Contributions

to the

Pathology and Diagnosis

of

Certain Affections of the Antrum of Highmore.

by

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PREFACE.

This volume contains four papers on subjects related to the antrum of Highmore.

The first is a record of the post-mortem examination of the antra and nasal fossae in 100 subjects. The intra-antral conditions are described and their relations to the pathological changes found in the nose, and to the fatal disease, are discussed.

In the second paper a résumé of the present knowledge of trans-illumination is given; the various phenomena observed while using this test are described, their significance pointed out and relative value estimated, the considerations being based on investigations made in living and dead subjects.

A new and simple method of inspecting the antrum is described in the third paper. Some of the intra-antral affections observed, their relation to the symptoms and to the conditions found in the corresponding

nasal fossa, and the results obtained by their direct treatment, are recorded.

The last paper deals with an infantile affection which is commonly regarded as empyema of the antrum. The other theories that have been advanced as to the nature of the disease are referred to, and all the published cases are briefly reported. Fresh evidence is adduced in support of the view that the disease is not empyema of the antrum but osteomyelitis of the superior maxilla, and the probable mode of origin is pointed out.

All the accompanying illustrations were specially prepared for the author and have not been published.

A

Contribution to the Pathology of Certain Affections

of the

Arteries of Tinnitus.

A CONTRIBUTION TO THE PATHOLOGY OF THE ANTRUM OF HIGHMORE.

By the kindness of the late Professor Coats opportunities were afforded me of examining the nasal cavities and antra of bodies received in the Post-Mortem Rooms of the Western Infirmary, Glasgow. The sole condition imposed, namely, that the subjects should be in no way disfigured, was easily fulfilled in the case of the antrum, but precluded me from thoroughly exploring the other accessory sinuses of the nose. This investigation therefore does not deal with the latter, which, however, are much less frequently diseased and of less importance than the antrum.

The following notes are based on the results of the examination of 100 subjects.

METHOD OF EXAMINATION.

The sex, age, and cause of death having been noted, the nasal fossae were examined by anterior rhinoscopy, and afterwards the antra were opened and thoroughly inspected. Entrance was gained to the antra by the method devised by the author which is fully described in the chapter on Inspection of the Antrum. Briefly stated this procedure consists in making an incision in the gingivo-labial fold, exposing the canine fossa by scraping the soft tissues aside, and then by means of suitable trocars boring a large opening into the cavity through which with the aid of a speculum and reflected light the interior is viewed. When freer access

is desired the aperture may be enlarged by chipping away with chisel and mallet the required amount of the anterior wall. Speedy entrance to the maxillary sinus is thus obtained without producing any disfigurement.

RELATIVE ADVANTAGES OF EXAMINING ANTRA IN POST-MORTEM AND DISSECTING ROOMS.

In my examinations I had the advantage of observing the antra a few hours after death before any important change could take place. On the other hand a cavity having the form and angular recesses of the antrum cannot be examined through an opening made in one of the walls so thoroughly as after exposing it by section. It is possible therefore that occasionally pathological changes in the lining membrane of the anterior wall of the cavity may have escaped my notice.

OBJECTS OF INVESTIGATION.

In conducting the present investigation the following objects have been kept in view:- 1. To ascertain the frequency of the various diseases of the antrum. 2. To note the relation of pathological changes in the antrum to those in the nose, and vice versa. 3. To consider whether the pathological changes found in the antrum bore an etiological relation to the disease from which the subject died.

In the subjoined tables the causes of death are occasionally

indefinitely expressed. This is due to several of the patients having died shortly after admission to the Infirmary and to no complete necropsy having been made. In the absence thus of a clinical and pathological report it was necessary to adopt the terms of the death certificate.

The following abbreviations are used:- R-right; L-left; I.T.-inferior turbinate; M.T.- middle turbinate; Meat.-Meatus; Sept.-Nasal Septum; Hyper.-Hypertrophy; Atr.-atrophy; Coll.- collapse; Dev.-deviation.

The Roman numerals (I to C) indicate the respective numbers of the subjects in my post-mortem note-book.

ANATOMICAL VARIATIONS IN ANTRA EXAMINED.

In addition to the pathological changes in the antra, note was also taken of the anatomical variations or peculdarities met with. It is more convenient to consider these first; they were of the following nature:- asymmetry of the antra, loculation, marked ridges, presence of ostia accessoria, etc.

ASYMMETRY OF ANTRA.

1. XXXII. M. 72. R. Antr. normal in size. L. Antr. ½ size of R. due to non-extension downwards into alveolus, and outwards towards zygoma.

Nasal Septum normal. Hypertrophic Rhin. Growth on R.I.T.

No asymmetry of face detected.

2. XXXV. F. 46. L. Antr. norm. in size, empty; lining membrane norm. small foramen accessorium. R. Antr. less than half the size of the L.; full of pus; lining memb. thickened.

Ridge on R. side of septum.

R. side of face flatter at and below malar process.

3. XXXVII. M. R. Antr. norm. in size. On opening at usual situation through facial wall of L. antrum a vertical partition is encountered separating two cavities. At first glance it appears as if the antrum were subdivided, but on closer inspection it is found that the cavity nearer the middle line is the inferior meatus of the nose, and that the partition is the inner wall of the antrum bulging unduly outwards; while what was taken as the inner wall of the antrum is really the inferior turbinate. The antrum is thus very small and confined to the zygomatic process, while the inferior meatus of the nose is unduly wide.

Nasal Septum normal.

4. XL. M. 59. R. Antr. norm. in size; contains small quantity of yellow mucus. L. Antr. much smaller than R. filled with yellow mucus. Nasal wall of L. Antr. is bulged outwards. Nasal Septum deviated to L. Slight flattening of L. cheek.

5. XLI. M. 64. R. Antr. norm. in size. L. Antr. narrower than R. Lining membrane of both Antra polypoid. Nasal Septum deviated to L.

6. XLVIII. M. 45. R. Antr. norm. in size. L. Antr. smaller than R. owing to but slight excavation of alveolar process. Lining memb. of both antra thickened. Nasal Septum deviated to L.

7. XLIX. M.44. L. Antr. large; prominences on floor corresponding to dental alveoli. In opening R. Antr. the inferior meatus of the nose is unintentionally entered owing to the unusual bulging outwards of its lateral wall. In consequence of this, and of the non-extension of the cavity downwards the R. Antr. has only half the capacity of the L. In the nasal fossae, septum vertical, and nothing to arouse suspicion of the difference noted. On measuring the breadth of the floor on the two sides, however, that on the R. is found the greater.

ASYMMETRY OF ANTRA.

The method adopted of examining the antra did not admit of the recognition of slight degrees of asymmetry. In 7 subjects, however, there was a striking difference in size between the two cavities amounting in 4 instances to over 50%.

The asymmetry was due either to imperfect development of the cavity downwards towards the alveolus or outwards towards the zygoma, owing to deficient bony absorption in these directions; or, to enchoachment upon the lumen of the cavity by the bulging into it of one of its walls-usually the nasal. In regard to the former cause, insufficient bony absorption; it it should be mentioned that all the subjects here considered were adults and the antra presumably fully developed. In children, on the other hand, I have sometimes found one antrum well developed while the other was much smaller and enclosed by a quantity of spongy bone part of which would presumably undergo absorption; in such cases the asymmetry may have been only temporary.

In 5 of the 7 subjects the dimensions of the R. antr. appeared ordinary while those of the L. were abnormally small; in the other 2 subjects the reverse held good.

Certain other conditions found in several of the cases were related to the asymmetry. Thus the nasal septum was deviated as a rule towards the smaller antrum; when the antrum was enchoached upon by the bulging into it of the lower part of the nasal wall the width of the floor of the nose on this side was greater than on the other; and in several of the subjects there was flattening or depression of the cheek over the smaller antrum.

Asymmetry of the antra may have an important bearing on the diagnosis and treatment of affections of these cavities. The value of transillumination is considerably depreciated by the fact that asymmetry was present in 7% of the subjects examined; for it is evident that a small cavity with thick walls will transillumine faintly in comparison with a large, thin-walled cavity, and suspicions may thus be falsely aroused as to the former being diseased. Further, under such circumstances the examination of the suspected antrum by exploratory puncture of the nasal wall may, owing to its thickness, be difficult or impracticable. Lastly, in order to open such an antrum from the canine fossa it would be necessary to bore through a considerable thickness of bone . In forming an opinion as to asymmetry of the antra, assistance might be received by comparing the width of the floor in the two nasal cavities, and the development of the two sides of the face.

LOCULATION OF ANTRA.

1. Case VIII. M. (adult). Nasal fossae normal. R. Antr. normal. L. Antr. contained the chief cavity and four smaller apparently closed compartments. Of the latter, the largest is bounded by the inner wall of the antrum and a partition which passes from the posterior part of this wall to the facial wall. A narrow cavity is thus enclosed the lining membrane of which is much thickened. The other three compartments abut on the facial wall. One, very narrow, lies behind the upper two-thirds of this wall, while the remaining two are situated below, their lower boundary being formed by the floor. The posterior part of the antrum is, in addition, partially divided by an incomplete septum which runs from the facial wall for some distance parallel with the zygomatic wall.
2. Case XVII. M. 51. Hypertrophy of Inf. Turbinates; popypoid L. Mid. Turb. R. Antr. normal. L. Antr. contained small quantity of pus, and lining memb. is thickened. A small narrow cavity lies along the nasal wall and is closed off from the main cavity by a special partition.

LOCULATION OF ANTRA.

Division of the antrum into two or more compartments is of rare occurrence. In the first case here reported one antrum was multilocular and the partitions were apparently complete; in the second case the cavity was bilocular, the smaller compartment being narrow and abutting on the nasal wall.

Loculation may mislead us both in diagnosing and treating antral affections. Thus, if exploratory irrigation were carried out in a case such as the above with a narrow loculus lying along the nasal wall, and perforating this wall from the inferior meatus in the usual manner an error might arise in one of two ways. Either the point of the trocar might enter a healthy loculus and the diseased main cavity be overlooked, or, it might traverse a diseased narrow loculus and enter a normal large compartment on washing out which a negative result would be obtained. Again, if it were necessary in consequence of suppuration to open a multilocular antrum from the canine fossa, and the loculi to escape our notice, these, if diseased and in communication with the main cavity, would nullify the success of the operation.

Besides loculation of the antrum one should be acquainted with a condition which may simulate it as observed in Case XXXVII (see also asymmetry of antra). When drilling from this subject's canine fossa a vertical bony partition was encountered which apparently divided the antrum; on examination, however, it became evident that what at first was taken to be the inner wall of the antrum was in reality the inferior turbinate, while the supposed partition was the wall separating the antrum from the inferior meatus.

RIDGES.

1. XIV. F. 46. L. Antr. empty, lining membrane thin. Two sharp, hard-edged ridges cross the floor transversely; they are fully ¼ in. high. R. Antr. normal.

2. XXXV. F. 46. L. Antr. a fold of mucous membrane stretches across the floor; small foramen accessorium present. R. Antr. very small, less than half the L; full of pus; lining membrane thickened.

3. LIX. M. 47. R. Antr. floor irregular, presenting several prominent ridges. L. Antr. Same.

4. LX. M. R. Antr. large. A bony ridge passes from roof to inner wall where it widens and terminates at the ostium which is situated lower than usual.

   L. Antr. presents a well marked bony ridge which appears like an archway passing from the outer wall along the roof to the inner wall where it terminates at the ostium as on the right side.

RIDGES.

A certain amount of ridging of the antrum especially of its floor is quite common, but in the four cases here reported it was of a marked character. Practically these ridges are important owing to the recesses they form, and the trouble they thus entail when it is necessary to remove the diseased lining membrane of the cavity.

OSTIUM MAXILLARE ACCESSORIUM.

Present on both sides.

1 XI M. 47. Perf. of Cart. Sept.

R. Antr. small amount of fluid present. L. Antr. Scanty fluid.

2. XXIX M. 58. Diam. 2mm.

R. Antr. normal. L. Antr. Normal.

3. LII M. 63. Walls thin. On R. side, 3 ostia; on L. 2; diams. vary from 3 to 8 mm; normal ostia, small.

R. Antr. normal. L. Antr. empty; lin. memb. norm. bony cyst on floor.

4. LIV M. 50. Atr. Rhin. Facial wall v. thin. Ostia Sym., Circular, 3 mm. diam.

R. Antr. normal. L. Antr. Cyst on floor.

5. LVI M. On R. side, circ., diam. 3 mm. On L. oval, 18 mm. in long diam; above and in front a much smaller opening.

R. Antr. Empty; cystic. L. Antr. Empty: Cystic.

OSTIUM MAXILLARE ACCESSORIUM.

Present on one side.

6. III F. 63. Wall of Antr. Very thin.

Ost. Acc. On L. side as large as pea.

R. Antr. Shallow circular depression behind Post. Acc.

. . Below it are 2 cysts with yellow contents.

7. XV. M. 58.

Ost. Acc. on R. side.

R. Antr. contains mucus; a stream of pus entering by Post. Acc.

L. Antr. Normal.

8. XXII. F. Perf. of Cart. Sept.

Ost. Acc. On L. side small.

R. Antr. Normal.

L. Antr. Contains small amount of mucus.

9. XXVI. M. 58. Facial wall of Antr. very thin.

Ost. Acc. R. side. Normal Ost. large.

R. Antr. normal.

L. Antr. presents 2 or 3 small polypi near Ost.

10. XXVII. M. 32.

Ost. Acc. on Right side and another close beside it.

R. Antr. presents extravasated blood in lining memb, and dried blood at lowest part.

L. Antr. contains half teaspoonful of thin brown fluid.

11. XXXV. F. 46. (See Asymmetry of Antr.)

Ost. Acc. on L. side, size of pin head.

R. Antr. full of pus, lining membrane thickened.

L. Antr. contains very scanty fluid.

12. LVII. M. 42. Indication on L. side.

Ost. Acc. on Ri side, 2mm. diam.

R. Antr. normal.

L. Antr. normal, depression and thinning behind Ost. as if Ost. Acc. about to be formed.

13. LXXIII. M. 27. Facial wall very thin. Indication on L. side.

Ost. Acc. on R. side, slit like.

R. Antr. contains cyst as large as bean.

L. Antr. normal.

14. LXXVI. M. 38. Facial wall of Antra very thick.

Ost. Acc. on R. side as large as pea.

R. Antr. contains single mass of inspissated mucus.

L. Antr. contains single mass of inspissated mucus.

15. LXXVII. M. 55. Facial wall thin.

Ost. Acc. on L. side, as large as head of pin, Ost. Max fairly large.

R. Antr. normal.

L. Antr. normal.

16. XCVII. M. 57.

Ost. Acc. onL. side larger than head of pin.

R. Antr. normal.

L. Antr. cystic.

OSTIUM MAXILLARE ACCESSORIUM.

One or more ostia accessoria were present:-

in 5 subjects on both sides,

6 " " the R. side,

5 " " " L. side.

Thus altogether 21 antra (=10%) possessed an accessory opening. Zuckerkandl observed one in every ninth or tenth case, and Gradenigo in 105 subjects found it in 17 (5 bilateral, 4 R, 8 L.)

Occasionally more than one led into the same antrum, e.g. in one subject there were three on the R side and 2 on the L, another subject had two on the L side, and a third had two on the R. side. Not infrequently a depressed and thinned portion of the upper and inner wall of the antrum was noted which would readily have yielded and thus given rise to an additional ostium.

The two sides presented equally often an accessory opening. Its shape was usually circular or oval, and its diameter varied from 2mm. to 18mm.

The condition of the antra possessing accessory openings was as follows: 8 were normal; 3 contained scanty cloudy fluid; 3 a small quantity of mucus, and 1 blood (due to head injury); in all 15 the lining membrane was normal. On the other hand, the lining membrane was cystic in 5 cases, and in 4 of these the cysts were situated on the inner wall of the antrum near the ostium accessorium. The comparatively frequent association of cysts of the lining membrane with accessory openings would seem to indicate a relation between the two conditions.

Some writers have regarded the ostium maxillare accessorium as a

consequence of a pathological process (Giraldès) and as comparable to a perforation of the tympanic membrane (Harke); their opinion is largely based on the fact that the ostium is absent in the young. The majority of my subjects with ostia accessoria had passed middle life, but instead of regarding these as due to manifest disease I think it more probable that an insidious thinning of the membraneus wall between the nose and antrum occurs and ends in their formation. Is it possible that the same process favours a cystic degeneration of the neighbouring antral lining membrane and so leads to the association of the two conditions?

The special features observed in the nasal fossae of subjects having ostia accessoria were:-perforation of the cartilaginous septum in 2 instances; atrophic rhinitis once; and thinness of the antral walls in several cases.

The presence of an accessory opening, which is not difficult to find in the living subject, allows fairly easy entrance to the antrum and consequently of its being readily irrigated. It may also influence the aspect of a case of antral suppuration by allowing the pus to pass into the nose at a point lower and further back than the ostium maxillare, and thus favour its flow into the naso-pharynx rather than anteriorly.

The ostium accessorium if large, may be a source of danger to the antrum by facilitating the entrance of morbid secretions from the nose. In one of the subjects examined, pus could be traced through an accessory opening into the antrum. On the other hand abnormal antral discharges will escape more readily and the spontaneous cure of pathological processes within the cavity be favoured.

VARIOUS OTHER ABNORMALITIES.

The following conditions were also found in the course of my investigations:-

1. Bony Shell in Antrum. LII. M. 63. L. Antr. On inner side of floor an elevation as large as a bean is present. This is found to consist of cancellous bone and on removal a small cavity is exposed containing scanty yellow fluid.
2. Bony Shell in Antrum. LX. M. L. Antr. A hemispherical elevation resembling a cyst with purulent contents is present on the floor. It is found, however, to be bony; and on breaking through the thin shell a sac is exposed containing a whitish substance and a little fluid. Beneath the sac the floor is rough, and underlying it is the carious root of the 3rd. Molar.
3. Thinness of lining membrane of Antrum. XC. M. 45. Anterior wall thin. Cavities empty. Lining membrane on both sides so thin as almost to feel absent but for ease with which probe glides over bony surface.
4. Perforation in anterior wall of Antrum. XXXIX. M. 27. When about to open L. Antr. a hole large enough to admit the probe is encountered ¼ in. above the alveolar border and opposite the 1st. molar, of which only the three roots remain. On introducing the probe it enters the antrum; the anterior wall of the cavity is very thin and the lining membrane has a pale gelatinous look. On removing the outer wall of the alveolar border a sac is found having thick fluid contents into which the three fangs project. There is no fluid in the antrum, and no apparent connection between the sac and antrum.

5. Absence of Ostia. XLIII. M. 63. In this subject's nose there is no trace of turbinates, the septum, excepting the membranous portion, had also been destroyed (syphilis). The antral openings cannot be found although they have been carefully sought for.

6. Antra abnormally small. LXXXIII. M.55. On proceeding to open the antrum in the usual manner, but after boring through a considerable thickness of bone, the nose is entered. A passage is now drilled through the upper part of the channel already made and the antrum reached. The cavity is as large as a bean and situated just below the eye; the lining membrane is normal. Both antra are alike. The subjects cheeks are deeply sunken.

7 Antra abnormally small. XCIV. M.19. On boring in the usual direction the antrum is missed, but by continuing more upwards the cavity is opened. It is found that the alveolar recess is not fully formed. Lin. memb. normal. Both antra alike.

BOTH ANTRA NORMAL.

No.	Subject.	Age & Sex.	Abnormality in R. Nasal fossa.	Abnormality in L. Nasal fossa.	Cause of death.
1.	I.	M. 27.	-	-	Meningitis with hydrocephalus.
2.	II.	M.	Hyper. I. T.	Hyper. I. T.	Strangulated Hernia.
3.	VII.	M. 13.	Slight Atr. I.T.	-	Diabetes mellitus.
4.	IX .	F. 17.	-	-	Epileptiform Convulsions.
5.	XII.	F.	-	-	Umbilical Hernia.
6.	XIX.	F. 38.	-	-	Puerperal pyaemia.
7.	XXIV.	M. 18.	-	-	Empyema; pleurisy; bronchiectasis.
8.	XXVIII.	M. 30.	-	-	Acute meningitis (?influenza).
9.	XXIX.	M. 58.	-	-	Strangulated hernia.
10.	XXXII.	M. 70.	Hyper. I. T.	Hyper. I. T.	Cancer of pharynx and oesophagus. Putrid bronchitis.
11.	XLIV.	F. 28.	Hyper. I. T.	Hyper. I. T.	Tumour of cerebellum. Chronic Valvular disease.
12.	XLVII.	F. 35.	Hyper. I. T.	Septal spur.	Diphtheria of larynx and trachea.
13.	XLIX.	M. 41.	Hyper. M. & I.T.	Hyper. M & I.T.	Chronic endocarditis.

No.	Subject.	Age & Sex.	Abnormality in R. Nasal fossa.	Abnormality in L. Nasal fossa.	Cause of death.
14.	LI.	M.	Sept. dev. to R.	-	Cerebral haemorrhage and atheroma.
15.	LII.	M. 63.	-	-	Atheroma of coronary arteries.
16.	LV.	F.	Septal ridge.	Hyper I. T.	Tumour of chest.
17.	LVII.	M. 42.	-	-	Tuberculosis of lungs, larynx, intestines, etc.
18.	LIX.	M. 47.	Sept. irreg.	Sept. irreg.	Cancer of stomach and liver.
19.	LXIII.	M. 64.	Great congestion	Great congestion.	Atheroma and thrombosis of Coronary artery.
20.	LXV.	F. 49.	-	-	Cardiac and renal disease.
21.	LXX.	M. 48.	-	-	Chronic suppurative peritonitis.
22.	LXXII.	M. 28.	Sept. dev. to R.	Hyper. L.I.T.	Acute pneumonia.
23.	LXXVII.	M. 53.	-	-	Fractured ribs; surgical emphysema; pneumonia.
24.	LXXX.	F. 42.	Slight Atr. I.T.	Slight atr. I.T.	Batty's operation.

BOTH ANTRA NORMAL. (continued).

No.	Subject.	Age & Sex.	Abnormality in R. Nasal fossa.	Abnormality in L. Nasal fossa.	Cause of death.
25.	,LXXXIII.	M. 55.	Sept. dev. to R Polyp. in mid meat.		Pleurisy; phthisis pul[illegible].
26.	XCII.	M. 45.	Sept. dev. to R.	Atr. I. T.	Intestinal Obstruction.
27.	XCIII.	F. 30.	-	-	Ectopic gestation.
28.	XCIV.	F. 19.	Atr. I.T.	Atr. I. T.	Purpura haemorrhagica.
29.	XCV.	F. 58.	Atr. I. T.	Atr. I. T.	Pneumonia.
30.	XCIX.	M. 40.	Sept. irreg.	Sept. irreg.	Sarcoma in region of porta hepati.

Both Antra Normal.

Both antra were empty and the lining membrane was thin, smooth and glistening in the above 30 subjects. To this strikingly small number of normal antra should possibly be added several cases in which the lining membrane was healthy but scanty cloudy fluid was present. I have suggested that the fluid in some of the latter may have been of post-mortem or extra-antral origin; these cases have, however, been grouped with those having serous contents and will be referred to subsequently.

Dmochowski in 152 subjects, found the antra healthy in 124, i.e. 81.5%. Gradenigo in 103 subjects found no pathological condition in 39 = 37%.

In the above 30 subjects the state of the nasal cavities was as follows:

	R.	L.
Both normal		
One "	—	2
Hypertrophic Rhinitis.	5.	5
" " one side	1	2
Atrophic Rhinitis (slight)	3	3
" " one side	1	1
Spur, ridge or irregulatity of Sept.	7	3
Polypus ~~chyp. post.~~	—	1
	30	30.

TABLE OF SUBJECTS HAVING ONE ANTRUM NORMAL.

No.	Subject.	Sex & Age.	Norm. Antr.	Corresponding nasal Fossa.	Condition of other Antrum. Lining Memb.	The Contents.	Correspondg. Nasal Fossa.	Cause of death.
1.	III.	F.63	R	=	cystic	nil	normal	Apoplexy.
2.	VIII.	M.	R.	-	thickened	nil	normal	Phthisis pulmonalis.
3.	XIV.	F.46	L.	-	normal	Serums	normal	Apoplexy.
4.	XV.	M.58	L.	Inf. Turbs. Hypertr.	normal	muc.& pus.	Inf. turb. hypertr.	Cardiac disease.
5.	XVII.	M.51	R.	Inf. Turbs. Hypertr.	thickened	pus	Inf. turb. hypertr. Mid. turb. polypoid.	Cardiac disease.
6.	XX.	F.19	R.	Pus and mucus present.	cystic	pus	Pus & muc. present.	Pneumonia.
7.	XXI.	M.	R.	Large septal spur.	cystic	nil	normal	Railway accident.
8.	XXII.	F.	R.	Perf. of Cart. Sept.	normal	serums	Perf. of Cart. Sept.	Cardiac disease.
9.	XXVI.	M.58.	R.	Mid. Turb. polypoid: Sept. spur.	polypoid	nil	Mid. turb. polypoid.	Cancer of stomach.
10.	XXXIII.	M.58.	L.	Inf. Turb. hypertr.	thickened	serums	Inf. turb. hypertr.	Cardiac disease.
11.	XXXVIII.	F.38.	R.	-	normal	pus	Large septal ridge.	Phthisis pulmonalis.
12.	XLIII.	M.63.	L.	Turbs. and Septum destroyed(syph.)	thickened	pus	Turbs. and septum destroyed (syph).	Cancer of stomach
13.	XLV.	M.76.	R.	Inf. Turb. hypertr.	cystic	pus	Inf. Turb. hypertr.	Chronic bronchitis.
14.	XLVI.	M.65.	R.	Inf. & mid. turbs. polypoid.	normal	bld.& muc	Polypoid hypertr.of Inf. & Mid. Turbs	Fatty degen. of liver and kidneys.
15.	L.	M.15.	L.	-	normal	green	normal	Head Injury.
16.	LIV.	M.50.	R.	Inf. & mid turbs. atrophied.	cystic	nil	Inf. & Mid. Turbs.atr.	Pneumonia.
17.	LXVI.	F.36.	L.	=	normal	pus	normal	Cardiac disease.
18.	LXVII.	F.58.	R.	-	normal	yellow	normal	Ovarian tumour.
19.	LXXI.	M.25.	L.	-	normal	serums	normal	Unknown.
20.	LXXIII.	M.27.	L.	-	cystic	nil	normal	Carcinoma of bowel.
21.	LXXV.	M.34.	L.	Dev. of Sept. to left.	normal	serums	normal	Comp. fracture of elbow joint.
22.	LXXXII.	M.67.	L.	-	normal	serums	normal	Unknown.

No.	Subject.	Sex & Age.	Norm. Antr.	Corresponding Nasal Fossa.	Condition of other Antrum. Lining Memb.	The Contents.	Correspondg. Nas. Foss.	Cause of death
23.	LXXXVII.	M.32.	L.	Normal.	normal	serous	normal	Cardiac disease.
24.	XCI.	F.45.	L.	Normal.	polypoid	pus	normal	Malignant abdominal tumour.
25.	XCVI.	M65.	L.	Dev. of Sept. to left.	polypoid.	muco-pus	unduly wide.	Apoplexy.
26.	XCVII.	M.57.	R.	Large Septal Spur.	cystic	nil	normal	Cancer of stomach.

SUBJECTS HAVING ONE ANTRUM NORMAL.

Twenty-six subjects had one antrum normal. If this number be added to that of the antra normal on both sides (60 antra in 30 subjects) a total of 86 normal antra in 200 (43%) is obtained.

This group of cases by affording a comparison of the two sides would seem to offer a good opportunity of studying the influence of antral disease on the nasal cavity and vice versa. Unfortunately, however, the affection of the antrum in but a few instances was of a mild nature and such as would not readily produce changes in the nasal mucous membrane. Thus the affected antrum in 6 instances merely contained serous fluid, and in 5 presented slight cystic degeneration of the lining membrane; in all of these cases there was no difference between the nasal cavities on the two sides, if spurs and deviations of the septum be left out of account. In fact there is only one case (No. 5), in which a pathological condition in the nose might be regarded as the result of antral disease. The diseased antrum in this subject contained pus and its lining membrane was thickened, the corresponding middle turbinate was polypoid, while that on the other side was normal.

The nasal condition in several instances would seem to have played a part in producing the antral disease, for in 4 of the 7 cases in which the lining membrane of the antrum was thickened or polypoid, marked changes mostly hypertrophic, had taken place in the inferior or middle turbinate of both sides. On the other hand, the nasal fossae were normal in the great majority of cases in which the affection of the antrum was insignificant.

ANTRA PRESENTING PATHOLOGICAL CONDITIONS.

The pathological changes noted were either in respect of the contents or lining membrane. The following classification is based on the naked-eye appearances.

I. Antra with normal lining membrane but with contents.

a. Serous fluid.

b. Mucus.

c. Pus.

d. Blood.

II. Antra with thickened lining membrane and containing -

a. No fluid.

b. Serous fluid.

c. Mucus.

d. Pus or Muco-pus.

III. Antra with polypoid lining membrane and containing-

a. No fluid.

b. Serous fluid, Muco-pus or Pus.

IV. Antra with cysts of the lining membrane and containing -

a. No fluid.

b. Serous fluid, Mucus or Pus.

TABLE OF ANTRA WITH NORMAL LINING MEMBRANE CONTAINING SEROUS FLUID.

1. X. F. 41. R. Antr. contains ten drops of very dark brown fluid. After its removal the lin. memb. appears pale and norm.
L. antr. same.
Nasal fossae norm.
Acute yellow atrophy of liver.

2. XI. M. 47. Both Antra small; lin. memb. norm. contain scanty cloudy fluid.
Hypertr. Rhin. Perf. of Sept. Cartilage.
Perforation of stomach; peritonitis.

3. XIV. F. 46. R. Antr. contains a few drops of cloudy fluid L. Antr. empty.
Nasal fossae norm.
Apoplexy and burn.

4. XVI. M. 25. R. and L. Antra contain a little thin opalescent fluid. Naso-pharynx and mouth filled with similar fluid.
Nasal fossae nobmal.

5. XXII. F. L. Antr. a small quantity of greyish fluid. R. Antr. norm.
Perfor. of Cart. Sept.
Cardiac Disease.

6. XXVII. M. 32. L. Antr. contains about half a teaspoonful of thin light brown fluid. Lin. memb. on roof has a dark smoky appearance. Fracture of outer wall of R. Antr. (See Blood in Antrum.)
Nasal fossae norm.
Abcident. Bruise over R. malar.

7. XXXV F. 46. L. Antr. contains one or two drops of opalescent fluid. R. Antr. abnormally small; contains pus; lining memb. thickened.

Hypertrophic rhinitis.

Pulmon. emphysema. Hyper. and dil. of R. Ventr. Thrombi in auricle.

8. XLII. M. L. Antr. quarter filled with thin dirty grey fluid. Lin. memb. norm. R. Antr. empty. Lin. memb. slightly thickened.

In mouth and pharynx a large quantity of fluid.

Deviation of Septum.

Suppression of urine.

9. L. M. 15. R. Antr. contains a little dirty green fluid and lin. memb. is of the same colour. L. Antr. empty. Lin. memb. presents here and there small red patches.

Dev. of Sept.

Found unconscious beside bicycle.

10. LX. M. Both antra present marked ridges and contain a little amber coloured fluid.

Nasal fossae norm.

Hypertrophy and dilatation of heart. Pericarditis. Granular kidney.

11. LXVII. F. 58. L. Antr. contains about a teaspoonful of yellow fluid. R. Antr. empty.

Nasal fossae norm. Cystic tumour of ovary.

12. LXVIII. F. 22. Both Antra contain a little clear fluid.

Clear fluid filling both nasal fossae, otherwise normal.

Ulcerative endocarditis of aortic valve. Infarctions with haemorrhage in kidney.

15. LXXI. M. 25. R. Antr. contains a little clear fluid. L. Antr. norm. Nasal fossae normal.

14. LXXIV. F. 70. Both Antra contain about half a teaspoonful of greyish fluid.

Nasal fossae norm.

Extensive cerebral haemorrhage with laceration of brain. Chr. interstitial nephritis. Atheroma of aorta, etc.

15. LXXV. M. 34. R. Antr. contains about a teaspoonful of clear fluid Lin. memb. norm. excepting on inner wall where it presents a fold resembling the wall of a collapsed small cyst.

L. Antr. norm.

Dev. of Sept.

Compound fracture of elbow joint.

16. LXXXI. M. 62. Both Antra contain cloudy fluid and trace of blood. Fluid similar to that in antra filling posterior half of both nasal fossae.

Fissured fracture of occipital bone. Cerebral haemorrhage.

17. LXXXII. M. 67. R. Antr. contains a few drops of frothy greyish fluid.

L. Antr. empty.

Nasal fossae lined with dried dirty-brown secretion.

18. LXXXIV. F. 40. Both Antra contain a few drops of cloudy fluid.

Nasal fossae norm.

19. LXXXVI. M. 35. R. Antr. contains a few drops of cloudy fluid. Lin. memb. thin with here and there a bright red area. L. Antr. contains about half a drachm of thin cloudy fluid.

Dirty grey crusts cover both middle turbinates.

Hypertrophy of L. Ventricle. Oedema of limbs and lungs.

20. LXXXVII. M. 32. R. Antr. contains two or three drops of cloudy fluid.

L. Antr. empty.

Nasal fossae norm.

Extreme general dilatation of heart. Atheroma. Fatty change of cardiac muscle. Lungs very oedematous. Liver hyperaemic.

ANTRA WITH NORMAL LINING MEMBRANE CONTAINING SEROUS FLUID.

Fluid other than blood, pus or muco-pus was present in both antra in 9 subjects, and in one antrum in 11 subjects, (6 times R. side, and 5 times L. side). In one of the 9 subjects a trace of blood was also present in both antra. As to the other antrum in the 11 subjects, in 8 instances it was empty and normal, in one it contained blood, and in two the lining membrane was thickened, pus being also present in one of the cavities.

As a rule the fluid had a grey cloudy appearance and amounted only to a few drops. In one case, however, its colour was dark brown owing to jaundice, in another light brown possibly due to an admixture of blood, in a third dirty green, and in a fourth and fifth yellow.

The grey cloudy fluid was found on microscopic examination to contain a few leucocytes, a large amount of shed ciliated epithelium- which imparted to the fluid its cloudy appearance- and crowds of microorganisms.

In my opinion this fluid when found in small amount is of post-mortem origin. During life the lining membrane of the antrum is moist and the contained air humid. Owing to the fall of temperatura at death, the moisture in the air is deposited on the surface of the membrane and together with that already there and within its substance, being unable to

escape through the bony walls, gravitates to the most dependent part of the cavity. A slighter degree of this condition was observed in some cases in which, although fluid was absent, the lining membrane at the lowest part of the antrum was moist, dull-white and sodden, and contrasted strongly with the dry glistening aspect at a higher level. These variations probably depend upon the condition of the antral lining membrane before death; if it has been saturated with moisture and actively secreting the fluid contents at the necropsy will be more abundant, and vice versa.

The presence of a small quantity of greyish fluid in antra otherwise normal must not therefore be regarded as a pathological condition.

The quantity of fluid, however, on several occasions exceeded that stated above varying from half a teaspoonful to about double that amount. While in some of these cases the fluid owed its origin to serous transudation there is hardly any doubt that in others it flowed in from the nose, the mouth and nasal fossae being filled with fluid similar to that found in the antrum. At the same time it should be noted that in several subjects, although the nasal cavities were full of fluid, only a few drops were found in the antra showing that under certain circumstances- to be more fully considered under the remarks on Blood in the Antrum- fluids do not enter this cavity from the nose.

As to the condition of the nasal fossae, hypertrophie rhinitis was found in 2 subjects, and perforation of the cartilaginous septum was present in one of these, and in another case.

TABLE OF ANTRA WITH NORMAL LINING MEMBRANE CONTAINING MUCUS.

1. XV. M. 58. R. Antr. largely filled with dark greyish mucus over which a stream of pus descending from ost. acc. passes.

L. Antr. norm.

Inf turbs. hyper. Large quantity of pus in nose coming from ethmoidal region.

Hypertrophy and dilatation of heart. Haemorrhage in lungs.

Hyperaemia of spleen, kidneys and liver.

2. LXXVI. M. 38. R. Antr. Directly below ost. acc., which is as large as a pea, a smooth dull grey cyst-like body is seen which on probing is found to be a lump of tough mucus. The lin. memb. is norm. L. Antr. has no ost. acc. but in posterior part of cavity a collection of mucus similar to that on R. side is found.

Nasal fossae norm.

Pernicious anaemia.

TABLE OF ANTRA WITH NORMAL LINING MEMBRANE CONTAINING PUS.

1. XV. M. 58. R. Antr. contains a large amount of dark grey mucus, over the surface of which a small stream of pus passes to a foramen accessorium, L. Antr. normal. Hyper. of Inf. Turbs. Large quantity of pus in both nasal fossae. Hypertrophy and dilatation of heart involving right and left ventricle. Haemmorrhage in lung. Hyperaemia of spleen, kidneys and liver.

2. XXIII. M.4. Antral cavities small and narrow; small quantity of pus in both. Underlying teeth good. View of nasal fossae unsatisfactory. Lobular pneumonia and collapse of lung.

3. XXXVII. M. R. Antr. On floor, beneath lin. memb. a small collection of pus. The underlying tooth- 1st. M.- is a carious stump. A little dried blood on lining memb. L. Antr. much smaller than R. Hyper. Phin. Fracture of skull; laceration of brain; general subarachnoid haemorrhage.

4. XXXVIII F. 28. L. Antr. contains about half a drachm of pus. R. Antr. empty. Septal ridge on L. side; nasal fossae otherwise normal. Phthisis pulmonalis.

5. LXVI. F. 66 R. Antr. contains a drop of pus. L. Antr. normal. Nasal fossae normal. Cardiac disease. General Oedema.

ANTRA WITH NORMAL LINING MEMBRANE CONTAINING PUS.

In a later chapter it will be shown that it is no uncommon occurrence to find in a normal antrum pus which has descended from one of the upper accessory cavities. It is impossible to state whether the pus found in the above cases had such an origin as no examination was made of the frontal or ethmoidal sinuses. Owing to the early age and consequently non-development of the frontal sinus such a mode of origin may be excluded in Case XXIII. It is more probable that fluid collected in the antra in this subject in consequence of excessive secretion and underwent retrograde change after the entrance of an infective agent (e.g. pneumococci).

Another explanation of the source of the pus in the above series is suggested by Case XXVII, in which a purulent collection due to a carious 1st. molar was situated beneath the lining membrane. Owing to the frequency with which the roots of teeth impinge on, or are separated from the antral lining membrane by a very thin covering of bone, it is evident that suppuration at the apex of a tooth so situated will readily discharge into the antrum without producing naked eye changes in the lining membrane beyond a small perforation. It is probably in consequence of this non-implication of the lining membrane that such cases are cured as soon as the offending tooth is extracted.

Lastly, pus, when in the nose in considerable quantity may find its way into the antrum, especially if the ostium is large or an ostium accessorium present, as in Case XV.

TABLE OF ANTRA WITH NORMAL LINING MEMBRANE CONTAINING BLOOD.

1. XIII. . M. 38. Dried patch of blood in both antra, probably entered from nose.
Head injury.

2. XXVII. M 32. R. Antr. contains a little dried blood of intra-antral origin; extravasated blood in lining membrane.
Head injury. Bruise over R. malar.

3. XXXVII. M. Both Antra contain a little dried blood which has probably entered from nose.
Head injury.

4. XLVI. M. 65. L. Antr. contains a small quantity of blood stained mucus. Source of blood doubtful.
Fatty degeneration of liver and kidneys, etc.

5. LXI. M. 30. Both Antra contain blood and mucus probably of intra-antral origin.
Rupture of urinary bladder etc.

6. LXXXI. M. 62. Both antra present traces of blood which has probably entered from nose.
Head injury.

7. LXXXVI. M. 35. Both antra present traces of blood the source of which is doubtful.
Hypertrophy of L. Ventr. Oedema of lungs and limbs.

8. XC. M. L. Antr. full of blood probably due to tearing of lining membrane. R. Antr. empty.
Head injury.

9. XCVIII. M. 45. Both antra contain blood which has entered from nose.
Wound of trachea: haemorrhage.

NORMAL ANTRA CONTAINING BLOOD.

Blood was found in both antra in 6 subjects and in one antrum in three subjects; in other respects the cavities were normal.
All the cases of blood in the antrum met with in the course of this investigation have been grouped together irrespective of the condition of the lining membrane, and under that series the above cases are fully described and their significance afterwards discussed.

Of the above 9 cases the blood came from an extra-antral source in Nos. 1, 3, 6, and 9. In Nos. 2, and 8, the haemorrhage arose probably from the torn antral lining membrane. In Nos. 4, 5, and 7 the origin was doubtful. Leaving these last three cases, and No. 2 in which the L. Antr. contained some brownish fluid, out of account, there are thus five cases in which the presence of blood may be regarded as accidental and which should therefore be added to the series of normal antra.

TABLE OF ANTRA WITH THICKENED LINING MEMBRANE, BUT WITH NO FLUID CONTENTS.

1. IV. M. 67. Lining memb. of both antra slightly thickened and of a light green colour. Ant. end R. Mid. Turb. polypoid; underlying uncinate process also polypoid, R. Sphenoidal Sinus full of pus; pus in R. Mid. Meatus. Perforation of cartilaginous septum.

Cancer of gall-bladder. Surface of body deeply jaundiced.

2. XXV. M. 28. R. Antr. Lin. Memb. in posterior angle oedematous, remainder fairly normal, all uniformly pale. L. Antr. Lin memb. velvety Nasal fossae normal.

Atheroma of aorta, Obstruction of coronary arteries. Aortic valvular disease.

3. XLII. M. R. Antr. Lin. memb. slightly thickened and oedematous. L. Antr. contains some dirty grey fluid (?from nose): lin. memb. normal. Nasal fossae normal. Large quantity of fluid in mouth and pharynx.

Suppression of urine.

4. XLVIII. M. 45. R. Antr. Lin. memb. is thickened and darkly mottled; empty. L. Antr. smaller than R. lin. memb. thickened and contains pus. Sept. deviated to L.

Pneumonia. Phthisis pulmonalis.

5. LXXXVIII. M. 19. L. Antr. Lin. memb. smooth, grey, moist and thickened. R. Antr. filled with mucus. Lin. memb. thickened. Nasal fossae normal.

Acute peritonitis.

ANTRA WITH THICKENED LINING MEMBRANE BUT WITH NO FLUID CONTENTS.

The lining membrane in the above five cases was but little affected; when the thickening was more marked it assumed a polypoid aspect- which will be considered later.

In four of the five cases the lining membrane in both antra was thickened; in one (No. 3) the antrum on one side was normal. In No. 4 pus was present in one antrum, and in No. 5 mucus was present in one antrum.

In four of the cases the nasal fossae were practically normal; in one, No. 1, on the right side a polypoid condition of the mucous membrane existed in the region of the middle meatus together with pus in the sphenoidal sinus.

ANTRA WITH THICKENED LINING MEMBRANE CONTAINING FLUIDS OTHER THAN BLOOD, PUS AND MUCO-PUS.

1. XVIII M 53. R. Antr. appears almost filled with fluid resembling bile; beneath this, however, is a considerable amount of odourless pus, Lin memb. thickened, plicated, and oedematous. L. Antr filled with bile-like fluid. Lin. memb. thickened. Fluid similar to that found in the antra was also aspirated from L. Sphen. Sin.
Nasal turbs. norm.
Cancer of liver following ducts. Intense jaundice.

2. XXXIII. M. 58. R. Antr. half filled with a thin transparent yellow fluid. Lin. memb. thickened and in posterior angle of cavity shreddy (?cyst). L. Antr. empty. Lin. memb. norm.
Both Inf Turbs. hyper. R. mid Turb. polypoid.
Flabby heart. Dilated ventricles. Old embolism of lung.

3. LXIV. M.64. R. Antr. contains some thin cloudy fluid. What appears to be pus is oozing in at ostium. Lin. memb. swollen.
L. Antr contains a considerable quantity of transparent yellow fluid. Lin. memb. swollen, in some places much so.
L. mid. turb. polypoid.; nasal fossae otherwise normal.
Cardiac hypertrophy with absence of valvular disease. Atheroma of aorta. Oedema of lungs. Passive hyperaemia.

4. LXXXIX. M. 47. Both antra contain about a drachm of thin cloudy fluid. The lin. memb. of both cavities is dull grey, presenting here and there an injected vessel and is slightly thickened.
Nasal fossae norm.
Mitral endocarditis.

ANTRA WITH THICKENED LINING MEMBRANE CONTAINING FLUIDS OTHER THAN BLOOD, PUS AND MUCO-PUS.

This class contains 4 cases. In No 1, a greenish bile-like fluid filled both antra; in the right pus was also present. In No. 2 the L. antrum was normal, while the R. contained a yellow transparent fluid. A similar fluid was also found in the L. antrum in No. 3, a thin cloudy fluid was present in the R. antrum in No. 3 and in both antra in No. 4.

The nasal fossae in Nos. 1 and 4 were normal. In Nos. 2 and 3 the middle turbinate on the same side as that on which the antrum contained yellow fluid was polypoid.

TABLE OF ANTRA WITH THICKENED LINING MEMBRANE CONTAINING MUCUS.

1.XXX. M. 57. R. Antr. full of pus and mucus. Lin. memb. thickened and of a dark dirty grey colour. L. Antr. same but contains a larger proportion of mucus. Polypi in mid. meat. of both sides.

Fracture of spine and pelvis. Rupture of liver and kidney

2. XL. M. 59. R. Antr. contains small quantity of yellow mucus. Lin. memb. slightly thickened, with dilated vessels. (see Asymmetry of Antra). Both Inf. Turbs. black and swollen with blood. Two small polypi to outer side of R. Mid. Turb Dilat. and hyper. of R. ventr. Plugging of pulmon. arts. Thrombosis and organization of thrombi in femoral veins. Face, hands, and feet livid.

L. Antr. filled with tough yellow mucus. Lin. memb. slightly thickened

3. XLVI. M. 65. R. Antr. contains a very little thin mucus. Lin. memb. in most dependent part of cavity is swollen and gelatinous-like. L. Antr. contains a small quantity of blood-stained stringy mucus. Both Inf. and Mid. Turb. hyper.

Fatty degeneration of liver and kidneys. Oedema and haemorrhage in lungs. Found intoxicated and unconscious.

4. LXXXVIII. M 19 R. Antr. full of very tough grey mucus. The surface of the thickened Lin. memb. has the pale smooth glistening aspect of a polypus; it is not lobulated. L. Antr. empty. Lin. memb. smooth, dull grey, moist and moderately thickened. Nasal fossae normal.

Acute peritonitis.

ANTRA WITH THICKENED LINING MEMBRANE CONTAINING MUCUS.

Four cases fall under this heading. In three of them both antra were similarly involved; in one, the lining membrane of one cavity was thickened but no contents were present.

In the case last referred to the nasal fossae were normal; in two subjects hypertrophic rhinitis was present, and in Nos. 1 and 2 several polypi were also found.

TABLE OF ANTRA WITH THICKENED LINING MEMBRANE CONTAINING PUS OR MUCO-PUS.

1. V. M. 45. R. Antr. half filled with blood. L. Antr. half filled with blood and creamy pus. Lin. memb. thickened; and on inner wall suffused with blood. Floor of both cavities smooth. Alveolus underlying both antra edentulous.
Both Inf. Turbs hyper. R. Infer. Turb. suffused with blood.
Acute pneumonia. Embolism of pulmon. art. Ac. pleur. Ac. pericard

2. VI. F.42. R. Antr. contains small quantity of pus. Lin. memb. very thick. L. Antr. same. Dental alveoli not near floor of antrum.
Marked atrophy of both Inf. Turbs.
Multiple abscess in liver. Ac. periton. Thromb. in portal vein.
Pyosalpinx.

3. XVII. M. 51. L. Antr. contains a little pus. Lin. memb. thickened.
R. Antr. normal.
Nasal fossae normal.
Extreme disease of aortic valve. Dilat. of arch. Hyper. of L.Vent

4. XVIII. M 58. R. Antr. appears almost filled with fluid resembling bile; beneath this, however, is a considerable amount of odourless pus. Lin. memb. thickened, plicated, and oedematous.
L. Antr. filled with bile-like fluid. Lin. memb. thickened.
Nasal turbs. normal.
Cancer of liver following ducts. Intense jaundice.

5. XXX. M. 57. R. Antr. full of pus and mucus, emitting a peculiar sweet smell. Lin. memb. thickened and of a dark, dirty, grey colour. L. Antr. the same excepting that the contents are made up of a large proportion of mucus. Upper jaw edentalous. R. M. Meatus filled with ♯ moderately large polypi. Single large polypus in L. M. Meat.

Fracture of spine and pelvis. Rupture of liver and kidneys, etc.

6. XXXI. M.43 L. Antr. half filled with pus and blood. Lin. memb. considerably thickened. R. Antr. contains a little blood and a few drops of pus; both can be traced over inner wall to ostium. Lin. memb. not thickened.

Small polypus to outer side of both mid. turbs.

Compound fracture of skull with laceration of brain. Fracture of ribs; perforation of lung. Rupture of kidney.

7. ~~XLIV.~~ XXXIV. F42. R. Antr. full of pus. Lin. memb. dark red, thick and ragged. L. Antr. contains small quantity of thin fluid resembling blood.

Anterior end of L. M. Turb. polypoid.

Parenchym. nephritis. Dilated heart. Thrombi in R. auricle. Haemorrhage. infarction of lung.

8. XXXV. F. 46. R. Antr. full of odourless pus. Lin. memb. thickened. Cavity very small; less than half the size of L. Antr.

L. Antr. normal. contains a very little cloudy fluid.

Both inf. turbs. hyper.

Pulmon. emphysema. Hyper. and dil. of R. Ventr. Thrombi in auricle

9. XLIII. M. 63. R. Antr. contains pus. Lin. memb. slightly thickened. L. Antr. empty. Both cavities narrow, with thick walls and

without ostia (see special description).

No trace of turbs. Septum entirely gone, excepting membranous portion. Nasal muc. memb. covered with thin layer of dirty pus. One large sphenoidal sinus, with an opening through which pus is aspirated, to L. of middle line.

Scirrhous cancer of stomach. Perforation. Peritonitis. History of syphilis.

10. XLVIII M. 45. L. Antr. smaller than R. Lin. memb. thickened especially on roof; contains about half a teaspoonful of thick pus, smelling of vomited material. R. Antr. empty, lin. memb. thickened and darkly mottled.

Turbs. normal. Nasal septum dev. to L.

Pneumonia, Phthisis pulmonalis.

11. LXII. M. 29. Both Antra contain a little pus. In both the lin. memb. is much thickened and oedematous.

Both nasal fossae largely filled with greyish friable secretion. Both Inf. turbs. much atrophied; Mid. Turbs. slightly atrophied.

Mammary abscess. Pneumonia.

ANTRA WITH THICKENED LINING MEMBRANE CONTAINING PUS OR MUCO-PUS.

In 11 subjects one or both antra presented a thickened condition of the lining membrane and contained pus or muco-pus. In 5 of the 11 subjects both antra were thus involved (Nos. 2, 3, and 11). In the remaining 8, the lining membrane of the other ~~membrane~~ was normal in 6, and thickened in 2 instances, and in some cases the cavity was empty and in others contained blood, bile-like fluid or pus.

The condition of the nasal fossae in these 11 subjects was as follows:- Normal 3, hypertrophic rhinitis 3, atrophic rhinitis 3, polypi 2.

ANTRA WITH POLYPI OR POLYPOID LINING MEMBRANE.

a. WITHOUT FLUID CONTENTS.

1. XXVI M. 58. L. Antr. On inner wall near ostium, several small polypoid growths. R. Antr. norm.
   Ant. end of both mid turbs. polypoid; that on R side large.
   Cancer of stomach. Anaemia, Acute pleurisy.

2. XXXIX M. 27. Lin. memb. of both antra pale with a glistening, gelatinous appearance in places. Dentigerous cyst underlying L. Antr.
   Turbs. not hypertrophied.
   Addison's disease.

3. XLI M. 64 Lin. memb. of both antra dusky red, swollen and polypoid, especially on floor and in post. angle.
   Nasal fossae norm.
   Sarcoma of mediastinum growing into inferior vena cava.

4. LXIX M.36 L. Antr. empty Lin. memb. slightly thickened. Thin polypus, half an inch long hangs from posterior edge of the ostium.
   (For R. Antr. see under b).
   Marked atrophy of inf. & mid. turbs.
   Phthisis pulmonalis.

5. XC M. R. Antr. Lin. memb. thin, excepting on floor where two hemispherical polyp/-like elevations, each as large as half a pea, are present.
   L. Antr. full of blood.
   Nasal fossae norm.
   Fracture of skull.

6. C. M. 39. R. Antr. The whole lin. memb. is thickened. On the floor the thickening is more marked and is due chiefly to flat polypi abutting closely on one another. On the inner wall, below and behind the ostium, is a firm white eminence as large as a pea. A little blood has entered through ostium. L. Antr. Lin. memb. thickened and resembling that of R. Antr. Cavity half filled with blood.
Nasal fossae norm. but blood-stained.
Fracture of skull.

b. CONTAINING SEROUS FLUID, MUCO-PUS OR PUS.

(4.) LXIX. M. 36. R. Antr. contains a little clear thin fluid. Lin. memb. pale, smooth and slightly thickened. Polypus present as on L. side (see 4)
Marked atrophy of inf. and mid. turbs.
Phthisis pulmonalis.

7. LXXIX. M. 32. R. Antr. large. Almost full of clear fluid. In post. angle a flat polypus which could cover a shilling; several smaller ones elsewhere. L. Antr. large, Lin. memb. thickened generally. In posterior angle, three polypi. Largest, about 1½ cm. diam. Bathed in scanty muco-pus.
No polypoid growth in nose. Muco-pus beneath both Mid. Turbs.
Aneurism of R. Antr. Cerebral Art. Extensive cerebral softening and haemorrhage. Patency of Foramen Ovale.

8. XCI. F. 45. R. Antr. full of foetid pus. Lin. memb. on close inspection is found slightly thickened and polypoid in places.
L. Antr. empty. Lin. memb. norm.
Nasal fossae normal; no pus visible.
Malignant abdominal tumour.

9. XCVI. M. 65. R. Antr. contains about half a drachm of thin muco-pus. Lumen greatly diminished by swelling of lin. memb. surface of latter is lobulated in places. L. Antr. empty. Lin. memb. dull grey but does not feel thickened. Lowest part of cavity moist.
Nasal Sept deviated to L. R side unduly wide.
Apoplexy.

ANTRA WITH POLYPI OR POLYPOID LINING MEMBRANE.

The polypoid change in these cases assumed one of two aspects:- 1. The lining membrane presented one or more distinct finger-like outgrowths resembling nasal polypi as in Nos. 1, 4, 5, and 7. 2. The lining membrane was thickened and its surface seemed to be fairly uniform but on closer inspection, the thickening was found to be made up of a number of broad-based, flat, polypoid masses closely packed together; this variety was typically represented in Nos. 6, and 9.

In 5 subjects both antra were polypoid; in 4, only one, the other cavity being normal.

The single polypi sprang from the inner wall of the antrum close to the ostium maxillare, or from the floor; when the polypoid development was more diffuse it took place chiefly on the floor, or in the posterior part of the cavity.

In 3 cases fluid of inflammatory origin- muco-pus or pus-was found in the affected antrum. In several of the other cases fluid of extra-antral (No. 6) or post-mortem (No. 4) origin was present.

The nasal fossae in 7 of the 9 subjects might be regarded as normal; while in 1, polypoid hypertrophy was present, and in another atrophic rhinitis.

Wertheim distinguishes, as has been done above, two forms of antral polypi, namely, papillary hypertrophies of the entire, swollen and oedematous mucous membrane, and growths with the same structure as nasal polypi; and he states that these may occur together in the same cavity.

Antral polypi are not uncommon as the following statistics show:-

Luschka met with antral polypi	5	times	in	60	p. ms.	=	8%
Zuckerkandl(1)	"	"	"	6	"	300	"	=	2%
Heymann (2)	"	"	"	14	"	250	"	=	5.6%
Dmochowski	"	"	"	1	"	152	"	=	0.6%
Kelly (3)	"	"	"	4	"	100	"	=	4%.

(1). Including strands passing between two antral walls.

(2). Including proliferations, cysts, congenital folds.

(3). Polypoid hypertrophy occurred in 5 other subjects.

Antral polypi probably develope in consequence of chronic inflammation, but their immediate cause is as little known as is that of ordinary nasal polypi. We believe, however, that a predisposition in the tissues themselves is more likely to account for the changes they undergo than extrinsic conditions. It is evident that antral polypi are rarely associated with suppuration for in only one of the above series was pus present in the antrum, while Wertheim found a polypus only once, and polypoid hypertrophy once, in his cases of antral suppuration.

TABLE OF ANTRA WITH CYSTS OF THE LINING MEMBRANE.

a, ANTRA WITHOUT FLUID CONTENTS.

1. III. F. 63. L. Antr. On inner wall below ostium, are two cysts, about 7 and 12 mm. diam. respectively, with yellow contents. The rest of the lin. memb. is thin and apparently normal. Large Ost. Acc. with tendency to formation of a second.
R. Antr. norm. Nasal Fossae norm.
Cerebral haemorrhage.

2. XXI. M. L. Antr. Lin. memb. slightly thickened; on inner wall, a cyst as large as a pea, containing mucus. R. Antr. norm. Nasal turbs. norm.
Injuries from railway accident.

3. LIV. M. 50. L. Antr. Mucous cyst as large as a hazel-nut on floor. Lin. memb. otherwise norm. Ost. Acc. present.
R. Antr. norm. Ost. Acc. present.
Marked atrophy of both inf. turbs.
Pneumonia. Rupture of urethra. Cystitis.

4. LVI. M. R. Antr. In posterior angle midway between roof and floor is a gelatinoid cyst, as large as a bean. On inner wall are two firm elevations the size of split peas; one is yellow and opaque, the other resembles the large cyst.
L. Antr. lin. memb. on roof is pale and gelatinoid. Inner wall is slightly red and presents a small opaque cyst beneath a large ostium accessorium. On the floor is another cyst as large as a pea. On right side, one large ostium accessorium,

on left side, one very large, and one small bet. acc.

Hyper. Rhin.

Chronic Bronchitis.

5. LVIII. M. 70. R. Antr. Mucous cyst on floor, as large as a bean. L. Antr. On inner wall, near floor, a cyst about size of a pea; and behind it, in post. angle, a smaller one.

Nasal turbs. norm.

Cancer of stomach. Chr. endocarditis; old pulmon. tuberculosis.

6. LXXIII. M. 27. R. Antr. Wall very thin. Lin. memb. pale red with injected vessels; in upper part smoky. A prominent fold of the lin. memb. descends over middle of inner wall and is continued across floor of cavity. A white, soft cyst as large as a bean, is situated on the lower part of the fold. On incising the cyst a mass of mucus can be squeezed out. A slit-like ostium accessorium is present in the fold above the cyst. L. Antr. Lin. memb. same as on R side but without cyst. No ostium accessorium but a thin area in situation corresponding to that on other side.

Nasal fossae norm.

Carcinoma of bowel. Intestinal obstruction.

7. LXXVIII. M. 42. R. Antr. Cyst as large as hazel-nut containing clear fl. on floor. L Antr. contains three cysts-one just above the floor in the angle formed by the meeting of the facial and zygomatic walls; a smaller one below this, on the floor; and a large one on the floor anteriorly.

Nasal fossae norm.

Phth. pulmon. Tubercles in liver, kidneys, tonsils, tongue, etc

8. XCVII. M. 57. L. Antr. About middle of inner wall a group of small cysts. The largest is almost the size of a pea, abutting on it are two a fourth its size, while at a lower level are two contiguous and somewhat larger. The cysts are firm; on slitting one open it is found filled with caseous substance. Ost. Acc. present. R. Antr. Lin. memb. norm. No Ost. Acc. Nasal turbs. norm.

Cancer of stomach.

b. ANTRA WITH FLUID CONTENTS.

9. XX. F. 19. L. Antr. full of pus. Lin. memb. thickened and presents several cysts as large as peas. Underlying teeth normal. R. Antr. empty. Lin memb. norm.

On both sides of both Mid. Turbs. thick muco-pus is present.

Pneumonia with multiple abscesses.

10. XLV. M. 76. L. Antr. contains fully half a drachm of thin pus mixed with yellow fl. The anterior part of the cavity is largely occupied by two gelatinous-looking swellings which spring respectively from the inner and outer wall and adjoining parts of the floor and press together. They contain a large quantity of clear thin fluid. R. Antr. empty. Walls of both antra very thin.

Inf. and Mid. turbs. hyper.

Chronic Bronchitis. Adenoma of liver. Extreme swelling of legs.

11. LIII. M. P. Antr. half filled with transparent canary-yellow fl. Greater part of lin. memb. is cystic. On outer wall two cysts attain a fair-size. On inner wall the memb. is velvety but on approaching the ostium it becomes norm. L. Antr. contains a little fluid of same character as in P. Antr., The lin. memb. everywhere presents a velvet-like thickening; on the outer and upper walls, however, it is red, oedematous and cystic; on the inner wall it most nearly approaches the normal.

Nasal turbs. norm. In P. fossa abundant thin mucus; on L side it forms thin, dirty-brown crusts.

Pneumonia. Healed phthisis.

12. LXXXV. M. 52. P. Antr. appears at first to be filled with a smooth, shining, pale red body, On touching this an almost clear fl. occasionally tinged with blood wells up. Several pipettefuls (altogether about 2 drachms) removed, the cyst meanwhile gradually collapsing upon the floor until the whole cavity can be inspected, when the lin. memb. is found on the whole smooth and thin. L. Antr. is filled in its greater part by a cyst springing from the lower part of the cavity. On pushing it aside thick mucus tinged with pus is encountered. The remainder of the lin. memb. is uniformly thin. There is no connection between either cavity and the underlying teeth. Both Inf. turbs. hypert. White creamy substance beneath both Mid. Turbs. which are normal.

Carcinoma of liver.

ANTRA WITH CYSTIC LINING MEMBRANE.

Cysts in the antral lining membrane were found in 12 subjects; in 5 of these they were present in both antra; in 6 in the L. and in 1 in the R.; the other antrum was normal in these 7 subjects.

In most instances only 1, 2, or 3 cysts were found in an antrum, but cystic degeneration of the greater part of the lining membrane was also observed. When the cystic change was limited to a small area, the rest of the lining membrane was, as a rule, normal.

The majority of the cysts were as large as a pea, some reached the size of a hazel-nut and in at least one instance (No 12) they were even larger.

Most of the cysts sprang from the inner wall or floor of the antrum. When several were present they were usually grouped closely together.

The cysts contained as a rule greyish mucus; sometimes a thin cloudy, or an oily yellowish fluid, or white cheesy material.

In 4 subjects fluid was found in the antrum itself. This consisted of pus in Nos. 9& 10, of a transparent yellow fluid in both antra in No. 11, and in No. 12 of an almost clear fluid in the R. antrum, and of a mixture of mucus and pus in the L. antrum.

Dmochowski states that under certain circumstances cysts may be the starting point of a catarrhal or even purulent process of the whole sinus. Pathogenic micro-organisms may develop in very thin walled cysts and may irritate the cyst wall so that it becomes inflamed and easily bursts, in consequence of which the entire contents escape into the cavity.

One or several ostia accessoria were present in 5 of the 12 subjects, namely, Nos. 1, 3, 4, 6, and 8. In No. 4 both antra presented cysts and

possessed at least one ostium accessorium. In these cases, excepting No. 3, the cysts were situated on the inner wall of the antrum close below the ostium accessorium. This proximity, the occurrence of an accessory opening in these cases four times oftener than usual (41% instead of 10%) and the fact that nearly all the subjects in which cysts were found, as well as the majority of those having ostia accessoria, had passed middle life, would seem to indicate a relation between cystic changes in the antral lining membrane and the formation of ostia accessoria. I have already suggested that the rarefactive process leading to the formation of the ostia may cause contraction of the connective tissue, blocking of the ducts and development of cysts.

The nasal fossae were normal in 7 of the 12 subjects; in 4, hypertrophic rhinitis was present; and in one, atrophic rhinitis.

Dmochowski who has studied antral cysts very fully considered that it was useless to give statistics as he found them so frequently; he referred, however, not only to those visible to the naked eye but to others seen only on closest examination.

Luschka also stated that small cysts often occur in the antral lining membrane and Giraldès found them frequently and in great numbers. Heymann in 250 p. ms. met with such growths in 19 antra, in 6 of which the cysts were associated with other tumours.

TABLE OF SUBJECTS WITH BLOOD IN THE ANTRUM.

1. V. M. 45. Both Antra half full of liquid blood. In L. Antr. some pus also, and lining memb. thickened and on inner wall suffused. R. Inf. Turb. suffused with blood.
Ac. pneumonia. Embol. of pulmon art. Ac. pleur. Ac. pericard.

2. XIII. M. 38. Dried patch of blood at lowest part of both antra. Lining memb. pale with vessels visible as fine threads. Ostia of moderate size. About half a teaspoonful of blood removed from L. Sphenoidal Sinus.
A little blood in both nasal cavities.
Head injury: concussion.

3. XXVII. M. 32. R. Antr. At lowest part a little dried blood. In lining memb. some extravasated blood. Two dark lines (indicating fracture) radiate from posterior angle of cavity along zygomatic wall for ¾in. becoming gradually fainter. L. Antr. contains half teaspoonful of thin light brownish fluid.
Injured by pile of wood falling upon him four days before. Rupture of bladder etc. Bruise over R. malar.

4. XXXI. M. 43. R. Antr. At lowest part a little blood and a drop or two of pus: both can be traced over nasal wall to ostium. Lin. memb. not thickened. L. Antr. half filled with blood and pus. A little blood in L. sphenoidal Sinus. Lin. memb. swollen.
Compound fracture of skull with laceration of brain. Fracture of ribs; perforation of lung. Rupture of kidney. (There was no bleeding from ears or nose).

5. XXXVI. F. 13. R. Antr. contains a small quantity of reddish fluid. Lin. memb. reddish-brown and slightly thickened.. L. Antr. same, but lin. memb. is discoloured only in most dependent part of cavity. Aspirated from L. Ethmoidal Sinus half teaspoonful of thick, cloudy red fluid containing whitish flakes. Both inferior turbinates are intensely red.

~~Both inferior turbinates are intensely red.~~

Cardiac Disease.

6. XXXVII. M. A little dried blood on lin. memb. of both antra. Blood tinged fluid in Sphenoidal Sinuses but none seen in nose.

Fracture of skull; laceration of brain; general subarachnoid haemorrhage. Copious bleeding from nose, ears and mouth.

7. XLVI. M.65. L. Antr. contains a small quantity of blood-stained stringy mucus. R. Antr. contains a little mucus. Lin. memb. swollen and gelatinous.

Fatty degeneration of liver and kidneys. Oedema and haemorrhage in lungs. Found intoxicated and unconscious.

8. LXI. M. 30. R. Antr. contains half a teaspoonful of blood and mucus. Walls blood-stained. On cleaning lin. memb. it is found mottled and light red in pieces. L. Antr. contains about a teaspoonful of blood and mucus. Lining memb. as on R. side. In L. Sphenoidal Sinus a small quantity of fluid resembling bile but not giving bilidary reaction with nitric acid.

Inf. Turbs. mottled and of dark livid hue.

Rupture of urinary bladder. Accumulation of non-inflammatory fluid in abdominal cavity. Vomiting of dark, faecal-smelling fluid.

9. LXXXI. M. 62. Both Antra contain fluid (?from nose). On inner wall of R. several small red spots which can be rubbed off. In L. Antr. a single soft clot of bloody mucus. Fluid same as in Antra, fills the posterior half of each nasal fossa. Fissured fracture of occipital bone. Laceration of frontal lobes of brain. Extensive cerebral haemorrhage. Atheroma of cerebral and other vessels.

10. LXXXVI. M. 35. R. Antr. Lin. memb. presents several bright red areas. L. Antr. contains cloudy fluid tinged with blood. Hypertr. of L. Ventr.; oedema of lungs and limbs; liver, spleen, stomach and intestines hyperaemic, and in last extravasated blood.

11. XC. M. L. Antrum full of blood. R. Antr. empty. No trace of blood in nose.
Fracture of skull. (Ecchymosis of L. upper eyelid).

12. XCVIII. M. 45. The lowest part of both antra is covered with liquid blood. From each collection a track of blood can be followed over the inner wall of the cavity to the ostium. The lin. memb. of the antra is norm. A considerable amount of blood is present in the naso-pharynx; some also below R. Middle Turb.
Wound of trachea; haemorrhage.

13. C. M. 59 R. Antr. contains a little blood at lowest part from which a dried stream can be traced to the ostium. L. Antr. is half filled with blood. Lin. memb. of both cavities thickened. Moist blood in both nasal fossae and in naso-pharynx.
Fracture of skull.

BLOOD IN THE ANTRUM.

Blood was found in both Antra in 9, and in one antrum in 4, subjects. Of these, 12 were males and 1 female.

The amount varied from a mere dry patch to a quantity sufficient to fill the cavity: in several instances it was mixed with mucus or pus.

The lining membrane, as a rule, was normal; in a few cases it was swollen or thickened. In one instance (No. 3) it contained extravasated blood; in two, (Nos. 8 and 10) it presented a bright red mottling; and in one (No. 5) it was of a reddish brown colour.

In considering the source of the blood, it is note-worthy that 7 of the 13 subjects died in consequence of head injuries the majority of which were fractures of the skull. In one case (No. 12) death was due to profuse haemorrhage resulting from a wound of the trachea. In another, (No. 7) the patient was found intoxicated and unconscious, and the probable cause of death is not stated. In 3 of the other four subjects, (Nos. 1, 5, 8 and 10) the fatal diseases were such as might reasonably be supposed to have led to bleeding into the antrum by diapedesis.

The bleeding in Nos. 3 and 11 was due to tearing of the antral lining membrane. In both instances only one cavity was involved; in the former a blow had been received over the corresponding malar and a line of fracture could be traced in the outer wall of the antrum; in the latter, injury had been sustained in the region of the orbit.

The source of the bleeding in 6 subjects (Nos. 2, 4, 6, 9, 12 and 13) was extra-antral; the blood having passed from the nose into the cavity through the ordinary, or an accessory, ostium maxillare. That this was the route followed was evident in several of the cases from the presence

of a track of dry blood leading from the ostium to the collection in the most dependent part of the antrum, by the presence of abundant blood in the nasal fossae, and in Nos. 2, 4, and 6 by the finding of blood also in the sphenoidal sinuses. In all the 6 subjects falling under this group both antra contained blood.

In five subjects (Nos. 1, 5, 7, 8 and 10) the blood probably escaped by diapedesis from the vessels of the antral lining membrane. In No. 1 death was due to acute pneumonia, and the antral lining membrane in places was suffused with blood. In Nos. 8 and 10 the interior of the antra presented a red mottling. In No. 7, haemorrhage by diapedesis is suggested by the conditions found at the necropsy in other parts of the body. The inferior turbinates in the majority of these cases were either intensely red or of a dark livid hue. It might be well to mention that in opening the antra in several bodies in which there had been venous engorgement at death, the cavities rapidly filled with blood; such cases have not been included in this series.

The question as to whether fluids in the nose could enter the antrum excited considerable discussion at one time (Jelenffy, Neumann). From experiments made on dead bodies Neumann concluded that entrance took place only when the ostium maxillare was exceptionally large or when an accessory opening was present. The latter condition was found in only one of the above cases (No. 3). and in this the blood came from the antral lining membrane. Having repeatedly observed a dried track of blood descending from the ostium to the lowest part of the antrum we believe that fluids can easily enter this cavity from the nose provided the head is in a favourable position and the ostium not abnormally small; this view is supported by the frequency with which pus drains into the antrum in cases of

frontal sinus suppuration. On the other hand, if the nose is suddenly filled with fluid this will not enter the antrum unless under pressure or unless the ostium is abnormally large. Reference has been already made (see remarks on normal antra containing serous fluid) to cases in which only a few drops of fluid were found in the antra although the nasal cavities were full. We are inclined to think that Neumann's results must have been obtained by plunging the cadaver's head beneath water; they would have been different had the water been allowed to trickle to the ostium maxillare.

The presence of blood in the antrum is of interest also from the clinical point of view on account of the possibility of its becoming infected and giving rise to suppuration. I have never met with a case of antral empyema which could be attributed to blood that had entered from the nose, and yet this must often take place while operating in the neighbourhood of the ostium maxillare, e.g. removing polypi or curretting the ethmoidal cells. Nor have I seen antral suppuration follow plugging of the nasal cavities for epistaxis even although it gave rise to intra-nasal conditions which were highly favourable to the development of an accessory sinus suppuration. In one instance the packing had been retained for a week and on removal was horribly foetid; double purulent otorrhoea had meantime set in; but, as the subsequent course of events proved, the antra escaped. Gellé and Saint Hilaire, on the other hand, have reported cases in which empyema of the antrum developed after plugging the nose for severe epistaxis; as the condition of the antra prior to the epistaxis was unknown, however, it is possible that another factor may have been present which really caused the suppuration.

Instances of intra-antral haemorrhage are of great rarity and I have had only one such case. The patient in the dark had knocked his cheek violently against the corner of a gate post. When I examined him a few hours later, the corresponding antrum could not be trans-illumined, and blood was oozing into the nose through the ostium maxillare. No treatment was employed, and all came well without suppuration supervening.

It is therefore probable that blood finding its way into the antrum in quantity will flow out again when the position of the head favours its exit, and the more readily it entered owing to the ostium being large, the more readily will it escape; a small quantity may also be absorbed. My experiences lead me to beldeve that blood in the antrum is rarely a cause of suppuration, although such a possibility cannot be denied.

ANTRA CONTAINING PUS.

LINING MEMBRANE NORMAL.

		Antrum affected.		Nasal Condition.	FATAL DISEASE.
1	XV.	M. 58.	R.	Hyper. Rhin.	Hypertr. & Dil. of heart.
2	XXIII	M. 4	R. L.		Pneumonia.
3	XXXVII	M	R	Hyper. Rhin.	Fracture of skull.
4.	XXXVIII	F. 28	L	Norm.	Phthisis pulmonalis.
5.	LXVI	F. 36	R	Norm.	Aortic and mitral disease.

LINING MEMBRANE THICKENED.

6.	V	M. 45	L	Hyper. Rhin.	Acute pneumonia.
7.	VI	F. 42	R. L	Atr. Rhin.	Multiple abscesses in liver
8.	XVII	M. 57	L	Polypoid Hyper.	Dis. of aortic valve etc.
9.	XVIII	M. 53	R	Norm.	Cancer of liver.
10	XXX	M. 57	R. L	polypi.	Fracture of spine.
11	XXXI	M. 43	R. L	polypi	Fracture of skull.
12	XXXIV	F. 42	R.	Norm.	Nephritis: dilated heart.
13	XXXV	F. 46	R.	Hyper. rhin.	Hyper. & dil. of heart.
14	XLIII	M. 63	R.	Atr. Rhin.	Cancer of stomach, syphilis
15	XLVIII	M. 45	L	Atr. rhin.	Pneumonia: phth. pulm.
16	LXII	F. 29	R.L	Atr. Rhin.	Pneumonia.

LINING MEMBRANE POLYPOID.

17	XCI	F. 45	R	Norm.	Maldgnant abdominal Tumour.

LINING MEMBRANE CYSTIC.

18	XX	F. 19	L	Norm.	Pneumonia with mult. abcesses.
19	XLV	M. 76	L	Hyper Rhin.	Chronic bronchitis.

PUS IN THE ANTRUM.

I have advisedly grouped the above cases under the heading of Pus in the Antrum. This title does not imply the existence of a suppurative process in the antrum and allows of the inclusion of cases in which the pus may have originated elsewhere, e.g. in the frontal sinus.

Pus was found in one or both antra in 19 subjects. The following table shows the condition of the lining membrane and the cavity affected.

ANTRAL LINING MEMBRANE.	R. ANT.	L. ANT.	BOTH ANTRA	TOTAL.	
Normal	3	1	1	5	19
Thickened	4	3	4	11	
Polypoid	1	–	–	1	
Cystic	–	2	–	2	

There is often an association of pathological states of the antra with abnormal conditions of the nasal fossae; let us consider in how far this existed in these cases. The first five subjects in which the antral lining membrane was normal, and in at least two of which the pus was of extra-antral origin, are best left out of account. In the remaining 14 the following was the intra-nasal condition.

Normal.	4.
Simple hypertrophic rhinitis	3
Polypoid hypertrophy or Polypi.	3
Atrophic Rhinitis	4

We may safely deduce from this table the fact that in the majority of the cases of suppuration in the antrum inflammatory processes had also been going on in the nasal cavities. It is almost impossible to determine

which may have been the primary condition.

We have also attempted to estimate the number of cases in which pus escaped by the anterior or posterior nares in sufficient amount to attract the patient's notice by its presence, foetor, or taste.

Symptoms probably present	Nos. 7, 8, 9, 10, 11, 12, 13, 16, 17, 18, 19,	=11
Probably no symptoms present	1, 3, 4, 5,	=4
Doubtful	Nos 2, 6, 14, 15,	=4

The causes of death in the 19 subjects were as follows:-

Pneumonia	4
" and phthisis pulmonalis	1
Phthisis pulmonalis	1
Chronic Bronchitis	1
Cardiac Disease	5
Malignant Disease	3
Multiple abscesses in liver	1
Fracture of skull	2
" " spine	1.

The number of cases is too small to permit of inferences being drawn as to the part, if any, these diseases played in producing the antral suppuration; pneumonia would certainly appear to be a fertile cause.

The following are the statistics of other workers as to frequency of pus in the antrum after death:-

Wertheim	examined	360	bodies	and	found	antral suppuration in	46	(12.6%)
Kiaer	"	200	"	"	"	"	39	(19.5%)
Lapalle	"	169	"	"	"	"	48	(28.4%)
Dmochowski	"	152	"	"	"	"	12	(7.9%)
E. Fränkel	"	146	"	"	"	affections in	54*	(37%)
Gradenigo	"	103	"	"	"	empyema in	19	(18.4%)
Kirkland	"	100	"	"	"	"	4	(4%)
Minder	"	50	"	"	sinuitis maxillaris in		6	(12%)
Kelly	"	100	"	"	pus in the antrum in		19	(19%)

*Including least lesion of walls, and swellings and cysts of the mucous membrane even if unaccompanied by suppuration.

The above percentages vary between wide limits (4% and 28%) (E. Fränkel does not state the number of empyemas he met with consequently his figures cannot be made use of in this connection) but if an average is taken it probably gives an approximately correct result namely, 15%.

CONDITION OF ANTRA CLASSIFIED ACCORDING TO FATAL DISEASE.

Cause of Death.	Number of subjects.	Antral Lining Membrane. Normal. Contents					Thickened. Contents.				
		No Fluid	Ser.	Purul.	Blood	Mixed or Other	No Fluid	Ser.	Purul.	Blood	Mixed or Other.
Cardiac Disease	19	12	5	1	-	5	2	3	3	-	2
Pneumonia	10	8	-	2	1	-	2	2	4	-	1
Phthisis Pulmon	6	6	-	1	-	-	4	1	-	-	-
Gastric Disease	6	4	2	-	-	-	5	-	1	-	-
Hepatic Disease	6	1	2	-	-	1	2	2	2	-	2
Apoplexy	6	5	3	-	-	-	1	1	2	-	-
Head Injury	8	1	2	-	5	3	1	-	-	2	1
Other Diseases	39	48	9	-	2	6	10	-	4	-	1
TOTAL	100	86	18	4	8	20	26	6	17	2	13

RELATION OF THE FATAL DISEASE TO THE POST MORTEM CONDITION OF THE ANTRA.

An enquiry into the relation of the fatal disease to the pathological conditions found in the antrum after death must be more or less of a speculative character. This is evident when we consider that in many instances morbid processes in the antrum are independent of general disease and clearly due to local causes: and even when there is reason to suspect a general rather than a local etiology, it is often impossible to deny that the antral changes may have begun prior to the onset of the last illness. It is therefore not my intention to attempt to draw definite conclusions from this part of the investigation, I shall rather indicate etiological relations that are suggested by the statistics.

In the following lists the subjects are classified according to the cause of death, and the condition of the antra in each case is noted.

Cardiac Disease

Subject.		Antral Lin. Memb. & Contents.
XXII		R&L norm; L with serous fluid.
XXXVI		R&L thickened, with brownish fl.
LXV	(with general oedema)	R&L norm.
LXVI	" " "	R&L norm. R. with pus.
LXXXVI	" " "	R&L norm. containing ser. fl. tinged with blood.
XV	(hypertr. & dilatation)	R norm. with mucus & pus L. norm.
XXXIV	" "	R thickened with pus; L. norm with reddish fl.
LX	" "	R&L norm. with scanty amber-col. fl.
LXXXVII	" "	R&L norm. R with ser. fl.

Cardiac Disease (cont.)

XL	" " R Vent.	R&L thickened with mucus.
XXXV	" " " Emphysema etc.	R. thicknd. & pus: L norm. & ser. fl.
LXIV	(hypertr.) atheroma of aorta: pass. hyperaemia.	R&L thicknd. R. with ser. fl. L with clear yell. fl.
XXXIII	(flabby; dilated vents; old embol. of lung).	R thicknd. with ser. fl. L.norm.
XVII	(dis. of aortic valve; etc.	R norm. L thicknd with pus.
XLIX	" and mitral valves; chr. endoc. pass. hyper.	R&L norm.
XXV	(dis. of aortic valve; atheroma of aorta: obstrn. cor. arts).	R&L thicknd.
LXIII	(mitral incomp: gen. ven. engorg.	R&L norm.
LXVIII	(ulcerative endocarditis)	R&L norm. with ser. fl.
LXXXIX	(mitral endocarditis)	R&L thicknd. with ser. fl.

CARDIAC DISEASE.

19 subjects died of cardiac disease. Of the 38 antra-

12 were normal 31.5%

15 contained serous fluid 39%

2 " " " & blood 5%

4 " pus

1 " " & mucus 13%

2 " mucus 5

62% contained fluid.

The frequency of antral suppuration in subjects dying of cardiac disease has been noted to be as follows:-

Lapalle in 16 cases of Cardiac Disease found 5 with empyema = 31.25%

Minder 5 " " " " 1 " = 20%

Kelly " 19 " " " " 5 " = 26.5%

Of the 19 cases of cardiac disease in only 4 were the antra empty. In the others either serous fluid, pus or mucus was present. The fact that serous fluid was found in 10 subjects is striking. I have already expressed the opinion that this fluid when scanty may form after death in consequence of the lowering of temperature and the condensation of moisture within the antrum. When more abundantly, however, transudation is probably the chief source. This view is supported by the finding of fluid in so large a proportion of cardiac cases, these being always associated in their terminal phases with general venous engorgement and other conditions favouring transudation.

PNEUMONIA

Subject.		Antral Lin. Memb. & Contents.
V		R&L contain blood; L thickened. memb. and pus.
LIV		R norm.; L cystic.
LXII		R&L thicknd. & containing pus.
LXXII		R&L norm.
XCV		R&L norm.
XX	(multiple abscesses)	R norm. L cystic and pus.
XXIII		R&L norm. & containing pus.
XLVIII	(phth. pulm.)	R&L thicknd. L with pus.
LIII	(healed phth.)	R&L cystic with clear yell. fl.
LXXVII	(after fractured ribs)	R&L norm.

10 subjects died of pneumonia; of the 20 antra:-

8 were normal 40%

6 contained pus 35%
1 " " and blood 10%
1 " blood 10%
2 " yellow fluid 10%
} 50% contained fluid.

The following statistics show the relation of pneumonia to antral suppuration.

Wertheim in 16 cases of Croupous Pneumonia found 6 empyemas and 3 bat.

Lapalle in 17 cases of Ac. pulm. Dis. found 9 subjects with empyema=52.94%

Minder " 13 " " " " " 8 " " Acc.Cav.Dis.=57.1%

Kelly " 10 " Pneumonia " 5 " with empyema = 50%

E. Fränkel 20 " " acute inflammatory processes in the antra in 10 (4 presented oedema,

2 markedly injected, 6 contained recent exudation with or without oedema).

The above statistics indicate that antral suppuration is present in half of the cases of pneumonia; and yet this association is rarely enquired into when investigating the etiology of antral suppuration in a patient.

E. Fränkel holds that the antra may become diseased in pneumonia independently of the nasal cavities for in all the cases examined by him the nasal cavities were intact. The objection that the inflammation in the nose may have subsided is opposed by the fact that the affections were recent and must have left thaces.

PHTHISIS PULMONALIS.

Subject.	Antral Lin. Memb. & Contents.
VIII	R norm: L loculated, thicknd. memb.
XXXVIII	R norm: L memb. norm. containing pus
LVII	R&L norm.
LXIX	R&L polypoid; R containing ser.fl.
LXXVIII	R&L cystic.
LXXXIII	R&L norm.

6 subjects died of phthisis pulmonalis; of the 12 antra-

6 were normal.....50%

1 contained serous fluid.....8.3%

1 " pus.....8.3%

4 had thickened lining membrane.....33.3%.

The following figures show the frequency with which antral suppuration has been met with in those dying of tuberculosis.

Lapalle	in 59	cases of	tuberculosis	found	19	with antral	empyema	=32.2%
Minder	" 17	"	"	"	4	"	"	=23.5%
Kelly	" 6	"	"	"	1	"	"	=16.6%
E Frankel	" 49	"	"		4	"	"	=8%
Wertheim	" 106	"	"		31	"	suppuration in the antrum or other accessory cavity or cavities	±29.2%

Harke found antral empyema in every fourth body dying of tuberculosis.

Statistics would seem to indicate a relation between tuberculosis and antral suppuration. The diminished resistance of the tissues and prevalence of pyogenic microorganisms in phthisical subjects probably account for the greater susceptibility of their antra to infection. The resulting suppuration, however, does not assume a special form and is not of a tubercular nature.

GASTRIC DISEASE.

XI	(perforating ulcer) peritonitis).	R&L norm. with ser. fl.
XXVI	(cancer: ac. pleurisy: oedema lower limbs).	R norm. L polypoid.
XLIII	(cancer: peritonitis).	R thicknd. with pus. L norm.
LVIII	(" chr. endocard.) old tuberc).	R&L cystic.
LIX	(cancer: cancer of liver)	R&L norm.
XCVII	"	R&L cystic, R.norm.

6 Subjects died of gastric disease (cancer in 5 cases); of the 12 antra -

5 were normal.....41.6%

2 contained serous fluid.....16.6%

4 had thickened lin. memb.....33.3%

1 " " " " and pus.....8.3%

Kelly in 6 cases of gastric disease found 1 with empyema = 8.3%.

HEPATIC DISEASE.

VI	(multiple abscesses: ac. periton: pyosalpynx)	P&L thickend with pus.
XLVI	(fatty degeneration, and of kidneys)	P&L norm. L with blood & mucus.
XVIII	(cancer)	P&L thicknd. with fl. like bile: pus also in R.
LXXXV	"	P&L cystic with fl.; pus also L.
X	(ac. yell. atrophy)	P&L norm. with dark brown fl.
IV	(cancer of gall-bladder.	P&L thickened.

6 Subjects died of hepatic disease; of the 12 antra:-

1 was normal 8.3%

2 had thicknd lining memb. 16.6%

4 " " " " and pus ..... 33.3% } 75% contained fluid.

5 contained serous or bile-like fluid or bld. 41.6% }

The relation of hepatic disease to antral empyema has been indicated as follows:-

Lapalle in 3 cases of hepatic disease found 1 with empyema =33%

Kelly " 6 " " " 3 " " =50%

Wertheim in 10 cases of cirrhosis of the liver found all the accessory cavities normal in only 2; an empyema of the antrum or other sinuses was present in 4.

Diseases of the liver would also appear to predispose to antral empyema but it is difficult to see in what manner. As F. Fränkel suggests it is possible that the bile in the circulation excites the lining membrane of the sinus to increased secretion. An admixture of bile, however, inhibits

the growth of microorganisms and should therefore tend to prevent the collection becoming purulent.

Wertheim advances the view that the antral affection may originate from suppurating haematomata, because the tendency to haemorrhage in those with cirrhosis of the liver favours the filling of the accessory cavities with blood.

APOPLEXY.

III	R norm. L cystic.
XIV	R norm. with ser. fl. L norm.
LI	R&L norm.
LXXIV	R&L norm. with ser. fl.
LXXIX	R&L polypoid: R with ser. fl.: L with muco-pus.
XCVI	R polypoid with muco-pus; L norm.

6 subjects died of Apoplexy; of the 12 antra-

5 were normal.....41.6%

2 contained pus.....16.6% } 50% contained fluid.

4 " serous fluid.....33.3% }

Lapalle in 19 cases of cerebral disease found empyema in 5 =26.31%

Minder " 3 " " " " " 1 =33%

Wertheim " 9 " apoplexy 0

Kelly " 6 " " " " " 2 =33.3%

FRACTURE OF SKULL AND HEAD INJUPIES.

XXXI	Blood & pus in R&L antr. L ldn. memb. thicknd.
XXXVII	Blood in R&L antr. pus in R; Lin. memb. norm. in both.
LXXXI	Blood & cloudy fl. in R&L.
XC	Blood in L; R polypoid & empty.
C	Blood in R&L; both polypoid.
XIII	Blood in R&L.
XXVII	Blood in R; light brown fl. in L.
L	Dirty green fl. in R. L norm.

8 Subjects died from head injuries: of the 16 antra-

1 was normal.....6.2%

14 contained abnormal fluids.....87.5%

---

12 " blood alone, or with other fluids..75%

3 " pus and blood.....18.7%

2 " fluids other than blood or pus.....12.5%

Kelly in 8 cases of head injury found empyema in 2 =25%

MALIGNANT DISEASE.

The cases of malignant disease have already been classified according to the region or organ involved. It has been thought worth while to add another table in which they are grouped together irrespective of the seat of disease.

XLI	Sarcoma of Mediastinum.	R&L polypoid.
LV	"Tumour of chest"	R&L norm.
XXXII	Cancer of pharynx and oesophagus.	R&L norm.
XXVI	Cancer of stomach	R norm. L polypoid.
XLIII	" "	R thicknd, with pus; L norm.
LVIII	" "	R&L cystic.
LIX	" " & liver	R&L norm.
XCVII	" "	R norm. L cystic.
LXXIII	" Bowel	R cystic, L norm.
XCI	"Malignant abdominal tum."	R polypoid with pus, L norm.
XCIX	" " "	R&L norm.
XVIII	Cancer of liver	R&L thicknd, with fluid like bile; pus in R.
LXXXV	" "	R&L cystic with fl.; pus in L.
IV	" Gall-bladder	R&L thicknd.

MALIGNANT DISEASE.

(Some of the following cases have already been considered under the headings "Gastric Disease" and "Hepatic Disease").

In 14 subjects malignant disease was present, of the 28 antra-

13 were normal 46.4%

9 had thickened lin. memb. 32%

4 contained pus alone (2), or mixed with other flds. ... 14%

2 " fluids other than pus ..... 7%.

The frequency of Antral Empyema in persons dying of malignant disease has been reported as follows:-

Lapalle in 16 cases of cancer, chiefly stom. & intest. found antral empyema in 5 =31.25%

Minder " 5 " cancer of stomach found antral empyema 0

Kelly " 14 malignant disease " " " " 4 =28%

Werthiem " 50 " cancer " suppuration in the antrum or other acc. cavs. in 8 =16%

Wertheim considers that there is no special tendency in cancer patients to inflammation of the accessory cavities. The frequency indicates rather that cachectic individuals are especially prone to infection of these sinuses. This is supported by his finding 5 empyemas in 20 cases of marasmus senilis.

PERNICIOUS ANAEMIA.

LXXVI		R&L containing mucus.

PURPURA HAEMORRHAGICA.

XCIV		R&L norm.

DIABETES MELLITUS.

VII		R&L norm.

ADDISON'S DISEASE.

XXXIX		R&L polypoid.

DIPHTHERIA.

XLVII		R&L norm.

BRONCHITIS, CHRONIC

XLV	(adenoma of liver)	R norm; L cystic with pus.
LVI		R&L cystic.

PLEURISY.

XXIV	(old empyema; bronchiectasis).	R&L norm.

MEDIASTINAL TUMOUR.

XLI	(sarcoma)	R&L polypoid.
LV	("tumour of chest")	R&L norm.

EPILEPTIFORM CONVULSIONS; NO LESION FOUND.

IX		R&L norm.

MENINGITIS.

I	(with hydrocephalus)	R&L norm.
XXVIII	(acute)	R&L norm.

TUMOUR OF CEREBELLUM.

XLIV		R&L norm.

PHARYNX AND OESOPHAGUS.

XXXII	(cancer)	P&L norm.

HERNIA.

XII	(umbilical)	P&L norm.
II	(strangulated)	P&L norm.
XXIX	(strangulated)	P&L norm.

INTESTINAL OBSTRUCTION.

XCII		P&L norm.

PERITONITIS.

LXX	(chr. supp.).	P&L norm.
LXXXVIII	(ac.).	P&L thicknd; P with mucus.

MALIGNANT ABDOMINAL TUMOUR-

LXXIII	(Carcinoma of bowel; intest. obstruction)	P&L norm. P cystic.
XCI		L norm. P. polypi with pus.
XCIX		P&L norm.

SUPPRESSION OF URINE.

XLII		P thicknd. L norm with ser. fl.

RUPTURE OF URINARY BLADDER

LXI		P&L norm. containing bld. & mucus

OVARIAN TUMOUR.

LXVII		P norm. L norm. with yell. fl.

ECTOPIC GESTATION; RUPTURE.

XCIII		P&L norm.

PUERPERAL PYAEMIA.	
XIX	R&L norm.
FRACTURE OF SPINE, ETC.	
XXX	R&L thicknd. with pus.
GENERAL INJURIES FROM RAILWAY ACCIDENT.	
XXI	R norm.; L cystic.
COMP. FRACTURE OF ELBOW-JOINT.	
LXXV	R norm. with ser. fl. L norm.
WOUND OF WINDPIPE.	
XCVIII	Blood in R&L.
AFTER OPERATION.	
LII	R&L norm.
LXXX	R&L norm.
CAUSE OF DEATH UNKNOWN.	
XVI	R&L norm. with ser. fl.
LXXI	R norm. with ser. fl. L norm.
LXXXII	R norm. with ser. fl. L norm.
LXXXIV	R&L norm. with ser. fl.

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Transillumination

of the

Antrum of Highmore.

TRANSILLUMINATION.

Historical Review.

The term Durchleuchtung (Transillumination) was introduced by Czermak[1] in 1858 to designate a method which he devised of examining the larynx. It consists in concentrating a light upon the front of the patient's neck while a laryngeal mirror is held in the dark pharynx in the usual manner for making a laryngoscopic examination. Various parts of the larynx and trachea may be seen in the mirror, as they are successively transillumined by the light applied to the corresponding region externally.

a. TRANSILLUMINATION OF THE ANTRUM.

While experimenting with this method Voltolini[2] found that the bones of the face could be transillumined if, in a dark room, a small incandescent lamp were held in the closed mouth. Although he failed to attach the proper significance to the phenomena he described, the credit is his of having first transillumined the antrum (1888), and of having indicated that this procedure would be of value as a diagnostic test.

In the following year (1889), Heryng[3] placed transillumination on a practical basis. He showed that when the light traverses a healthy antrum, the cheek as high as the orbit and a sickle-shaped segment corresponding to the lower eyelid became red (for convenience we may term the bright area, the antral tache); while in empyema these regions remain dark owing to the altered conditions in the antrum preventing the passage of light through the cavity. He further proved that when a serous cyst occupies the antrum transillumination is unaffected, while if it distend the cavity the area of brightness is increased. Heryng con-

cluded that transillumination was to be regarded as the surest means of diagnosing empyema.

The method now attracted considerable attention and was extensively tried so that the mistakes in diagnosis to which it may give rise soon came to be detected. Ziem[4] was one of the first to warn against too implicit confidence in transillumination; he referred to the possibility of the pus in the antrum being so scanty as not to interfere with the passage of light and thus cause no difference in the brightness of the two sides. Srebrny[5] and Lichtwitz[6] confirmed Ziem's objection, which had been made speculatively, by reporting several cases in which pus was washed out of the antrum although the transillumination of the affected cavity had been satisfactory and equal to that of the other side.

Another source of error was indicated by Wiebe,[7] namely, asymmetry of the antra, e.g. one cavity may be small with thick walls, while the other is of normal or unusually large dimensions with thin walls. In such cases probably the larger cavity will transilluminate brilliantly while the smaller will not, and so the supposition may arise that the latter is diseased. The various anatomical and other conditions that may interfere with transillumination of the antrum have been enumerated by Zuckerkandl,[8] and Lothrop,[9] and will be referred to later.

b, TRANSILLUMINATION OF THE EYE.

In 1890, Vohsen,[10] by using a stronger light, showed that the eye also may be transillumined. The pupil then appears as a fiery, red disc, and even details of the fundus may be recognisable.

Two years later Davidsohn[11] contributed an important paper in which he maintained that the appearance of the eye should alone be relied upon in making a diagnosis of empyema of the antrum by transillumination. When the antrum is empty, the eye is transillumined by direct light; but if even a small amount of pus lie on the floor, it will prevent the passage of light and the pupil will remain dark. He also pointed out that notwithstanding the presence of a little pus in the antrum and a non-illumined eye, the antral tache may be produced by light diffused from the nasal fossa, provided the latter is fairly normal. The eye on the other hand, cannot be transillumined by light from this source. In short, he affirmed that the illumined pupil under all circumstances certainly excludes the presence of pus even in small quantity but that the converse does not always hold good.

Davidsohn also took into consideration the effect of the shape of the palate upon the transillumination of the eyes. From the examination of a number of persons he had found that with very high vaulting of the palate transillumination was always negative; whereas the eyes were lit up but not so brightly as under normal conditions when the arching was less pronounced. He therefore attached no value to the intensity of the transillumination of the eye, but held that even when very feeble it proved the absence of pus.

A more extended trial disproved the infallibility of Davidsohn's sign. Ziem[12] showed that anatomical conditions may exist which allow of the transillumination of the eye by light passing through the nose, so that the antrum may be full of pus although the sign is observed. Herzfeld[13] and Rosenberg[14] also reported cases in which the pupil had been

transillumined although pus was present in the antrum.

c. THE SUBJECTIVE LIGHT SENSATION.

In 1892, the writer[15] pointed out that during transillumination a person with closed eyes may see a dull red glow, and that in almost all cases in which the antral tache is absent from one side, the light can be perceived on the opposite or bright side only.

In the following year, the symptom was discussed more fully by Garel[16] and Burger,[17] independently of one another, and without knowledge of what had previously been written on the subject.

Burger investigated the symptom in a large number of individuals and found that while the pupil was lit up in only half of these, the light sensation was never absent when the antra were normal; in patients with empyema, on the other hand, light was perceived on the healthy side only. He therefore regarded the subjective light sensation as of more diagnostic importance than transillumination of the pupil.

Unfortunately the same anatomical conditions that render transillumination of the eye unreliable apply to the subjective light sensation. It is possible for the symptom to be produced solely by light which has passed through the nose as was first suggested by Ziem; a view which we can support from experimental evidence. Further, the objection that Burger took to Davidsohn's sign may in turn be taken to the symptom he himself so highly extolled, namely, that a very small quantity of pus in the antrum will not prevent the light traversing the cavity and reaching the eye. Lastly, the test is of little use

when dealing with unintelligent subjects for careful observation on the part of the petient is often necessary in order to perceive the light.

CONTROL TESTS WITH THE ELECTRIC LAMP.

Various modifications of the ordinary method of transillumination have been devised with the object of giving a confirmatory diagnosis.

Vohsen recommended the application of a lamp covered with a funnel-shaped prolongation to the outside of the nose or upper jaw while the dark mouth and nasal cavity are inspected.

Robertson[18] stated that if the nasal fossae are examined by means of a speculum during transillumination, the inferior and middle turbinates appear clearly illuminated when the antrum is normal; but if there is empyema, the inferior turbinates especially are in dark shadow.

Escat[19] introduced a further development of Vohsen's test which he termed "illumination by contact" or "retro-maxillary illumination". It consists in applying a small lamp of about 4 volts to the posterior surface of the superior maxilla. The lamp is enclosed in a cylindrical metal capsule, which is open at one end; to the capsule a stem is fixed which fits into a galvano-cautery handle. The resulting transillumination is similar both objectively and subjectively to that produced by Heryng's lamp, but the pupil is not so well lit up. By retro-maxillary illumination Escat was able to test the condition of the antrum in cases in which this cavity did not transillumine by Heryng's method owing to extrinsic causes, e.g. blocking of the nose with polypi, and in which consequently empyema might have erroneously been supposed to be present.

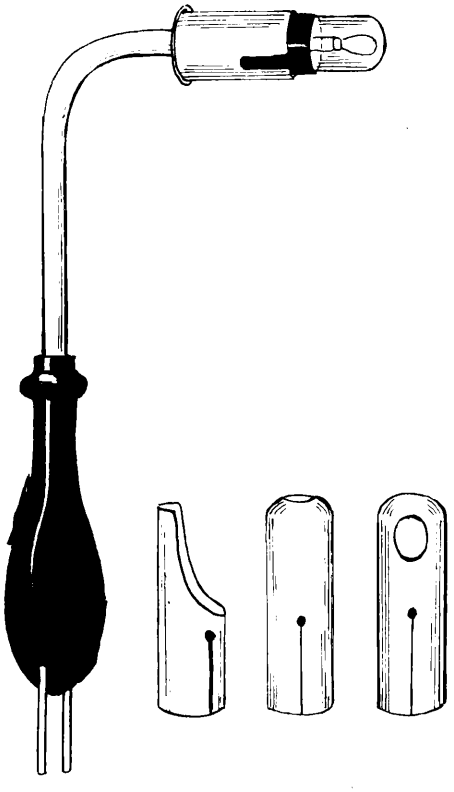

Fig. 1. AUTHOR'S LAMP AND TWO SHOES FOR TRANSILLUMINATION.

a, For palatal, and b. For retro-maxillary transillumination of the antrum. c. For transillumination of the frontal sinus.

THE LAMP.

Heryng's lamp, which was the first specially constructed for transillumination of the antrum consists of a small globe shaped incandescent lamp fixed on the upper surface of a handle closely resembling Türck's tongue depressor.

Several modifications have been since introduced of which Hirschmann's is one of the best. This may be employed for transillumination of the frontal sinus by covering the lamp with a funnel-shaped cap which is open at the end.

The writer has had a lamp constructed which can be used for the antrum, by both the palatal (Heryng) and retro-maxillary (Escat) methods and for the frontal sinus. To the end of a suitably curved handle a lamp is connected over which various end pieces fit. One of these is scoop-shaped and keeps the tongue off the lamp during palatal transillumination; another, completely encloses the lamp and has an opening on one side which can be applied to the posterior surface of the superior maxilla as recommended by Escat; the third is funnel-shaped and open at the end, and is thus adapted for transillumination of the frontal sinus (Fig.1).

TECHNIQUE.

Transillumination should be carried out in complete darkness otherwise the contrast between the illuminated and non-illuminated area will be less striking. When the room cannot be thoroughly darkened a black cloth may be used to envelope the head of the patient and observer.

If the patient wears a dental plate, this must be removed or it may prevent or interfere with the passage of light to the antrum.

The lamp should be placed on the middle of the tongue so that the light may pass equally to both sides and should be depressed sufficiently to keep it from touching and possibly burning the palate when the mouth is closed.

The current should be gradually increased by means of a rheostat - an almost necessary adjunct in the use of this test- until the proper intensity is attained. Slight differences between the two sides may not be observable if too strong a light is used, while on the other hand a comparatively powerful light may be required to penetrate the tissues when dense or thick.

During transillumination the pupil is dilated, there may, however, be some difficulty in catching sight of its This is best done by looking down into the patient's upturned eyes.

In applying the subjective light test the current should be rapidly switched on and off several times while the patient keeps the eyes closed. If conditions are favourable an impression of light is received in each eye and not a single picture as in ordinary vision. It is thus possible for the patient to say whether the light is brighter on one side than another, or is present on one side only. If the difference between the two sides is not marked, and if the patient is uncertain or unintelligent, his opinion should be accepted with reserve.

If ordinary transillumination yield indefinite or no manifestations, the retro-maxillary method should be tried when it will frequently be found that the previously dark crescent and pupil are lit up. In em-

employing this test the lamp is passed to the posterior end of the superior gingivo-buccal fold above the last molar, and the window is pressed against the zygomatic surface of the superior maxilla. In order to transillumine satisfactorily it is sometimes necessary to slightly change the position or inclination of the lamp. The patient's mouth should be half open.

TRANSILLUMINATION OF THE NORMAL ANTRUM.

In order to interpret as fully and correctly as possible the signs presented by the diseased antrum when tested by transillumination an acquaintance with the appearances of transillumined normal antra is first requisite.

Under ordinary circumstances the parts of the face that transillumine and appear more or less brightly red are-those around the lips, the cheeks, the bridge of the nose, the lower eyelids, the pupils, and the eyeballs to the inner side of cornea. Only those bright areas or taches, the intensity and extent of which may be influenced by the condition of the antrum will be considered. If the subject should seem to be treated in too great detail, the apology offered is that no attempt has hitherto been made to analyse the appearances, and that many of the misconceptions held and unfavourable judgments pronounced as to transillumination have arisen from ignorance of what exactly should be noted.

FIG. 2. DIAGRAM SHOWING POSITION OF CRES-
CENTIC AND LACHRYMAL TACHES.

The dotted line below the eye indicates the position of the infraorbital margin. The crescent-shaped area between it and the edge of the lower eyelid when illumined forms the Crescentic Tache. The oval area mapped out below the inner third of the eye shows the situation of the Lachrymal Tache.

CRESCENTIC TACHE.

It is very commonly supposed that in transillumination the light passes through the anterior wall of the cavity and produces redness of the corresponding part of the face; this is not what usually occurs. In the great majority of persons it will be found that the illuminated area has a crescentic shape and lies above the lower margin of the bony orbit. This is at once evident if the test be practised on a cadaver with sunken eyeballs when only the lower eyelids and tissues situated above the infra-orbital margins are transillumined. The light that produces the crescentic tache passes through the roof of the antrum; this may be demonstrated by drawing forward the lower eyelid when the conjunctival sac will be found to be rendered specially bright by a stream of light from below (Fig 2).

INFRAORBITAL TACHE.

In certain individuals, however, the light traverses the facial wall of the antrum and produces a bright area, which may for convenience be termed the Infraorbital Tache. The persons in whom this tache is observed are those that transillumine well, e.g. young adults, spare individuals, and those with good-sized thin-walled antra. In short, to obtain the infraorbital tache the conditions for transillumination must be more favourable than when the crescentic is alone observed, assuming that the light employed is of the same intensity.

If a good subject for transillumination be examined with a light which is at first feeble and is gradually made stronger, it will be

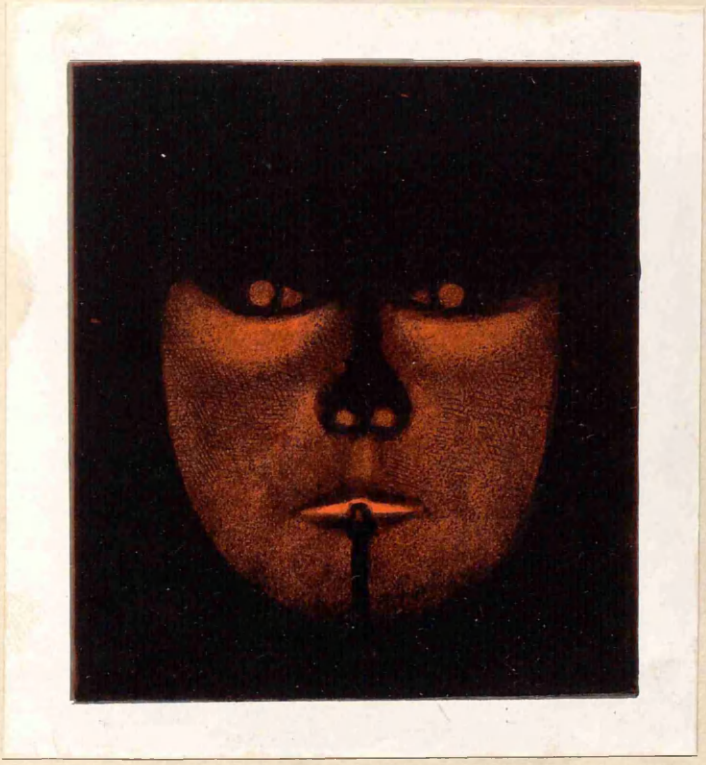

Fig. 3. TRANSILLUMINATION OF THE ANTRA. The Crescentic Taches and Pupils are well lit up; the Infraorbital Taches are dim.

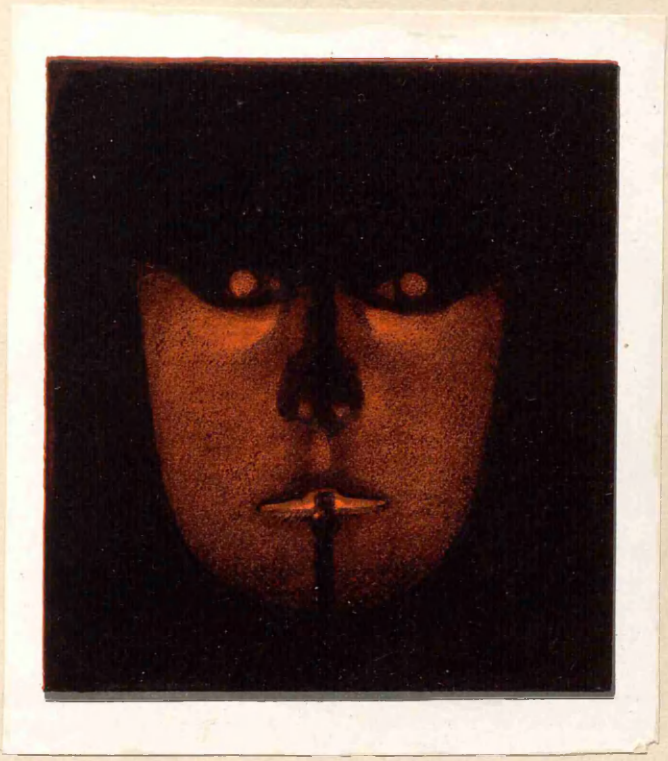

Fig. 4. TRANSILLUMINATION OF THE ANTRA. General illumination of the cheeks and pupils. The Crescentic and Infraorbital Taches are not demarcated.

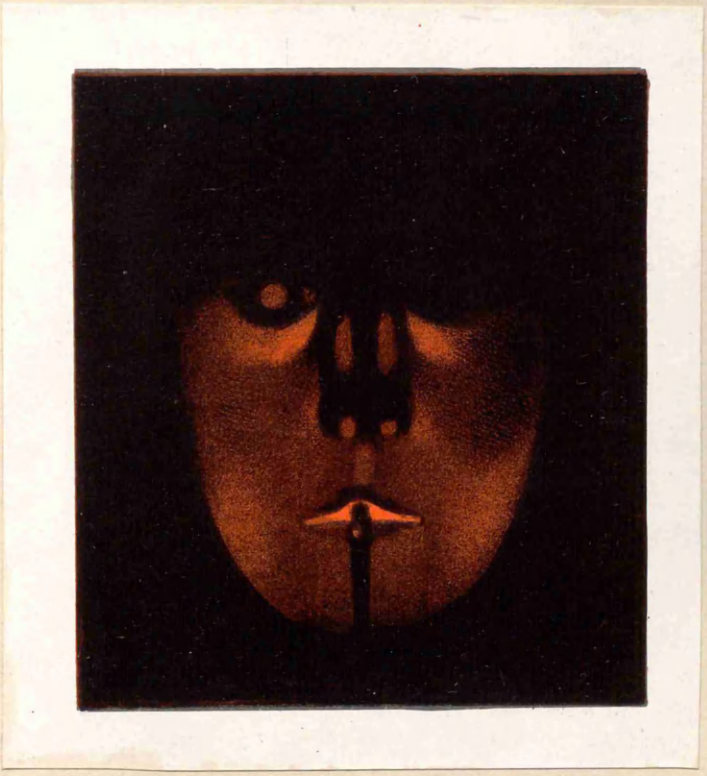

Fig. 5. TRANSILLUMINATION OF ANTRUM.

On the right side transillumination is normal, the Crescentic Tache and Pupil being bright, and the Lachrymal Tache specially so. On the left side the antrum having been packed with gauze, the crescent and pupil are dark but the Lachrymal Tache is still present. The Nasal Taches are also shown.

Fig. 6. TRANSILLUMINATION OF THE ANTRA.
The Lachrymal Taches are well illumined. The Crescents are dark in their outer parts and therefore not characteristic. The Pupils and Nasal Taches are also dimly seen.

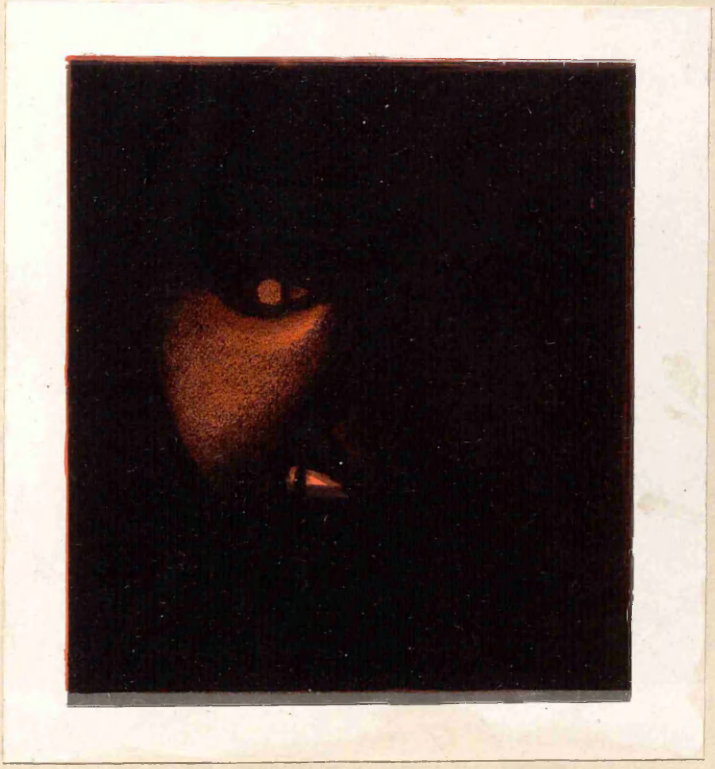

Fig. 7. TRANSILLUMINATION OF THE RIGHT ANTRUM.
BY THE RETRO-MAXILLARY METHOD.
The Crescentic, Infraorbital and
Lachrymal Taches and the pupil
are bright.

found that the region first rendered bright is the conjunctival sac, then the crescentic tache comes into view, and last the infraorbital tache. The two latter are at first separated by a curved dark area which corresponds to the infraorbital margin, but as the intensity of the light is increased they merge into one another, the characteristic crescent disappears, and the cheek from eye to alveolus assumes a red glow (Figs. 3 and 4).

LACHRYMAL TACHE.

Everyone who examines a large number of persons by transillumination cannot fail to observe the frequent presence of a bright area beneath the inner third of the eye. This may attract attention either because it is the only part lit up, the crescentic and intraorbital taches being absent (Fig. 5), or, because it is the brightest portion of the illumined region (Fig.6). In the former case, especially when the condition is bilateral, the question naturally arises, does this tache indicate a normal, though possibly small, antrum?

While experimenting with transillumination on the cadaver the writer made a point of determining the significance of the illuminated area above referred to. His first impression that it corresponded to the upper and anterior angle of the antrum proved to be incorrect for on filling the cavity with wool the tache still appeared on switching on the current. It was then thought that it might be produced by the passage of light from the middle meatus of the nose. This supposition was also shown to be erroneous, or at least to afford an insufficient explanation, for on firmly plugging not only the middle meatus but the

whole nasal cavity, the tache was not obscured, the antrum meanwhile being empty. Finally, after thoroughly packing both nose and antrum, the tache no longer appeared in two of the subjects tested, while in a third it was still present as well as a trianguler bright area to the outer side of the ala. It was therefore evident that the tache did not correspond to a special part of the antrum or nose, but that the light necessary to produce it might come from either, or might pass upwards through the soft tissues covering the canine fossa.

The tache was now carefully mapped out in a number of patients, and its situation noted. In all, this was found to be the same, namely, beneath the inner third of the eye and overlying the lower and inner part of the orbital margin, a small portion of the tache being above the margin while the greater part was below. (Fig. 2).

On examining and transilluminating anatomical preparations with reference to this area it became apparent that the tache corresponded to the lachrymal groove. Hence the term "lachrymal tache" which is here proposed.

The presence of this tache does not therefore indicate that the antrum is transillumined. There may be a brilliant lachrymal tache although the cavity is full of pus or packed with gauze(Fig.5).

NASAL TACHE.

In transilluminating the antrum, part of the bridge of the nose is very often seen to be more or less bright. The situation of this illuminated area, or "nasal tache", corresponds fairly closely with the

nasal bone. One or both sides may be illumined. The presence of the tache and the degree of its luminosity depend upon the amount of light that reaches the under surface of the bony nasal bridge. Any condition interfering with the patency of the nasal fossa anteriorly tends to diminish or abolish the tache, while abnormal width, especially of the inferior meatus, tends to its increased brilliancy. With polypi or an enlarged inferior turbinate in contact with the septum no tache may therefore as a rule be expected. With a much deviated septum a bright tache is usually present on the same side as the concavity, while the corresponding area on the opposite side is dark. In atrophic rhinitis the nasal taches are exceptionally brilliant.

The nasal tache gives no direct information as to the condition of the antrum. If taken in conjunction, however, with the symptom of subjective light sensation, and with the illumination of the pupil it may assist in preventing misconceptions. Thus, an inequality in the brightness of the pupils, and a corresponding difference in the subjective light sensation is occasionally met with in patients whose crescentic taches are equally bright. This anomaly may often be explained by observing the nasal taches, when they are seen to present a corresponding difference which in turn is due to intra-nasal variations.

INTRA NASAL APPEARANCES DURING TRANSILLUMINATION.

Some authors (Robertson, Caldwell[20]) have recommended the examination of the nasal cavity during palatal transillumination, maintaining that if empyema is present the inferior and middle turbinates will be in the

shade.

We have tried this test frequently but have not found it of value. The light streams through the palate so strongly that the lower part of the nasal fossa and the inferior turbinates are brilliantly lit up making it difficult to determine whether any light comes from the antrum.

It occurred to us, however, that if the nose were examined during the use of the retro-maxillary method, information might be gained as to the condition of the antrum which was unobtainable e.g. owing to a high palate, by transillumination as ordinarily applied. The difference between this modification and the palatal method consists in passing the light through the cavity transversely instead of vertically. Many cases were examined in this way. It was found that a strong light passed into the nose through the wall separating it from the antrum, and that it was especially bright beneath the inferior turbinate. Unfortunately, however, this theoretically valuable test proved unreliable in practice owing to the illumination of the inferior meatus from the mouth so that it was impossible to estimate how much light, or if any, traversed the antrum. The inferior turbinate was thus lit up even when an empyema was present or the antrum filled with gauze.

PUPIL AND SUBJECTIVE LIGHT SENSATION.

The pupil during transillumination is dilated. Herzfeld suggests as a possible explanation of this anomaly the fact that the light falls obliquely on the retina, and that in the peripheral parts which are those chiefly involved, the rods and cones are not so numerous and

cannot be sufficiently excited to produce contraction of the pupil.

The subjective light sensation usually corresponds with the degree of illumination of the pupil. If the pupil is bright, the perception of light is marked; if the pupil appears but dimly illumined, the perception is feeble or doubtful.

This association, however, is not constant. Our statistics show that the pupil was illumined in two cases in which the light perception was absent, while the light was perceived in 16 cases in which the pupil was not visible. One would naturally expect the subjective light sensation to be the more delicate of the two tests, for a light might well be perceptible to the patient, while still too faint to illumine his pupil.

The delicacy of the subjective light test is counterbalanced, however, by the necessity of depending upon the intelligence of the patient, and even when this is of a high order, the explanation and time needed to elicit the desired information. We therefore place more reliance upon our observation of the pupil than upon the patient's statements as to his perception of light.

TRANSILLUMINATION IN CHILDREN AND YOUNG ADULTS.

In children under ten years of age, a light of gradually increasing intensity usually first illumines the lachrymal taches; subsequently, the whole cheek is lit up, together with the pupils. The crescentic taches are not differentiated, the red glow over the cheeks being uniform with the exception perhaps of the lachrymal taches which may be especially bright.

In those from ten to fifteen years of age the lachrymal taches and pupils are, as a rule, bright. In some there is an extension outwards of the illumined area beneath the inner third or inner half of the eye.

In young adults a crescentic tache is usually present. This may vary in size from little more than the lachrymal tache to a full-sized crescentic tache passing to beyond the outer angle of the eye.

Thus, in young patients the extent of the transillumined area affords information as to the degree of development of the antrum. In exceptional cases this does not proceed symmetrically on the two sides. Such at least is the inference one is inclined to draw, when in the absence of symptoms of antral disease, the tache over one cavity is smaller and fainter than that over the other.

CONDITIONS THAT MAY INFLUENCE TRANSILLUMINATION.

a, EXTRA-ANTRAL CONDITIONS.

Experience has shown that the antrum is transillumined best in spare, thin-boned, fair persons, whose palate is not more highly arched than normal, and whose nasal fossae are free and roomy. These conditions are best fulfilled in thin anaemic women with a broad type of face.

Conversely, stout, large-boned, dark men, those with a high V-shaped palate or with narrow and obstructed nasal passages usually transilliumine badly.

Transillumination of the pupil may be prevented by purulent ulcer of the cornea, dulness of the lens or vitreous, or closure of the

pupil (Ziem). Burger thinks that the differences in transillumination of the eye may be due in a large proportion of cases to the condition of the pigment layer of the choroid.

The above mentioned conditions, with the exception of the high palate need no explanation of the manner in which they affect transillumination.

INFLUENCE OF THE FORM OF THE HARD PALATE ON TRANSILLUMINATION.

Davidsohn was the first to call attention to the part played by the hard palate in transillumination. He appears, however, to have taken into account its influence on the pupil only. With very high vaulting of the palate and steep sloping of the lateral parts of the alveolar process he found that transillumination of the eye did not take place . On the other hand, in those in whom the arching was not so high the transillumination was positive but the pupils were less intensely red than when the palate was normal. The increased thickness of bone associated with high palate is probably the chief factor interfering with transillumination. (The influenge of the high palate on transillumination is more fully estimated under Tables III and IV).

b, INTRA-ANTRAL CONDITIONS.

These may be either of anatomical or pathological nature.

The anatomical peculiarities which may cause the signs to be partially or totally obscured are:- The small size of the cavity and the presence of bony partitions.

Pathological conditions either by giving rise to the accumulation of morbid products within the antrum or by causing changes in the lining membrane may affect transillumination favourably or unfavourably.

a, CONDITIONS INCREASING THE BRILLIANCY.

1. Cysts with clear contents causing thinning and distension of the antral walls.

b, CONDITIONS DIMINISHING THE BRILLIANCY.

1. Collections of pus, mucus, blood etc. which may be of intra-or extra-antral origin.
2. Inflammatory thickening of the lining membrane.
3. Tumours which may originate within the cavity or invade it from without.

VARIATIONS IN THE SAME SUBJECTS AT SHORT INTERVALS.

It is evident that several of the causes mentioned as influencing transillumination will vary in degree and consequently in effect from time to time. Thus, the antrum may be full of pus at one moment, while a little later e.g. after the patient has held his head in a dependent position, it may be empty; a lining membrane which is only slightly thickened to-day may be considerably swollen to-morrow, if an acute nasal catarrh has been contracted in the interval; the varying patency of the nasal fossae in so far as it is dependent upon the state of the inferior turbinates, must also be taken into account.

RELATIVE VALUE OF THE SIGNS ELICITED BY TRANSILLUMINATION.

The various objective and subjective appearances produced during transillumination having been described and their significance considered we are now in a position to form an estimate of their relative value.

It is evident from what has been stated that transillumination is not an infallible test. Fortunately, however, its faults are rarely those of omission for it seldom fails to indicate the presence of an antral affection; it may, on the other hand, suggest disease in the cavity when this is normal, and the disturbing cause situated elsewhere.

It has been shown that none of the signs elicited by transillumination is absolutely reliable. Each and all may be produced independently of the antrum by light from the nose.

The infraorbital, lachrymal and nasal taches, and the intra-nasal appearances during transillumination are of subsidiary or no value and may be here left out of account. An opinion should be based upon the crescentic tache, pupil and subjective light sense.

Of all the manifestations of transillumination the most trustworthy is the crescentic tache. It may certainly be produced by light which has traversed the nose only, but this is very exceptional so that the presence of a bright crescentic tache reaching outwards to beyond the external angle of the eye is highly presumptive of a normal antrum.

The additional presence of the illuminated pupil and the subjective sensation of light, strengthens the impression gained from the bright crescent as to the normal state of the antrum. The ocular ~~manifestat-~~

manifestations are, however, oftener absent and are more exposed to disturbing factors outside the antrum than the crescentic taches.

The subjective light sensation although a more delicate test than the illumined pupil is less valuable as its proper application demands a fair amount of intelligence on the part of the patient.

EXPERIMENTS.

Some of the experiments made by the author and already referred to may here be recorded.

TRANSILLUMINATION IN THE CADAVER.

In the bodies examined, the crescentic, infraorbital, lachrymal and nasal taches were present; the pupil, however, was not taken into account owing to the unsatisfactory manner in which it transillumined.

Floor of the antrum lined with tin-foil and lower half of cavity filled with wool.- Only inner third of crescent (lachrymal tache chiefly) illumined, and that less bright than on opposite side.

Packed Antrum completely.- Inner third of crescent, and narrow track passing down at side of nose to below ala; all else dark.

Repeated in other two subjects.- Same result.

Packed upper part of Antrum only.- Same result as with antrum completely packed but black area on cheek smaller, not extending so far downwards.

Repeated in another subject.- Same result.

Packed Nasal Cavity, Antrum left empty.- Perfect crescent reaching to inner side of inner canthus. Nasal tache gone, ~~outer two-thirds~~ the corresponding darkness extending inwards to junction of nose with face.

and Antrum.

Packed Nasal Cavity.- Nasal tache gone. Outer two-thirds of crescent and parts below, black. Lachrymal tache and narrow track passing down at side of nose, bright.

In another subject.- Bright lachrymal tache and triangular area over canine fossa.

In another subject.- No illumination.

Small incandescent lamp introduced into antrum through opening made in canine fossa.- Lachrymal tache produced. Piece of wool size of bean put in antero-superior angle of antrum; lamp re-introduced. No lachrymal tache.

TRANSILLUMINATION IN THE LIVING SUBJECT.

The illumination of the Crescent, Lachrymal Tache and Pupil, and the Subjective Light Sensation may each be produced by light from the nose.

Subject 1. In a patient with a wide nasal cavity a small incandescent lamp held in the middle meatus lit up the crescent and pupil on the same side, and both nasal taches brightly, and the pupil on the opposite side faintly; light was perceived in both eyes but especially in that on the same side as the lamp.

Subject 2. An electric lamp in the middle meatus caused the pupil to glow as brightly as when transillumined from the mouth.

Subject 3. Palatine transillumination yielded a very bright lachrymal tache and a dim crescent. On packing middle meatus both were abolished. Light perception was present with and without packing.

Subject 4. Palatine transillumination yielded a very bright nasal tache, a faintly red pupil and subjective light perception. All abolished by packing middle meatus.

Subject 5. Palatine transillumination yielded no tache at all but subjective light sensation was present. This was abolished on packing middle meatus.

Subject 6. Palatine transillumination yielded lachrymal tache. Antrum packed with gauze. Lachrymal tache now dimmer but not abolished.

Subject 7. Palatine transillumination yielded lachrymal tache. Antrum filled with gauze. Lamp in middle meatus lit up lachrymal tache.

The illumination of the Crescent, Lachrymal Tache and Pupil, and the Subjective Light Sensation may be independent of the passage of light from the nose.

Subject 8. Crescent, pupil and subjective light sensation produced by palatine transillumination. On plugging nose, no change.

Subject 9. Bright pupil and subjective light sensation present. Unaffected by packing nose.

Subject 10. Lachrymal tache and pupil very bright. Unchanged with nose packed.

Subject 11. Only lachrymal tache illumined. Not less bright when nose was plugged.

Subject 12. Lachrymal tache illumined by lamp in mouth, but not by small lamp in corresponding middle meatus.

STATISTICS OF TRANSILLUMINATION.

Tables I and II are based on the examination by the author of 100 persons who had no symptoms of antral disease and in whom the hard palate was normal and not high.

Table I.

Comparative frequency of crescentic tache, illuminated pupil and subjective light sensation.

	Crescent.	Pupil.	Subjective Light.
Present on both sides equally	62	53	60
" " " " but unequally	17	17	21
" " one side only	8	7	9
Absenton both sides	13	23	10
	100	100	100

Table II.

The three signs were associated together as follows:-

A. The two sides being equal (70%).

Crescent, pupil and subjective light present	47	Data Satisfactory (55).
Crescent and pupil	1	
Crescent and subjective light	7	
Crescent	2	Data Insufficient (15).
Pupil and subjective light	1	
Pupil	1	
Subjective light	5	
Lachrymal Tache only	3	
No illumination	3	

B. The two sides being unequal (30%).

1. The inequality probably due to the condition of the nose. The nasal fossa on the darker side markedly narrowed owing either to swelling of the inferior turbinate or deviation of the septum.

Crescent, pupil and subjective light present 11

Crescent and subjective light present 1

In 1 case pupil and subjective light absent on one side.

In 2 cases the difference was only in the pupils and subjective light.

In 3 cases the difference was only in the subjective light.

2. The cause of the inequality not apparent.

Crescent, pupil & subjective light on one side; other, darker 9

Crescent, pupil & subjective light on one side; other, negative 6

Crescent & subjective light on one side; other, darker 1

Crescent & subjective light on one side; other, negative 2

Table I shows that equal crescentic taches and subjective light sensation were present in about the same number of persons (60-62%), while the pupils were equally illumined in about 10% less (55%). Of the three signs the bright pupil is the one most frequently absent.

The condition of the nose, as shown in Table II, B, 1. exercises an important influence upon transillumination. When preparing these statistics the question was considered whether only those cases in which the nasal fossae were free and equal should be reckoned; it was decided, however, to include, but take note of such as might be otherwise in order that the frequency of this disturbing element might be estimated.

It was found that intra-nasal abnormalities might be regarded as the

probable cause of the inequality of the crescents in 7 instances, of the pupils in 8, and of the subjective light sensation in 12.

If then these cases be added to those in which the illumination was symmetrical, totals are yielded of 69, 61, and 72 cases in which the crescents, pupils, and light sensation respectively might be considered as equal on the two sides.

Table II shows the manner in which the three signs were associated.

In forming an opinion as to the condition of an antrum from the transillumination, the crescentic tache together with either or both of the ocular manifestations should be taken into account.

Proceeding on these lines we find that in 55 cases data were afforded which would enable one to state with a considerable degree of certainty that both antra were practically healthy.

In 30 cases the antra transillumined unequally and in 12 of these the difference might be accounted for by the unequal patency of the nasal fossae. If these 12 cases be added to the 55 already mentioned, a total of 67 is obtained in which we get # strong presumptive evidence of the normal state of the antra.

In 15 cases the manifestations were insufficient or absent on both sides so that we were left in doubt as to whether a bilateral anatomical or pathological condition interfered with transillumination.

Lastly, in 18 cases the difference between the two sides during transillumination could not be accounted for by the intra-nasal condition and was such as to suggest an affection of the darker side. While this could be absolutely disproved only by inspecting the cavity, the presence of pus was excluded by exploratory irrigation in 9 instances.

The question as to whether the unilateral darkness was due to disease or to an anatomical abnormality, must remain unsettled.

To sum up, Transillumination gave-

Presumptive evidence of the antra being normal in		67 cases.
Equal on both sides	55	
Unequal, due to intra-nasal causes	12	
Indefinite or no information in		15 "
Manifestations equal on both sides but insufficient	12	
No illumination on both sides	3	
Presumptive evidence of disease or of anatomical abnormality in the antrum on one side in		18 "

INFLUENCE OF HIGH HARD PALATE UPON TRANSILLUMINATION.

Comparative frequency of crescentic tache, bright pupil and subjective light sensation in 50 persons in whom the hard palate was abnormally high. For convenience in comparing with Table I the numbers are given as percentages.

TABLE III.

	Crescent	Pupil	Subjective Light.
Present on both sides equally	52	46	50
" " " but unequally	12	6	14
" on one side only	12	12	8
Absent on both sides	24	36	28
	100	100	100

If we compare Table III with Table I it becomes at once evident that all three signs are more frequently absent when the hard palate is high. Thus, with a normal hard palate the crescent, pupil and light sensation are absent in 13%, 23% and 10% respectively, but when the palate is high these numbers rise to 24%, 36%, and 28% respectively.

Of the three signs, when they appear equally on the two sides, the most constantly present is the crescent.

In considering the association of the three signs in persons with high palate the two sides have been reckoned separately (100 antra in 50 persons) and the frequency with which the illumination was unequal on the two sides has not been indicated. The corresponding numbers as deduced from Table II are placed alongside for comparison.

TABLE IV.

Association of the three signs in 100 antra.

	Hard Palate.			
	Normal.		High.	
Crescent, pupil & subjective light	69.5		48	
" "	1	80.5	6	61
" " "	10		8	
"	2.5		8	
" " "	1		3	
"	1	19.5	1	39
" "	5		8	
Lachrymal Tache only	3		13	
No illumination	7		6	
	100		100.	

It has been already stated that to form an opinion as to the condition of an antrum from transillumination it is desirable to take into account the crescent together with one or both of the ocular signs. These conditions were fulfilled in 80.5% of the antra associated with normal palates, but only in 61% of the antra when the palate was high. The presence of this abnormality therefore reduces the value of transillumination about 20%.

An interesting fact revealed by Table IV is the frequency with which the lachrymal tache is present when the palate is high. The 13 instances noted are those in which this tache was alone seen, in many more it was associated with the other manifestations.

CASES IN WHICH THERE WAS LITTLE OR NO ILLUMINATION ON BOTH SIDES.

The cases in which both sides were dark objectively or in which only the lachrymal taches or subjective light sense was produced have been especially considered with the view of determining the probable cause of interference with the transillumination. It will be found on Table II that 11 cases come under this category.

Three of the patients were heavily built men, the thickness of whose bones may have prevented the passage of light.

In three cases the patients suffered from marked rhinitis and it is not unlikely that chronic inflammatory changes may have involved the antral lining membrane and led to its thickening.

In two cases the antra were probably very small or absent. Both patients were young men in whom attempts to reach the antra from the inferior meatus by boring with Lichtwitz's trocar failed even after a

considerable thickness of bone had been penetrated. In one of the cases the inferior meatus on both sides was found to extend abnormally far outwards.

The above explanations are largely conjectural. In the three remaining cases no probable cause was discovered.

TABLE V.

The results of transillumination in 100 consecutive cases of antral suppuration (unilateral and bilateral) occurring in the author's practice.

Crescent, Pupil and Subjective Light Sensation present on the healthy side and all absent on the diseased side	72
Crescent & Pupil present on healthy side, absent on other	1
Crescent & Subjective Light Sensat " " "	4
Crescent " " " "	5
Crescent, Pupil and Subjective Light Sensation absent on both sides-	
Pus in both Antra	13
Pus in one Antrum	4
Crescent, Pupil and Subjective Light Sensation present on both sides and pus in both antra	1
	100.

This table proves that transillumination is a valuable diagnostic test in antral suppuration. If, in order to form an opinion we require information regarding the crescent and one of the ocular signs , this is available in 77 cases. Evidence of disease, but somewhat less reliable, is given in other 5 cases in which the crescents alone differ.

The absence of all the signs on both sides although here correctly

indicating bilateral disease, must be accepted with caution on account of the other disturbing factors already mentioned that may give the same result.

In four instances transillumination indicated bilateral disease whereas pus was found only in one antrum; in all probability the lining membrane of the empty antrum was thickened in consequence of previous disease.

Lastly, transillumination misled in one case. All the signs of a healthy antrum were obtained on both sides, while in reality bilateral suppuration was going on. The small amount of pus in the cavities, and the usuaually favourable conditions for transillumination presented by the patient easily accounted for the miscarriage of the test in this case.

The preceding tables show indubitably that while transillumination may suggest disease where no disease exists, it seldom fails to point it out when present.

FALLACIES.

A fallacy is most likely to arise in one of three ways.

I. Transillumination may be equally brilliant on both sides and yet one antrum may contain pus.

In such a case usually the amount of pus in the cavity is very scanty, and the lining membrane is little or not at all changed. These conditions are sometimes found when the pus is of dental or extra-antral origin. This fallacy will more readily occur if too strong a light is used.

II. Transillumination may be bright on one side and darker or even completely absent on the other, and yet on the non-illumined side the antrum may contain no pus.

This may be due to the following conditions on the darker side:- 1 Abnormal thickness of the bony walls of the antrum and small size of the cavity (asymmetry). 2. Thickening of the antral lining membrane in consequence of previous disease. 3. Tumour in the antrum. 4. More or less obstruction of the corresponding nasal fossa.

On the other hand, the antrum that transillumines well, may, as shown under I, contain pus.

III. Both antra may transillumine badly or not at all.

Although in these cases bilateral disease may be present, the darkness is usually due to the light being too weak or to conditions outside the antrum influencing transillumination unfavourably e.g. thick bones, high palate, and obstructed nasal cavities.

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Inspection

of the

Antrum of Highmore.

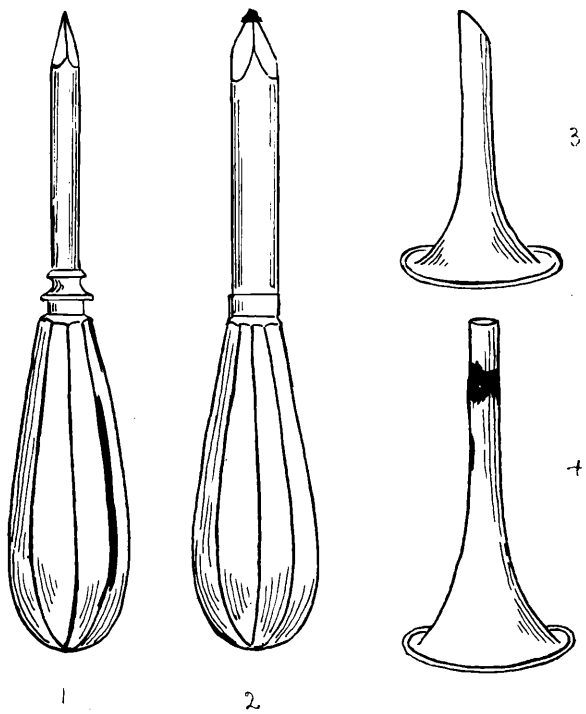
INSPECTION OF THE ANTRUM.

The methods of diagnosing disease of the antrum at present in vogue give information only as to the fluid contents of the cavity but none as to the condition of the lining membrane if we except transillumination which occasionally indicates this to be more or less thickened.

In dealing with the antrum, questions frequently arise which make the inspection of its lining membrane desirable. Thus, there may be doubt as to whether pus is forming in the antrum or merely collecting there: whether the suppuration is limited to a small area or inwolves the whole lining membrane; and whether the changes in the lining membrane are slight and will probably yield to mild measures, or considerable and demand a radical operation.

Further, how else than by inspection are we to gain a true knowledge of antral affections? Is it not something of a reproach that although cysts and polypi are present not infrequently, as proved by post-mortem examinations, we have no signs or symptoms by which to diagnose them during life?

Lastly, are our remedial measures to remain as limited as heretofore? If we fail to check a discharge by simple means e.g. syringing or insufflating powders, is our sole alternative method to be the radical operation entailing general anaesthesia and confinement indoors for at



The Author's Instruments for Opening and Inspecting the Antrum of Highmore.

least a week?

Considerations such as these led the writer to seek an easy mode of gaining access to the antrum, and having devised this, to attempt the treatment of the diseased lining membrane by methods which had proved of utility in similar conditions of the mucous membrane of the nose and ear.

The method of opening the antrum is as follows:- The gingivo-labial fold beneath the canine fossa is painted with 20% solution of cocaine. Four to six c.mm. of 10% solution of cocaine are injected at two or three points in the anaesthetised area into the soft tissues over the canine fossa. After three or four minutes have elapsed, the zygomatic-alveolar ridge is noted, and commencing just in front of it an incision is carried forward along the gingivo-labial fold for about 1½ to 2cm. The facial wall of the superior maxilla is now exposed by pushing aside the investing soft tissues with a raspatory. The sharp trocar (Fig.1) is applied to the bony surface at a point about 5mm. in front of the zygomatic-alveolar ridge and about the same distance above the incision in the mucous membrane. Having bored a passage large enough to admit the end of the blunt-pointed trocar (Fig.2) the latter is used to make the full-sized opening. By completing the operation with a blunt-pointed instrument the danger of injuring the opposite wall is averted.

The trocars should be directed backwards, upwards and slightly inwards.

The operation is simple, often painless, although occasionally somewhat so when boring through the bone, can be accomplished within a couple of minutes after anaesthesia is established, and has in my experience but one drawback, namely, the necessity for the submucous injection of cocaine.

I have tried Eucaine in 20% solution but sensation was not satisfactorily established.

The landmark referred to, the zygomatic-alveolar ridge descends from the malar process to the alveolar border above the first molar. I have recommended that the incision terminate posteriorly just in front of this ridge, for, when carried further back a small arterial twig is cut. If this escape, the bleeding is unimportant and no special measures for its control are necessary.

In exposing the canine fossa one is not likely to pass so high as the infraorbital foramen, still, it should be kept in mind.

The advantages of using large trocars to make an opening into the antrum are, that they secure a cleaner wound with greater ease, rapidity and precision, and with less discomfort to the patient, than does the ordinary method of chiselling.

To obtain a good view of the interior of the antrum a speculum is necessary. A large sized ear speculum, or Zaufal's naso-pharyngeal speculum cut down, serves the purpose. An instrument such as that depicted (Fig. 3) is, however, most satisfactory. It resembles a large, elongated aural speculum of circular calibre, with / bevelled end. The last provision facilitates its introduction, and when in use gives a more extensive field of view, and allows of the freer manipulation of instruments in the cavity. An extra long speculum (Fig. 4) is useful at times, e.g. when oedema of the lining membrane more or less occludes the lumen, the opposing surfaces may be pushed apart by the instruments and the deeper parts inspected.

To introduce the speculum the left forefinger is used to raise the lip and so cause the wound to gape. The speculum is then passed gently through this. If any difficulty be encountered it is best overcome by

looking through the speculum, mopping away the blood if neeessary, and then pushing aside the soft tissues with a probe, or avoiding the bony ridge of the opening by altering the direction of the instrument.

On introducing the speculum the posterior part of the antrum directly meets the view. By inclining the instrument in various directions, and turning the bevelled part towards the region to be examined, the lining membrane of the greater part of the cavity may be minutely inspected. The parts of which a view is unobtainable are the anterior wall and those portions of the other walls immediately adjacent, especially the roof. The ostium maxillare is usually not seen owing to the inner wall being viewed in perspective, but its position is easily determined by a right-angled probe under control of the eye. If the artificial opening were bored further outwards e.g. over the zygomatic-alveolar ridge, instead of in the canine fossa, the ostium would be visible and a better view of the inner wall obtainable, but for general purposes the route already recommended is probably best, and it has the further advantages that here the bone is thinnest, and the speculum most easily introduced.

Immediately after the operation, having syringed the antrum if necessary, a look may be taken at its lining membrane. The detailed examination is best postponed, however, till the following day, the wound meantime being loosely packed with iodoform gauze.

On the first night there may be some pain but it is usually insignificant. Slight swelling of the cheek may be present after the operation or may develop more markedly on the following day or later, especially if the patient has been exposed to cold, and may last from a couple of days to a week. It is sometimes considerable, extending to the lower eyelid, and causing marked disfigurement but is associated with ~~compar-~~

comparatively little discomfort.

At the patient's second visit, the gauze is removed, the antrum syringed and the lining membrane thoroughly examined by means of a strong bright light reflected through the speculum.

Occasionally the patient complains of the speculum causing pain; this may be avoided in a large measure by painting the parts with cocaine and using a smaller speculum. The tenderness is usually referred to the lower bony edge of the opening on which the instrument presses.

As long as it is desired to have access to the antrum the wound in the soft tissues must be kept open by means of packing: after this is discontinued it rapidly narrows and closes.

Over 40 antra have been opened and inspected in the manner described. The various affections met with, the methods of treatment employed, and the results obtained are briefly recorded below.

ANTRA IN WHICH THE LINING MEMBRANE WAS NORMAL OR BUT SLIGHTLY CHANGED.

In several of these cases suppuration was apparently going on in the antrum for pus was being regularly washed out by syringing through an opening made in the alveolus. On inspecting the cavity, however, the lining membrane seemed normal, or but slightly thickened on the floor. In order to exclude the antrum as the seat of the suppuration it was packed with gauze, and as the discharge of pus from the nose was undiminished clear evidence was thus afforded that the antrum was merely a reservoir for pus draining into it from the frontal sinus or anterior ethmoidal cells. This method is therefore capable of yielding valuable information as to the source of pus issuing from the anterior part of the

middle meatus. It should be mentioned here that in some of the other cases of frontal sinus suppuration the antral lining membrane had undergone marked pathological changes and was pyogenic.

In one of the cases of this group the patient suffered from nasal polypi the recurrence of which could not be controlled, and in another there was persistent and excessive swelling of the inferior turbinates without manifest cause. The antra in both of these cases were suspected on account of other signs and symptoms, but wrongly, as inspection proved.

In those cases in which the antrum was opened but the lining membrane found normal, the wound was immediately allowed to close. A couple of stitches to keep the soft tissues together and prevent the entrance of food would perhaps have been advisable, but none were used, the patient merely placing a small pad of gauze in the gingivo-labial fold over the wound while eating. In all of the cases healing took place without any untoward effect.

GENERAL THICKENING OF THE ANTRAL LINING MEMBRANE.

The majority of the patients whose antra were inspected suffered from chronic antral suppuration and in most of these cases the appearances presented by the diseased lining membrane varied but little, and consisted in a general thickening.

The surface of the membrane was pale and smooth; ulceration was observed in no instance. The degree of thickening was not uniform, without exception it was greatest on the floor, and least in the upper part of the cavity, a fact which emphasises the irritant action of pus lying in the antrum. In one case, in which the antrum had been previously syringed from the

alveolus for several months, a nipple shaped proliferation a quarter of an inch long projected from the floor, the passage for the cannula running through the centre of it. Besides being thickened, the lining membrane was sometimes swollen so that adjacent walls instead of passing into one another imperceptibly met at an angle, and the point of the probe was lost sight of between the folds. A tooth was found lying loose in the cavity in two instances; one had been forced up in an attempt to extract it. In cases in which the suppuration might possibly have been of dental origin, the floor of the antrum was carefully examined but without even discovering the mouth of a sinus or other indication to support this view.

The antral suppuration in several of the cases presenting the above appearances was associated with nasal polypi, or frontal sinus suppuration, or both, and in one instance with foetid atrophic rhinitis.

In these cases of chronic suppuration in the antrum attempts were made to check the discharge either by modifying the diseased mucous membrane, or by destroying it and encouraging the growth of a new lining membrane.

Various medicaments were tried. Antiseptic powders were insufflated, boric acid, iodoform, iodol, airol, aristol, and eucophen being in turn applied, but all without appreciable benefit. Packing the cavity with boric acid increased the discharge; with iodoform, it was somewhat diminished.

Liquid applications of an astringent or caustic nature e.g. chloride of zinc, silver nitrate, carbolic acid, were also repeatedly employed but proved inefficient.

Of all medicaments tried, chromic acid fused on the end of a probe was found to be the most useful. It had the additional advantage of being easily applied. Experience showed that it was inadvisable to cauterise more than

half of the antral surface at a sitting. Where thickening was marked, as on the floor in many cases, the head might be firmly rubbed over the lining membrane, but caution was necessary where the membrane was less thick, otherwise considerable pain might be suffered afterwards. In my later cases I found it best to cauterise lightly twice or thrice at intervals of a few days and to syringe out the cavity after each application with a solution of bicarbonate of soda. Usually on the second day following the cauterisation the surface of the mucous membrane that had been treated presented a dirty grey appearance and was found to consist of necrosed tissue which could be wiped or picked away more or less completely. Perfect healing required from two to three weeks, and the membrane was then smooth, grey and much thinner than before.

By means of chromic acid used in the manner described I was able to get the lining membrane into an apparently much healthier state and to diminish suppuration, but unfortunately not to check it completely. The treatment was continued as a rule for not longer than three or four weeks, and possibly if it had been persevered with cures might have been obtained. The difficulty, however, was to keep the opening free owing to the soft tissues constantly encroaching upon it. If this tendency to closure of the wound could be overcome without causing discomfort to the patient, and easy access to the cavity maintained for as long a period as desired, excellent results might, I believe, be obtained.

Curetting was also tried. This to be effective must secure the removal of the entire diseased lining membrane. I have found that it is not possible to operate thus without severe pain even if only a small area, which previously has been thoroughly painted with 30% solution of cocaine,

be treated at a time. After a few trials, therefore, I abandoned the idea of curetting without a general anaesthetic.

OEDEMA AND THICKENING OF THE ANTRAL LINING MEMBRANE.

In a few cases oedema was the most striking change presented by the antral lining membrane. On introducing the speculum little or no lumen was found, the inner and outer walls of the cavity being swollen to such a degree as to meet. These swellings had a dull grey aspect, and were yielding, elastic and somewhat fluctuant, giving one the impression of a bag partly filled with fluid. On aspiration, however, no fluid was obtained, and an incision there was no apparent leaking or appreciable shrinking. If the cavity were loosely packed with gauze, the lumen on the following day was found to be greater, and the oedema of the lining membrane correspondingly less; and if the packing were repeated for several days the swelling gradually disappeared, and less or more thickening alone remained.

In the most marked cases of oedema of the antral lining membrane the discharge was usually of a muco-purulent nature and the prominent feature in the nasal fossae was polypoid rhinitis, or polypi , sometimes of an obstinately recurrent character.

After the oedema had subsided, the lining membrane was treated with chromic acid in the manner already described. A decided opinion cannot be expressed as to the ultimate effect, but the impression gained was that the abnormal secretion from the antrum was diminished and the nasal condition improved.

POLYPI AND POLYPOID DEGENERATION OF THE ANTRAL LINING MEMBRANE.

Polypi were found in one case and polypoid degeneration in three.

The case of polypi in the antrum was that of a young woman who suffered from abundant muco-purulent nasal discharge and a polypoid condition of the inferior and middle turbinates. On opening her left antrum a white soft cheesy material was encountered. After washing this out the greater part of the lining membrane was seen to be smooth thin and pink. A pedunculated multilobular polypus about the size of a bean hung from the inner part of the roof, and a similar growth but double its size sprang from the floor. In the right antrum polypi were found attached to the inner, outer, and anterior wall, and to the floor. All these growths resembled nasal polypi in appearance.

In the cases of polypoid degeneration, either flat, sessile bodies, having the grey gelatinous look of polypi were situated individually on various parts of the antral lining membrane, or were closely packed together. All three patients had antral suppuration, although the discharge of pus was not abundant, and two suffered in addition from recurrent nasal polypi.

The pedunculated polypi were snared, and the sessile ones reduced by cauterisation with chromic acid. The antral affection was cured in one case and improved in the others; the nasal condition was also ameliorated.

CYSTS OF THE ANTRAL LINING MEMBRANE.

Cysts were found in the antrum in one case. The patient was a young woman who had muco-purulent rhinitis, probably of a strumous nature, with a tendency to recurrent polypoid proliferations of the middle turbinates.

On examining her left antrum the cavity was found filled with very

tough mucus, after the removal of which a large white cyst was seen close to the opening. On incising it scanty pus and a quantity of thick mucus escaped. Other cysts previously concealed were now disclosed. One was situated on the floor, a small flat one sprang from the inner wall, a moderate sized one hung from the roof, and the sac of a collapsed one was present on the outer wall.

The cysts were incised, and chromic acid was applied to their lining membranes where accessible. Shortly afterwards there was marked improvement in the nasal condition but as both fossae participated, it is doubtful whether this can be attributed to the treatment of one antrum, the other having not been opened.

Inspection of the antrum has revealed to me some highly interesting conditions, but as regards treatment I have no sensational results to chronicle. The ease and safety with which the method can be carried out justify its adoption as a diagnostic procedure. On the other hand, the results I have obtained by the direct treatment of antral disease as described in this paper warrant only its reserved recommendation.

The So-called Empyema of the Antrum of Highmore in Infants

(Osteomyelitis of the Superior Maxilla.)

THE SO-CALLED "EMPYEMA OF THE ANTRUMIN INFANTS."

(OSTEOMYELITIS OF THE SUPERIOR MAXILLA).

Infants occasionally suffer from a disease characterised by redness and swelling below one eye, the formation of sinuses in this region and in the alveolus, and by a purulent discharge from the corresponding nostril. As these features resemble those of the classical "empyema of the antrum" the condition has usually been regarded as an infantile variety of this disease, hence the name. Cases of this kind have been published rather as curiosities to record the early age at which an antral empyema may occur than as contributions to the elucidation of the nature of the disease.

The affection is by no means common as the small number of cases reported testifies. Brief epitomes are given below of those found in our literary search, and of one case hitherto unpublished.

The following cases were described under the title of "Empyema of the Antrum."

1. (Rees). Child first seen when 2 weeks old and then presented swelling and inflammation of left cheek with appearance of pointing below the eye, protrusion of eyeball, inflammation and chemosis of conjunctiva, left side of palate depressed, and ulceration of alveolar border with exposure of a rudimentary molar. The tooth was extracted, and on passing a director into the antrum pus escaped. Next day abscess near inner canthus was lanced; warm water injected into antrum flowed from wound on cheek. Swelling gradually subsided; opening on cheek and in mouth closed spontaneously after some weeks, and infant was cured. The author has seen another similar case. In both he considers that the abscess of the antrum was due to pressure of the arch of the pubis on the infant's face during parturition.

2. (Grandidier). Child, 6 weeks old, presented swelling and redness of right cheek, eyeball pushed upwards, bulging of right half of hard palate and purulent discharge from alveoli after expulsion of teeth. No previous illness. Death on fourteenth day. At post-mortem examination the entire right superior maxilla was found necrosed. The condition was regarded as a periostitis of the upper jaw, leading to empyema of the antrum and terminating in necrosis.

3. (Bouchut). Child, 2 months old, after catching cold had a discharge of pus from left nasal cavity; two days later severe conjunctivitis;

on following day, abscess of gum at site of left canine which burst and discharged for two days. Later, the alveolar border softened, then a second abscess formed. Ultimately all the maxilla softened. Treatment consisted in opening abscess and using emollient injections. Cured. The condition was regarded as a caries of the maxilla following an inflammation of the nasal mucous membrane which extended to the antrum.

4. (Fürst). The presentation was normal, and delivery took place without instrumental aid. On the following day there was a yellow purulent discharge from the right eye and inflammation of the eyelids. The condition was treated as gonorrhoeal conjunctivitis, and apparently improved. On the eight day, however, blood-stained pus began to flow from the nose. About a fortnight later, on the 20th. to the 22nd. day, a swelling formed at the inner angle of the right eye. This was at first small, but rapidly increased and extended to the outer angle. At the same time a watery secretion which subsequently became purulent flowed from the right nostril, and also forced a passage through the right upper alveolar border. Immediately after the formation of the swelling a rudimentary tooth was removed from the upper jaw; another was expelled, and the pus found an exit by the empty alveoli.

The author first saw the child when four weeks old. She then presented a bluish-red, fluctuating swelling about the size of a pigeon's egg in the region of the right malar bone, and marked hyperaemia and oedema of the palpebral conjunctiva; gonococci were found in the secretion. On pressing the swelling pus escaped from the right nostril, and especially from the alveolus of the right upper second incisor; no

gonococci were discovered in the pus. The corresponding half of the hard palate was soft but not swollen. Disinfecting solutions were syringed through the nose and alveoli. Subsequently an incision was made corresponding to the edge of the orbicularis, and abundant pus escaped. After three days there was a rapid loss of strength, and death from exhaustion followed.

At the post-mortem examination, it was found that the entire right upper jaw was destroyed. Abscesses beneath, and amongst the fibres of the temporalis, and beneath the zygomatic process of the frontal bone, and multiple pyaemic abscesses on both sides in the lungs, kidneys, etc. and purulent pericarditis and pleurisy were present.

5. (Rudaux). An infant, 3 weeks old, presented redness and swelling of the left eyelid, thrush of mouth and gums, and an erupted tooth below canine fossa. A few days later, on pressing sub-orbital region pus escaped from left nostril and henceforward continued to discharge abundantly. Five days later, the pus made another passage below the inferior eyelid. The author saw the child when 2½ months old. He enlarged the infraorbital fistula, removed small sequestra, and curetted. Six weeks later, there was still discharge, and he then reflected a flap, opened the antrum and established free communication between it and the nose. When 9 months old the child still had sero-purulent discharge from the nose. The case was regarded as one of suppuration of the maxillary sinus due to the premature eruption of a tooth in the canine fossa.

b. (Grédenberg's Case, quoted by Noure). A child, 3 weeks old, after crying constantly for 24 hours, presented swelling around the left eye which next day increased and involved half the face. At the same time redness developed beneath the eye, and in the left upper gum a tooth appeared in the course of a night and fell out when touched. On the 3rd. day of illness, the author found a fluctuating area about a centimeter below the inner angle of the eye on pressing which pus and blood escaped from the left nostril. The gum was gangrenous for a short distance. On the 5th. day a vertical incision was made over the fluctuating swelling and half a teaspoonful of pus escaped; an opening was made through the alveolus to communicate with the incision; curetted, washed and packed. On the 7th. day a fluctuating red swelling formed below and to the outer side of the first incision and when opened the abscess cavity was found to communicate with the antrum. There was also a free passage from the wound on the face and from the alveolus into the left nasal fossa. Two days later the temperature became normal. Pus still flowed from the two wounds and from the nostril. Within 28 days five sequestra were removed; after the extraction of each, the discharge ceased or diminished but subsequently recommenced, the swelling and redness appearing anew. When the last sequestram was removed, however, the purulent nasal discharge ceased and the openings gradually closed. Two months after the first operation the infant was cured. The author's diagnosis was- empyema of the maxillary sinus due to the too early appearance of a tooth.

7. (D'Arcy Power). The patient at birth had both sides of the face, especially the right, badly bruised by forceps. When a month old he seemed to have difficulty in closing his mouth and refused the bottle. About the same time redness and swelling appeared below the right eye and eventually an abscess was opened. When 8 weeks old he came under the author's care on account of the discharging sinus.

The right side of the face was found to be somewhat fuller than the left, and the skin of the lower eyelid and cheek was red and hot. On pressing the cheek pus oozed from the sinus and from the alveolar border of the upper jaw. The upper part of the superior maxilla was felt to be bare. The sinus was enlarged and an opening made through the floor of the antrum so that a drainage tube could be passed from the eyelid into the mouth. The child died ten days after the operation.

8. (Douglas). A fortnight after birth the infant had "an ordinary sore eye". A week later, the writer found the right cheek swollen, the right eyeball protruding, the eyelids hyperaemia, the conjunctiva congested, and the right side of the roof of the mouth bulging. Pressure over the cheek caused pus to exude from the right nostril. The antrum was opened from the outer side of the alveolus and pus flowed freely; the cavity was syringed, the fluid escaping by the nose. The distortion of the right side of the face gradually subsided, the eye returned to its normal position, and the child is now in perfect health. There was no difficulty at birth but for a week afterwards the mother's nipples were sore and discharged "matter".

9. (Platt), quoted by Mayer). Shortly after birth some swelling of the right side of the face was noticed, and a discharge from the nostril on the same side. An opening soon formed on the lower edge of the right orbit, a little to the inner side of the middle line, from which pus escaped. Soon after pus was seen to ooze from the right upper gum, about half way back. The infant, a female, came under Platt's care when 5 months old, and then appeared to be unusually healthy. There was no history of previous disease of any kind in parents or child. The following conditions were noted by him:- Slight swelling of right side of face, sinus below right eye as above described, scanty discharge of pus from right nostril, and small sinus in upper gum about region of second molar tooth. From this ~~tooth~~ sinus a rudimentary tooth and some pieces of dead bone were removed when a free opening into the antrum was found. On two subsequent occasions pieces of necrosed bone were removed from the sinus in the mouth. The discharge diminished rapidly and the child when last examined was practically well. The condition was regarded as empyema of the antrum due in all probability to gonorrhoeal infection of the nose during birth. No bacteriological examination of the pus was made.

10. (Sherlow). An infant aged nine months was brought to the author with an inflamed swelling in the left cheek, said to have been forming there for two or three days. Pus was discharging freely from the nostril of the same side. A fistulous opening was found in the alveolar border of the upper jaw in the position where the first molar tooth might be expected to appear. A probe passed through the opening impinged on what seemed to be bare movable bone. On en-

larging the opening this movable body was removed and proved to be the perfect crown of a molar tooth. On antiseptic wash syringed through the alveolar opening flowed freely from the nostril. With daily irrigation the patient made an uneventful recovery in a few weeks.

The following cases are probably additional examples of the disease under consideration but have been reported under designations other than that of "empyema of the antrum".

11. (Dujardin-Phlegmon of the orbit). The child was brought to the author when 19 days old for an affection of the left eye which had set in four days before. The eyelids were found swollen and red; exophthalmus was very pronounced; and the conjunctivae were hyperaemic. The general symptoms were not severe. Poultices and ointment applied. Two days later, the local condition was worse, and phlegmon of the orbit was no longer doubtful. After an interval of five days fluctuation was detected at the inner part, and on incising, a great quantity of pus escaped. On the following day more pus came and some also escaped by the corresponding nostril and by the mouth. Ten days later, the cure was complete.

12. (Roure.-Maxillary and orbital osteo-periostitis). When 10 days old, the conjunctiva of the right eye became red and a day or two later slight exophthalmus was apparent. When 15 days old the exophthalmus was considerably and the right half of the face was swollen. On pressing the cheek pus escaped from the right nostril. The corresponding alveolar margin was red swollen and presented two openings

from which also pus oozed. Two teeth fell out. A probe could be passed through the openings into the antrum and an extensive bare surface felt. The lower eyelid was incised, and the probe passed along the floor of the orbit which was bare, and down to the alveolar opening. Next day there was swelling and fluctuation in the region of the lachrymal sac; after incising, communication was found to exist with the other openings. At the same time an abscess at the upper and outer part of the orbit was opened. The fistulas were regularly washed and drained and improvement was evident. The general condition, however, got worse, abscesses formed in distant parts, and the infant died.

14. Schmiegelow.-Osteomyelitis of the superior maxilla). The infant of healthy parents became suddenly fevered and had slight convulsions when ten weeks old. Both lids of the right eye became very oedematous. At the same time there was swelling and tenderness of the alveolar process and of the corresponding part of the hard palate. The general condition was grave, the child lying in a dazed state. About a week later, a small abscess which had formed on the inner side of the alveolar process opposite the canine, burst. Six days later, the canine was extracted and only then the pus found a free exit and the symptoms began to subside. Small sequestra were expelled frequently. Foul pus flowed from the left nostril. The general condition improved. When the child came under the author's care about two months after the onset of the illness, the right cheek was swollen, pus welled from the right lachrymal sac, and there was marked periosteal swelling of the alveolar process which extended over the hard palate to the middle line. A discharging fistula marked the site of the canine tooth. Behind it a loose rudimentary tooth was

seen, on removing which a quantity of pus escaped. The right nasal cavity contained foul pus and its lateral wall was broken down and sequestra met with in all directions. Regular syringing was prescribed; fluid injected through the alveolar fistula escaped by the nose. Two months later the swelling of the superior maxilla had diminished. Three years later, the patient had thriven but there was still some discharge from the right nasal fossa.

14. (Röpke.-Acute osteomyelitis of the upper jaw). A healthy infant at the beginning of his second week did not take the breast well and cried constantly. Swelling of the left cheek and purulent discharge from the left nostril were then noticed, on the following day the left eye was swollen. When 14 days old the infant came under the care of the author who found the condition as noted, besides bulging of the left half of the hard palate, and several fistulas. The crown of the molar tooth lay loose in granulations of the alveolar process. The probe encountered necrotic bone in every direction. The granulations were removed, the cavity irrigated and packed. Three days later, improved. Two days later digestive disturbances set in, the infraorbital swelling increased, and the nasal discharge was more copious. An abscess opened in the infraorbital region. The child became weaker and died 10 days after operation.

15. (Röpke. Case 2). A strong boy, 7 months old, who had never been ill before, became fevered and presented marked swelling of the left upper jaw. An abscess in the region of the left molar was incised The swelling of the face increased, however, so that the eye could

not be opened. The author now found swelling of the hard palate extending to the middle line and of the alveolar process on the left side. Foul pus escaped from a fistula in the canine fossa and from the left nasal fossa. The outer wall of the latter was carious. In the region of the zygomatic arch there was great swelling without fluctuation. An opening was made in the canine fossa; the anterior wall of the superior maxilla and the lower orbital wall were found necrosed and scraped; and a large sequestrum was removed from the malar process. The wound was regularly cleaned and packed. After 9 months there was still a fistula in the canine fossa and sequestra were occasionally discharged. The left half of the face was slightly sunken.

16. (Quellis.-Tuberculosis of the superior maxilla). In an infant, 6 weeks old, an abscess formed below the left eyelid, pointed, and a fistula resulted from which small pieces of bone escaped; a foul purulent discharge came from the left nostril. The author saw the child when 15 months old and found the anterior wall of the left superior maxilla and the corresponding half of the hard palate prominent. The floor of the nose was rough and bare: a few tubercular bacilli were found in the discharge. A flap was raised, the superior maxilla scraped, a piece of bone and carious tooth removed. The wound and fistula healed but the discharge from the nose continued.

The following case was under the writer's care.

17. Peter— was a strong and apparently healthy infant until fourteen days

old. Both lower eyelids and cheeks then became swollen. On the right side, the swelling which was never considerable soon subsided and gave no trouble; on the left, however, it increased rapidly and was accompanied by protrusion of the eye. In a day or two pus began to flow from the eye, the left nostril, and the posterior part of the left half of the upper jaw. The eyeball now returned to its normal position and the swelling of the cheek in a great measure subsided. The discharge from the eye continued for a month, that from the nose and mouth was still going on when the child was aged 4½ months was brought to me.

I found the patient well nourished, with slight swelling of the cheek on the affected side but an apparently normal eye. There was an abundant foul purulent discharge from the left nostril, and about the site of the left upper first molar pus was escaping, and a hard white mass was seen which the mother affirmed had been there for long. This was easily detached and proved to be the inverted crown of the first molar. The rest of the tooth was gone and the cavity of the shell which looked downwards was filled with a large granulation springing from the gum.

After enlarging the sinus opening, a probe could be passed into a comparatively large cavity, and water injected escaped by the nose carrying with it a small quantity of pus.

Syringing was now practised regularly for several weeks but a sanious discharge from the nose continued. Examination of the left nasal fossa with the probe then revealed necrosed bone on the floor and lower part of the outer wall. The removal of several sequestra was followed by cessation of the purulent discharge and rapid im-

provement in his general health.

When seen recently he was seven years of age, and a well-developed, though not very robust boy. His mother informed me that he had never had any teeth in the left half of the upper jaw with the exception of the second molar. In his nose, the only abnormality I could discover was a small synechia between the septum and the middle of the inferior turbinate.

With the view of elicidating the cause of the child's illness enquiry was made as to the possibility of injury to the face during or after delivery but without obtaining any evidence relative thereto. No history could be ellicited of venereal disease in the parents who have a large and healthy family. On questioning the mother as to discharges about the time of the patient's birth, I learned that ten days after her confinement when she had began to attend to the household duties, a discharge set in accompanied by painful micturition. This condition lasted four or five weeks and then passed off spontaneously.

From a perusal of the above reports it would appear that the disease under consideration usually presents the following features.

The subject as a rule is a healthy infant two or three weeks old; the age at the onset in the cases described was "shortly after birth", 8, 8, 10, 10, 14, 14, 15, 21 and 21 days, 1, 1½, 2, 2½, 7 and 9 months respectively. General symptoms e.g. constant crying, fever, slight convulsions, may usher in the illness. The first local manifestation is nearly always swelling and redness of the eyelids on the affected side, occasionally

leading to closure of the eye. In some instances the inflammatory precess involves more particularly the cellular tissue of the orbit and causes pronounced conjunctivitis and exophthalmus. The swelling of the eyelids may extend downwards to the level of the naso-labial suleus. After a variable interval of usually two or three days, an abscess forms below the inner angle of the eye and may subsequently burst, or pus may flow from the lachrymal sac. About the same time a purulent discharge from the corresponding nostril sets in and it is found that this is increased by pressing upon the infraorbital abscess.

On examining the mouth, swelling of the underlying alveolus and bulging of the corresponding half of the hard palate, are evident, probably also a partially erupted molar or canine. The removal of the rudimentary tooth, which is but loosely attached, gives free vent to pus. A probe passed into the resulting gap enters a fairly large cavity which is really a dental sac but is commonly thought to be the antrum. Fluids injected into this cavity may escape by the nose. On probing the fistulas, and the lateral wall of the nose on the affected side, necroses may be detected.

The further course of the disease varies. If the pus escapes freely and the patient's general condition is good, after a longer or shorter interval during which sequestra may be discharged or removed, the suppuration may cease and the sinuses close. On the other hand the presence of diseased bone may maintain the discharge indefinitely. In not a small proportion of cases death has resulted from inanition or septic infection.

Having dealt with the clinical picture of this disease we now pass to the consideration of its pathogenesis.

Of the above series of seventeen cases, the first ten were regarded as examples of empyema of the antrum; ~~two~~ one was diagnosed ~~respectively~~ as phlegmon of the orbit; ~~and~~ another as maxillary and orbital osteo-periostitis; three,

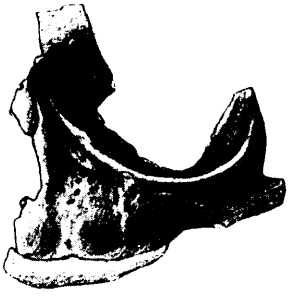


Fig.1. Left Superior Maxilla of Newly Born Child. Facial surface showing prominence caused by Dental Sac.

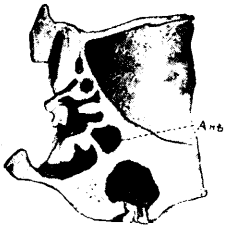


Fig.2. Left Superior Maxilla of Newly Born Child Section showing Antrum, Cavity of Dental Sac, and Nasal Turbinals.

as osteomyelitis of the upper jaw; and one as tuberculosis of the upper jaw.

It is easily understood how this condition came to be regarded as empyema of the antrum. Its clinical features closely resemble those of an affection occurring in adults which until recently was described under the name of empyema of the antrum. In such cases it was supposed that inflammation extended from the nose into the antral cavity and led to swelling of its lining membrane and blocking of the ostium; that the inflammatory products were retained and continued to accumulate until they forced a passage externally or into the mouth or nose; and that the necrosis resulted from the severity of the disease. We now know that such a course of events probably never follows a simple inflammatory process but is due to the growth of a cyst or solid tumour within the antrum.

If the antrum of an infant and its anatomical relations are considered it will be evident that an empyema while theoretically possible, could not give rise to the train of grave symptoms that has been sketched.

In order to elucidate the matter sections were made of the superior maxilla of newly-born infants. Fig. 2 is a coronal section displaying the left nasal cavity, part of the orbit, a dental sac, and the antrum; the last has been cut so as to show its vertical and lateral dimensions at their greatest. It is evident from the drawing that the antral cavity is much smaller than the dental sac, and that the latter owing to its size and position might readily be mistaken for the former. Further, assuming secretion to go on within the antrum while its orifice is blocked, rupture would take place into the nose through the thin partially fibrous wall and not through the comparatively thick bone into the dental sac or soft tissues of the cheek. These considerations justify the exclusion of antral empyema as the cause of the disease in question.

In the case reported under the title of "phlegmon of the orbit" a too limited view has been taken of the condition. Although pus was discharged from the nose and mouth the fact is mentioned only incidentally.

The credit of pointing out what appears to us to be a more correct explanation of the nature of the disease than any hitherto advanced belongs to Schmiegelow. He considered that the group of symptoms above described is due to acute osteomyelitis of the upper jaw. This view is supported by the acute onset, the thorough implication of the superior maxilla causing it to become prominent in all directions, the limitation of the morbid process to this bone and the rapidly resulting extensive necrosis.

Lastly, Avellis discovered a few tubercle bacilli in the child (Case 16) that was under his care, and consequently regards not only his case but all cases of the disease in question as due to tuberculosis of the medullary tissue of the nasal and palatine process of the superior maxilla. This generalisation appears to us to be hardly warranted. A microscopic examination is not mentioned as having been made in the other cases above reported and there was nothing in the condition of the patients' or in their family histories to suggest tuberculosis; further, the onset, course and termination of the affection differed from these phases in undoubted cases of tuberculosis of the superior maxilla.

Before proceeding further let us briefly consider whether an affection similar to the so-called "empyema of the antrum" in infants, occurs in adults, and if so, whether features- which can be much more easily investigated in these cases than in the very young—throw light on the pathogenesis of the disease.

To the former question an affirmative reply may be given. Cases have been observed by myself and others in which the morbid progess was evidently of the same nature as that under consideration. Thus, Lichtwitz

reports a case of acute osteomyeletis of the superior maxilla in a man aged 29, who in consequence of having been struck in the region of the left canine fossa by a copper tube suffered from recurrent swelling of the left half of the face, a discharge of pus into the mouth from the alveolus of the upper left lateral incisor, and a similar discharge from the left nostril. The whole left alveolar border formed a large sequestrum on the removal of which all the symptoms passed off. The antrum was examined but contained no pus. The discharge from the nose had found its way into this cavity, not through the antrum but by a fistula which opened beneath the inferior turbinate.

Another somewhat similar case which came under my care is that of a man who after a spree awoke to find himself on a hillside with his head resting on a stone. A day or two later the left cheek swelled greatly, and the left half of the hard palate became markedly depressed. Shortly afterwards a sinus opened upon the cheek and another above the gum. Three months later when he came under my care a large cavity was found in the jaw between the floor of the antrum and the roots of the teeth. The cavity was full of granulations and in connection with the sinuses mentioned and with the nose : a considerable extent of the neighbouring bone was carious.

It cannot be denied that a great similarity exists between the cases above referred to of acute osteitis or osteomyelitis, of the superior maxilla in adults, and the infantile affection termed "empyema of the antrum". I am of opinion that the pathological process termed is essentially the same in both classes of patients and that any clinical differences observed may be accounted for by the anatomical differences which exist between the fully developed superior maxilla and this bone at birth. In its latter state it is spongy, penetrated by numerous foramina and largely occupied by dental

sacs. Inflammation of any part of the bone would readily extend throughout it, a dental sac and extrusion of the rudimentary tooth cause of rupture of and lead to swelling, necrosis, and the formation of a sinus on one or more of its surfaces- facial, palatal, orbital or nasal.

In adults on the other hand the body of the superior maxilla is occupied by the antrum whereby the morbid process in the bone is more limited so that it is exceptional for more than one or two of its bony walls to be affected. Hence the disease when contrasted with that occurring in infants is more localised, accompanied by less general disturbance, followed by less destruction, and is much less fatal.

It has already been shown anatomically that the so-called antral empyema of infants has little if any relation to the antrum. The same may be said of its counterpart in adults. In the two cases quoted, as well as in the large majority of milder cases investigated by me in which one or more of the bony walls of the antrum were diseased, the cavity itself was normal, and in no instance could the bone disease be attributed to an empyema of the antrum.

Assuming that the so-called empyema of the antrum in infants is of the nature of an acute periostotis, or osteomyelitis of the superior maxilla and judging from the etiology of these affections in the adult, one would consider trauma, cold, infection, and the tubercular and syphilitic diatheses as the most probable causative factors. On examining the clinical histories of the recorded cases this view is found to be amply justified as will now be shown.

A traumatic influence has most frequently been regarded as the exciting cause. In the two cases observed by Rees there had been face presentation and to this was ascribed injury of the superior maxilla; Spenser Watson

has also seen two cases in which he considered the mischief was probably connected with injuries ~~during delivery with forceps, xxx~~ received during parturition; in D'Arcy Power's patient there had been bruising of the face during delivery with forceps; and in Dujardin's the lower eyelid had been scratched at birth. On the other hand, in several of the cases, as also in my own, labour was normal and no injury was incurred by the infant.

Rudaux and Greidenberg attributed their cases to the premature eruption of a tooth; this, however, is really a consequence and not a cause of the disease.

In Bouchut's case, cold in the head marked the onset of the illness.

In the majority of instances the parents were healthy; no mention is made of any of them having been tubercular; and only one is stated to have suffered from syphilis. Nor has anything been noted in regard to the general health of the infants that would indicate a special predisposition in those attacked.

The part played by infection is doubtful as little has been done in the way of bacteriological research. In Fürst's case there was undoubted gonorrhoeal conjunctivitis, and in this writer's opinion the inflammation travelled by the naso-lachrymal canal to the maxillary sinus, and there set up suppuration with softening and destruction of the surrounding bone.

Platt considered that the antral empyema in his patient was due in all probability to gonorrhoeal infection of the nose during birth. A medical friend has related to me a fatal case of "empyema of the antrum" in an infant the mother of which at the time of confinement had gonorrhoea. In Roure's case the mother suffered from metritis and septic vaginitis during the last months of pregnancy. The mother of Douglas's patient had sore nipples which discharged "matter". Schmiegelow and Röpke also believe that

infection takes place from the nose. Lastly, in the case reposted by me the mother began to suffer from a discharge, the nature of which cannot be determined, a few days before the patient presented the first symptoms of illness.

It will be observed that in the above cases the relation of gonorrhoea to the "empyema" is altogether conjectural and that the gonococcus was not found in the nasal secretion of any of the cases. Our knowledge of nasal gonorrhoea in both adults and infants is very imperfect, indeed, the affection is not even mentioned by the majority of rhinological authors, In no irstance, however, have grave structural changes been reported as resulting from an attack. Störk, who has written perhaps most fully on the subject, describes two cases in adults the principal symptom in which was a very profuse nasal discharge. The coryza in infants, which is not infrequently associated with ophthalmia neonatorum is not specially severe and has been shown to produce no pathological changes in the nasal mucous membrane (Rosinski). It follows therefore that even if gonorrhoeal rhinitis had been present in the above cases of "empyema" it is not likely to have caused extensive necrosis of the superior maxilla; and that this destruction if the result of an infective process was due to organisms other than the gonococcus.

That the disease may sometimes be of an infective nature is possible, but in the absence of data we must meantime remain ignorant of the mode and site of entrance of the micro-organisms.

Contrary to the view generally entertained we would regard the alveolus and not the nose, as the part first involved in consequence of injury or infection. For, from a survey of the cases it is evident that the anterior surface of the superior maxilla is the site of the earliest manifestations of the disease, the nasal discharge setting in later. Besides, if the in-

infection travelled by way of the nose and antrum we would expect nasal symptoms to be invariably present, whereas in several cases- two of which terminated fatally- there were no nasal symptoms. Again, we would expect that in some patients there would be only nasal symptoms, the morbid process exhausting itself or being cut short before other complications developed; of such cases we have no knowledge and can find no record.

On the other hand, all the cases of the above series showed pathological changes in the mouth; a sinus had formed in the alveolus in every instance excepting two, and in these there was bulging of the hard palate on the affected side. There is no doubt too, that cases do occur in which the alveolus is primarily and severely affected while nasal symptoms are absent. A case reported by Wood bears out this statement.

Acute necrosis of alveolar process of superior maxilla. Two days after birth- the delivery having been normal but tedious- the child had slight chemosis of both eyelids. Next day the alveolar process of the left superior maxilla was much swollen. On the following day there was extensive sloughing. After removal of the slough two pieces of bone were extracted. The child progressed favourably until the 12th. day when erysipelatous eruption appeared on the abdomen; it died on the 15th. day apparently from sapraemia.

It will be gathered from what has been stated that in our opinion the disease is caused by influences of a traumatic or infective nature, more probably the former, acting on the alveolus. The most vulnerable parts of the latter are the dental sacs of which that of the first molar is especially liable to suffer owing to its large size and prominence.

This sac, we believe to be the seat of origin of the mischief. In short, we regard the condition commonly designated "empyema of the antrum in infants" as primarily an infective periostitis arising in connection with the dental sac of the first molar the inflammation subsequently involving more or less of the superior maxillary bone. Let us see in how far this view is in accord with the various clinical features.

Of these the chief are:- The extrusion of the crown of the rudimentary tooth which may be attributed to pressure within the sac; exophthalmus, the presence of swelling and the formation of sinuses upon the cheek or palate, and the discharge of pus into the nose; all of which manifestations may be accounted for by the close proximity of the sac to the regions involved; lastly, the ultimate more or less extensive caries of the spongy bone surrounding the sac.

The early treatment of these cases consists in providing a free escape for the pus. The opening should be made in the alveolus or canine fossa where there is indication of pointing, or, if a sinus has already formed in either of these situations, it should be enlarged. Regular syringing should then be carried out. The passage of pus into the mouth should be guarded against as far as possible in order to lessen the risk of absorption and the consequent generalisation of the infection. It is probably best to proceed not too energetically, the expulsion of sequestra may be aided but it is doubtful whether a radical operation should be attempted. Apart from the disfigurement which is ldable to follow such a procedure, the results of the operations hitherto performed have on the whole been discouraging.

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