Flexner W in considerable numbers.
"	Ba. G.	"	No B. dysenteriae.
"	S. G.	"	Flexner W in small numbers.
"	Be. G.	P.M. Organs	No B. dysenteriae (large intestine not sent).
"	Mr. G.	Blood	No agglutination against Flexner W.
"	Mrs. G.	"	Agglutinated Flexner W 1 in 40 (? significance).
"	A. G.	"	No agglutination Flexner W.
"	Ba. G.	"	Insufficient serum.
Feb. 7	Mr. K.	"	Normal agglutination.
"	Mrs. K.	"	Ditto.
"	E. K.	"	Agglutinated Flexner W 80 in 160 (slight but definite).
"	B. K.	"	Ditto.
Feb. 8	Mrs. M.	Faeces	Flexner W, a few colonies.
Feb. 9	E. K.	"	No B. dysenteriae.
Feb. 11	Mrs. B.	"	Flexner W, numerous colonies.
"	Mrs. E.	"	No B. dysenteriae.
Feb. 13	"	Blood	No agglutination to Flexner W.
"	Dr. E.	"	Ditto.
"	S. T.	"	Ditto.
Feb. 17	"	Water sample	Colonies on agar D 37° C. = 12 per c.cm. Presumptive B. coli plus in 5 c.cm. No dysentery bacilli on plating 800 c.cm.
Feb. 19	Mr. K.	Faeces	No B. dysenteriae.
March 2	E. K.	"	Flexner W, numerous colonies. (See reports on Feb. 7th and 9th.)
March 11	E. K.	"	No B. dysenteriae (hospital clearance).
"	Mrs. B.	"	Ditto
March 23	Mrs. K.	"	Flexner W (abundant).
March 31	M. H.	"	No B. dysenteriae.
April 2	Mrs. K.	Blood	Flexner W agglutinated 1 in 40. (Compare with blood of Feb. 7th—that is, suspicious).
April 9	Mrs. K.	Faeces	No B. dysenteriae (hospital clearance).
"	J. K.	"	Flexner W present.
April 15	J. K.	"	No B. dysenteriae (hospital clearance).
<i>Sonne Cases.</i>			
April 12	Mr. M.	Blood	Haemolysed on arrival at laboratory.
"	F. M.	Faeces	B. dysenteriae Sonne (pure culture).
April 23	F. M.	"	No B. dysenteriae (hospital clearance).
April 26	Mrs. M.	"	Ditto.
May 2	"	Water sample	No B. dysenteriae in 100 c.cm.

F. M., aged 6, commenced with similar symptoms on April 10th, and a faecal specimen obtained on the 12th showed Sonne bacilli in pure culture. A blood specimen taken from Mr. M. at the same time was unfortunately haemolysed on arrival at the Ministry's laboratory. F. M. was admitted to hospital on receipt of the bacteriological finding; there was no apparent illness while in hospital, and no treatment was given. A negative stool was obtained on April 23rd, after which he was discharged (April 26th).

On April 24th Mrs. M. complained of violent abdominal pain for about two hours, diarrhoea (but no apparent blood and mucus), and vomiting. Temperature and pulse were normal when seen, and a faecal specimen obtained on April 26th was negative. The family also included another child, P. M., and a baby. Both were said to have had very slight similar symptoms. Although Sonne dysentery was only bacteriologically proved in one child (F. M.), there appears little doubt that the whole family

of six were affected at one time or another. Mr. V., who lived next door and had been attended by the doctor who had drawn attention to the M. family, had also suffered from diarrhoea at the beginning of April. Unfortunately no bacteriological tests could be carried out.

No possible connexion could be traced with the Flexner series. The milk supply was the same pasteurized supply as that used by some of the Flexner series, but in view of its large sale in the area and the absence of any explosive outbreak it was assumed not to be the source of infection. The shallow well water supply to the houses occupied by the M. and G. families showed gross contamination on bacteriological analysis, but no dysentery bacilli were isolated from 100 c.cm.

The accompanying table shows the specimens examined at the Ministry's laboratory.

I would gratefully acknowledge the co-operation of Dr. J. H. Bellamy of Ashby and of Dr. A. H. G. Johnston of Scunthorpe, of Dr. Neil R. Beattie of the Ministry of Health, and particularly of Dr. William Scott, pathologist to the Ministry, who carried out the whole of the laboratory investigation.

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THE DIAGNOSIS OF BRAIN ABSCESS.

BY

HERBERT V. O'SHEA, M.D., M.Ch., D.L.O.,

ASSISTANT SURGEON, METROPOLITAN EAR, NOSE, AND THROAT HOSPITAL;
SENIOR SURGEON, EAR, NOSE, AND THROAT DEPARTMENT,
CHILDREN'S HOSPITAL, PLAISTOW.

THE diagnosis of brain abscess is often a matter of great difficulty to the surgeon; in some cases while he may be pretty certain of the presence of an abscess he may fail to locate it. For diagnostic purposes brain abscesses may be classified into two groups:

1. Those in which the classical symptoms of abscess of the brain are present. This group may be subdivided as follows: (a) Those cases in which localizing symptoms are present, where the abscess is caused by direct extension of the infective process. The best examples of this group are the otogenic abscesses, which occur as a result of middle-ear disease and are known as temporo-sphenoidal when they are found in the temporal lobe, and as cerebellar abscess when the cerebellum is the seat of the disease. Another instance of this type of abscess may be found in the frontal area of the brain following suppuration in the frontal or ethmoidal sinuses or injuries in that region of the skull. (b) Those in which localizing symptoms are absent—namely, those cases in which the cause is situated at some distance from the abscess and the infective agent is carried by the blood stream. Metastatic abscesses are examples of this kind and are the most difficult to locate. It is well to remember that sometimes otogenic abscesses are formed at some distance from the original focus of infection, and have even been found in the opposite side of the brain.

2. Abscesses of the symptomless or latent type, in which there is an entire absence of symptoms and in some cases an apparent absence of cause. In this latter type the fate of the patient is sealed before an absolute diagnosis is made, owing to the abscess bursting into the lateral ventricles, or, on the other hand, owing to the increase in tension or acute inflammation which results in a breaking down of adhesions formed during the course of the disease, and spread of pus between the dura and brain, causing fulminating meningitis and encephalitis.

In the first group the abscess may be acute or chronic; in the second group it must of necessity be chronic. In some cases in which the infection spreads very slowly a chronic abscess is formed with such dense fibrous walls that it seems like a solid tumour. In these cases, owing to its weight, the abscess may move from its original position and be found either in the fronto-parietal or occipito-parietal region.

EXAMINATION OF THE PATIENT.

When tackling a case of suspected abscess of the brain the previous medical history of the patient must be carefully gone into; and no illness, however slight, may be ignored. An apparently trivial complaint may give a clue to the diagnosis when everything else has failed. Thus, in going into the previous history of the case, it may be learned that there has been a slight earache at some time or the other which has passed off as quickly as it came, and may or may not have been accompanied by a slight discharge. It may then be found that one membrana tympani is not quite normal. It may have lost some of its lustre as compared with the normal drum on the other side, or there may be slight thickening, retraction, or evidence of a healed pin-point attic perforation.

Again, in the case of an abscess of the frontal lobe there may be a history of frontal headache indicating frontal or sphenoidal sinusitis or ethmoiditis, infection being conveyed directly, or indirectly by the veins. In other cases there may be an account of injury in the region of the orbit or nose. Fractures, or even a simple contusion without any damage to the bone, may be the cause of a brain abscess. These points in the medical history of the patient apply to abscesses due to more or less direct extension of the infection.

When dealing with metastatic abscess other signs and symptoms must be looked for. The heart must be examined for evidence of valvular disease; vegetations conveyed by the blood stream may cause embolic abscess of the brain, often of the frontal lobe. The lungs must also be examined, as thrombi, resulting from suppurative conditions such as phthisis, bronchiectasis, pneumonia, and empyema, may be carried by the systemic circulation to the brain.

When embolism occurs in cases of pyaemia and leads to breaking down of the cerebral tissue, the middle cerebral artery is usually the vessel affected, the left oftener than the right. The symptoms resemble closely those of cerebral haemorrhage, for which it has often been mistaken, but usually the parts of the brain affected follow closely the distribution of the artery; while in haemorrhage large areas of the brain may be ploughed up indiscriminately. Osteomyelitis and syphilitic disease of the skull bones may give rise to cerebral abscess; in obscure cases, therefore, a Wassermann test should be carried out.

OTOGENIC ABSCESS.

By far the commonest form of brain abscess is that of otogenic origin. It is not always easy, when called to see a patient suffering from an intracranial complication following middle-ear disease, to diagnose what the exact condition is. Lateral sinus thrombosis, meningitis, and brain abscess are all caused by the pyogenic organisms, usually the streptococcus or staphylococcus, and one or more conditions may be found at the same time. Severe pain over the seat of the abscess, with rigors followed by a sharp rise in temperature, may be due to a suppurative pachymeningitis following an extradural abscess. In addition there may be a localized swelling over the part owing to the inflamed or oedematous condition of the tissues. In such a case as this one finds little or no sign of intracranial tension, and thus no localizing symptoms. When a subdural abscess forms, the symptoms are similar but more severe.

One must bear in mind, especially in otogenic cases, that an extradural abscess may coexist with extensive mastoid disease without any symptoms of intracranial trouble and even very little suggestion of extracranial trouble, except the usual discharge from the ear and bulging behind that

organ. Such a case came under my care about twelve months ago. On operating the entire mastoid region was destroyed, a large subperiosteal abscess was evacuated, and an extradural abscess which extended lateral and anterior to the sigmoid sinus was opened. The sinus was covered with granulations but otherwise healthy, and the patient made a rapid recovery.

Abscess caused by chronic middle-ear disease may occur in the temporal lobe as a temporo-sphenoidal abscess, or in the cerebellum. The abscess may be adjacent to the diseased bone—namely, the tegmen tympani—and is then due to a direct spread of an extradural or intradural collection of pus. In other cases the infection is carried by the veins or perivascular lymph spaces to form an abscess at some distance in the white matter of the brain. The abscess is almost invariably single; and when headache, vomiting, and later optic neuritis occur during the course of chronic middle-ear disease, brain abscess must be suspected. It will further be noticed in such cases that the discharge has ceased, also the earache, but that tenderness becomes more pronounced on deep pressure over the temporal or mastoid region. A sharp rise in temperature, shivering, and headache generally accompany the formation of pus in the brain. This is usually followed by a short latent period in which there are few or no symptoms; but then appear symptoms of compression and toxæmia, the latter due to absorption of pus.

In the early stages the difficulty is to differentiate between meningitis and cerebral abscess, and, in addition, in the case of cerebellar abscess, to exclude acute diffuse labyrinthitis.

The following points should be noted in making a differential diagnosis between brain abscess and meningitis:

<i>Brain Abscess.</i>	<i>Meningitis.</i>
<i>Pulse:</i> Slow and regular.	Irregular in rate and force.
<i>Temperature:</i> Subnormal.	Raised.
<i>Superficial reflexes:</i> Disappear late and are unilateral.	Disappear early and are bilateral.
<i>Retraction of neck:</i> Absent.	Usually present.
<i>Optic discs:</i> Slightly swollen and unilateral.	Highly oedematous and bilateral.

When meningitis is suspected lumbar puncture should be performed and the cerebro-spinal fluid examined. The result of this examination is not always to be relied upon, as the fluid may be cloudy but sterile, though a brain abscess is present, or it may be clear and sterile in the presence of purulent meningitis. Usually, however, if the fluid is turbid and under tension, and organisms are present, one may be sure that the condition is at least a purulent meningitis.

When the fluid is clear and the presence of brain abscess is suspected the amount withdrawn should be just enough for the examination. This is especially important when there is a chance that the cerebellum may be the seat of the disease, as when too much fluid is withdrawn the foramen magnum may be blocked up by the abscess being pushed down into the spinal canal, and respiration would then cease.

Localization of the Abscess.

The exact position of the abscess can be localized only by carefully watching for any signs or symptoms that can be assigned to any centre of the cortex or white matter of the brain. In the group of otogenic abscesses localization is comparatively easy; in the metastatic or the latent type it is very different, and at times impossible.

A temporal lobe abscess of otogenic origin will usually be found on the same side of the brain as the diseased ear. The next sign to be looked for is paralysis, the presence of which will depend upon whether the abscess is small or large. In the former case there is nothing to be seen; in the latter pressure may be exerted superficially on the cortex, the first thing to be noticed being facial paralysis, and later, as the abscess increases in size, paralysis of the arm, and, finally, of the leg. In such cases the abscess is situated superficially and low down in the temporo-sphenoidal lobe, and gradually spreads upwards.

When the leg is paralysed first, and then the arm and face, it shows that the abscess is situated deeply, and is pressing on the motor fibres which traverse the internal capsule. The speech centre is affected when the left inferior frontal convolution is pressed upon, and motor aphasia results. Similarly auditory aphasia occurs when the abscess is situated in the posterior part of the superior temporal convolution. Ocular paralysis, such as ptosis and strabismus lateralis with a fixed and dilated pupil, denotes pressure on the third cranial nerve of that side. Crossed paralysis of the face and limbs occurs when the parietal lobe is the seat of the abscess.

Generally speaking, one-third of the cases of cerebellar abscess are preceded by lateral sinus infection, and when the two diseases coexist the symptoms of the one mask those of the other. One-third of the cases of cerebellar abscess arising from middle-ear disease follow a suppurative labyrinthitis with complete destruction of the membranous labyrinth. In these cases one gets nausea, vomiting, vertigo, etc.—in other words, symptoms of labyrinthine disease, which may immediately precede the formation of the cerebellar abscess, or antedate it by months or even years. The remaining one-third of the cases of cerebellar abscess are found quite apart from disease of the lateral sinus or labyrinth, and occur from direct extension of the infection from the mastoid antrum or cells. In these cases an extradural abscess is sometimes encountered on the posterior wall of the petrous bone.

A case of otitic cerebellar abscess from which focal symptoms are absent is likely to be mistaken for abscess of the temporal lobe. When focal symptoms develop the difficulty lies not in differentiating between a temporo-sphenoidal and cerebellar abscess, but between the latter and acute suppurative labyrinthitis.

In the majority of cases when focal symptoms are present the differential diagnosis is easy. Vertigo, spontaneous nystagmus, Rombergism, ataxia, etc., suggest cerebellar abscess; various aphasias, sensory and motor, suggest temporal lobe abscess. Since, however, these lesions may occur and proceed to a fatal termination with an almost complete absence of localizing symptoms, the smaller points must be carefully analysed in order to locate the lesion.

Headache is common to both diseases; in temporo-sphenoidal abscess it is less severe, varies in intensity from time to time, and is usually confined to the temporal region on the affected side. In cerebellar abscess, as well as being more intense and practically continuous, the pain is situated in the occipital lobe on the side of the lesion.

Vomiting is always present at the beginning of each lesion, but as the disease progresses the vomiting becomes less frequent or disappears altogether in some cases of temporal lobe abscess, while it is frequently seen at irregular intervals in cerebellar disease. The nausea and vomiting are unconnected with the intake of food, and may occur several times a day.

Mental dullness characterizes temporo-sphenoidal abscess. The patient is unable to give his attention to things, and has to be roused to answer questions. In cerebellar abscess, on the other hand, this condition is not present until well towards the end, and is then usually found together with signs of general intracranial pressure.

Vertigo in temporal lobe abscess is a variable and inconstant symptom. When present it is due to general increase in intracranial pressure. In cerebellar disease vertigo and ataxia may appear quite early. The individual feels giddy, and tends to fall to the side of the lesion.

Eye changes, such as optic neuritis, inflammation of the papillae, and choked disc, are very much more frequent in cerebellar abscess, and this fact may be very important in making a differential diagnosis.

Lastly, **muscular paresis**, when present in abscess of the temporal lobe, is always contralateral, while in cerebellar abscess it is sometimes homolateral.

Differentiation from Suppurative Labyrinthitis.

Before leaving the subject of the differential diagnosis of cerebellar abscess mention must be made of diffuse suppurative labyrinthitis, the symptoms of which in the acute stage may resemble those of cerebellar abscess.

The principal points in the differential diagnosis are as follows:

Cerebellar Abscess.

1. Onset gradual.
2. Changing rotatory nystagmus, more pronounced to the side of the lesion, but may vary with the direction of the eyes, first to one side, then to the other.
3. The nystagmus increases as the disease progresses.
4. Vertigo is at first influenced by the nystagmus, but later becomes persistent even in the absence of the nystagmus.
5. Ataxia always occurs to the side of the lesion; has no particular relation to the direction of the nystagmus present; and no tendency to disappear.
6. Caloric reaction present, usually normal.
7. Hearing usually normal if only cerebellar disease is present.
8. Dysdiadokokinesia and inco-ordination present.
9. Finger-pointing test shows deviation usually outwards on the side of the lesion. Applies only to the limb on the affected side.
10. Temperature raised at first, gradually drops, and becomes normal or subnormal.
11. Pulse rate usually slow. Sometimes bradycardia is present with a rise in temperature.

Diffuse Suppurative Labyrinthitis (acute stage).

- Onset sudden.
- Rotatory nystagmus to the sound side; increases as the eyes are turned to the sound side, and diminishes or ceases when they are turned to the affected side.
- The nystagmus decreases and tends to disappear by the end of two or three weeks.
- Rotatory vertigo is in the plane of the nystagmus. It diminishes and ceases with the disappearance of the nystagmus.
- Ataxia is in the plane of the nystagmus and in the opposite direction to the quick movement. It disappears when the nystagmus ceases.
- Absent.
- Entirely lost in affected ear.
- Both absent.
- Deviation occurs in a direction opposite to the quick movement of the nystagmus. Both limbs involved.
- At the onset is elevated, but in uncomplicated cases quickly returns to normal; is rarely subnormal.
- Pulse rate normal, or varies normally with changes in temperature.

When the acute stage has passed on to the latent stage of labyrinthitis the difficulty in diagnosis no longer exists. In labyrinthine disease there is complete deafness and the labyrinth ceases to respond to the various tests—an end-result which would not be found in cerebellar abscess.

ABSCESS WITHOUT LOCALIZING SIGNS.

The next type of brain abscess to be considered also comes under Group I; it includes cases with the usual symptoms of brain abscess but presenting no localizing signs. In most of these cases the abscess is metastatic, and is usually to be found in the white matter of the brain, perhaps in the neighbourhood of the internal capsule. Sometimes otogenic abscess may form deep in the white matter, following an acute middle-ear inflammation; the local condition in the tympanum may have entirely cleared up, while all the time the infection has spread through the dura and finally settled deep in the white matter, leaving no trace of its track, all inflammation having resolved. In other cases the inflammation may travel along the perivascular lymphatic vessels to form an abscess some distance away.

Another cause of this type of brain abscess is infection from disease of the nose. In these cases an examination of the nose and accessory sinuses should be carefully carried out. The abscess is usually in the frontal lobe—the silent area of the brain—and though it presents the usual symptoms of abscess it very rarely exhibits focal symptoms. In some cases pus may be noticed in the region of the cribriform plate, owing to the abscess bursting through the thin plate of bone forming the roof of the nasal cavity in that area.

SYMPTOMLESS ABSCESS.

Lastly we come to the symptomless or latent variety of brain abscess. It is only when rupture occurs that symptoms appear, and then the picture is usually not one of brain abscess, but of fulminating meningitis, which practically always ends fatally.

The only remark to be made about these cases is that patients suffering from ear trouble must be watched, whether the condition is just occasional earache or obvious chronic middle-ear disease; also any form of paralysis, whether it be facial, ocular, or of any of the limbs, must be looked out for. Any of these signs or symptoms should make one suspicious and decide to keep the individual under close observation.

The following account of a case of this type (symptomless) of brain abscess which the author met with a short time ago may be of interest.

Mrs. X, aged 66 years, was suddenly seized with acute pain in the right ear. Within twenty-four to thirty-six hours the pain gradually subsided, on the appearance of a thick discharge of pus from the affected ear, and the patient felt much better. No doctor was called, but the patient stayed in bed the next morning. Towards the afternoon her maid went to the bedroom and found her lying on the floor unconscious and clawing the right side of her head.

When I examined the patient I found the condition described above, together with incontinence, facial paralysis on the affected side, and slight paresis of the limbs of the opposite side. There was also evidence of meningeal and cerebral irritation. The temperature was 103.5° F. On examining the right ear I found no discharge, but a thickened and inflamed drum membrane with a small attic perforation. I diagnosed temporo-sphenoidal abscess and meningitis following middle-ear disease, and my colleague Mr. Austin McManus, who also examined her, concurred.

The prognosis was obviously hopeless, but we decided to operate immediately. I performed a radical mastoid operation, and found the following condition: The mastoid region was remarkable for having no cells; it was very sclerosed. In the antrum, which was very small and situated deeply, were a few granulations covered with pus. The tegmen was soft and spongy, as in acute osteomyelitis, and a small sinus led into the middle fossa. I removed the entire bony covering and exposed the dura. There was no extradural collection of pus, but the membrane was thickened, inflamed, and bulging under great tension.

I incised the dura, and immediately very thick and cheesy pus escaped, accompanied by blood-stained cerebro-spinal fluid. The amount of pus was not great, but the type was that found in chronic abscess; some granulations were present on the inner side of the opening in the dura. I carefully put a seeker through the opening made and met with no resistance, except in an upward direction. It seemed as if the entire temporal lobe was pushed away from the dura by the acute and profuse secretion of fluid following the meningeal inflammation. I put two fine rubber tubes in the dural opening to act as a drain, and also exposed the lateral sinus, which was quite healthy. I partly closed the original mastoid incision and drained the antrum through the external auditory meatus.

The patient lived about twenty-four hours after the operation without regaining consciousness.

Unfortunately I had no opportunity of making a post-mortem examination. The conclusion I came to was as follows: This patient had chronic suppuration in a dense acellular mastoid with a minute antrum. Instead of draining, as it normally should, into the tympanic cavity and thence through a perforation in the drum (which it eventually did, but too late), it burrowed its way gradually through the tegmen and dura, forming adhesions in its course, into the temporal lobe, there forming a small chronic abscess. Ultimately, for some unknown reason, an acute otitis media arose, and the pus under pressure caused a perforation of the membrana tympani, but spent most of its energy intracranially. Rupture of the abscess occurred, with subsequent meningitis, which would account for the symptoms and signs present when the patient was first seen.

I would add that the previous medical history of the lady was carefully inquired into and nobody had ever heard her complain of ear trouble; it was said that she always seemed very healthy and enjoyed life. The appearance of the drum membrane on examination would seem to bear out this history.

The case is of interest because (1) it shows that an intracranial condition may coexist with chronic mastoid disease and cause little or no symptoms; and (2) because it is in direct contrast to a case I reported in this *Journal* (October 19th, 1929, p. 717), in which obvious symptoms of temporo-sphenoidal abscess were present, but operation proved the condition to be one of simple mastoiditis.

TREATMENT OF BONE TUBERCULOSIS BY LARGE AMOUNTS OF VITAMINS A AND D.

BY

C. LEE PATTISON, M.B.,

MEDICAL SUPERINTENDENT, KING EDWARD VII HOSPITAL, SHEFFIELD.

Our inability to arrest the spread of a tuberculous focus in bone, until considerable destruction has occurred, makes it worth while to investigate any therapeutic agent which seems likely to control this infection.

The results of Mellanby and Green,¹ which have demonstrated the potent action of vitamin A on bacterial infection in animals and man, especially their suggestive results obtained by treating cases of puerperal sepsis² with preparations very rich in vitamin A, made it seem probable that the value of cod-liver oil as a therapeutic remedy in tuberculosis is really due to its vitamin content. It appeared desirable, therefore, to see whether the exhibition of much larger doses of vitamin A than those usually given in cod-liver oil would hasten the healing process in this disease; also, since bone calcification, as shown by Mellanby, is controlled by the vitamin now known as vitamin D, and since the present investigations were made on bone tuberculosis, it was decided to increase this vitamin in the diet as well as vitamin A, although not to such a great extent. It has been mentioned in a previous communication³ that the giving of extra amounts of vitamin D alone (in the form of irradiated ergosterol—radiostol) did not appear to increase the rapidity of recalcification of bones affected with tuberculosis to any marked extent.

Two preparations of different strengths, both containing a large quantity of vitamin A and one of them having a high vitamin D content in addition, have been used in this investigation. Both were kindly supplied by the British Drug Houses Ltd.

Preparation No. 1.—The vitamin A of this preparation gives 150 blue with the antimony trichloride test, and has about twenty times the vitamin A potency of cod-liver oil. It also contains 10,000 antirachitic units per c.cm. (Coward).

Preparation No. 2.—This has double the vitamin A content of preparation No. 1 (that is, 300 blue), but only 100 antirachitic units per c.cm.

Forty-three patients were given large doses of these preparations as described below, while 35 patients were given 10 c.cm. of cod-liver oil daily. These latter were intended to act as controls, and were selected because they had similar degrees of infection and bone invasion to certain patients in the other group of cases. The patients included in these tests were of varying ages—from 3 to 15 years—and in both groups there were cases with early disease, with acute rapidly progressing disease, with chronic slowly increasing disease, and with disease in which recalcification of bone was commencing.

Of the 43 patients, 15 were given an average dose of 7.8 c.cm. of preparation No. 1 daily for an average period of 3.5 months, and were then given an average dose of 9.4 c.cm. of preparation No. 2 for a further average period of 3.4 months. The remaining 28 patients were given an average dose of 9.6 c.cm. of preparation No. 2 for an average period of 4.1 months.

The 35 control patients were given 10 c.cm. of cod-liver oil daily during the period of investigation. It may be well to mention that the patients of all three groups had received cod-liver oil daily before the actual test started. It will be noticed that all the patients, including the controls, got a fair supply of vitamin A and D, but that those receiving the special vitamin preparations Nos. 1 and 2 had very much more vitamin A than the others.

The clinical condition of the patients in the different groups and the x-ray appearance of their affected bones had been carefully recorded some months before the investigation; this was done again both at the commencement and at the end of the test period. An examination of the accompanying table will show that of the 43 patients having the vitamin preparations 32 were improved clinically, and 11 were not; that in 25 of these 43 cases the x rays showed arrest of disease or increased calcification, while in 18 there