

The diseases of the antrum : (maxillary sinus) / [Lloyd T. Lavan].

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THE ANTRUM

LLOYD LAVAN

Part. I.



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THE DISEASES
OF THE
MOUTH AND TEETH.

BY
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PART I.
THE DISEASES OF THE ANTRUM
(MAXILLARY SINUS).

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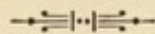
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P R E F A C E .



I HAVE undertaken this work at the request of medical friends, but not without much misgiving, owing partly to being a practitioner of dentistry and not of surgery, and partly to the small amount of time left at my disposal by the exigencies of a large practice.

As dental disease and its consequences are receiving much more attention from physicians and surgeons than formerly, I believe that the information contained in the following pages will be found interesting, and, I hope, of practical value.

LLOYD T. LAVAN.

15, GEORGE STREET, HANOVER SQUARE, W.

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THE SURGICAL ANATOMY OF THE MAXILLARY SINUS OR ANTRUM OF HIGHMORE.

The antrum is one of the accessory sinuses or air-chambers of the nose. It occupies the interior of the body of the superior maxilla. It opens into the middle meatus of the nose, and is lined with a delicate muco-periosteum, the epithelium of which is ciliated, continuous with the mucous lining of the nose and the other nasal accessory sinuses (the frontal, ethmoidal and sphenoidal sinuses). The bony plates forming the boundaries of the antrum are covered on both sides with periosteum, so that they are rarely entirely deprived of nutrition through the cutting off of their blood supply, to which fact the comparative rareness of caries and necrosis as sequelæ of antral disease is probably due.

The Development of the Antrum.

The accessory sinuses of the nose do not attain their full size until the 20th—25th year, *i.e.*, at or about puberty. Of these sinuses the antrum is the first to develop, appearing during the fifth month of foetal life. At birth it forms a shallow groove (in the nasal process of the superior maxilla) upon the outer wall of the nasal fossa. The superior maxilla at this period consists mainly of the alveolar process containing the developing teeth, which are almost in contact with its

orbital plate. The next step in development is a continuous deposition of cancellous bone between the orbital plate and the alveolar process, *pari passu* with absorption in the neighbourhood of the nasal groove (the future antrum). This deposition and absorption continue until the 25th year, the shallow nasal groove becoming a cavity (the antrum) enclosed within the superior maxilla. Up to the sixth—eighth year, *i.e.*, the period of the second or permanent dentition, the cavity is small and its walls are thick. It gradually increases in size at the expense of the thickness of its walls from childhood to puberty, after which age it undergoes no further change of form until extreme old age is reached, when the cavity may again become smaller. It is, however, often large and thin-walled in the aged.

The **adult antrum** is a pyramidal cavity with its base towards the nasal cavity and its apex towards the malar bone, into which it sometimes extends. It has a roof, a floor, and three walls (facial, nasal and zygomatic). Antra vary much in shape and size, even upon the two sides of the same skull. The average capacity is $2\frac{1}{2}$ drachms, but extremes of 1 and 8 drachms are recorded. The average dimensions are $1\frac{1}{2}$ inches in height, 1 inch in breadth and $1\frac{1}{4}$ inches in antero-posterior depth. It is relatively somewhat larger in the male than in the female, and in the adult than in the young or aged. In very large antra only a thin layer of bone separates the cavity from the teeth, ethmoidal cells and sphenoidal sinus, and the antrum in such cases, *i.e.*, when very large, may extend between the floor of the

nasal chamber and the hard palate. Pockets and recesses are frequently formed in the interior of the antrum by bony septa, especially under the roof (near the lachrymal groove and above the infra-orbital canal), over the roots of the molars and in the malar concavity. A bony partition sometimes (in $2\frac{1}{2}$ per cent. of antra) extends completely across the antrum, either vertically or horizontally, dividing the cavity into two separate and usually non-communicating chambers, each with its own opening into the nose.

The roof of the antrum is formed by the orbital plate of the superior maxilla, a thin partition of bone which separates the orbit from the antrum and in which runs the infra-orbital canal, containing the infra-orbital nerve and vessels. This canal sometimes appears as a well-marked ridge projecting into the antrum, and care must be taken when curetting not to injure it. There is sometimes a defect in the canal, and this may be the cause of the neuralgic pain met with in some cases of antral suppuration. Above the canal there is often a pocket or recess which must not be overlooked when curetting. Instead of a single plate the roof of the antrum may be separated into two layers by air cells, which when situated entirely in the orbital plate of the superior maxilla are termed "maxillary cells," and when communicating with the anterior ethmoidal cells—"maxillo-ethmoidal cells."

The floor of the antrum is formed by the alveolar process of the superior maxilla and is situated normally at the same level as the floor of the nasal chamber, but in small antra it may lie much higher

up, and in large ones much lower down, the antrum in such cases sometimes extending between the floor of the nasal chamber and the hard palate. The larger the antrum the nearer are the teeth to it. The first and second molars nearly always lie immediately below the floor of the antrum and the third molar (wisdom tooth), and the second bicuspid do so frequently. The floor is usually very uneven, and several pockets are often present over the molar roots. In very large antra the floor is very thin and prominently indented over the roots of the teeth (the first and second molars and second bicuspid), but it is rare for the roots to actually project uncovered into the antrum except occasionally the roots of the first molar. The floor is at its lowest level and thinnest over the first molar, this situation being, therefore, generally selected for opening the antrum, as there is the least bone to perforate and the best drainage at this point, and perhaps more especially because there is little fear of missing the antrum, even if it is very small or abnormally situated. Upper molars have three roots, two buccal and one palatal, and each root has a separate socket. Of the three sockets of the first molar the anterior buccal is the most suitable for opening through, as it is the straightest, a point of importance in the accurate adaptation of a plate and plug.

The anterior or facial wall of the antrum, which is formed by the facial surface of the superior maxilla, is the thinnest of its walls and, therefore, becomes most distended in fluid collections in the antrum, as in suppuration when the natural opening into the

nose is blocked and there is, therefore, no egress for the pus, and in cyst in the antrum. The infra-orbital foramen lies just in front of its upper margin, and care must be taken when opening the antrum widely for the radical operation not to injure the infra-orbital nerve and vessels, which pass out of it. The facial wall is limited anteriorly by the canine ridge and posteriorly by the molar ridge, between which lies the "canine fossa," the situation through which the radical operation of curetting the antrum is performed.

The inner or nasal wall of the antrum is formed by the uncinatè process of the ethmoid, the vertical plate of the palate bone, the maxillary process of the inferior turbinate bone and a small portion of the lachrymal bone. It is divided into two portions by the inferior turbinate bone. The portion above this bone is incomplete, the deficiency in the bony wall being filled in with membrane. The natural opening of the antrum into the nose is situated in this membrane. The deficiency in the bony wall forms a large irregular opening near the roof of the antrum, bounded by the ethmoid, palate and inferior turbinate bones. It is reduced to a small oval opening (the "**ostium maxillare**") by the nasal mucous membrane, a flap of which almost entirely closes the ostium. The "ostium maxillare" opens into the sulcus semilunaris (a groove under cover of the middle turbinate bone in the middle meatus). In addition to the normal ostium there are sometimes (in 10 per cent. of the subjects examined) one or more accessory openings in the mucous membrane. These are usually situated below and behind the normal ostium, but

they may open in front of it, sometimes into the infundibulum (the nasal end of the duct of the frontal sinus). Unlike the normal ostium such accessory openings are not covered by the middle turbinate bone. When the accessory opening or openings are situated below and behind the normal ostium the discharge in empyema of the antrum may flow backwards into the naso-pharynx, instead of in the more usual direction of the nostril. The position of the ostium maxillare, near the top of the antrum, precludes the discharge of accumulated fluid (pus) until the antrum is nearly full or the patient's head is bent forward. The ostium maxillare sometimes becomes blocked in empyema of the antrum, owing to the swelling of the mucous membrane. It is not easy of access to instruments (probe, catheter, &c.) owing partly to the flap of mucous membrane and partly to the downward projection of the middle turbinate bone. In rare cases there is no opening at all into the nose. The lachrymal canal lies just exterior to the nasal wall of the antrum. The portion below the inferior turbinate bone consists of a thin osseous plate, which forms the outer boundary of the inferior meatus of the nose. When an exploratory puncture is indicated it should be made just below the inferior turbinate bone, to avoid missing the antrum, which might occur if it were made lower down nearer the floor of the nasal chamber.

The posterior or zygomatic wall of the antrum is formed by the zygomatic surface of the superior maxilla, a thin plate of bone dividing the antrum from the zygomatic fossa.

THE ACCESSORY SINUSES OF THE NOSE.

As previously mentioned, the antrum is one of the air-chambers or accessory sinuses of the nose.

The accessory sinuses of the nose are classified thus :—

1. **Anterior Group.**—The maxillary sinuses, or antra; the frontal sinuses and the anterior ethmoidal cells.
2. **Posterior Group.**—The posterior ethmoidal cells, and the sphenoidal sinuses.

The commonest disease of the antrum is sinusitis (empyema); in fact the other forms of disease (cysts and tumours) are rare, and as the sinusitis is frequently multiple, involving the frontal and ethmoidal sinuses, and sometimes also the sphenoidal sinus, as well as the antrum, I append a short description of these cavities.

1. The **frontal sinuses** are situated between the two tables of the skull, in the lower part of the frontal bones, above the root of the nose and the inner ends of the eyebrows. Each sinus has a floor and two walls (anterior and posterior). The floor lies partly above the orbit and partly above the nasal fossa. The opening or “ostium frontale” (the frontal end of the “fronto-nasal canal”) is situated in the nasal part of the floor. They first appear during the seventh year of life, as extensions of the anterior ethmoidal cells, and grow slowly up to the 20th or 25th year, after which they rapidly increase to their full size. In old age

their size again increases owing to the inner tables following the shrinking brain. They vary greatly in shape and size, even on the two sides of the same skull, and one or both may be absent, or both may be fused into a single cavity. There is never bi-lateral symmetry. The frontal sinuses are divided from each other by a thin septum of bone, which frequently becomes destroyed in disease (empyema), and is often oblique in direction. The frontal sinuses are in close proximity to the brain, their posterior walls, formed by the inner tables of the frontal bones, being part of the floor of the anterior cerebral fossa.

Their anterior walls are normally formed by the superciliary ridges of the outer tables of the frontal bones. When the sinuses are very large they may extend upwards to the frontal eminences and backwards well into the roof of the orbit. The external configuration of the frontal bones is not a sure guide to the size of the underlying sinuses, as a large sinus may co-exist with a feebly marked superciliary ridge, the necessary space being provided by retrocession of the internal table, and a prominent bump here may be due entirely to a heaping up of bone. It may, however, be stated that a prominent superciliary ridge usually points to a well-developed sinus.

The anterior wall is thicker than the posterior. A normal frontal sinus measures a little over an inch in width and a little under an inch in height. The frontal sinus opens into the middle meatus of the nose, usually into the "infundibulum," the nasal end of its duct ("fronto-nasal canal") being in close proximity to the opening ("ostium maxillare") of the antrum.

The frontal sinus sometimes communicates directly with the antrum instead of with the middle meatus of the nose. In such cases frontal suppuration almost necessarily leads to antral suppuration, and *vice versâ*.

2. The **ethmoidal sinuses** occupy the interior of the lateral masses or "labyrinths" of the ethmoid, and are situated in the upper and posterior part of the nasal fossæ. Each of the sinuses is composed of a number of cells and is included between two vertical plates of bone, the outer one of which (the os planum of the ethmoid) forms part of the orbit; and is very thin and sometimes incomplete in places, the deficiencies being filled in with membrane, and the inner one (the cribriform plate of the ethmoid) part of the outer wall of the nasal fossa. The cells communicate with each other and with the superior and middle meati of the nose on that side. The cells are divided into an anterior and a posterior group. Anatomists further sub-divide the cells of the anterior group into anterior and middle ethmoidal cells, but as there is no clinical reason for or advantage in differentiating between these cells, the term "anterior ethmoidal cells," when used in describing empyema of these cavities will be understood to include all the cells of the anterior group. The cells of the anterior group open below the middle turbinate bone into the middle meatus, some (the "anterior" of anatomists) into the "infundibulum," others (the "middle" of anatomists) into the "sulcus semilunaris," and the posterior cells open above the middle turbinate bone into the superior meatus, below and in front of the opening of the sphenoidal sinus.

The openings or "ostia" of the posterior cells are larger than those of the anterior group; purulent retention in empyema being, therefore, rarer in the former than the latter.

The duct of the frontal sinus ("fronto-nasal canal") passes through the anterior group. The anterior cells sometimes communicate directly with the antrum. The ethmoidal cells begin to develop during the fourth or fifth year, but they do not attain their full size until the 20th year. Many of the ethmoidal cells are imperfect and are completed by contiguous bones, and are named after them, thus: fronto-ethmoidal, lachrymo-ethmoidal, maxillo-ethmoidal, sphenoid-ethmoidal and palato-ethmoidal cells.

3. The **sphenoidal sinuses** are a pair of irregular cavities situated in the body of the sphenoid. They are divided from each other by a bony septum of variable thickness, which is seldom perforated either in health or disease. They are in close proximity to the brain, their roofs forming part of the floor of the anterior cerebral fossa. The sinuses vary greatly in size and their walls consequently in thickness. Each sinus opens by one large ostium (the "ostium-sphenoidale") near the top of its anterior wall into the "sphenoid-ethmoidal recess," which is situated above the superior meatus of the nose. Sometimes, however, the sinuses open into the posterior ethmoidal cells, from which they may become infected in empyema. When the sphenoidal sinuses are large the posterior ethmoidal cells are usually small, and *vice versâ*. The sphenoidal sinuses become enclosed cavities at the third year, but they do not attain their full size until

after puberty. The anterior wall and floor of each sinus is formed by a sphenoidal turbinate bone ("bones of Bertin"). These two bones fuse with the sphenoid at about the 12th year. The naso-palatine artery and sphenopalatine (Meckel's) ganglion are situated near the lower border of the anterior wall, and care must be taken when operating not to injure them.

Considering the close proximity of the nasal accessory sinuses to each other, the continuity of their lining mucous membrane, the apposition of their openings, and the occasional direct communication existing between them, it is not surprising that suppuration of one of the sinuses frequently spreads to the others.

THE DISEASES OF THE ANTRUM.

The diseases of the antrum are classified thus:—

1. **Inflammatory Disease (sinusitis):—**
 1. **Suppurative Catarrh** or "**Empyema antri**," which may be either acute or chronic.
 2. **Non-Suppurative Catarrh**, which may be either acute or chronic.
2. **Fistulæ** of the antrum.
3. **Cysts** of the antrum or "**Hydrops antri**."
4. **Tumours** of the antrum.

Inflammatory disease (sinusitis) is by far the commonest form of antral disease. In both the acute

and chronic varieties the inflammatory process nearly always proceeds to suppuration. Cases of non-suppurative catarrh, either acute or chronic, are seldom seen in practice, as patients rarely seek advice unless suppuration has supervened.

Antral suppuration is nearly always unilateral. It is rare for both antra to be affected simultaneously, but suppuration in one antrum may be followed by suppuration in the opposite antrum, sometimes after several years. Empyema of the antrum is termed "open" when the natural opening into the nose is patent, and "closed" when this opening is blocked. "Closed empyema" of the antrum is rare. The "open" variety is also termed "**latent empyema,**" owing to the absence or masking of the usual symptoms of inflammation (pain, heat, redness and swelling), and the "closed," in contra-distinction, is sometimes termed "**evident empyema.**"

"**Antral Abscess**" is the popular name for suppuration of the antrum. It is applied indiscriminately to both the acute and chronic varieties of suppurative catarrh.

SUPPURATIVE CATARRH, OR "EMPHYEMA" OF THE ANTRUM.

This is, clinically, by far the most important disease of the antrum, owing to the frequency of its occurrence, the variety and ill-omened nature of its sequelæ (suppuration, polypi, cysts, periostitis, caries, necrosis and malignant disease), and the possibility of very serious complications (inflammation and

suppuration of the other accessory sinuses of the nose, *i.e.* "multiple sinusitis," followed sometimes, though rarely, by orbital and intra-cranial mischief).

Before considering the symptoms and diagnosis of empyema I shall point out the four commonest reasons for which advice is sought in these cases :—

1. An intermittent unilateral purulent discharge from the nostril.

In an adult this suggests suppuration of the antrum. In a child such a discharge suggests a foreign body in the nose.

2. A "Sickly taste" in the mouth.

This also suggests suppuration of the antrum, and is due to the discharge passing backwards into the naso-pharynx, owing to the abnormal position of the natural opening into the nose, or to the presence of one or more accessory openings.

3. Distention of the outer or facial wall of the antrum.

This also suggests suppuration of the antrum, with the natural opening into the nose blocked.

4. Supra-orbital neuralgia.

Advice is sometimes sought in cases of antral suppuration (empyema) for headache, especially supra-orbital neuralgia, the patient making no allusion to the nasal discharge or otherwise drawing the surgeon's attention to the antrum.

The above signs are merely clues to help the practitioner to get on the right road. They are not positive evidence, or in the least degree proofs of antral suppuration.

CAUSES OF SUPPURATIVE CATARRH ("EM- PYEMA") OF THE ANTRUM.

1. **DENTAL**, the commonest cause, is due to pus burrowing into the antrum from the root of an **abscessed** tooth, usually the first or second molar, but any abscessed tooth or root in the upper jaw may infect the antrum. It is everywhere stated that "carious," *i.e.* decayed, teeth are often the primary or contributory cause, but this is an error. It is also believed that empyema of the antrum may set up caries of the teeth in its vicinity, but this is an even greater fallacy. **The only tooth or root that can infect an antrum is one either acutely or chronically abscessed.**

2. **NASAL**, due to **syphilitic, tuberculous, or malignant ulceration of the nose**, and possibly any catarrhal process of the nasal mucous membrane, especially **acute nasal catarrh** (coryza, or cold in the head), and the catarrhal condition occurring in the course of, or during convalescence from, certain acute infectious and other disorders, especially **influenza, pneumonia, scarlet-fever, measles, typhoid, small-pox, diphtheria, gonorrhœa, acute rheumatism, cerebro-spinal meningitis, mercurial ptyalism and lead-poisoning.** The nasal mucous membrane being continuous with that of the antrum and other accessory sinuses of the nose, catarrh of the nose often leads to catarrh of the antrum and the other accessory sinuses. The catarrh in these cases is usually non-suppurative, spontaneous cure resulting.

If, however, certain pyogenic micro-organisms or the special micro-organisms of the above diseases gain

admission to the nasal cavity suppuration may result, the catarrhal condition of the nasal mucous membrane and the patient's lowered vitality being the predisposing causes, and the pyogenic or special micro-organisms, the exciting cause. In these cases the starting point of the suppurative process is nearly always one of the anterior ethmoidal cells, the disease spreading thence to the antrum and frontal sinus.

Influenza is the commonest nasal cause of empyema of the antrum. A severe cold in the head sometimes leads to empyema of the antrum, and a few cases are due to orbital suppuration, the pus burrowing into the nose through the ethmoidal cells, from which the disease spreads to the antrum and frontal sinus.

3. TRAUMATIC, following the removal of nasal polypi, the prolonged use of plugs in epistaxis, the forcing of a tooth into the antrum in attempting its extraction, a blow on the cheek, with or without fracture of the superior maxilla, operations involving the antrum, the resection of the infra-orbital nerve, the careless use of the galvano-cautery or strong acids, and unskilful operations in the middle meatus, or intra-uterine pressure when occurring in a newly-born infant.

It is difficult to understand how antral suppuration can occur in a newly-born infant, as the antrum at birth is merely a groove in the outer wall of the nose ; responsible observers have, however, recorded such cases.

4. NECROSIS OF THE SUPERIOR MAXILLA.

This is usually the result of syphilis, but it is sometimes due to the fumes of phosphorus (in phosphorus-workers), or mercury (in looking-glass makers), tubercular deposits, malignant disease, the exanthemata, the administration of mercury, abscessed teeth or roots, empyema of the antrum, fracture of the superior maxilla by a blow or undue violence in extracting a tooth, the escape of arsenic applied to devitalize the nerve of a tooth, or specific inflammations, such as cancrum oris or ulcerative stomatitis. Necrosis of the jaw is sometimes idiopathic.

5. FOREIGN BODIES IN THE ANTRUM, such as a tooth, a piece of steel (a broken beak of a forceps), a portion of drainage tube, the larvæ of certain flies and worms (maggots), or particles of tobacco (in snuff-takers).

Some cases of suppuration of the antrum have been ascribed to nasal polypi, ozæna and erysipelas, but these conditions are more likely the result than the cause of the antral suppuration, if they have any connection at all with it.

Although, of course, it is of the greatest importance to ascertain the exact cause of the suppuration, it may be stated that suppuration of the antrum is usually either dental or nasal in origin, and more often dental than nasal. It is, in fact, nearly always due to an abscessed tooth or root.

In antral suppuration of dental origin the organisms are anaërobic, and the pus is fœtid ; in that of nasal

origin the organisms are aërobic, and the pus is non-fœtid.

In suppuration of the frontal sinus the pus is non-fœtid and often profuse. In suppuration of the ethmoidal cells the pus may be either fœtid or non-fœtid, usually non-fœtid, and is small in amount. In suppuration of the sphenoidal sinus the pus is scanty, with a tendency to dry into crusts, and is usually fœtid.

PATHOLOGY OF SUPPURATIVE CATARRH (" EMPYEMA ") OF THE ANTRUM.

The catarrh may be acute or chronic. In the acute there is at first a considerable serous discharge, which soon becomes purulent. If the natural opening into the nose becomes blocked, as it sometimes does, owing to the swollen condition of the mucous membrane, distention and, possibly, perforation followed by a fistula may result. Spontaneous cure sometimes occurs, but the usual termination is for the suppuration to become chronic. A case in my practice was cured by the extraction of the abscessed tooth (an upper wisdom) that had caused the antral trouble, followed by sea-bathing, the patient taking sea-water into his mouth and ejecting it through his nose. When the catarrh has become chronic the mucous membrane undergoes fibroid thickening and the mucous glands may degenerate into cysts and polypi. Nasal polypi, granulations or hypertrophies are nearly always present in the middle meatus in

long-standing cases. These growths indicate that the disease has spread to the anterior ethmoidal cells, and are not due to the irritation of the antral discharge, as generally believed.

The frontal sinus and anterior ethmoidal cells on the affected side become infected in about 50 per cent. of the cases of chronic suppuration of the antrum. This condition is termed "multiple sinusitis," and is nearly always brought about by actual extension along the mucous membrane and not by perforation of the antral walls, though this, in rare cases, does occur. When the natural opening becomes blocked the periosteum sometimes, though rarely, becomes involved, periostitis, leading to destruction of the bone (caries and necrosis), resulting. Caries and necrosis are both rare sequelæ of antral suppuration, but when they do occur perforation results, the disease invading the ethmoidal cells and frontal sinus, and subsequently the sphenoidal sinus, ending sometimes in orbital and intra-cranial complications.

Intra-cranial complications, which, fortunately, are not frequent sequelæ of antral suppuration, may result from perforation of the posterior wall of the frontal sinus, or the roof of the sphenoidal sinus, followed by extra-dural, sub-dural or cerebral abscess, purulent basal or general meningitis, thrombosis of the cavernous, petrosal or superior longitudinal sinuses, or by a combination of two or more of these complications.

Though sometimes a sequence of acute suppuration, chronic suppuration most often originates without any acute symptoms.

SYMPTOMS OF EMPYEMA OF THE ANTRUM. ACUTE SUPPURATIVE CATARRH.

1. The earliest symptoms are a dull, deep-seated pain in the antrum, accompanied by severe neuralgic pain in the cheek and forehead on the affected side, and tenderness upon pressure over the gums, in the bicuspid and molar region, sometimes preceded by a rigor and rise of temperature. There may also be redness, tenderness, and swelling of the cheek on that side.

2. The next symptom is a sudden muco-purulent or purulent discharge from the nostril of the affected side. This gives much relief. If no discharge occurs, or if it ceases owing to the blocking of the natural opening, the antrum should be at once punctured, otherwise the pain remains very severe and the outer or facial wall becomes very much distended. If unrelieved perforation and fistula may result.

CHRONIC SUPPURATIVE CATARRH.

The empyema may be either "open" (**latent empyema**), or "closed" (**evident empyema**). "Evident empyema" is rare.

SYMPTOMS OF "LATENT EMPYEMA" OF THE ANTRUM.

1. The chief and sometimes only symptom is a **nasal discharge** on the affected side, usually from the nostril, but sometimes passing backwards into the

naso-pharynx, owing to the abnormal position of the natural opening, or the presence of an accessory opening. When the pus passes backwards, the patient complains of a "sickly taste" in the mouth. Chronic suppuration may exist in the antrum for years without giving rise to pain or swelling.

The character of the discharge. The discharge is unilateral, purulent, intermittent and usually foetid. The pus is of a canary yellow colour and liquid. In long-standing cases it sometimes becomes brownish-yellow, and in rare cases, green and viscous. A few cases are recorded in which the pus was caseated, the antrum being filled with a cheese-like mass. This very rare condition was formerly termed "Cholesteatoma" of the antrum.

The amount of the discharge is not constant but varies with the patient's general health; thus, during a sea voyage, it may cease altogether, reappearing however when he returns to his ordinary surroundings.

2. Nasal obstruction is not a constant symptom. Its amount varies with the chronicity of the case. Many long-standing cases are associated with nasal polypi, granulations and hypertrophies in the middle meatus. These growths are due to and symptomatic of ethmoidal inflammatory disease, and when present in cases of antral suppuration point to the disease having spread to the anterior ethmoidal cells, a complication usually leading to suppuration of the frontal sinus also. The lining mucous membrane of the antrum in such cases is usually similarly degenerated, the interior of the cavity being filled with polypoid hypertrophies. There is however one swelling often

present in the middle meatus that is due to and symptomatic of antral suppuration. It is a cushion of mucous membrane, termed "**Kauffmann's Swelling**," situated between the anterior end of the middle turbinal and the outer wall of the middle meatus. The middle turbinal appears to be cleft in the middle. This appearance is due to the presence of the additional cushion of mucous membrane ("Kauffmann's swelling"). The pus appears in what looks like the cleft, but which is in reality the space between the middle turbinal (internally) and "Kauffmann's swelling" (externally).

3. The patient may experience an **offensive smell**, which is not always apparent to others—a point which distinguishes it from ozæna ("atrophic rhinitis"), a disease associated with a most offensive nasal discharge, the smell of which, however, the patient is unaware of, owing to the atrophic changes in the nasal membrane.

The nasal discharge in antral suppuration can hardly be mistaken for that of ozæna, but as this has sometimes occurred the following remarks may not be out of place.

1. The discharge in antral suppuration proceeds from one nostril only, and is intermittent, purulent, and fœtid; whereas in ozæna it nearly always proceeds from both nostrils, and is constant, and not only purulent but mixed with offensive crusts and of a disgusting and penetrating odour.

2. Ozæna is a disease of childhood, seldom beginning after the 16th year, and usually persists throughout life; the discharge, however, usually

lessens after 20, and sometimes entirely disappears in old age.

Suppuration of the antrum is a disease of adult life, but it may occur in a child (rare).

4. Pain is not a constant symptom, but when present it may be a prominent one, owing to its severity and neuralgic character. It is probably caused by a defect in the infra-orbital canal, which traverses the roof of the antrum, and the consequent exposure and irritation of the infra-orbital nerve. The relative patentcy or closure of the "ostium maxillare" has, I believe, nothing to do with the pain occurring in these cases. The pain may be referred to the supra-orbital region, the cheek, the eye or the occipital region.

The pain usually takes the form of headache, especially supra-orbital neuralgia. It is sometimes periodic, usually worse during the morning, and has been mistaken for "brow-ague," neuralgia, &c. Tooth-ache is also sometimes present.

5. Secondary symptoms, such as cough, dryness of the throat, huskiness of the voice, catarrhal deafness, asthma, and indigestion, may arise as the result of the irritation of the purulent discharge passing backwards into the respiratory and alimentary passages.

Chronic septic poisoning may result from the constant swallowing of the purulent discharge. When this occurs the patient's general health is profoundly affected. His appetite is lost and his digestion so deranged that the little food taken gives rise to nausea, flatulence and pain. The subtle effect produced on his nervous system is evidenced by mental lassitude, depression, loss of energy and inability to perform his

daily work. There is in fact a general lowering of vitality, and the patient seems "under a cloud." His appearance in severe cases resembles malignant cachexia, owing to the sallowness of his complexion, and the loss of weight resulting from mal-nutrition. The possibility of many of the simpler ailments, met with in general practice, being septic in origin should be kept in mind. Oral sepsis due to diseased teeth may also lead to chronic septic poisoning.

6. Eye symptoms do not usually occur unless the sphenoidal sinus becomes affected, except displacement of the eyeball, which may arise in uncomplicated cases of antral suppuration, and is due to the distention of the orbital plate when the natural opening into the nose is blocked.

When the suppuration has spread to the ethmoidal cells the discharge may find its way into the orbit, presenting as a tender brawny swelling at the inner angle of the orbit. The swelling may either displace the eyeball downwards and outwards or open externally, giving rise to a fistula.

When the suppuration has spread to the sphenoidal sinus the optic and other nerves of the eye may become affected, leading to partial or complete loss of vision, ptosis, strabismus, paralysis, or intense neuralgia.

SYMPTOMS OF "EVIDENT EMPYEMA" OF THE ANTRUM.

1. Distention of the anterior (facial) wall of the antrum is often the only symptom.

2. Displacement of the eyeball owing to distention of the roof (orbital plate) of the antrum may occur.

3. Pain (variable).

The opening into the nose being blocked or, in very rare cases, absent, there is of course no nasal discharge. The pain in these cases is probably due to the tension of the pent up discharge. The distention of the facial wall may in very chronic cases be followed by permanent thickening of the bone, somewhat resembling an osseous tumour.

DIAGNOSIS OF SUPPURATIVE CATARRH ("EMPYEMA") OF THE ANTRUM.

ACUTE SUPPURATIVE CATARRH.

If seen before a nasal discharge is established, which is somewhat rare in practice, the patient appears to have a severe cold with face-ache or neuralgia, and a diagnosis must be made between acute catarrh of the antrum and acute alveolar abscess, thus :—

1. Tenderness of the teeth to tapping. In acute alveolar abscess **one tooth**, *i.e.*, the one connected with the abscess, **is especially and extremely tender**. In acute catarrh there may be more or less equal tenderness of several of the teeth in the bicuspid and molar region.

2. The character of the pain. Acute alveolar abscess begins with a dull aching pain around a decayed ("carious"), stopped or crowned tooth, or the root or roots of a broken tooth. A tooth or root so affected becomes tender and slightly

raised in its socket, owing to inflammation of its periodontal membrane. As soon as pus forms **severe throbbing pain** occurs and the tooth or root becomes loose and extremely tender to pressure or tapping. Pus may sometimes be seen welling up around it. In acute catarrh there is **severe neuralgic pain in the cheek and forehead** on the affected side and a dull deep-seated pain on that side of the upper jaw.

3. Swelling of the gums and face. In acute alveolar abscess swelling of the soft parts (gum, cheek, &c.) follows the throbbing pain, the severity of which then becomes much reduced. In acute catarrh no swelling results unless the "ostium maxillare" becomes blocked, which however is rare. When this occurs the outer or facial wall of the antrum gradually distends and the pain increases in severity. NOTE.—When swelling occurs the pain decreases in acute alveolar abscess, but increases in acute catarrh.

Given a case in which the suppurative process is well established before advice is sought, and these cases are by far the most common in practice, we find the patient with one of three symptoms :—

1. A unilateral, purulent, intermittent discharge from the nostril.
2. Pus in the naso-pharynx, giving rise to a "sickly taste" (rare).
3. A gradually swelling cheek, associated with great and increasing pain (rare).

Any one of these symptoms following acute neuralgic pain in the cheek and forehead and deep-seated pain in the jaw on that side is pathognomonic of acute suppurative catarrh of the antrum.

CHRONIC SUPPURATIVE CATARRH.

The suppurative catarrh ("empyema") may be either "open" (**latent empyema**) or "closed" (**evident empyema**).

DIAGNOSIS OF "LATENT EMPYEMA" OF THE ANTRUM.

It must be remembered that in long-standing cases of chronic suppuration of the antrum, the frontal sinus and anterior ethmoidal cells become infected in about 50 per cent. of the cases, also that antral suppuration is sometimes secondary to suppuration of the frontal sinus and anterior ethmoidal cells.

Before a diagnosis is given in cases of suspected chronic suppuration of the antrum a careful examination should be made by means of the following tests, in the order in which they are given, until pus is shewn to proceed from the antrum and the antrum alone, proving the case to be one of uncomplicated antral suppuration :

1. RHINOSCOPY.

Examine the nose by both anterior and posterior rhinoscopy to exclude the possibility of the discharge having a nasal origin, such as suppuration resulting from syphilis, tubercle, ozæna (atrophic rhinitis), gonorrhœal or leucorrhœal infection (purulent rhinitis), a foreign body, a rhinolith, the exanthemata, malignant disease, hypertrophic rhinitis, adenoids, naso-pharyngeal catarrh, fibrinous or croupous rhinitis, or empyema of the frontal, ethmoidal, or sphenoidal sinus.

Though the chief object of the rhinoscopic examination is to ascertain the origin of the purulent discharge, notice should also be taken of the intra-nasal appearances.

INTRA-NASAL APPEARANCES.

1. In antral suppuration a cushion of mucous membrane, termed "**Kauffmann's swelling**," is usually seen between the anterior end of the middle turbinal and the outer wall of the middle meatus.

It is due to inflammation of the mucous membrane and periosteum of the unciniate process of the ethmoid, and when associated with a purulent discharge in the middle meatus is pathognomonic of antral suppuration.

2. In suppuration of the anterior ethmoidal cells, which is a frequent sequence of long-standing antral suppuration, polypi, granulations and large hypertrophies are present in the middle meatus.

3. Ulceration of the nose is usually syphilitic, more rarely tubercular, lupoid or malignant. The intra-nasal appearances of syphilitic, tubercular, lupoid and malignant ulceration are given below. (*See "Diagnosis of a Unilateral Discharge from the Nostril."*)

PURULENT NASAL DISCHARGES.

A purulent nasal discharge may occur at any age from infancy to 60 years of age, after which it is rare. It may be unilateral, *i.e.*, from one nostril only, or bilateral, *i.e.*, from both nostrils.

The discharge is unilateral in : 1. Suppuration of one or more of the anterior group of nasal accessory sinuses, when the sinuses affected are on the same side. 2. A foreign body in the nose. 3. A rhinolith.

The discharge is bilateral in : 1. Ozæna. 2. Gonorrhœal or leucorrhœal infection. 3. Nasopharyngeal catarrh. 4. Adenoids. 5. Some long-standing cases of hypertrophic rhinitis. 6. Nasal suppuration occurring in the course of the exanthemata, especially measles, scarlet-fever and small-pox, and in other acute infectious disorders, such as diphtheria and glanders. 7. Syphilitic rhinitis ("snuffles") of infants. 8. Nasal suppuration due to struma. 9. The late stages of acute rhinitis ("cold in the head").

The discharge is either unilateral or bilateral in : 1. Double suppuration of the frontal sinuses. Double antral suppuration hardly ever occurs ; when it does the discharge is bilateral, but such cases are rare. 2. Syphilitic (tertiary) ulceration and necrosis of the nose. 3. Tuberculous and lupoid ulceration of the nose. 4. Fibrinous or croupous rhinitis. 5. Malignant disease of the nose.

Ozæna is sometimes unilateral, especially at an early stage of the disease.

THE DIAGNOSIS OF A UNILATERAL DISCHARGE FROM THE NOSTRIL therefore lies between :—

1. Suppuration of one or more of the anterior group of nasal accessory sinuses, *i.e.*, the antrum,

frontal sinus and anterior ethmoidal cells. When from the antrum the discharge may be fœtid or non-fœtid. It is fœtid when the empyema is of dental origin and non-fœtid when of nasal, the latter being rare. When from the frontal sinus or anterior ethmoidal cells it is non-fœtid, except when the empyema of these sinuses is secondary to empyema of the antrum of dental origin. The discharge from all the sinuses involved is then fœtid.

2. Syphilitic (tertiary) ulceration and necrosis of the nose. The discharge in these cases is profuse, of a distinctive and very offensive odour, quite unlike that of ozæna, and sometimes blood-stained (sanguineous). Deep ulceration is seen on anterior rhinoscopy, especially about the septum (vomer and septal cartilage), and this, in necrosis, is associated with large granulations around the piece of dead bone. The ulceration may lead to perforation of the soft and hard palate, and sometimes to its complete destruction. As in these cases the nasal accessory sinuses often become infected, they should always be examined. Syphilis is the commonest cause of nasal ulceration.

3. Tuberculous and lupoid ulceration of the nose (rare). The discharge in these cases is small in amount and non-fœtid. It may be muco-purulent, purulent or blood-stained. The nature of the ulceration is placed beyond doubt by curetting the ulcer deeply. When of tubercular origin the typical bacillus will be found. This diagnoses it from syphilitic and malignant ulceration, which in their turn can be diagnosed from each other by watching the action of iodide of potassium, given internally.

Tuberculous ulceration is more superficial and indolent than the syphilitic, and its usual site is the anterior part of the septal cartilage. The chief symptom of lupus of the nose is obstruction caused by the lupoid nodules. Lupus of the nose is usually due to the disease spreading into the nostrils from the skin of the face. Tubercle and lupus are both much rarer causes of nasal disease than syphilis.

4. A rhinolith. The discharge in these cases is purulent or sanguineo-purulent. It is associated with more or less obstruction on that side. It occurs in adults, especially in females. Its usual site is the inferior meatus.

5. A foreign body in the nose. The discharge in these cases is similar to that due to a rhinolith. A foreign body is the commonest cause of a unilateral purulent nasal discharge in children. It must, however, be remembered that antral suppuration, though rare, may occur in children. A supernumerary tooth sometimes erupts in the nose. The usual site of a foreign body is the inferior meatus.

6. Fibrinous or croupous rhinitis. The discharge in these cases is muco-purulent and associated with membranous shreds. It is a disease of early childhood and is rare after the eighth year.

7. Ozæna. The disgusting and penetrating odour of the discharge and the presence of offensively smelling crusts in it should lead to its diagnosis. Owing to atrophic changes the nasal cavities become abnormally wide in ozæna. In a unilateral case the affected nostril is much wider than the healthy one.

8. Malignant disease of the nose. The discharge in these cases is greenish and the growth is nearly always a sarcoma. Sarcoma is described under "Tumours of the Antrum."

If the discharge is not due to syphilis, tubercle, a rhinolith, a foreign body, fibrinous rhinitis, ozæna or malignant disease, it must almost certainly proceed from suppuration of one or more of the anterior group of nasal accessory sinuses, *i.e.*, the antrum, frontal sinus and anterior ethmoidal cells. In very rare cases the discharge in suppuration of one or both the sinuses of the posterior group, *i.e.*, the posterior ethmoidal cells and sphenoidal sinus, may appear at the nostril, though it nearly always trickles backwards by way of the posterior naris (choana) into the naso-pharynx. It is not at all easy to ascertain which of the sinuses is diseased, or, if more than one, how many are involved.

To arrive at this diagnosis the following points should be noted:—

1. The antrum is usually the sinus primarily diseased and the one most often affected, the suppurative process spreading in about 50 per cent. of the cases to the frontal sinus and anterior ethmoidal cells on the same side.

2. The frontal sinus and anterior ethmoidal cells are usually concurrently diseased, independent empyema of either of them being rare. Empyema of the frontal sinus is bilateral in about one-third of the cases.

3. Pus in the middle meatus trickling towards the nostril points to empyema of one or more of the anterior group of sinuses. When the pus is fœtid antral suppuration, either uncomplicated or involving the frontal sinus and anterior ethmoidal cells, should be suspected. When the pus is non-fœtid the case is most probably one of concurrent empyema of the frontal sinus and anterior ethmoidal cells. In empyema of the antrum of nasal origin the pus is non-fœtid also, but these cases are not common.

4. Pus trickling from the posterior naris (choana) into the naso-pharynx points to empyema of one or both of the posterior group of sinuses.

5. The direction taken by the pus is not, however, an absolutely certain guide to its origin, as it may be drawn forward in empyema of the posterior group by blowing the nose, &c., and it may flow backward in empyema of the anterior group, owing to the abnormal position of the "ostium maxillare," or the presence of one or more accessory openings. It must also be remembered that the pus may flow both forwards (to the nostril) and backwards (to the naso-pharynx) in empyema of any of the nasal accessory sinuses.

It is, therefore, necessary in all cases to examine the nose by both anterior and posterior rhinoscopy.

6. The discharge is intermittent when proceeding from the antrum or sphenoidal sinus, owing to the openings of these sinuses being situated at some distance from their floors, the discharge having to accumulate until the sinus is nearly full or the head is bent forwards before it can gain an exit. The discharge is constant when proceeding from the frontal

sinus or ethmoidal cells, the openings of these cavities being situated in their floors. After swabbing out the middle meatus with a pledget of cotton wool the pus in empyema of the antrum reappears immediately, in empyema of the frontal sinus and anterior ethmoidal cells more slowly, and is often profuse in the former (frontal) and small in amount in the latter (anterior ethmoidal cells).

7. Empyema of any of the nasal accessory sinuses may be associated with more or less headache and neuralgia, but the pain in each case is not sufficiently definite or distinctive to be of much diagnostic value. In a general way, however, it may be stated that supra-orbital neuralgia points to empyema of the antrum, frontal headache to empyema of the frontal sinus, deep-seated pain in the nose to empyema of the ethmoidal sinus, and ocular and occipital pain to empyema of the sphenoidal sinus. Too much importance must not, however, be attached to this symptom, as the character of the pain varies a great deal in these cases and may be entirely absent. Partial or complete blocking of the respective openings, or "ostia," usually very much increases the pain in all cases.

We have so far collected a good deal of useful information, but not evidence that can conclusively prove which of the sinuses is or are at fault.

Given a case in which there is a purulent nasal discharge of sinus origin, syphilis, tubercle, &c., having been eliminated, we must look for the distinctive or characteristic symptoms of empyema of each of the sinuses, to arrive at a definite diagnosis.

8. The distinctive symptoms of latent empyema of the ANTRUM :—

1. The presence of “**Kauffmann’s swelling**” in the middle meatus.
2. **Unilateral opacity** on transillumination, especially opacity under the eye, in a case in which there is a purulent nasal discharge from the nostril on the same side—not otherwise.
3. **The finding of pus in the antrum** by means of an exploratory puncture.

9. The distinctive symptoms of latent empyema of the ANTERIOR ETHMOIDAL CELLS are :—

1. The presence of **polypi and granulations in the middle meatus.**
2. **Tenderness upon pressure over the lachrymal bone.**
3. **The finding of carious areas and spicules of bone on probing the middle meatus.** A blunt probe should be used.
4. **Nasal obstruction** due to large polypi, &c., and a **great increase in the breadth of the root of the nose,** in long-standing cases.

10. The distinctive symptoms of latent empyema of the FRONTAL SINUS are :—

1. **Tenderness upon external pressure or tapping,** applied either to the anterior wall or floor.
2. **Opacity** of one or both frontal sinuses **on transillumination.**
3. **The finding of pus in the sinus** by means of intra-nasal probing or catherisation, a test not unac-

accompanied by the danger of infecting a previously healthy sinus.

11. The distinctive symptoms of latent empyema of the SPHENOIDAL SINUS are :—

1. The presence of well-marked **ocular symptoms**, viz., partial or total loss of vision, ptosis, strabismus, paralysis or intense neuralgia.

These symptoms are due either to the inflammatory process spreading to the nerves and vessels in the sphenoidal fissure or to pressure upon them by the distended walls of the sinus when the "ostium sphenoidale" is blocked.

2. **The finding of pus in the sinus** by means of intra-nasal probing. The pus trickles from the posterior naris into the naso-pharynx, is scanty in amount, with a tendency to dry into crusts, and is usually fœtid.

2. FRÄNKEL'S POSTURE TEST.

Swab out the middle meatus to remove every trace of pus, and direct the patient to bend his head forwards with the cheek of the suspected side uppermost. Keep him in this position for two or three minutes. Pus is then generally found in the middle meatus in suppuration of the antrum, but it must be remembered that this occurs also in suppuration of the frontal sinus and anterior ethmoidal cells.

If just prior to the examination the patient has blown his nose violently the antrum may be empty and no pus will then appear when this test is applied. Several attempts to find pus in this way should

therefore be made at intervals of a few hours, and the patient be told not to blow his nose violently before presenting himself for examination.

3. THE SUCTION TEST.

Swab out as in the posture test, and then introduce the nozzle of a compressed Politzer's bag into the nostril of the suspected side. Compress the nostrils and tell the patient to swallow, simultaneously allowing the bag to expand. This may draw pus into the middle meatus.

4. TRANSILLUMINATION.

An electric lamp, attached to a tongue-depressor, is placed in the patient's mouth and his lips allowed to close around its handle. A thick curtain should be drawn around the patient to exclude extraneous light, or, better still, the transillumination be made in a dark room. When the current is switched on two patches of light appear on each side of the face if the antra are healthy, a roundish patch in the centre of each cheek, and an oblong patch under each eye. The pupils also appear in red light. The patient may be given charge of the switch, with instructions to disconnect should the lamp become too hot. Although of great value, especially in the differential diagnosis of inflammatory disease of the antral mucous membrane, cyst, and tumour of the antrum, transillumination cannot demonstrate the presence of pus in the antrum as generally believed.

Briefly stated the facts are as follows:—

1. Distinct and equal translucency on both sides occurs normally in healthy antra; but opacity is not necessarily evidence of disease, though it usually is when one side only is opaque. Opacity on both sides is usually due to abnormal thickness of the antral walls, bilateral disease of the antra being rare.

2. Moderate opacity on one side, especially opacity under the eye, points either to chronic thickening of the mucous membrane of the antrum on that side, the result of inflammatory disease (catarrh) which may be either suppurative or non-suppurative, or, much more rarely, to the antrum being filled with pus. That the opacity is usually due to thickening of the mucous membrane is shown by the opacity nearly always persisting after the antrum has been syringed out. It is of great importance to remember that the opacity is nearly always due to chronic thickening of the antral mucous membrane, the result of inflammatory disease (catarrh), which may, or may not, be associated with suppuration and not to the presence of pus in the cavity. I wish to specially emphasise this point as antra have often been opened on the evidence of transillumination alone, and then found to contain nothing but the clear natural secretion. It may, however, be stated that **UNILATERAL OPACITY ASSOCIATED WITH A UNILATERAL PURULENT NASAL DISCHARGE FROM THE NOSTRIL ON THAT SIDE IS PATHOGNOMONIC OF ANTRAL SUPPURATION.**

This fact is of extreme importance and should be carefully noted.

3. Great opacity on one side points to a solid growth (tumour) in the antrum on that side. The commonest tumour of the antrum is sarcoma. Sarcoma often undergoes cystic degeneration. In fact, cystic disease of the antrum is most frequently due to sarcoma, and is therefore often associated with malignant disease.

4. Considerably increased translucency on one side points to either cyst or polypus in the antrum of that side, and is due to the walls of the antrum having become absorbed and distended and the cavity filled with fluid.

5. The patient's subjective sensation of light is perhaps as reliable a test as the objective appearances. It is greater over the healthy antrum than over the diseased one.

5. EXPLORATION OF THE ANTRUM.

This may be made by one of two methods, catherisation or exploratory puncture.

1. Catherisation, *i.e.*, washing out the antrum by means of a hollow tube passed into it through the natural opening ("ostium maxillare") is difficult.

2. Exploratory puncture with a trocar and canula :—

1. Through the outer wall of the inferior meatus of the nose.

2. Through the alveolus in the neighbourhood of the first molar.

3. Through the "canine fossa."

An exploratory puncture having been made, the antrum should be inflated or syringed out and search

made for pus, the finding of which practically proves the existence of antral suppuration, cases in which the antrum is only a reservoir for pus coming from a higher sinus being very rare, and even when this occurs the antrum soon becomes infected. It is therefore hardly accurate to say that the antrum may be a reservoir as well as a generator of pus, as often stated.

It must be remembered that the antrum may be quite healthy, or at any rate not the seat of suppuration; great care should therefore be taken to perform the exploratory puncture as aseptically as possible to avoid setting up suppuration in a previously healthy antrum.

An exploratory puncture should only be resorted to when the results of both rhinoscopy and transillumination are negative, *i.e.*, when there is neither a well-marked "Kauffmann's swelling" nor unilateral opacity, in a case in which there is a unilateral purulent nasal discharge, which is due neither to nasal disease nor to empyema of any of the other nasal accessory sinuses.

I consider that it is very rarely necessary to make an exploratory puncture. Rhinologists, however, commonly perform this operation before giving a diagnosis.

When puncturing through the canine fossa care must be taken to direct the trocar upwards and not forwards, as the floor of the nose has often been entered and the antrum missed altogether.

An exploratory puncture is best performed through the outer wall of the inferior meatus of the nose, thus:

1. Repeatedly apply pledgets of cotton wool soaked in hot saturated solution of eucaine- β for ten minutes to the outer wall of the inferior meatus of the nose. Supra-renal extract may with advantage be added, to reduce the slight hæmorrhage induced by the eucaine. Cocaine should never be used in either oral or dental surgery, too many lives having already been sacrificed to this dangerous and doubtful drug.

2. Pass a fine trocar and canula into the antrum from a point half an inch from the anterior end of, and just below the, the inferior turbinal. Withdraw the trocar but leave the canula in position.

3. Fit a syringe to the end of the canula and wash out the antrum, gently—to avoid infecting the other sinuses—with a warm antiseptic lotion, *e.g.*, boracic lotion (10 grains to the ounce). The fluid will pass through the antrum and out of the corresponding nostril. Collect the fluid in a basin as it flows from the nostril. If pus is present in the antrum it will be readily seen in the fluid.

Some surgeons fix a Politzer's bag to the end of the canula instead of a syringe, and inflate the antrum instead of syringing it out. Pus will then be seen in the middle meatus if the antrum is the seat of suppuration. Most surgeons, however, prefer syringing to inflating.

DIAGNOSIS OF "CLOSED" OR "EVIDENT EMPYEMA" OF THE ANTRUM.

A diagnosis must be made in these cases between chronic suppuration, mucocele, cyst, and tumour. For this, *see* "Diagnosis of Tumours of the Antrum."

A "mucocele" is similar to a closed empyema, except that its contents are mucoid instead of purulent. (See "Non-suppurative Catarrh of the Antrum.")

TREATMENT OF SUPPURATIVE CATARRH ("EMPYEMA ") OF THE ANTRUM.

ACUTE SUPPURATIVE CATARRH :—

1. Apply hot compresses, or ice, to the affected cheek, and give frequent inhalations of mentholised steam to relieve the pain. This is prepared by adding 15 drops of alcoholic solution of menthol to a pint of nearly boiling water. This may be all that is necessary in some of the milder or sub-acute cases, in which spontaneous cure is not uncommon.

In the acute cases, in which the pain is severe, especially when the "ostium maxillare" is blocked, the antrum must be opened and washed out. The best way to do this is to extract the first molar and open the antrum through its anterior buccal root. If this tooth is absent the perforation should be made as nearly as possible in its former site. All roots and diseased or loose teeth on that side of the upper jaw should also be extracted. The antrum should then be gently syringed out by the patient with weak warm antiseptic solution twice a day for a few days. If the "ostium maxillare" is blocked its patency must be restored by means of a probe passed into the antrum from the nose, and if this is not possible an artificial opening must be made in the vicinity of the natural opening. If the case does not yield to this treatment the disease becomes chronic, and must then be treated

as one of chronic suppurative catarrh. This is the usual termination of acute suppurative catarrh of the antrum. Some surgeons attempt to wash out the antrum through the natural opening before resorting to an operation. This is very difficult and even if successful not of much value as the natural opening is situated at the top of the antrum, and is therefore useless for drainage. The natural opening is also quite inaccessible to the patient for syringing purposes.

CHRONIC SUPPURATIVE CATARRH.

The treatment varies according to whether the natural opening is open or blocked. It is open in "Latent Empyema" and closed in "Evident Empyema."

"LATENT EMPYEMA" OF THE ANTRUM.

In about half the cases the empyema is uncomplicated, *i.e.*, limited to the antrum; in the other half, the frontal sinus and anterior ethmoidal cells are similarly diseased, a condition termed "multiple suppurative sinusitis."

UNCOMPLICATED "LATENT EMPYEMA" OF THE ANTRUM :—

If in a case that has been perforated and syringed out for acute suppurative catarrh there is a discharge six weeks after the operation, or in a case, either an acute one that has become chronic or one chronic *ab initio*, that has not undergone any treatment, the

antrum must be opened through the alveolus in the neighbourhood of the first molar, if this has not already been done, the opening kept patent by means of a plug attached to a dental plate, and the antrum syringed out by the patient several times a day with warm weak boracic or other lotion, which may be changed later to a mild astringent, such as sulphate of zinc, two grains to the ounce.

This is termed **treatment by lavage**.

If this fails to cure the suppurative process after four months' unremitting care on the part of the patient—and the success of the treatment depends almost entirely on his syringing out the cavity regularly and thoroughly—the antrum must be opened widely through the canine fossa, its diseased mucous lining curetted, and free drainage established into the nose.

This is termed **the radical operation**.

The objects of the treatment are :

1. **To remove the source of septic infection**, usually an abscessed tooth.

2. **To restore the antral mucous membrane to a healthy condition**, by drainage and syringing out, and when these fail by curetting it thoroughly.

TREATMENT BY LAVAGE :—

1. **Remove all prominent nasal polypi and hypertrophies** (such as the anterior end of the middle turbinal if it is very much swollen) that may be present in the middle meatus, and **extract all roots**

and diseased or loose teeth on that side of the upper jaw.

2. **Open the antrum** with an antral perforator, under nitrous oxide gas, in the neighbourhood of the first molar. If this tooth has just been extracted the perforation should be made through its anterior buccal root. This method is termed the "**alveolar method.**" The floor of the antrum is at its lowest level and thinnest over the first molar, this point being, therefore, the best for drainage. Some surgeons, however, open the antrum through the canine fossa (the "**canine fossa method**") and others through the outer wall of the inferior meatus of the nose (the "**nasal method**"), to avoid, as they put it, robbing the patient of a tooth. This should not be considered for a moment, as the first molar is a tooth very liable to decay and the advantages of the alveolar method far outweigh the loss of a tooth.

The advantages of the alveolar method are:—

1. The antrum is drained from its lowest point.
2. There is practically no fear of missing the antrum even if it is very small or abnormally situated.
3. The patient can syringe out his antrum easily.
4. The floor of the antrum is usually very thin at this point.

3. Immediately after perforation **wash out the antrum** with a warm antiseptic lotion, such as boracic acid (15 grains to the ounce), carbolic acid (one in 60), or common salt (one drachm to the half-pint). An impression should next be taken by a dentist for a plate and plug, pending the completion of which, *i.e.*,

about four hours, the opening should be plugged with gauze.

4. The plate and plug. The purest and best material for both plate and plug is black vulcanite. The proper construction and adaptation of these appliances require special care to obtain the best results from the treatment, and to avoid injuring neighbouring teeth. The plug should be solid. A solid plug is much better than the usual silver tube, through which the discharge constantly percolates into the mouth, and the septic oral fluids are permitted free ingress into the antrum. The plate and plug should be worn constantly, and only removed for syringing out the cavity.

5. The patient must syringe out his antrum three times a day at first, then twice a day, gradually reducing the frequency, as the discharge lessens, until once a week is reached. When the lotion passes through the cavity in a perfectly clear stream, when syringed out only once a week for a month, the plug should be gradually shortened to ensure the wound healing from within outwards. When the wound is nearly closed, the plate, with the small piece of plug remaining, should be removed. When syringing, the patient should incline his head forward, and use no violence, as otherwise the anterior ethmoidal cells, and even the frontal sinus may become infected. The fluid should pass freely through the antrum and out of the corresponding nostril. The best syringe is Higginson's enema syringe fitted with a curved silver tube terminal. The solution for syringing should always be used warm. The following are the best

solutions at first: 1. Boracic solution (15 grains to the ounce). 2. Alkaline solution (compound phenol solid. B. & W.). 3. Salt solution (1 drachm to the pint). 4. Weak Condy's fluid. Later a mild astringent, such as sulphate of zinc (2 grains to the ounce), may be used.

Changing the solution often hastens the cure. If the syringing be thoroughly and regularly performed, and this is of far greater importance than which of the solutions is used, the cure takes from a few weeks to several months.

6. If the discharge is purulent after four months of lavage the radical operation is indicated.

7. Failure of cure by lavage may be due to:—

1. The antrum being divided by bony septa, which prevent efficient irrigation and drainage.

2. The antral mucous membrane having undergone fibroid thickening or having become greatly hypertrophied, the cavity being filled with large unhealthy granulations sometimes associated with polypi and cysts.

3. The fact that the antrum becomes re-infected from the anterior ethmoidal cells or the frontal sinus, the case being one of "multiple suppurative sinusitis" and not "uncomplicated antral empyema."

This shows the extreme importance of arriving at a precise diagnosis in all cases of empyema of the nasal accessory sinuses. It is absolutely useless to either drain or curette a suppurating antrum when the other sinuses are similarly diseased, as it becomes almost immediately re-infected.

THE RADICAL OPERATION.

This consists of opening the antrum widely through the canine fossa, curetting its diseased mucous lining, and establishing free drainage into the nose.

This operation is indicated in cases of chronic suppuration that have not yielded to treatment by lavage, and for the removal of cysts, polypi and other small innocent tumours of the antrum.

If not previously done, all nasal polypi and hypertrophies in the middle meatus must be removed, and all diseased and loose upper teeth and roots on the side of the diseased antrum extracted prior to the performance of the radical operation.

This operation is performed thus:—

1. Administer a general anæsthetic.
2. Make an incision along the gingivo-labial fold at the level of the malar process of the superior maxilla, and retract the soft parts and periosteum upwards.
3. Remove, by means of a gouge and mallet, a piece of bone large enough to admit the tip of the index finger at the nasal end of the floor of the antrum, *i.e.*, at the point of intersection of a vertical line drawn between the first and second bicuspid, and a horizontal line drawn at the level of the floor of the nose.
4. Curette the diseased lining membrane with Meyer's ring knives. This must be done very thoroughly, and the knives should have malleable handles, so that every crevice may be reached. An electrophore or mirror should be worn on the surgeon's

forehead to illuminate the cavity. The free hæmorrhage which usually occurs should be checked by packing the antrum with strips of dry gauze. Special attention should be given to the concavity in the malar bone, the ethmoidal region, the neighbourhood of the infra-orbital canal, and the floor over the molar roots.

5. Swab out the cavity with chloride of zinc (40 grains to the ounce) or pure carbolic acid.

6. Open through the antrum into the inferior meatus of the nose by means of gouge and mallet. The opening should be made large enough to admit the tip of the index finger, as considerable contraction takes place.

7. Pack the sinus with iodoform gauze, passing one end through the nostril.

8. Close the buccal opening by bringing the soft parts together with one or two fine cat-gut sutures.

9. On the third day after the operation remove the gauze through the nose.

10. Irrigate the antrum daily for two or three weeks through the nose with boracic lotion by means of an Eustachian catheter fitted to a Higginson's enema syringe.

11. Painful swelling of the cheek and epiphora may follow the operation. Both are transitory.

Failure of cure by the radical operation may be due to :—

1. Particles of diseased mucous membrane having been overlooked.

2. An inaccurate diagnosis, the case being one of multiple suppurative sinusitis and not of uncomplicated

antral suppuration. In such cases the antrum is almost certain to become almost immediately re-infected. When the frontal sinus and anterior ethmoidal cells are also similarly diseased it is clearly impossible to effect a cure by merely curetting the antrum.

TREATMENT OF MULTIPLE SUPPURATIVE SINUSITIS.

The sinuses usually affected are the antrum, frontal sinus and anterior ethmoidal cells. The disease generally originates in the antrum, and involves the frontal sinus and anterior ethmoidal cells secondarily. Sometimes, however, it originates in either the frontal sinus or one of the anterior ethmoidal cells, from which the infection spreads to the other sinuses. Like empyema of the antrum, multiple suppurative sinusitis is usually either dental or nasal in origin. When of dental origin the suppurative process begins in the antrum, spreading thence to the anterior ethmoidal cells and frontal sinus, and the pus in such cases is foetid. When of nasal origin the suppurative process begins in the anterior ethmoidal cells, spreading thence to the antrum and frontal sinus, and the pus in such cases is non-foetid.

To effect a cure a somewhat severe operation is required, which should only be undertaken by a skilled rhinologist.

The procedure is as follows :—

1. The first or palliative part of the operation consists of :—

I. Opening the antrum through the alveolus and

syringing it out daily, as in treatment by lavage (*see* page 43).

2. Removing the anterior half of the middle turbinal and all nasal polypi and granulations. All roots and diseased or loose teeth on that side of the upper jaw should also be extracted.

3. Removing every trace of disease from the anterior ethmoidal cells by means of a curette or Grünwald's forceps. Great care must be taken not to injure the cribriform plate of the ethmoid, which forms part of the roof of the nasal fossæ. This generally completely cures the headache and considerably reduces the discharge. If the patient decides to risk a severer operation to secure the entire cessation of the discharge, or if the headache persists, or distention of the frontal sinus supervenes, or if the patient's health is much affected, or if he is going abroad where skilled attention cannot be obtained in the event of the disease increasing in severity, the following radical operation is indicated :

2. The second or radical part of the operation consists of :—

1. Opening and curetting the frontal sinus.
2. Enlarging the fronto-nasal canal to the diameter of a lead pencil, with suitable burrs.
3. Passing a perforated tube through the fronto-nasal canal and out of the nostril. This tube should be removed daily, for irrigation. For the details and technique of this operation refer to special rhinological text-books. When the frontal sinus is small its entire

anterior wall may be removed. The sinus is thus obliterated and no fronto-nasal drainage is necessary. The deformity resulting is usually slight.

In addition to the antrum, frontal sinus and anterior ethmoidal cells, the posterior ethmoidal cells and sphenoidal sinus may become affected in severe cases, or the posterior ethmoidal cells and sphenoidal sinus may alone be diseased in rare cases, either independently or concurrently, usually the latter.

An attempt may be made to syringe out the sphenoidal sinus with antiseptic lotions. When there is purulent retention an attempt may be made to break down the anterior wall of the sphenoidal sinus and gently curette its degenerated mucous lining. Operations on the sphenoidal sinus are extremely delicate, and should only be attempted by skilled rhinologists.

THE TREATMENT OF "CLOSED" OR "EVIDENT EMPYEMA" OF THE ANTRUM.

The natural opening into the nose being blocked, or in very rare cases absent, there is of course no nasal discharge. The symptoms of closed or evident empyema are given at page 23, and the diagnosis under "Diagnosis of Tumours of the Antrum."

The treatment consists of rendering patent the natural opening into the nose, and if this is not possible, making an artificial opening in its neighbourhood. The case should then be treated in the same way as latent empyema, first by lavage (*see* page 43), and if this fails, by a radical operation (*see* page 47).

NON-SUPPURATIVE CATARRH OF THE ANTRUM.

These cases are infrequent in practice, as advice is rarely sought in inflammatory disease of the antrum, unless suppuration supervenes.

The catarrh may be either acute or chronic.

ACUTE NON-SUPPURATIVE CATARRH.

1. Symptoms :—

1. There is a dull deep-seated pain in the antrum accompanied by severe neuralgic pain in the cheek and forehead on the affected side, tenderness upon pressure over the cheek and gums in the bicuspid and molar region, sometimes preceded by a rigor and rise of temperature.

2. These symptoms are followed by a watery discharge from the nostril on the affected side. This gives much relief.

It will be noticed that the symptoms of acute non-suppurative catarrh differ from those of acute suppurative catarrh only in the character of the nasal discharge. In the non-suppurative it is watery, and in the suppurative it is purulent or muco-purulent. The inflammatory process in the non-suppurative variety may become chronic, but spontaneous cure is the more usual termination. In the suppurative variety

spontaneous cure sometimes occurs, but the more usual termination is for the suppurative process to become chronic.

2. Treatment.

Hot compresses or ice to the affected cheek and frequent inhalations of mentholised steam (*see* page 41), to relieve the pain, is usually all that is necessary.

CHRONIC NON-SUPPURATIVE CATARRH.

Just as suppurative catarrh may be open ("latent empyema") or closed ("evident empyema") so may non-suppurative catarrh be open or closed ("mucocele"). Mucocele is a very rare condition. For its diagnosis, *see* "Diagnosis of Tumours of the Antrum."

1. Symptoms of "open" non-suppurative catarrh :—

1. There is usually a sense of discomfort in the antrum.

2. There is an occasional watery discharge from the nostril on the side of the affected antrum, followed by a feeling of relief.

3. The discharge may be followed by œdema of the upper eyelid and supra-orbital region, the patient being quite unable to open that eye during the attack, which usually lasts three or four days.

2. Treatment.

1. Attend to the patient's general health.

2. Advise sea-bathing, the patient being told to take sea-water into his mouth and eject it through his

nose. A sea voyage will probably be of much benefit. It is advisable in these cases to extract all roots and diseased or loose teeth on the affected side of the upper jaw.

These cases are extremely obscure and are usually left undiagnosed and consequently untreated.

It is important, however, to place them under treatment, as polypi may result if the inflammatory process is not checked, and polypi in the antrum are often the precursors of malignant disease. They may even, I believe, become malignant. It should therefore be remembered that inflammatory disease of the antrum is not necessarily associated with a purulent nasal discharge, and that cases of non-suppurative catarrh are not free from danger, as the long-continued inflammation may lead to degenerative changes which may culminate in the growth of polypi, which may become malignant.

FISTULÆ OF THE ANTRUM.

1. Classification :—

1. **Spontaneous Fistulæ**, due to the burrowing of pus from the antrum, may occur in acute suppurative catarrh of the antrum when the natural opening into the nose is blocked, and the case has not received appropriate treatment. A spontaneous fistula is usually single and cutaneous, occurring in the cheek or lower eyelid, but it is sometimes oral, presenting in the hard palate or alveolar process.

2. **Surgical Fistulæ**, resulting from perforation of the antrum for lavage, are single and oral, being generally situated in the alveolar process or canine fossa.

3. **Traumatic Fistulæ**, resulting from fracture of the upper jaw, gunshot wounds of the face, or injury to the floor of the antrum in extracting a tooth, may be single or multiple, cutaneous or oral.

2. Symptoms :—

1. Air passes out of the fistula when the patient sneezes or blows his nose.

2. Fluids injected into the fistula pass into the nose.

3. Pus escapes into the mouth in oral fistulæ.

The first two symptoms are of course absent when the natural opening into the nose is blocked.

3. Treatment :—

1. **A Cutaneous Fistula** heals quickly if an opening be made into the antrum from the mouth, and the whole tract is syringed through frequently with antiseptic and stimulating lotions. The opening into the antrum should be made through the alveolus in the neighbourhood of the first molar, and as soon as the cutaneous fistula has closed the case must be treated as one of latent empyema of the antrum, by lavage, &c. (*see* page 43). A plastic operation may be necessary to obliterate the scar.

2. **An Oral Fistula** must be treated as a case of latent empyema, by lavage, and if this fails to cure, by curetting the lining mucous membrane of the antrum (*see* "Radical Operation," page 47).

CYSTS.

As there seems to be a great deal of confusion regarding the origin and nature of cysts of the jaws, and as cysts of the upper jaw are nearly always situated in the antrum, I will describe them shortly before dealing with cystic disease of the antrum.

Cysts of the jaws are classified thus :

1. **Dental Cysts**, or Periosteal Cysts.
2. **Dentigerous Cysts.**
3. **Cysts of independent formation :—**
 1. Simple.
 2. Compound or "Multi-locular."

Their origin and nature can, I think, be explained in quite a simple manner. Of course, it does not really very much matter how or why they come into existence, the main thing being to be able to diagnose and treat them.

Briefly stated the facts are as follows :—

1. Some "cysts" of the jaw are found connected by a fibrous or calcified cord-like attachment to the root of a very much diseased tooth, which is generally in so bad a state that it must almost certainly have been abscessed. In such a "cyst" no internal epithelial lining is usually present, and its contents may be either serous or purulent. Such a "cyst" is usually small, gives rise to no great distention, is always found either connected with or in close proximity to a very badly diseased tooth, and occurs

more frequently in the upper than the lower jaw, generally in the neighbourhood of the incisor or canine teeth. Such a "cyst" is termed a "**Dental Cyst,**" or "**Periosteal Cyst.**" **It is really a chronic abscess sac that has undergone degenerative changes and become distended with fluid.**

2. Other "cysts" are found containing one or more teeth or dental particles. Such a "cyst" is usually lined internally with epithelium, occurs much more frequently in the lower than the upper jaw—in fact they are extremely rare in the superior maxilla—and is termed a "**Dentigerous Cyst.**"

To explain the probable origin of such a "cyst" I must make a short digression. It is well known that if a small piece of root be broken and left in the jaw, in extracting a tooth, it becomes absorbed. This could not take place without the aid of some sort of absorbent organ.

It is more than probable, therefore, that any foreign body in the jaws, such as a misplaced, malformed or broken tooth or root, becomes enveloped by some sort of absorbent organ. Is it not likely, therefore, that a "dentigerous cyst" is nothing more than an absorbent organ (enclosing a misplaced, malformed, or broken tooth or root), which instead of leading to the absorption of the foreign body and disappearing with it, as normally occurs with dental particles buried in the jaws, has undergone degenerative changes and become distended with fluid?—I think so.

3. Other "cysts" are found unconnected, either externally or internally, with teeth. These are termed

“Cysts of independent formation.” They may be simple or compound (multi-locular). The simple variety may occur singly or in large numbers. Such “cysts” are really hypertrophies of the degenerated tissues of the mucous membrane, just as polypi are, but the degenerative changes have gone still further, leading to the distention of the masses with fluid. “Multi-locular cysts” are very rare in the upper jaw, though not infrequent in the lower. Such “cysts” appear to be produced by epithelial invasion, being, therefore allied in origin to epithelioma, but clinically they have more of the character of sarcoma, cases of “multi-locular cysts” having often been described as “cystic sarcoma.” They do not usually contain any sarcomatous elements; occasionally, however, they do, such “cysts” being, of course, malignant.

A great deal of the mystery and confusion surrounding the subject of “Cysts” of the jaws is due to some modern pathologists including certain “cysts” under “odontomes,” looking upon them as tumours resulting from developing teeth. This view I believe to be erroneous. The subject will be thoroughly thrashed out when considering the tumours of the jaws.

It will, however, be clear that the term “cyst,” as used clinically, is a very loose one, and is applied to both innocent and malignant forms of disease.

CYSTIC DISEASE OF THE ANTRUM.

Cystic disease of the antrum was formerly termed “Hydrops antri” (dropsy of the antrum), from the

belief that it was due to the blocking of the natural opening into the nose, and the consequent retention of the natural mucous secretion. There are no grounds for believing this to be a factor in the causation of this condition.

Cystic disease of the antrum is rare, and when it does occur is not usually due to a cyst in the ordinary sense at all, but to either a sarcoma undergoing cystic degeneration, or to the antral mucous membrane having degenerated into a mass of hypertrophies, polypi or cysts, as the result of long-standing inflammation.

With the exception of "Dental Cysts," "cysts" of the upper jaw are usually situated in the antrum.

Cystic disease of the antrum may be due to:—

1. One or more "cysts," which, unless they become much distended, give rise to no symptoms and are often quite unsuspected. The lining membrane of the antrum in these cases is normal.

2. The whole of the lining mucous membrane having become greatly hypertrophied, and the mucous glands and other tissues having degenerated into cysts and polypi as a result of chronic inflammatory disease.

As each of these two forms of cystic disease of the antrum gives rise to distinct symptoms and requires different treatment. I propose to classify cystic disease of the antrum, on clinical grounds, thus:—

1. **Cyst in the antrum.**

2. **Cystic degeneration of the antral mucous membrane.**

CYST IN THE ANTRUM.

This condition is most frequently due to a sarcoma undergoing cystic degeneration. When not associated with sarcoma the cyst is nearly always a "cyst of independent formation," resulting from the hypertrophy of one of the mucous glands, and not in any way connected with a tooth. It may remain attached to one of the walls of the antrum throughout life without giving rise to any symptoms. There are seldom more than one or two such cysts presents. Sometimes, though very rarely, the cyst is a "dentigerous cyst," *i.e.*, contains a tooth, or one or more dental particles. The symptoms and treatment of both forms are alike (*see below*). For cystic-sarcoma *see* "Tumours of the Antrum."

Symptoms. The outer or facial wall of the antrum, which is the thinnest of its walls, may become gradually and painlessly distended until it is so thin that it crackles like parchment. This "parchment-like crackling" is diagnostic of a cyst. When the distention is very great the facial wall becomes osteo-membranous and fluctuation is perceptible. Occasionally, though rarely, the other walls of the antrum yield slightly, the palate becoming somewhat flattened and the nostril on the affected side partially obstructed.

Treatment. Tap the antrum either through the socket of a tooth or by perforating the osteo-membranous facial wall. A quantity of clear or yellowish serous fluid is evacuated, frequently containing flakes of cholesterine. After evacuation the

antrum should be syringed out daily with a simple stimulating lotion. The swelling generally subsides and the opening closes. This is generally sufficient in simple cases, in which there is usually only one large cyst.

CYSTIC DEGENERATION OF THE ANTRAL MUCOUS MEMBRANE :—

Instead of the growth of one or two cysts the whole of the mucous membrane lining sometimes undergoes cystic degeneration, as a result of chronic suppuration, the interior of the antrum becoming filled up with a large number of small cysts, polypi, and hypertrophies. There is very much less distention of the facial wall in this condition than in cyst in the antrum, and the process is much slower. In such cases tapping and washing out would only relieve the distention without effecting a cure.

Treatment. The antrum must be curetted thoroughly. For the technique of this operation (the "Radical Operation") *see* page 47.

TUMOURS OF THE ANTRUM.

Tumours of the antrum are not common. The malignant occur much more frequently than the innocent. With the exception of polypi, innocent tumours of the antrum are very rare. Sarcoma is by far the commonest tumour of the antrum.

Classification of Tumours of the Antrum :—

I. INNOCENT :—Polypus, Fibroma, Euc hondroma, Osteoma, and Odontoma.

II. MALIGNANT :—

1. Carcinoma (cancer) :—

1. Columnar Epithelioma.
2. Squamous Epithelioma (“épithélioma térébrant”).

2. Sarcoma :—

1. Central Sarcoma (originates in the interior of the bone).

(1) **Myeloid Sarcoma.**

(2) **Vascular Sarcoma** (“Erectile tumour”).

2. Periosteal Sarcoma (originates in the periosteum) :—

(1) **Spindle-celled Sarcoma.**

(2) **Round-celled Sarcoma** (medullary or encephaloid sarcoma).

POLYPUS OF THE ANTRUM :—

1. Cause. Polypi of the antrum are hypertrophies of one or more of the tissues (connective, glandular and fibrous) of its mucous or sub-mucous membrane, and are the result of degenerative changes brought about by chronic inflammatory disease, usually long continued suppuration ("empyema."). They are usually multiple, and small.

It is very rare for polypi to grow large enough to cause distention of the antral walls.

2. Varieties :—

1. Fleshy (composed of connective or areolar tissue).
2. Cystic (composed of glandular tissue).
3. Semi-gelatinous (composed of fibrous and glandular tissue).

3. Pathology. They resemble nasal polypi in structure. They are all well supplied with blood vessels, bleeding freely when interfered with. Polypi of the antrum are sometimes semi-malignant, or at any rate forerunners of malignant disease in that cavity.

4. Symptoms. There are usually no symptoms, unless the polypi become very large, causing distention of the facial wall of the antrum, or protruding through the natural opening into the nose. In a case recorded by Sir James Paget, the only symptom was a constant flow of clear watery fluid from the nostril of the affected side.

5. Treatment. The polypi must be entirely removed, otherwise they will recur. A large opening

should be made through the canine fossa into the antrum and the polypi, together with the diseased mucous membrane connected with them, scraped away. For the technique of this operation (the "Radical Operation") *see* page 47.

FIBROMA OF THE ANTRUM is very rare. It originates in the periosteum of one of the walls of the antrum. It is dense in structure and grows very slowly, expanding the walls of the antrum and causing by its pressure the displacement and absorption of the surrounding hard and soft structures, until it protrudes into the orbit, nose, palate, zygomatic fossa, and under the cheek. It is said to result from a blow on the cheek, but it is more probably due to the irritation of diseased teeth. A fibroma sometimes originates in the periosteum of the alveolus, whence it may invade the antrum from without by crushing in its walls. It does not recur if entirely removed. Fibroma of the antrum is rare, many of the reported cases being really malignant growths ("fibro-sarcoma"). A fibroma often undergoes calcareous degeneration, being then termed an "osteo-fibroma." Occasionally, though this is very rare, a very much thickened dentigerous cyst, closely resembling a fibroma, may be present in the antrum.

EUCHONDROMA OF THE ANTRUM may arise in the periosteum of either the interior of the antrum, or more frequently the external surface of the superior maxilla, whence it may invade the antrum from without. It is so exceedingly rare that it is of academic interest only. It grows very slowly, occurs usually in the young, and does not recur if entirely

removed. It produces displacement and absorption of the surrounding hard and soft structures until it protrudes beneath the skin. It may contain a small or large quantity of fibrous tissue, being then termed a "fibro-euchondroma," or it may ossify in places, being then termed an "osteo-euchondroma." A "fibro-euchondroma" is apt to be mistaken for a "chondrosarcoma," and *vice versâ* (see page 70).

OSTEOMA OF THE ANTRUM may arise in one of the bony walls of the antrum. Like euchondroma, it is so exceedingly rare that it is of academic interest only. It is of extremely slow growth. Many of the reported cases were instances of "Leontiasis ossea" (diffused hyperostosis), odontomata (dental tumours) and ossifying sarcomata.

Varieties of Osteomata :—

1. Cancellous osteoma.
2. Dense or Ivory osteoma.

"**Leontiasis ossea**" or **Diffused Hyperostosis** is a general hypertrophy of the bones of the skull and face, leading to great deformity. It affects the young, beginning with inflammation of the bones following an injury or exposure to cold. It leads to great distortion of the face, destruction of the eyes, and considerable interference with respiration and mastication. It ends, sometimes after many years, in death from emaciation.

Aeromegaly is a disease giving rise to a great overgrowth of the hands, feet, lips, tongue, nose and jaws, especially the lower jaw. It attacks both sexes, occurring usually between the ages of 20 and 40.

ODONTOMA OF THE ANTRUM is the rarest of all tumours occurring in the antrum. It is composed of dental tissues, *i.e.*, enamel, dentine, and cementum. Odontomata will be described under "Diseases of Teeth."

MALIGNANT TUMOURS OF THE ANTRUM.

CARCINOMA (cancer).

The variety attacking the upper jaw is always **epithelioma**, either columnar or squamous, and may originate in the gum, palate, or interior of the antrum. The **columnar** always originates in the lining membrane of the antrum, thence invading the surrounding tissues, hence the term applied to this variety of "primary epithelioma" of the antrum. The **squamous** always originates in the gum or palate, thence invading the antrum, hence the term "épithélioma térébrant" (boring epithelioma), or "secondary epithelioma" of the antrum. Carcinoma, unlike sarcoma, never attacks persons under 40 years of age, 45 to 50 being the commonest age.

Columnar epithelioma ("primary epithelioma" of the antrum) begins very insidiously, the only symptoms at first being neuralgic pains in the temple or face on the affected side. Next the antrum becomes distended but not nearly so much as in sarcoma, and its walls destroyed, the cancerous growth, which is very vascular, fungating and protruding into the nostril and orbit.

Squamous epithelioma ("secondary epithelioma" of the antrum) begins still more insidiously, and does

not cause any distention of the antral walls, which, however, it very rapidly and extensively destroys. The disease is often first suspected after the extraction of a tooth, a piece of soft growth being found attached to its roots. In such a case the socket of the extracted tooth does not heal, but becomes filled with a fungating mass of cancerous substance.

In both forms of epithelioma the glands of the neck are involved early, whereas in sarcoma they do not usually become affected till late.

SARCOMA.

Sarcoma is by far the commonest tumour, not only of the antrum but of the upper jaw. It may begin either in the interior of one of the bony walls of the antrum, when it is termed a "**central sarcoma**," or in the periosteum of one of the bony walls, when it is termed a "**peripheral sarcoma**" or "periosteal sarcoma."

Central sarcoma is the only form of malignant disease of the antrum originating in the bone itself. All the other forms (carcinoma, round-celled sarcoma, and spindle-celled sarcoma) arise in the periosteum of the lining membrane of the cavity. Central sarcoma is nearly always mycloid; sometimes, however, it takes the form of a round-celled sarcoma (formerly termed "vascular sarcoma"). It grows from the cancellous bone between the shells of compact bone.

Mycloid sarcoma grows quickly, though not so rapidly as the other varieties of sarcoma, expanding the bone, which becomes absorbed, allowing the

tumour to protrude under the mucous membrane, the characteristic dark maroon colour of mycloid disease being then visible. Its favourite starting-point is the nasal process.

Cysts sometimes form in the substance of a mycloid tumour.

Mycloid disease occurs usually before the age of 25, but patients much older than this have been attacked. It recurs after removal, reappearing sometimes in the opposite antrum. It may follow a blow.

It tends to bleed and ulcerate but not to fungate.

It is not so malignant as the other varieties of sarcoma.

Vascular sarcoma of the antrum is very rare. It is analogous to "erectile tumours," and the "pulsating tumours" of bones.

Peripheral or Periosteal sarcoma originates in the periosteum of any part of the antrum, and is generally either a spindle-celled sarcoma or a round-celled sarcoma, both of which are common in the antrum.

Mycloid sarcoma beginning in the periosteum is extremely rare.

Spindle-celled sarcoma.

A spindle-celled sarcoma usually somewhat resembles a fibroma, but is softer and on section yields a serous fluid, whence the term sometimes applied to it of "albuminous sarcoma" is derived. It grows with rapidity and may follow a blow. It tends to ulcerate, but not to bleed freely or fungate. When mixed with fibrous tissue it is termed a "fibro-

sarcoma." Spindle-celled sarcomata frequently ossify, whence the terms often applied to them of "ossifying or osteoid sarcoma" are derived. They may also be mixed with cartilage, the tumour being termed a "chondro-sarcoma," or "chondrifying sarcoma." Chondro-sarcomata are followed by secondary deposits in the lungs, a clinical fact of considerable importance as an enchondroma which this variety of sarcoma much resembles is not followed by any such secondary deposits. A spindle-celled sarcoma, though very rarely, may undergo fatty degeneration, such a growth having been mistaken for a fatty tumour (lipoma).

Varieties of spindle-celled sarcoma :—

1. Pure spindle-celled sarcoma (albuminous sarcoma.
2. Fibro-sarcoma.
3. Osteo-sarcoma.
4. Chondro-sarcoma.
5. Lipo-sarcoma.

Round-celled sarcoma (medullary or encephaloid sarcoma) grows with great rapidity. It is soft and very vascular, bleeding freely and fungating like epithelioma, for which it has often been mistaken. Most of the round-celled sarcomata of the upper jaw commence in the antrum. Round-celled sarcoma of the antrum if allowed to run its course may spread to the opposite side of the upper jaw, or to the same side of the lower jaw. If the whole of the affected superior maxilla is removed at an early stage of the disease there is a good chance of a cure resulting.

DIAGNOSIS OF TUMOURS OF THE ANTRUM.

The diagnosis of tumours of the antrum is not easy. But as the malignant occur much more frequently than the innocent, an early and correct diagnosis is of the very greatest importance, the patient's life often depending on the early recognition and prompt removal of the new growth.

The examination of the swelling should be made in the following manner:—

1. Transilluminate, as in chronic suppuration of the antrum. Great opacity of the affected side points to a tumour, moderate opacity (especially opacity under the eye) to a "closed empyema" or a "mucocele," and excessive translucency to a very much distended cyst or polypus (very rare).

2. Examine the walls of the antrum and note which, if any, of them are distended. Distention of the facial wall only points to a fluid collection, i.e., a cyst, a "closed empyema" or a "mucocele" (very rare).

A cyst is distinguished from a closed empyema and a mucocele by the absence of all symptoms of inflammation, by its slow growth, and if large, by the "parchment-like crackling" of the distended facial wall.

It is a very difficult matter to distinguish between a closed empyema and a mucocele without performing an exploratory puncture, but if the natural opening of the antrum was patent at an early stage of the affection,

there may be a history of a watery discharge from the nostril on that side instead of a purulent one, as in empyema.

If the alveolar border and nasal wall are as much distended as the facial wall, the probability is that the swelling is a solid growth, either an innocent or a malignant tumour.

Nasal obstruction is a symptom of distention of the nasal wall.

If the walls are slowly and regularly distended the growth is probably an innocent tumour; if quickly and nodularly, probably a malignant tumour.

An innocent growth in the antrum is usually a fibroma, and a malignant one a sarcoma.

3. Examine the glands of the neck.

The glands of the neck are affected early in epithelioma, but not until late in sarcoma, and not at all in innocent tumours.

If an innocent tumour is suspected, a differential diagnosis between polypus, fibroma, enchondroma, osteoma and odontoma must be made.

Polypus usually gives rise to no definite symptoms, and its diagnosis without an exploratory operation is almost, if not quite, impossible, unless it is very large and protrudes through the natural opening of the antrum into the nose, where it can be seen, or causes distention of the antral walls.

It is very rare, however, for polypi of the antrum to become large enough to cause distention of the antral

walls. Small polypoid hypertrophies, on the other hand, are very common sequelæ of long-continued inflammatory disease of the antral mucous membrane, especially of "empyema."

Fibroma, Enchondroma, Odontoma, and Osteoma are hard to the touch and grow slowly and painlessly. They do not affect the general health nor infiltrate the skin, glands or surrounding tissues. When large they may cause by their pressure the absorption of the surrounding hard and soft structures. As enchondroma, odontoma, and osteoma are exceedingly rare, a hard innocent tumour in the antrum is most likely to be a fibroma.

If a malignant tumour is suspected a differential diagnosis between epithelioma and sarcoma must be made by means of the following rules:—

1. Sarcoma occurs much more frequently in the antrum than epithelioma.
2. Epithelioma never attacks persons under 40 years of age.
3. Sarcoma usually attacks young persons and children, though it may occur at any age.
4. The cervical glands are enlarged early in epithelioma, but not until late in sarcoma.
5. Sarcoma tends to bleed and ulcerate but not to fungate, except the round-celled (medullary) variety. Epithelioma tends to fungate.
6. Epithelioma is usually accompanied by more severe neuralgic or gnawing pain in the head and face than sarcoma.

7. Epithelioma grows more rapidly than sarcoma, except, perhaps, the round-celled (medullary) variety.

If the tumour be sarcoma a differential diagnosis between mycloid sarcoma, spindle-celled sarcoma and round-celled sarcoma must be made.

1. **Rate of growth.** The round-celled grow the most rapidly, the spindle-celled come next, and the mycloid are the slowest.

2. **Density.** The spindle-celled are often quite firm, and the round-celled quite soft. The spindle-celled vary according to the tissues with which they are mixed, which may be fibrous tissue, cartilage, bone, or fat.

3. **Colour.** The mycloid are of a dark maroon colour.

4. **Vascularity.** The spindle-celled do not bleed, the others do, especially the round-celled.

5. **Ulceration.** The round-celled do not ulcerate, the others do.

6. **Fungation.** The round-celled fungate, the others do not.

If the tumour be epithelioma a differential diagnosis between squamous epithelioma ("épithélioma térébrant," or secondary epithelioma of the antrum) and columnar epithelioma (primary epithelioma of the antrum) must be made.

1. Epithelioma of the antrum is rare, and when it does occur usually invades the antrum secondarily, starting from the palate or gum, where it can be seen, except at a very early stage. Primary epithelioma

(“columnar epithelioma”) of the antrum is so rare that it is almost negligible.

2. There is distention of the walls of the antrum in the columnar variety, but not in the squamous.

3. The squamous originates in the palate or gum, and invades the antrum secondarily, whereas the columnar originates in the antrum and invades the palate, gum, and other neighbouring structures secondarily.

4. Both varieties begin very insidiously, but the squamous is the more insidious of the two, being often not even suspected until after the extraction of a tooth, to the roots of which a piece of the growth is found attached.

The above rules apply to tumours that are either distinctly innocent or distinctly malignant, *i.e.*, tumours composed entirely of either innocent or malignant material. Such tumours I propose on clinical grounds to term “**Pure Tumours.**”

It is far from uncommon, however, to find tumours composed partly of innocent and partly of malignant material; examples:—fibro-sarcoma, chondro-sarcoma. Such tumours I propose on clinical grounds to term “**Mixed Tumours.**”

PURE TUMOURS.

The general rules given on pages 71-75 will enable a distinctly innocent growth, *i.e.*, a “pure innocent tumour,” to be diagnosed from a distinctly malignant one, *i.e.*, a “pure malignant tumour,” except at a very early stage of the disease.

MIXED TUMOURS.

This form of new growth sometimes all but baffles diagnosis. As an inexact diagnosis in such cases has often led to the loss of a patient's life, or the unnecessary removal of his superior maxilla, I feel sure that the reader will pay particular attention to the following remarks.

We must suppose that we have a patient with a swelling of one antrum (antral disease is usually unilateral) that is not a fluid collection (purulent, cystic or mucoid), and that does not present the typical characters of either an innocent or malignant growth.

Such a swelling is almost certain to be some form of new growth (tumour), and as innocent tumours of the antrum are rare and of very slow growth, the new growth under consideration is in all probability an early stage of malignant disease, which in the antrum most frequently takes the form of sarcoma.

Epithelioma of the antrum is very rare.

We have, therefore, in obscure cases to suspect incipient sarcoma. It must be remembered, however, that the swelling may be due to :—

1. A very much thickened "dentigerous cyst."
2. An odontoma (dental tumour). Both "dentigerous cyst" and odontoma are so exceedingly rare in the antrum as to be negligible.
3. Exostosis of the facial wall of the antrum, resulting from an old-standing and very chronic empyema.

4. A tumour arising in the malar bone, or behind the superior maxilla, and encroaching on the antrum. When from the malar bone the tumour distends the face and sulcus between the cheek and the gum. When from behind the superior maxilla the upper jaw may be pushed bodily forward.

5. A mixed tumour.

INCIPIENT SARCOMA OF THE ANTRUM.

Incipient sarcoma in the interior of the antrum is extremely difficult to diagnose from an innocent growth, such as a fibroma, unless there is a history of slow growth. The glands are not affected, and no other signs of malignancy are yet apparent. There is, however, one symptom that does not occur if the growth be innocent, *i.e.*, supra-orbital neuralgia on the affected side. This is often the only symptom of sarcoma of the antrum at an early stage.

The only possible procedure in these obscure cases is to open the facial wall of the antrum, as in the radical operation for obstinate suppuration (*see* page 47), and examine the interior of the sinus and ascertain the nature of any new growth or swelling present in it.

TREATMENT OF TUMOURS OF THE ANTRUM.

Before any operation for the removal of a new growth is performed the swelling should be punctured and aspirated, as it may possibly be due to a cyst, a closed empyema, or a mucocele.

If the result is nil the facial wall of the antrum should be removed, as in the radical operation (*see* page 47) and the new growth examined.

Small innocent tumours should be removed together with the portion of bone to which they are attached.

Large innocent tumours often necessitate the removal of the greater portion, and sometimes the whole, of the superior maxilla.

Malignant tumours require the removal of the entire superior maxilla. If the disease is at a very early stage, the orbital plate is sometimes left, not very wisely, I think, as the disease frequently recurs in it.



