was the difficult complication of empyema between the diaphragm and the base of the lung. In the present series of 1932, although there was extensive pleurisy, which in some instances was audible at the diaphragmatic level on both sides of the chest, in front and behind, there was fortunately only one instance in which possibly such an empyema resulted.

The case, however, of a woman, 63 years of age, was one of great difficulty, for a double pneumonia with pleurisy affecting both lower lobes supervened upon an extremely severe herpes round the costal margin, which had left much recent scarring. Post-herpetic pain, which at times was almost unbearable, had followed. This symptom, combined with the dullness caused by the pneumonia and pain by the pleurisy, presented a clinical problem of great perplexity. Added to all these complications were a diagnosis by radiography of a pulmonary new growth, the removal of 10 oz. of blood-stained fluid from the left pleura, and fever which lasted for thirty-two days after admission to hospital. In spite of the patient's age, the extreme prostration, the continuous pain, the prolonged fever, and extensive pleuro-pneumonia, she eventually made a good recovery.

An Army officer, aged 62, came into hospital a livid grey colour, with a pneumonia which implicated both upper lobes and the right lower; his respirations were for eleven days between 40 and 50 a minute, and for long intervals he lay in a stuporous sleep. His recovery was as remarkable as it was heartening, for he was a splendid patient.

There were two fatal cases in the series, and both were tragedies. One was a little boy, aged 3 years, who was admitted to the Children's Hospital, Great Ormond Street, with bilateral broncho-pneumonia. For thirteen days he ran a high temperature, which then subsided, and he improved so greatly that convalescence appeared to be at hand. Suddenly he became much more distressed, and died. The post-mortem examination disclosed confluent broncho-pneumonia, with small abscesses and haemorrhagic hepatitis.

The fatal case in the adult was a young man of 23, with double pneumonia. Unfortunately there was no post-mortem examination, but a loculated empyema was opened and there was every reason to suspect that there was in addition a considerable pulmonary abscess, if indeed this abscess was not the primary focus of pus formation. The pus grew staphylococci and a Gram-negative bacillus.

In this series there occurred that clinical feature so misleading and so difficult to teach at the bedside—namely, the commencement of a pneumonia by what may be described as a smothering of the air entry with no alteration in the percussion note, and often no other physical signs, or at most some extremely fine and scattered rales. This sign would later develop as a frank pneumonia or in a shower of sharp rales suggestive of the milky way on a fine September night.

A rise in the number of polymorphonuclear leucocytes, coupled with the development of areas of bright, consonating rales, made it probable that small pulmonary abscesses had developed in some of these cases, which healed as convalescence proceeded.

The treatment in all cases was essentially on the same lines, and doubtless open to criticism in many respects. That only two cases were fatal I attribute first to fine and courageous nursing and the skilled observation and assistance of my house-physician, Dr. C. Gray; secondly, perhaps, I put that stolid obstinacy of a West Countryman which admits that an apparently dying patient is rather ill, and thus insensibly gives hope to the patient, nurses, and all concerned, when, tired by their efforts, they must

naturally feel inclined to lose heart. I mention this on account of the great trouble in which I found myself when, after a few cheerful words, I turned to a valued sister and said, "I suppose you realize how ill this patient is?" Her rage at my having told the truth so long after she had known it confirmed my belief in the value of an ox-like heredity. Thirdly, I would put the great value of digitalis, morphine, and atropine, strophanthin, alcohol, and liquid peptonoids. I am aware that in writing thus I am an outcast possibly from scientific medicine, and also an object of opprobrium to hospitals in this economic crisis, and to the enemies of alcohol, to whom I would venture to praise the value of a good liqueur brandy. The preparation of digitalis I used was digiglusol, and I was well satisfied. Fourthly I put an atmosphere of calmness with non-disturbance of the patient, and was devoutly thankful for the intense drowsiness and semi-coma that some of them showed, reducing them, as it did, to mere breathing machines. Fifthly, and I suppose those who read this note would put it first, I would mention "good luck."

A successful serum administered early would naturally make this treatment obviously inadequate, but these patients came under care too late for such a serum in the present state of its evolution, and I hope that this short review of severe cases may be some encouragement to others when struggling with similar ones.

ACUTE MASTOIDITIS *

BY

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This disease is so diverse in its manifestations that it still offers many problems to specialist and practitioner alike, problems inadequately dealt with even in the best textbooks, which are concerned to describe only what one might term the "normal" case. I would go so far as to say that in acute mastoiditis there is no such thing as a "normal" case.

ANATOMICAL AND DEVELOPMENTAL CONSIDERATIONS

In regard to the development of the ear, the Eustachian tube deserves mention if only to emphasize that by its origin from a recess in the primitive pharynx it early establishes a connexion between that cavity and the middle ear, which arises in its own expanded outer end. It is almost superfluous to stress the fact that the overwhelming majority of middle-ear infections pass up through the Eustachian tube, the micro-organisms being derived from foci in the tonsils, adenoids, or nasal fossae. That mastoid infections are the result of a direct spread as opposed to a blood stream infection has a considerable bearing on the course of the disease.

The development and anatomy of the mastoid is, in spite of the uniformity of its external contour, in marked contrast to that of the other important elements of the auditory apparatus, which are almost completely rigid and unvarying. The mastoid itself is derived from the petrous and squamous portions of the temporal bone, which early in the history of the embryo fold themselves round the primitive otocyst containing the germ of the internal ear. The structure of this enfolding mass is, so to speak, a more fluid one, with the result that a large number of variations of internal structure are possible in

* A summary of an address given to the West Norfolk Division of the British Medical Association on December 18th, 1931.

the fully formed bone. These variations apply particularly to the air cells which form the bulk of the mastoid. It is often supposed that these air cells develop as buds from the centrally placed antrum, much as the alveoli of the lung grow out from a central core. This is not the case. The antrum itself certainly grows backwards from the tympanic cavity, and varies enormously in size and outline, but the remaining cells arise independently, and those that open into the antrum do so secondarily. The majority remain discrete, and in number and size they present a diversity of patterns from one individual to another. They may be large and numerous, or entirely absent, but although no two bones are alike, it is possible and helpful to divide the mastoid into two broad groups: the sclerotic and the diploëtic. The sclerotic mastoid is, as the name suggests, very dense and resistant to infection, and associated clinically with the chronic type of otitis media, whereas the diploëtic, with its loose texture, offers a ready path to an inflammatory process, and is usually encountered in the type we are to consider—the acute mastoid.

PATHOLOGY

Pathologically, acute mastoiditis is an infective osteomyelitis, differing from the same disease in other bones only in the features imposed by its anatomical structure. The acute infection is associated with bone necrosis and suppuration in the air cells, and in the behaviour of the purulent products lies the clue to the many clinical manifestations of the disease. Pus, in whatever part of the body it is formed, has one characteristic: it always tends to track along the path of least resistance. We can now see how the varying signs and symptoms of mastoiditis are produced: how in one case the pus comes rapidly to the surface, in another remains pent up under tension, or again tracks deeply to infect the dura, brain, and other important structures. It is obviously impossible to make a logical classification of all the possible variations, but I shall illustrate the most important of them in a continuous and consecutive series of cases which came under my care in the West Norfolk Hospital and in consultations outside. They include all cases of mastoiditis under observation during a given period, and it will be seen that each, although obviously a mastoiditis, presented a different syndrome.

Before going on to the individual types, as shown in these cases, it is worth considering a question which must have occurred to each of us. How soon and how late, in relation to an acute otitis, can mastoiditis develop? I have operated on two cases in which advanced necrosis of the mastoid was present before perforation of the drum. During a bad influenza epidemic I operated on a nurse who had the most widespread disease I have ever seen in less than twenty-four hours from the onset of earache. There is no doubt that given a virulent infection or a very cellular bone, or both together, mastoiditis may be developed and, what is more, may become recognizable, in a few hours from the onset of the otitis from which it spreads. In contrast to the fulminating case is the type which presents a process resembling more closely a quiet necrosis of bone. The illness may be apyrexial, yet it undoubtedly dates from an acute otitis media. The first sign may be a cold abscess forming behind the ear, or one pointing to cerebral mischief. The whole mastoid may be excavated by disease without giving rise to pain, or, as I have suggested, to pyrexia. The contents of the cavity differ from the cholesteatoma seen in chronic cases, and there is no doubt that this type is rightly classed as an acute mastoiditis. There is yet one more case which may come on at any time during a patient's life, and that is the acute grafted on the long-standing chronic. There is no limit whatever to the time in which it may appear.

ILLUSTRATIVE CASES

A complete list of the symptoms and signs which can be met with in acute mastoiditis would only be confusing and meaningless, but in the cases described below an attempt will be made to point out the significance of some of them as they arise.

CASE I

The first case was that of an old lady of nearly 80, whom I saw in consultation. Following influenza she had an acute left otitis media which lasted several days, and was apparently resolving when it was found that she had become noticeably drowsy, and soon afterwards commenced to vomit. There was only a moderate pyrexia, and practically no localized tenderness over the mastoid. I felt sure her symptoms were due to an extradural collection of pus under tension, and, in spite of her age, advised an operation. The diagnosis was confirmed and the abscess found deep to a rather dense cortex, but her resistance was poor, and the infection passed into the meningeal spaces, and she died two days later of meningitis. The important lesson of this case is that absence of mastoid tenderness does not by itself negative a diagnosis of acute mastoiditis. There may be anything up to three-quarters of an inch of unaffected bone between the examining finger and the inflammatory process.

CASE II

The next case was that of a middle-aged woman, whose condition at first sight hardly suggested any mastoid trouble at all. She was admitted to hospital with an external rectus paralysis in the left eye, associated with headaches. Head retraction and Kernig's sign were slight, but definitely present. This combination of both rectus paralysis and meningism, associated with suppuration in the auditory apparatus, is known as Gradenigo's syndrome, and on looking into the case it was found that an otitis media on the affected side had been present for a few weeks. There was again no mastoid tenderness. At operation the bulk of the mastoid was found to be unaffected, but a number of cells related to the dura of the middle cranial fossa were broken down and a collection of pus was present. The headache and meningism cleared up very rapidly, and the external rectus paralysis was practically well before she went home a fortnight later. Again the classical signs of inflammation were lacking, but there was nevertheless a very grave condition present.

CASE III

The next case was that of a child, aged 13, who had had otorrhoea for a year. For a few weeks prior to admission she had an accession of pain associated with a progressive facial paralysis on the affected side. Although there was no pyrexia or tenderness I class this case as an acute exacerbation on top of a chronic infection, as the pain suggested that something new was going on, and the operative findings showed that actual mastoid involvement was recent in spite of a year's otorrhoea. I opened the mastoid and found healthy bone almost throughout, but there was a fistula leading to the facial canal, with a septic granulation growing at its orifice. I drained the mastoid and antrum, and the facial paralysis gradually cleared up. This child had a fairly dense bone, and it was her misfortune that the progress of suppuration was facilitated in the direction of the facial nerve rather than towards the exterior. Again no pyrexia and no tenderness, yet a little delay might have meant a permanent facial paralysis.

CASE IV

Another patient, a boy of 9, was sent to me with a history of about one week's otorrhoea, which was apparently subsiding, when his temperature rose and his neck became stiff and painful on the side of the affected ear. There was a pulsating discharge from the drum, which was obviously adequately drained, but there were no localized signs of mastoiditis. This child's condition calls attention to a very vital point in the diagnosis of mastoiditis—namely, that a persistent temperature, in spite of adequate drainage of the middle ear, points very strongly to mastoid involvement, and is by itself an indication for operation. I have operated many times on the strength of this alone, and never failed to find pus. As I expected, in this child the disease was deep-seated, and was tracking beneath the mastoid process and about the origins of the muscles arising in that region. This accounted for the pain and stiffness in the neck. Had he been allowed to pro-

gress to the point of abscess formation he would have had the condition known as Bezold's abscess, which appears actually in the upper part of the neck.

Another variety which is not infrequently encountered is the zygomatic mastoid. The mastoid air cells are prolonged to a greater or less degree into the zygoma, and may extend actually in front of the ear. In such cases the suppuration is superficial and the condition easily diagnosed, but in those cases where the zygoma alone is affected a pre-auricular abscess may be confusing if the possibility of a mastoiditis is not borne in mind. The treatment differs only in that the incision must be prolonged above and in front of the ear, and care must be taken not to enter the temporo-mandibular joint.

CASE V

I was asked to see a boy at Wisbech who, after several months' otorrhoea, developed a painless fluctuating swelling behind the ear. I opened his mastoid and found the whole bone was excavated by the disease to such an extent that all I had to do was to round off a few corners and establish a drainage down to all the important structures. This case illustrates very well the quiet necrosis which sometimes takes the place of the most commonly occurring acute osteomyelitis.

CASE VI

The last case is one that is most commonly met with, and approximates most nearly to the so-called normal. The patient was a child—and this group occurs chiefly in children—who had earache following a sore throat. The day before admission to hospital she had a myringotomy, but in spite of adequate drainage the temperature remained up, and there was oedema and tenderness behind the ear. Pus was found immediately beneath the surface, and the operation completed on the usual lines.

DIAGNOSTIC FEATURES

As already stated, it is not possible to make a logical grouping of the various symptoms which may occur in mastoiditis, but it may be helpful to tabulate a few of the points which come out in the above cases, and which may be of assistance in establishing a diagnosis.

(a) It is never too early in the course of an acute otitis media to suspect mastoiditis.

(b) Persistent pyrexia, in spite of adequate drainage of the middle ear, suggests mastoid involvement, and is itself an indication for operation.

(c) Absence of tenderness and signs of inflammation over the mastoid do not negative a diagnosis of mastoiditis.

(d) Involvement of important structures, such as the dura mater and the facial nerve, are often the first indications of mastoiditis, and must be constantly watched for.

(e) To await oedema behind the ear and pushing forward of the auricle is to allow the disease to progress unduly. These signs only indicate that the suppuration has come right through to the periosteum.

(f) Early diagnosis and operation spell less danger and less possibility of continued suppuration later on.

There are many cases sent to hospital wrongly diagnosed as mastoiditis on the strength of oedema and displacement of the auricle, and there are two conditions which commonly give rise to them. The first is inflammation and suppuration in the post-auricular gland, which is usually secondary to scalp infections or pediculi. The absence of otorrhoea or any form of otitis media should give the clue to the correct diagnosis. The second is meatal boil. Boils occur only in the outer hair-bearing area of the meatus, and the lining here is so closely adherent to the underlying cartilage that the pus is always in the early stages under considerable tension and causes excruciating pain. The infection may pass backwards and give rise to oedema and tenderness over the mastoid. The presence of a discharge from the ear further suggests the possibility of mastoiditis. There is no real excuse, however, for an error of diagnosis, as a meatal boil can always be seen on inspection. Even if its core cannot be distinguished the swelling and obstruction to the meatus are beyond anything seen in an acute otitis. The intensity of the pain is also characteristic.

I shall not go into any detail about the operation for acute mastoiditis beyond stressing the importance of a prompt and complete clearance of all infected bone. I also make a point of exposing the lateral sinus and the dura of the middle fossa almost as a routine. There is no doubt that many subsequent radical operations could be avoided, as well as permanent damage to hearing, by a more thorough technique in the operation for the acute condition. One last point. It is frequently necessary to do a second operation at a later stage for the removal of tonsils and adenoids. Even with the mastoid healed, otorrhoea may, and often does persist, and it is essential to remove all the causative infective foci. It would be only a slight exaggeration to say that this measure should be carried out in every case.

SUMMARY

1. Mastoiditis is extremely varied and uncertain in its manifestations.
2. It may appear very early or very late in relation to an otitis media.
3. To await mastoid oedema and displacement of the auricle is unnecessary and harmful to the patient.
4. Complete clearance of all infected bone is essential for permanent cure.
5. Removal of tonsils and adenoids is often necessary at a later stage.

A COMPARATIVE STUDY OF CHEST RADIOGRAMS AND THE MANTOUX TEST IN CHILDREN

BY

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AND

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This paper is the third of a series reporting our investigations on the subject of tuberculosis in children. Our first paper¹ dealt with the mortality in the average child population as contrasted with that in contact children; our second paper² compared the incidence of tuberculous infection in these two classes; the present paper is an attempt to estimate the value of radiological examination of the chest in the diagnosis of tuberculosis in childhood.*

Five hundred children up to the age of 15 were included in our present series. They were attending the Brompton Hospital as out-patients, either as contacts and apparently in good health, or as patients with symptoms referable to the respiratory system; thus they are not representative of the general population of that age. No selection of cases was made, all children being included in the order they attended the out-patient department. Each patient was tested with tuberculin by the intracutaneous method of Mantoux, the technique described in our previous paper² being used. We consider that a positive reaction to tuberculin signifies that the child is infected by the tubercle bacillus. It may be argued that, even when a child has been infected the reaction is not necessarily positive—as, for example, in a child suffering from miliary tuberculosis, or recovering from one of the infectious diseases. As all the children were well enough to attend the out-patient department of the hospital, and the previous history was carefully investigated, this does not affect the conclusion drawn from our series. Each child

* The investigation was carried out by means of a grant from the Halley Stewart Trustees to the research department of Brompton Hospital. The radiographs on which it is based were very kindly taken for us in the radiological department of the hospital, but the responsibility for their interpretation rests entirely on a sub-committee of the medical staff, consisting of Drs. G. E. Beaumont, Maurice Davidson, E. Atkin, R. C. Wingfield, and ourselves. It may thus be that in the employment of special terms we have departed from the usage of radiology, but we have endeavoured to define in every case the exact meaning which we attach to such expressions as "infiltration," "fibrosis," and so forth.