and on the level of the costal cartilages. The skin between the two openings having been separated from the subjacent parts, the diverticulum of the stomach is drawn up under the skin and over the costal cartilages as far as the small skin incision to the edge of which its apex is united by a few sutures. A small opening is now made here into the stomach, and the orifice fixed to the skin by one or two points of suture.

The lower part of the wound is then closed by continuous suture. As a result, the diverticulum of the stomach is drawn upwards; its base is gripped by the muscular fibres of the rectus, while a short upward-directed subcutaneous oesophagus is also formed. All escape of fluid is thus prevented, and the patient can be safely fed at once.

SUPPURATIVE FRONTAL SINUSITIS:

ITS SURGICAL TREATMENT, BASED ON AN ANALYSIS OF FORTY CASES.

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SUPPURATIVE disease of the nasal accessory sinuses in its relation to general systemic affections, to septic intracranial lesions, and to infective processes within the tympanic and orbital cavities has been brought somewhat prominently before the profession of late years, more especially since the various epidemics of influenza have visited this country. The difficulties of accurate diagnosis, of differential diagnosis, and of a true estimate of the damage inflicted, or likely to be inflicted, upon the individual in question, present problems at once interesting and instructive to those engaged in this particular department of medical work.

For practical purposes the nasal accessory sinuses may be divided into two main groups, (1) those whose ostia drain into the middle meatus, and (2) those whose ostia drain into the superior meatus.

In the first group are included the maxillary antra, the anterior ethmoidal and fronto-ethmoidal cells and the frontal sinuses; in the second group the posterior ethmoidal cells and the sphenoidal sinuses.

Pus coming from any of the sinuses included in the first group drains into the anterior portion of the middle meatus, whilst its flow is materially increased upon stooping or upon bending the head forwards and downwards. More especially is this the case when the maxillary antrum is the source of the purulent collection. In suppurative disease of the posterior group of cells, the flow takes place backwards towards the nasopharynx, and is usually to be seen upon rhinoscopic examination covering the posterior ends of the middle turbinates and the adjacent regions of the lateral walls of the nasopharynx.

The main difficulty in practice is first of all to determine from which sinus or sinuses the flow of pus is taking place. To ascertain this it is frequently necessary to examine the patient on more than one occasion.

Experience shows that it is a matter of comparative rarity to find only one sinus or one group of cells affected. In the vast proportion of cases two or more sinuses are involved.

Zuckerkandl, with his great and unique experience, never found a single case *post mortem* in which frontal-sinus suppuration was uncomplicated with ethmoidal; and E. Fraenkel, in 146 autopsies, did not find one uncomplicated case of suppurative frontal sinusitis.

This tendency to multiple sinusitis may be due to the virulence of the original infective process or to an auto-infection. The anatomical arrangement of the various ostia also favours the passage of pus from one sinus to another. Thus, it is no uncommon thing to find that when one or other of the higher sinuses is affected a secondary infection of one of the lower sinuses follows. It is not always, however, a case of actual infection or disease of the lower sinus which results. The sinus may act merely as a reservoir into which pus trickles, and, should it be drained at a sufficiently early stage, no permanent damage may have been inflicted upon its delicate mucosa. This mechanical infection is more especially prone to take place as the result of frontal-sinus suppuration when the purulent fluid flows down the infundibulum directly into the maxillary antrum, guided thither either by the intimate relationship of the two ostia or along a narrow gutter of mucous membrane running from the open end of the infundibulum to the ostium maxillare.

The principal etiological factors responsible for frontal-

sinus suppuration may be grouped as (1) local, (2) general causes.

The most important local causes are extension from some previously-existing morbid intranasal lesion and traumatism. General causes are epidemic influenza, diphtheria, syphilis, scarlet fever, measles, pneumonia, and catarrhal affections of the upper respiratory tract.

The particular germ responsible for the production of any of these general diseases may be found within the sinus. Bacteriologically, however, no specific organism is responsible for the incidence of the sinusitis. Various cocci—streptococci, staphylococci, meningococci, pneumococci, and various bacilli; for example, Pfeiffer's, Friedländer's, etc.—have from time to time been demonstrated in pus taken from infected sinuses.

The histo-pathological changes which take place are at first confined to the mucosa, but later on the underlying or surrounding bony structures may become the seat of a cario-necrotic process ending in perforation and extension of septic disease to the intracranial or orbital cavities.

The mucosa lining the affected sinus or sinuses undergoes marked degenerative changes in chronic cases, becoming succulent, oedematous, and finally polypoid. As a result the natural orifices of the sinuses tend to become occluded. Distension follows, with at times disastrous consequences. In practice the latent and open form of empyema is the one most commonly met with; that is, where there is a free secretion of pus from the mucosa lining the sinus, with, at the same time, sufficient egress to prevent the supervention of tension symptoms. The advent of any acute catarrhal condition, or any increase in the virulence of the infective agents, may rapidly transform a latent into an acute and closed empyema.

In the diagnosis of acute suppurative frontal sinusitis no special difficulties are encountered, but it is quite otherwise in cases of chronic latent empyema. Localized pain, which is such a valuable symptom in the diagnosis of deep-seated suppuration is usually conspicuous by its absence. It is true that pressure over the floor of the sinus, which happens to be its thinnest wall, does at times produce marked pain, but an almost equal amount of discomfort is not uncommon when similar pressure is made over the floor of the opposite sinus. To elicit this symptom to the best advantage the finger must be introduced well under the supraorbital arch and pressure made upwards and inwards.

It is rare to find local pain complained of over the anterior wall of the sinus. This wall is its thickest wall, and in chronic cases is prone to become still thicker as the result of a formative osteitis.

The line of flow of pus is perhaps one of the most valuable of the objective indications of the disease. Pus coming from the frontal sinus appears in the anterior portions of the middle-meatal region, its flow is not much influenced by the position of the head as in bending forwards, its colour is usually of a light canary yellow tint, and the patient is usually conscious of a slightly disagreeable odour.

My experience has been that the fronto-ethmoidal cells are invariably affected in cases of frontal-sinus suppuration, and from the practical point of view should always be broken into and drained in operation cases. An accurate estimate of the presence or otherwise of pus in the frontal sinus is, I believe, more readily obtained by excluding the participation of the maxillary antrum and anterior ethmoidal cells in the suppurative process—in other words, more by the presence of negative than of positive indications.

In the diagnosis of empyema of the maxillary antrum positive information is usually obtained by the aid of transillumination. The opacity of the affected side contrasts markedly with the brilliant illumination of the opposite antrum. The fact also that the patient is usually conscious of a glow of light in the eye of the non-affected side—a sign which is absent from the affected side—is a useful aid to diagnosis. In doubtful cases washing out of the affected sinus either by the introduction of a cannula through its natural orifice or the passage of a Lichwitz's trocar through the thin inner bony wall of the sinus, that is, just under cover of the inferior turbinated body, serves to definitely demonstrate the presence or absence of pus in the antrum.

The diagnosis of anterior ethmoidal suppuration presents greater practical difficulties, partly on account of the frequent existence of polypoid granulations in the middle-meatal region, and partly also on account of the difficulty of seeing the orifices of the cells. To facilitate observation it is advisable to remove, either by scissors and cold wire snare or by

means of a Gröndwald's forceps, the anterior one-third of the middle turbinated body. When this has been successfully accomplished it is possible to probe the anterior ethmoidal cells and to syringe pus from infected areas. It is also possible to block by means of a pledget of wool the orifice of the ostium maxillare and then to watch the line of flow of pus, the patient's head being meantime bent slightly forwards to facilitate the exit of secretion. Even now doubt will frequently remain in the observer's mind as to the implication of these ethmoidal cells and as to the number implicated. The removal of the anterior end of the middle turbinal is, however, not only fully justified under such circumstances, but is also the first preliminary step essential to the successful treatment of frontal sinus and anterior ethmoidal suppuration. Transillumination of the frontal sinus gives such uncertain results that it is not to be relied upon.

In 357 out of 500 skulls examined by Logan Turner with both sinuses present 98, or 27 per cent., failed to illuminate upon both sides, 50, or 14 per cent., failed upon one side, 40 illuminated upon the opposite side, and 23 were negative upon the opposite side.

A definite, or as nearly definite diagnosis as is possible, having been arrived at, the next step is the consideration of the line of treatment to be adopted for a given case. Speaking generally, intranasal treatment should, I hold, always precede any external operation, not only on account of its being a comparatively mild proceeding, but also because the success of any external operation is thereby more likely to be secured. I must, however, admit that it has never been my experience to see a genuinely chronic case of frontal-sinus suppuration cured solely by intranasal procedures, and a consideration of the histo-pathological appearances of the degenerated mucosa lining the sinus must, in my opinion, militate greatly against the chances of its so doing. At the same time it is only fair to state that cases of complete cure have been recorded by Chiari and others.

Even provided that an external operation has been decided upon, intranasal treatment should be carried out several days—seven to ten—before its performance. By so doing, the troublesome hæmorrhage which accompanies intranasal operations, especially operations upon the middle turbinal, is done away with—a very material advantage when we consider that the patient is under the influence of a general anaesthetic.

The main object of intranasal treatment is to secure as free drainage as possible from the infected sinus. This is best accomplished by the removal of the anterior third of the middle turbinated body. The infundibular orifice is thus brought into view, when it is possible to pass a cannula into the sinus and to thoroughly wash it out. Although this proceeding is possible and practicable in some cases, it must be admitted that it is a difficult manipulation, and requires the daily attendance of the patient for many weeks. All attempts to open the sinus from the interior of the nose are to be deprecated, the necessary manipulations being both dangerous and uncertain.

When faced with this question, whether an external operation, with its various risks, its uncertainties, and its possible failure, should be undertaken or not, many pros and cons must be weighed in the balance.

In the first place, To what extent is pus in the frontal sinus injurious? That it affects the health of the individual will, I think, be generally admitted. Its absorption into the general blood stream and its possible inhalation into the respiratory passages must not be overlooked. The fact, also, that septic disease of the bony walls of the sinus, with extension to the meninges or frontal lobes of the brain, is not uncommon, renders its presence a menace to the life of the individual. Again, even in the absence of any definite implication of bone, pathogenic organisms are at times transmitted along small venules or lymph radicles to distant organs, there to set up localized or generalized suppuration.

In the majority of cases I have operated upon, the factors which have mainly decided the question in favour of external operation have been failure of intranasal treatment, persistent purulent discharge, severe attacks of headache, and general mental hebetude. How exactly the almost constant headache and dull apathetic mental condition are brought about it is difficult to say. I can hardly think that it is due to tension within the sinus, for two reasons. In the first place, in these chronic cases, these open empyemata, there is always a fair leakage of pus into the nose, there is usually no bulging of the floor of the sinus, and there is no acute localized pain such as

one is accustomed to associate with pent-up pus. On the contrary, there is often comparatively little pus in the sinus, although it is constantly being secreted.

It may, however, be argued that if the surgeon is able by intranasal treatment to secure a free vent for pus, even although he is unable to arrest its secretion, the need of any external operation is done away with. Under such circumstances the patient has the continuous annoyance of having pus in his nasal passage or passages, of running the risk of having neighbouring sinuses infected, of the possible extension of disease to the orbital, tympanic, or cranial cavities, and of the supervention of septic disease of some portion of the respiratory tract. Are complications such as these sufficiently frequent, even in the absence of pain and fever, to warrant the surgeon in advising external operation?

Again, if an external operation be performed, be it an Ogston-Luc, a Kuhnt, or a Killian, what are the prospects of cure? The word "cure" is so often loosely used and loosely applied that it is better to definitely state what meaning, in this paper at any rate, it is meant to convey.

In using the word "cure" I mean that rhinoscopic examination shows the entire absence of pus, that headaches have ceased, that the primary incision has completely healed, and that no diplopia is present. Such a restricted use of the word "cure" must mean that the percentage of recoveries is not particularly great. If one considers for one moment the complicated series of cells forming the ethmoidal labyrinth and the other nasal accessory sinuses it must be granted that it is a matter of the very greatest difficulty to so completely eradicate all suppurating foci that not a drop of pus appears within the nasal passages upon rhinoscopic examination. I hold that even the presence of a small quantity of pus is sufficient to reinfect any one of the sinuses, and therefore must of necessity be an element of danger to the patient. Others hold that all that is required is to produce and to maintain free drainage so as to avoid tension symptoms, for example, headache, neuralgia, etc., and that the more or less continuous secretion of pus must be put up with. With this view I do not agree.

The broad fact remains, however, that after opening and draining the sinus headache disappears, and the state of the general health becomes much improved. That in certain cases an osteitis of the bony walls of the sinus takes place is evident from the marked thickening of the bony walls so often met with during operation. It is possible that this sclerosing osteitis, by pressing upon the terminal filaments of sensory nerves, is in part, at any rate, responsible for the pain so frequently complained of.

The dangers to life are both direct and indirect. Direct dangers are the onset of septic osteomyelitis, septic meningitis, septic orbital cellulitis, and intracranial abscess. Indirect dangers are pyosepticaemia, inhalation pneumonia (septic), purulent bronchitis, and septic disease of the middle ear with its possible consequences.

It must be admitted, however, that it is extremely difficult to estimate the actual danger to life. The same difficulty is met with in estimating the dangers of septic middle-ear disease. The meningitis or the pneumonia from which the individual dies is recorded as the cause of death regardless of the fact that these diseases may be, and frequently are, secondary to primary suppuration within the nasal accessory sinuses or the tympanic cavities. With regard to cosmetic results my experience is that the greatest deformity is prone to follow the performance of the Killian operation. That some deformity will result is probable, although it is surprising how slight it sometimes is even in cases of extensive operation. In several of my cases I have noted that a peculiar keloid-looking scar develops months after operation, and this I take to be due to the constant action of the fibres of the orbicularis palpebrarum muscle preventing local rest to the tissues, just as I believe the movements of the platysma muscle are responsible for the keloid appearance of scars after operations upon the neck.

A very guarded prognosis is always advisable. The virulence of the infective agent, the number of sinuses involved, the histo-pathological changes produced in the mucosa, the general health, and the surroundings of the patient are all factors worthy of consideration.

The results which I have obtained in the treatment of frontal sinus suppuration leave much to be desired, and my object is to place on record an epitome of the cases operated upon with their ultimate histories. With this end in view there is appended to this paper a summary of results based upon an analysis of 40 cases operated upon during the last

eight years—cases whose after-history has been followed and carefully noted. The analysis includes the age and sex of the patient, the sinus or sinuses involved, the duration of the disease prior to operation, the date of the operation, the particular operation performed, the duration of the after-treatment and the final result.

The main practical difficulties encountered in treatment are (1) the efficient removal of all disease, (2) the maintenance of free drainage, and (3) the warding off of secondary infection.

It must be obvious to any one acquainted with the complicated series of cells, which taken together form the various nasal accessory sinuses, that complete eradication of all sepsis is a matter of the greatest difficulty. More especially is this the case when dealing with the complicated series of cells which go to form the ethmoidal labyrinth. A survey of the table at the end of this paper shows how frequent the implication of the ethmoidal cells is, and therefore how real the difficulties are. The fact also that various diverticula are met with in the frontal sinus, that the sinus is frequently prolonged backwards over the orbital roof, and that it is in communication with an air-containing space—the nasal passage—are factors of the greatest practical importance.

In only 6 of the 40 cases, or 15 per cent., was the frontal sinusitis uncomplicated. In 21, or 52.5 per cent., the maxillary antrum upon the same side was affected, and in 18, or 45 per cent., the corresponding ethmoidal cells.

In mixed cases, where two or more groups of cells are affected, it is advisable to first of all deal with the maxillary antrum and ethmoidal cells, and subsequently, if necessary, with the frontal sinus. It has been urged by some writers that the higher sinuses should first of all be treated, and subsequently those on a lower level, on the ground that re-infection of the lower sinuses may take place so long as disease of a higher sinus exists. Against this, however, there is the undoubted fact that the treatment of antral and ethmoidal suppuration is simpler, and that it can be efficiently carried out without external operation, and again until an exact diagnosis of frontal empyema from clinical signs and symptoms is possible it seems to me preferable to attack those sinuses which experience proves are not only the ones most frequently affected, but also the ones most amenable to treatment. My experience is that the most important aids to the diagnosis of frontal-sinus suppuration are exclusion symptoms—namely, exclusion of the participation of the maxillary antrum in the suppurative process, either by transillumination or by washing out its cavity, and, secondly, exclusion of the participation of the ethmoidal cells by blocking the ostia of the maxillary antrum and frontal sinus with pledgets of wool, and then examining for a flow of pus in the mid-meatal region.

A diagnosis of frontal-sinus suppuration having been arrived at, and external operation having been elected, it remains to decide as to which particular operation is to be performed. The aim in all cases is the same—namely, to remove the purulent contents of the sinus and to encourage a return to a state of health in its lining mucosa or to effect a complete obliteration of the sinus itself. The means to be adopted vary according to the amount of disease present, the condition of the mucosa, and the size and capacity of the sinus.

To open the sinus a median or a supraorbital incision is made. The median incision is chiefly useful in cases of bilateral empyema. The supraorbital incision is the one more frequently employed, and on the whole is the one followed by the least amount of deformity. In a few exceptional cases a combination of both incisions is useful. A portion of the anterior bony wall or floor of the sinus or of both having been removed, and the mucosa lining the sinus having been exposed and incised, attention should be directed to whether it is granular, polypoid, or necrotic, and to the size and capacity of the sinus itself. In cases where the sinus is full of pus but where no extensive pathological changes are found in the mucosa my practice is to do as little as possible, to cleanse the sinus, and to secure efficient drainage. Where, however, the mucosa is the site of marked pathological degeneration my practice is determined by the size of the sinus. In a sinus where the antero-posterior diameter does not exceed $\frac{1}{2}$ in. I set about removing the whole anterior wall, and this irrespective of its superficial extent, with the definite intention of endeavouring to effect its complete obliteration. Under such circumstances the amount of after-deformity is surprisingly little and the after-results surprisingly good.

A most important practical consideration is the advisability

or otherwise of completely closing the external wound at the time of operation. My own experience is against closure of the primary incision on account of the risks of retention of pus, septic infection of the diploë, and the frequency with which it is necessary to reopen it. No doubt complete sewing up of the original incision gives a certain *éclat* to the operation, and produces a more finished piece of work, but it is not, in my opinion, in the true interests of the patient.

My practice now is, after a few unfavourable experiences of primary closure, to sew up only the outer third, or at the most the outer half, of the original incision, and to bring any packing which may be used through its inner half, or to insert a fairly large drainage tube. The more open the wound is kept the better the result. This applies with equal significance to the intranasal opening from the sinus. Provided that a sufficient amount of the middle turbinate body has been removed, and that the infundibular passage has been efficiently enlarged, a drainage tube leading into the nose is unnecessary.

In sinuses where the antero-posterior diameter exceeds $\frac{1}{2}$ in.—and this is very frequently the case—I prefer to remove all mucous membrane and to encourage the obliteration of the sinus by a gradual filling up with healthy granulation tissue. The process is certainly slow and tedious, but the results, provided fresh infection can be avoided, are good. To avoid reinfection of the granulating area is one, if not the greatest, practical difficulty encountered in the successful treatment of sinus suppuration. The greatest care is necessary to endeavour (1) to clear out all infected areas of mucous membrane within the sinus, (2) to remove all infected fronto-ethmoidal and, if necessary, anterior ethmoidal cells, and (3) to keep the corresponding nasal passage clear and free from stagnant and decomposing secretion. In uncomplicated cases, where it is deemed advisable to obliterate the sinus, the idea occurred to me that it might be worth while to shut off all communication with the nose by closing the infundibular passage. For this purpose I propose to employ ivory screw nails, and with a small screw-driver to screw the nail into the passage until the lumen is completely obliterated. The frontal sinus then becomes a bony cavity communicating with the air only through the original supraorbital incision. Subsequent treatment consists in keeping it lightly packed and in encouraging the formation of healthy granulation tissue. In this way the sinus is ultimately obliterated by a bed of healthy cicatricial tissue.

Of the 40 cases two, or 5 per cent., died from abscess within the corresponding frontal lobe. In both cases the abscess was complicated with septic meningitis.

Twenty-eight of the patients, or 70 per cent., made a complete recovery, and have had no recurrence of suppuration.

Four of the patients, or 10 per cent., have still a discharge, although small in amount, from the sinus.

In five of the cases, or 12.5 per cent., despite fairly persistent treatment, in two of the cases extending over a period of four years, fairly profuse suppuration still persists from both frontal and both ethmoidal sinuses.

In one case (No. XI) the result is unknown. The patient has since gone to South Africa. A good result is not anticipated, the patient having developed pulmonary tuberculosis.

The intricate arrangement of the accessory nasal sinuses, the difficulty encountered in securing at any one operation a complete eradication of disease, of maintaining free drainage, and the risks of reinfection are factors which militate in no small measure against a successful issue.

The great improvement in general health following successful operative procedures, the freedom from headache and from a constant purulent nasal discharge, should, however, encourage the surgeon to devote time and minute care to the treatment of these troublesome, at times dangerous, and at all times tedious cases.

Epitome of Cases.

CASE I.—Female, aged 39. Duration of suppuration many years. Right and left frontal, ethmoidal, sphenoidal, and maxillary sinuses involved. Operation, December, 1895. Median incision: removal of anterior wall of frontal sinuses. Partial cure.

CASE II.—Male, aged 25. Duration of disease one year and a half. Left frontal, maxillary, and ethmoidal sinuses involved. Operation, March, 1896. Median incision; obliteration of sinus; alveolar drainage of antrum. Cure.

CASE III.—Male, aged 42. Duration of disease six months. Right frontal and maxillary sinuses involved. Operation, July, 1896. Median incision; nasal drainage of frontal sinus and alveolar drainage of maxillary antrum. Complete recovery. Recurrence of disease in

frontal sinus, post-influenzal, in July, 1904. Reopening of sinus; recovery; cure.

CASE IV.—Male, aged 18. Duration of disease two to three years. Right and left frontal and right and left maxillary antra involved. Operation, August, 1896. Median incision; alveolar drainage of antra. Cure.

CASE V.—Female, aged 18. Duration six months; uncomplicated case. Median incision; intranasal drainage; rapid recovery. Cure.

CASE VI.—Female, aged 26. Left frontal and ethmoidal sinus involved; duration of disease two years. Operation, March, 1897. Supraorbital incisions; nasal drainage; abscess in left frontal lobe; extensive basal meningitis. Death.

CASE VII.—Male, aged 19. Duration of disease six years; right and left frontal and right and left ethmoidal sinuses involved. Operation, April, 1897. Median incision; two further operations performed; considerable deformity, but ultimate cure.

CASE VIII.—Male, aged 38. Duration of disease six months; uncomplicated case of right frontal-sinus suppuration. Operation, April, 1897. Median incision; occasional discharge, probably from ethmoidal labyrinth.

CASE IX.—Female, aged 28. Duration of disease twelve years. Right frontal empyema; left maxillary antrum; supraorbital incision; Caldwell-Spicer operation upon maxillary antrum; right frontal sinus reopened and drained both externally and internally. Ultimate cure.

CASE X.—Male, aged 53. Duration of disease three years. Left frontal sinus and left maxillary antrum involved. Operation, July, 1897. Supraorbital incision; alveolar drainage of antrum. Cure.

CASE XI.—Male, aged 22. Duration of disease two and a half years. Right and left frontal sinuses and left maxillary antrum involved. Operation, October, 1897. Supraorbital incisions; Kuhn's operation upon frontal sinuses; Caldwell-Spicer's operation upon maxillary antrum. Patient developed pulmonary phthisis; went to South Africa. Result unknown.

CASE XII.—Male, aged 24. Duration of disease one year. Right and left frontal and ethmoidal sinuses and right maxillary antrum involved. Operation, January, 1898. Median incision; intranasal drainage. Cure.

CASE XIII.—Female, aged 27. Duration of disease seven years. Right and left frontal, maxillary, and ethmoidal sinuses involved. Operation, September, 1898. Very unsatisfactory case. Partial cure.

CASE XIV.—Female, aged 21. Duration of disease 2 years. Left frontal and ethmoidal sinuses involved. Operation, December, 1898. Supraorbital incision; sinus kept packed. Cure.

CASE XV.—Female, aged 37. Duration of disease a few years. Left frontal and maxillary sinuses involved. Operation, November, 1898. Supraorbital incision; Caldwell-Spicer-Luc operation upon antrum. Cure.

CASE XVI.—Male, aged 16. Duration of disease doubtful. Right and left frontal and ethmoidal sinuses involved. Operation, February, 1899. Median incision; drainage with tubes in nose; daily irrigation. Cure.

CASE XVII.—Male, aged 18. Duration of disease, two years. Right and left frontal and ethmoidal sinuses involved. Operation, March, 1899. Left sinuses dry; from right sinuses still slight discharge. Cure upon one side.

CASE XVIII.—Male, aged 54. Duration of disease two years. Right frontal, ethmoidal, and maxillary sinuses involved. Operation, October, 1899. Supraorbital incision; alveolar drainage of antrum; intercurrent attack of erysipelas. Cure.

CASE XIX.—Male, aged 47. Duration of disease a few years. Right and left frontal and right and left maxillary antra involved. Operation, October, 1899. Unsatisfactory case; still discharges; result doubtful.

CASE XX.—Male, aged 45. Duration of disease a few years. Right and left frontal, ethmoidal, and maxillary antra involved. Operation, October, 1899. Kuhn's operation upon frontal sinuses; Caldwell-Spicer's operation upon maxillary antra; patient still under treatment; still frequent headache.

CASE XXI.—Male, aged 21. Duration of disease five years. Right and left frontal and ethmoidal sinuses; left sphenoidal and left maxillary sinus involved. Operation, November, 1899. Kuhn's operation; Caldwell-Spicer's operation upon antrum. Unsatisfactory case; when last seen, still slight discharge.

CASE XXII.—Male, aged 40. Duration of disease a few years. Right and left frontal and maxillary sinuses involved. Operation, February, 1900. Three separate operations performed; relief to all head symptoms; general health unsatisfactory; slight discharge persists.

CASE XXIII.—Male, aged 25. Duration of disease thirteen months. Right frontal and maxillary sinuses involved. Operation, May, 1900. Supraorbital incisions; alveolar drainage. Cure.

CASE XXIV.—Female, aged 25. Duration of disease doubtful. Left frontal sinus affected. Operation, October, 1900. Supraorbital incision, nasal drainage, daily irrigation, rapid progress. Cure.

CASE XXV.—Male, aged 36. Duration of disease six months. Left frontal sinus affected. Operation, April, 1901. Supraorbital incision. Rapid cure.

CASE XXVI.—Female, aged 12. Duration of disease uncertain. Left frontal and ethmoidal sinuses involved. Supraorbital incision, drainage with nasal tubes. Cure.

CASE XXVII.—Male, aged 40. Duration of disease uncertain. Right frontal sinus involved. Uncomplicated case. Operation during acute stage. Rapid cure.

CASE XXVIII.—Female, aged 32. Duration of disease one year. Right frontal and maxillary sinuses involved. Operation, October, 1901. Frontal sinus packed; packing gradually removed. Maxillary antrum infected, but apparently not diseased. Cure.

CASE XXIX.—Male, aged 30. Duration of disease four years; right and left frontal and ethmoidal sinuses involved. Killian's operation; cure.

CASE XXX.—Female, aged 35. Duration of disease doubtful; right and left frontal sinuses and right and left maxillary antra involved; discharging fistula in middle line of forehead. Very extensive operation; insertion of gold plate under skin of forehead; comparatively slight deformity. Cure.

CASE XXXI.—Female, aged 21. Duration of disease eight months. Right and left maxillary antra and left frontal sinus involved. Operation, July, 1902. Rapid cure.

CASE XXXII.—Male, aged 35. Duration of disease unknown; left frontal sinus affected. Operation, October, 1902. Killian's operation; considerable deformity. Cure.

CASE XXXIII.—Female, aged 26. Duration of disease three years; left frontal and maxillary sinuses affected; supraorbital incision; alveolar drainage; abscess in left frontal lobe; extensive basal meningitis. Death.

CASE XXXIV.—Male, aged 22. Duration of disease six months; left frontal sinus affected. Operation, November, 1902. Supraorbital incision, nasal drainage. Cure.

CASE XXXV.—Male, aged 25. Duration of disease doubtful; left frontal sinus and maxillary antrum affected. Operation, March, 1903. Kuhn's operation upon frontal sinus; alveolar drainage, followed by Caldwell-Spicer-Luc operation upon antrum. Cure.

CASE XXXVI.—Female, aged 29. Duration of disease doubtful; right and left frontal and ethmoidal sinuses involved. Operation, November, 1903. Kuhn's operation. Cure.

CASE XXXVII.—Female, aged 34. Duration of disease doubtful; uncomplicated left frontal sinusitis. Operation, June, 1904. Supraorbital incision. Nasal drainage. Cure.

CASE XXXVIII.—Male, aged 27. Duration of disease fourteen months; left frontal sinus and left ethmoidal labyrinth affected. Operation, August, 1904. Kuhn's operation, rapid recovery. Cure.

CASE XXXIX.—Male, aged 46. Duration of disease seven years. Right frontal sinus and right ethmoidal cells affected. Operation, August, 1904. Killian's operation, slight deformity. Cure.

CASE XL.—Female, aged 20. Duration of disease 2 years; left frontal sinus, ethmoidal labyrinth, and maxillary antrum affected; Killian's operation (October, 1904) upon frontal sinus. Excellent progress up to date.

THE CAUSES, SYMPTOMS, AND COMPLICATIONS OF THE DISEASES OF THE NASAL ACCESSORY SINUSES

IN THEIR RELATION TO GENERAL DISEASES, OPHTHALMOLOGY,
AND NEUROLOGY.

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It is for the purpose of this paper unnecessary to go into the interesting but intricate chapter of the anatomy of the "adnasal" cavities (I have coined the word "adnasal" in place of "nasal accessory," and hope the expression may recommend itself). It will suffice to mention that the frontal, the ethmoid, the sphenoid, and the maxillary sinuses have this in common, that they are irregular, bony cavities, some of them subdivided by bony lamina, standing in connexion one with another or with the nasal cavity by narrow openings. The adnasal cavities are lined by mucous membrane, continuous with the mucous membrane of the nose, and a diseased condition of an adnasal cavity may therefore have originated in the cavity itself or in an adjoining cavity, or in the nose, and may affect the bone, the periosteum, or the mucous membrane.

CAUSES.

Whilst syphilis is a frequent cause of disease of the adnasal cavities, tuberculosis is rare. The most frequent are inflammatory affections, due to infectious organisms. Principal among these are acute coryza and influenza; in both the infection is carried into the adnasal cavities directly from the mucous membrane of the nose. Lindenthal¹ and others have shown the presence of the influenza bacillus in the pus of adnasal cavities after influenza. Next to influenza in frequency, acute croupous pneumonia causes adnasal disease (E. Fraenkel²), a fact which is, I believe, not generally known, and ought to be borne in mind. As the pneumococcus is found in the healthy nose, and has been found in healthy adnasal cavities, it seems that by some cause or another it may suddenly become active and virulent. Of other infectious diseases, scarlatina, measles, diphtheria, erysipelas, small-pox, and cerebro-spinal meningitis may be followed or accompanied by adnasal disease. In regard to epidemic cerebro-spinal meningitis, Weichselbaum³ has found the