of whom have been much indebted to him for advice and encouragement, and to those he, in his turn, has been chivalrously loyal.

He has fought many battles with word and pen, but I do not think that anyone, be it friend or foe, can accuse him of ever hitting below the belt. His whole career has been characterised by the most scrupulous honesty of action and of purpose, thus affording a most excellent object-lesson that, at least in our profession, "Honesty is the best policy."

DIFFUSE OSTEOMYELITIS FROM NASAL SINUS SUPPURATION.

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(*Concluded from p.* 84.)

Treatment.

Prophylaxis.—In the event of an acute sinusitis with external swelling, immediate operation and drainage of the sinus are imperative not only to relieve the pain and general symptoms, but also in order to lessen the risk of diffuse osteomyelitis.

In discussing the prophylaxis of post-operative osteomyelitis, it must first of all be remarked that experience of this disturbing sequela has led, within the last four or five years, to a complete revision of the indications for operation on the frontal sinus. Caution and hesitation have replaced the eagerness and boldness which formerly prevailed, and few surgeons of prominence now make a rule of operating upon the frontal sinus solely because there is a purulent discharge from the cavity. The uncertainty of complete cure and the danger of osteomyelitis have conspired to reduce the number of these operations within recent years, and the pendulum has now swung back to the position so steadfastly and consistently maintained by Hajek, that in quiet and uncomplicated frontal sinus suppuration only intra-nasal treatment is justifiable. It is felt that a major operation should not be performed for a minor malady. This change affects the Killian no less than the Ogston-Luc operation.

As to the comparative risks of the two operations, the Killian and the Ogston-Luc, the opinion expressed by Luc is that the former is the safer for two reasons; first because the better

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exposure in the Killian operation reduces the chances of blindly damaging the cribriform plate, and so lessens the risk of post-operative meningitis; secondly, because the subsequent freer drainage of the opened frontal sinus must also reduce the danger of post-operative osteomyelitis.

With Luc's first reason the facts are in full accord. Since the general adoption of the Killian operation accidental injury of the cribriform plate and consequent early post-operative meningitis have become less frequent. But Luc's second contention, that osteomyelitis is less likely to result, is, in my opinion, not yet firmly established. Luc, quoting his own experience, states that in his "first period" he had five cases of fatal intra-cranial complication, one of them being a case of osteomyelitis; while in his "second period" with double the number of operations he had no accidents at all. The total number of his operations is not given in the paper I referred to, but that the Killian operation has been followed by osteomyelitis the experience of other operators, including Killian himself, abundantly shows. As to whether osteomyelitis is more liable to follow the Ogston-Luc or the Killian operation I am unable from the cases hitherto reported to form a decided opinion.

Arguing *à priori* it is true that in the Killian operation the drainage of the sinus is more free and efficient, and for this reason one would anticipate fewer cases of post-operative osteomyelitis. On the other hand, the trauma is more severe; the amount of bone surface and the extent of raw bone edges exposed to the infection are greater than in the older operation.

In any case, the tendency of late years, a tendency encouraged by Killian himself, is to avoid external operation altogether in simple acute sinusitis and to secure the best possible intra-nasal drainage; and, in acute sinusitis with peri-sinus abscess, to be content with simple opening of the abscess and the sinus, followed by external drainage until the inflammation subsides.

Further, even in cases operated on *à froid*, Cauzard and many other recent writers postpone suture of the external wound for at least forty-eight hours.

Another detail in the technique of the radical operation upon which great stress is properly laid is to lessen the chances of secondary infection by removing disease in, or at all events by securing free drainage of, all other sinuses—ethmoidal, sphenoidal, and maxillary—which happen to be the seat of suppuration.

Further, in dealing with the affected frontal sinus itself—and the same applies to the maxillary antrum—forcible curetting

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of the walls of the cavity should be avoided. In this connection an observation made by Lermoyez deserves to be quoted in full, especially as it seems to throw some light upon the genesis of post-operative osteomyelitis :

"I am perfectly convinced of the harmful effect of the curette, for in almost all frontal sinuses I have opened for the first time I have found the cortex white and healthy; while, on the other hand, in operations for recurrence I have found the same wall *red, friable, and attacked by diffuse osteitis*" (italics mine). "It is, no doubt, necessary to cleanse a fungating frontal sinus thoroughly, but it is also important to recognise that the curette should be used with the utmost gentleness, for our object is to remove the fungosities and not to scrape the bone."

In concluding our summary of the prevention of post-operative osteomyelitis we must not omit to mention that one of the advantages claimed by Watson-Williams for his osteoplastic operation is that by this method the nutrition of the bone-flaps is preserved, and the tendency to osteomyelitis is thereby lessened. This surgeon has not lost any of his cases from osteomyelitis, and the experience of Charters Symonds in performing the operation successfully upon a patient who had recently suffered from diffuse osteomyelitis may be cited in its favour. Up to the present time, however, the number of cases operated on by the osteoplastic method is insufficient to enable us to estimate its value.

There are a few rhinologists whose prophylaxis of osteomyelitis consists in not operating externally upon the frontal sinus at all. This attitude is, however, untenable in the face of any threatening general or local phenomena dependent upon the sinus disease. So long as the symptoms consist in nothing more serious than the discharge of a little pus, then the maintenance of intra-nasal drainage is all that is necessary, as we have already said. But when satisfactory nasal drainage cannot be secured or continued, and when such symptoms appear as persistent headache, vertigo, loss of memory, local pain and tenderness, peri-sinus abscess or fistula, and above all, when indications of intra-cranial mischief manifest themselves, then abstention from operation is pusillanimous.

Curative Treatment.—Once progressive osteomyelitis has set in, the only chance of saving the patient lies in the immediate and entire removal of the diseased bone. We can scarcely hope to cure diffuse osteomyelitis by simple drainage, hence limited and partial measures, such as incisions, trephining, etc., are useless. As soon, therefore, as œdematous swelling of the soft parts appears, the sinus must be opened, or, if operation has been performed, the wound must be re-opened forthwith, and a search made for pericranial abscess

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and discoloration of the bone. If these indications of osteomyelitis are found, the whole thickness of the bony cranium must be entirely removed down to the dura, even when the vitreous appears to be healthy. Further, the superficial area of the bone resected must

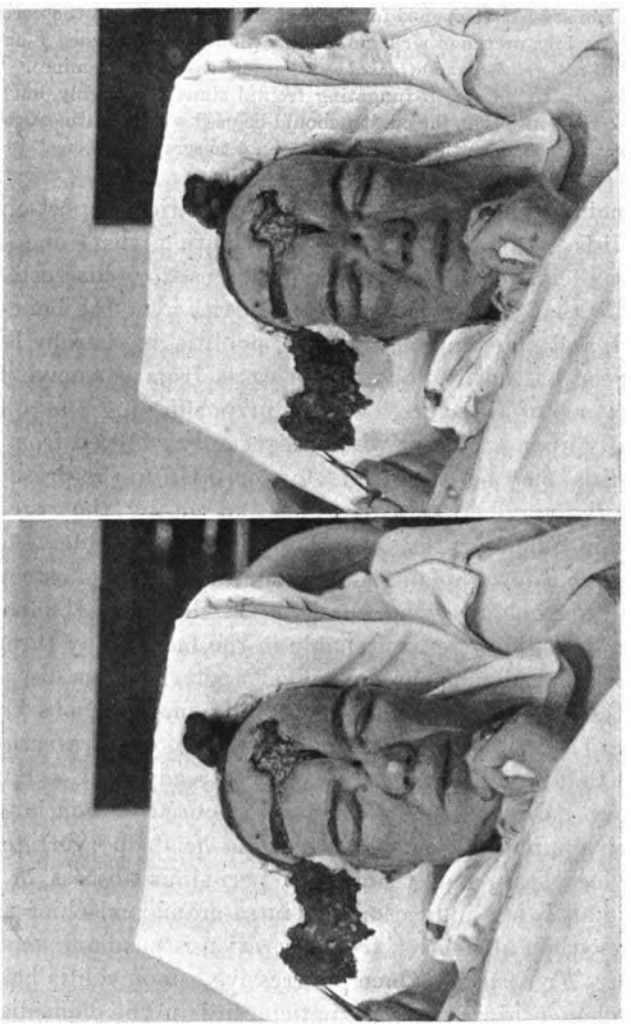


FIG. 4.—Stereoscopic photograph of a case of osteomyelitis (under Dr. Walker Downie's care). Female, aged twenty-eight. Osteomyelitis spontaneous (syphilitic) in origin. The disease began in the ethmoidal region and induced necrosis of the frontal bone. Note sequestrum (held by forceps). Duration of illness two years. Recovery.

exceed the obvious limits of the disease. Intervention must be comprehensive; resection must be radical. In doubtful areas it is safer to remove bone than to leave it, so that in all cases removal should be carried wide of the disease. The sacrifice of large sections of the bony cranium need arouse no apprehension, for if the case recover the defect will be made good by osseous regeneration.

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Certain details in technique should receive attention. Efforts should be made, for example, to prevent the transference of infection. Thus, when we come to cut through the bone beyond the limits of the obvious disease, and where it seems to be healthy, the forceps and other instruments employed should be newly sterilised, and the fresh edge of the resected healthy bone should be touched with phenol or hydrogen peroxide, or powdered with iodoform. As a precaution against further extensions, a series of small trephine-holes might be drilled through the healthy bone some distance from its margins with the object of relieving tension. The removal of the strip of apparently healthy bone beyond the obvious limits of the disease is advisable in view of the pathological fact that the bacterial invasion is always in advance of the naked-eye signs of the disease.

An instance of the amount of bone that may be safely and successfully removed is shown in Fig. 4, and we may also quote the case shown before the Laryngological Section of the Royal Society of Medicine in 1911 by Charters Symonds, in which the frontal bone, part of the roof and inner wall of the orbit, and the orbital ridge were entirely removed. Not only did the patient recover, but after a time the greater part of the frontal bone was regenerated and "the elevation of the forehead was restored."

Wheresoever the disease has spread, there must the surgeon follow it, and its further advances must be forestalled and countered by the measures we have suggested.

Failing these there is little else to be done. Schilling has suggested, in desperate cases, the cutting of a linear gutter across the bony vault of the cranium from one temple to the other. Unfortunately this attempt to "ring" the disease, as woodmen ring a forest fire, would only be partial. The route to the vulnerable base of the skull would still lie open to attack.

The use of vaccines and antitoxins suggests itself, but these remedies would be valueless if the diseased bone were not first removed.

Conclusion.

Our discussion of diffuse osteomyelitis secondary to nasal sinus suppuration has taught us that sinus osteomyelitis is a septic disease set up by a relatively heightened bacterial virulence, following operation or acute infection, the ultimate determining cause of which is unknown.

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Until we unveil that hidden factor in its ætiology each time we operate on the frontal sinus we shall do so wanting the full and comfortable assurance that mastery of all the natural eventualities of the situation alone can confer.

In addition to the authors whose writings I have freely quoted, I desire to express my most grateful thanks to Dr. Andrew Wylie for kindly granting me permission to publish the notes of his case of diffuse osteomyelitis secondary to maxillary antrum suppuration: to Dr. Walker Downie for the use of the valuable photograph reproduced in Fig. 4; to Mr. E. D. Davis for the notes on his case (hitherto unpublished); and to Sir StClair Thomson, Dr. Logan Turner, Dr. Scanes Spicer and Mr. Charters Symonds for their kindness in supplementing by private communications the published reports of their respective cases. (The notes of Dr. Logan Turner's case are now published for the first time.)

Appendix.

Note.—Dr. Scanes Spicer's case.

This case, which is quoted by Gerber and Luc as one of septic osteomyelitis proved to be a case of syphilitic bone disease of the frontal bone. The patient was shown before the Laryngological Society of London in 1904. The frontal sinus had been operated on and found to contain pus. The pathologist reported that the diploë contained granulation-tissue but no pus.

A few months later the swelling in the bone recurred. On this occasion anti-syphilitic treatment led to the rapid disappearance of the disease. The patient was then shown before the Laryngological Society in 1905, and the diagnosis of syphilis recorded.

Dr. Scanes Spicer has kindly informed me that a third appearance of the swelling took place a year or two later, and again it yielded to anti-syphilitic treatment.

Cases.

(1) Logan Turner.—Male, aged thirty. "Frontal, ethmoidal and antral suppuration (right side). Discharge for several years. Had had Ogston-Luc operation twice on frontal by two different operators. When seen by me had an eyebrow fistula and some œdema of soft parts. Did complete frontal operation, removing bridge as well as floor and anterior wall (before the days of Killian). Curetted ethmoid and opened antrum.

Duration of fatal illness, three months. Repeated scalp abscesses and removal of practically whole of frontal bone at successive operations; pus between bone and dura mater.

Death from pyæmia—abscess round rectum. No sectio. Never any definite signs of meningitis or brain abscess.

Definitely spread from frontal sinus; always a possibility that the osteomyelitis had commenced before radical operation."

(2) Van den Wildenberg (Antwerp).—Female, aged twenty-three. At the

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first examination bilateral fronto-ethmoidal sinusitis was found, with acute symptoms. Endo-nasal operation. Recurrence. Killian radical operation on left side. Three weeks later swelling with fluctuation in the region of the right orbit. Radical operation on this side refused by patient. Simple incision at the inner angle of the right orbit. Pus evacuated and a small sequestrum of the os ungis removed. Fourteen days later extensive operation on this side and a large sequestrum, involving the crista galli and the lamina cribrosa of the ethmoid, removed. In the frontal region a very extensive zone of osteomyelitis discovered. In three days focal symptoms—motor aphasia, paralysis of the right hand—led to trephining, and an extra-dural abscess was drained. Symptoms unrelieved, and twelve hours later a brain abscess was opened. Coma. Death.

The osteomyelitis originated, it was thought, in the wall of the right (non-operated) frontal sinus, which showed signs of osteitis.

(3) Von Eicken.—(Sex, age, and dates not given). Right antrum opened. Submucous resection performed. Radical operation on right frontal sinus, ethmoidal and sphenoidal cells. Primary suture, wound reopened later. Extending periostitis and osteomyelitis. Abscess in frontal lobe, opened and drained. Meningitis. Death.

(4) Von Eicken.—(Sex, age, and dates not given). Frontal sinus and ethmoidal suppuration. Acute symptoms after accidental traumatism. Operation. Extensive necrosis of bone in region of left lachrymal, ethmoidal and frontal bones. Repeated operations. Meningitis. Death.

(5) Wolff Freudenthal.—Male, aged twenty-five. Influenza followed by headache and nasal discharge. A fortnight later swelling over right eye. Temperature 102·5° F. Fluctuation over right frontal sinus. *Operation:* Bone above and external to frontal sinus discoloured and covered with bloody patches. Bone removed 3 cm. up and 2 cm. out from the frontal sinus. Extra-dural abscess evacuated. Symptoms unrelieved. *Second operation:* Brain abscess found and evacuated (100 c.cm. pus). Recovery in six weeks.

(6) Charters Symonds.—Male, aged thirty. The infection followed chronic suppuration of both frontal sinuses, and existed before operation. In a series of operations the frontal bone was removed together with a part of the sphenoid, the roof of the right orbit and its inner wall and the orbital ridge. On the left side part of the orbital ridge was left. Recovery.

The greater part of the frontal bone was reconstructed with the consequent restoration of the elevation of the forehead. On the left side the frontal sinus has been operated on by the method of Watson Williams, with no perceptible scar.

(7) Dan McKenzie.—Female, aged twenty-eight. Frontal sinusitis treated endo-nasally for two years. Autogenous vaccine (*Staphylococcus albus*) tried; no effect on discharge. Ten years previously operation on left maxillary antrum. Followed by prolonged illness with swelling of face; sequestrum involving part of lower edge of bony orbit removed. Recovery.

After X-ray photographs, Killian radical operation on May 7, 1909. "Bridge" cracked accidentally. Temperature normal, and skin-wound united in a week.

May 14.—Some pain, and small abscess in wound lips (? stitch abscess) opened. May 15.—Swelling and tenderness over bridge of nose. Temperature 101° F.

May 28.—Operation; wound reopened. Bone exposed at former operation white and necrosed; removed. Sub-pericranial abscess over frontal bone evacuated. Nasal bones white and necrosed; counter-opening made on right side of nose.

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May 30.—Fresh autogenous vaccine (*Staphylococcus albus*) prepared and used regularly. June 1.—Eyelids on left œdematous; some chemosis and protrusion of globe; œdema over left temple. June 3.—Œdema of right eyelid. Temperature 102° F. Sleep disturbed. June 4.—Abscess under temporal fascia opened; pus found deep under orbital roof. June 7.—Meningitis. Temperature 105° F. Lumbar puncture; cerebro-spinal fluid turbid, contains leucocytes; no bacteria on culture. *Operation.*—Frontal bone trephined 1½ in. above right frontal sinus. Diploë apparently healthy. Granulations on dura, but no extra-dural pus. Exploration of frontal lobe negative. June 9.—Coma. Death. *Post-mortem.*—Basal meningitis; infection seemed to have reached meninges by extension of suppuration back under roof of orbit. Osteomyelitis of lower frontal and temporal bones and orbital plate of frontal.

(8) ANDREW WYLIE.—Male, aged 29.

Admitted July 12, 1912. Discharge from left nostril of two years' duration. Transillumination and puncture showed pus in left antrum.

July 18.—Caldwell-Luc operation on left antrum. Mucous membrane polypoid. Operation uneventful.

Discharged a week later. Antrum washed out shows little or no pus.

August 3.—Re-admitted with pain and swelling of left side of face of four days' duration. Œdema of left lower eyelid. Temperature 103° F.

August 8.—Incision below left eye just beneath lower margin of orbit. Pus evacuated from subperiosteal abscess of orbital floor. Bare bone felt on probing.

August 10.—Chemosis less, pain less. Temperature 101° F.

August 27.—Dead bone removed from lower margin of malar bone. Temperature 98° to 100° F.

September 12.—Large sequestrum, loose, involving part of bony floor of orbit, malar bone with malar foramen, removed.

September 17.—Bare bone felt in ascending process of superior maxilla. Temperature 100° to 101° F.

September 19.—Left optic disc somewhat congested. Temperature about 99° F.

September 22.—Headache, but no signs of meningitis. Temperature 100° F.

September 29.—Marked increase of proptosis in right eye with œdema of eyelids. ? Cavernous sinus thrombosis. Delirium.

September 30.—Death.

Post-mortem.—Purulent osteomyelitis of frontal bone. Extra-dural abscess over frontal lobe. Pus in cavernous, transverse and circular sinuses extending to petrosal sinus on each side. No brain abscess. No meningitis.

(9) WALKER DOWNIE.—Male, aged thirty-six. Nasal polypi removed six years ago. Purulent discharge from nose for years. December, 1910, swelling in middle line of forehead midway between root of nose and edge of hairy scalp. Slow increase in size of swelling; not painful. Pressure on it caused pus to come into both nasal fossæ, especially into right. February 8, 1911, operation, necrosis of outer table of frontal bone found and eradicated.

(10) E. D. DAVIS.—Female, aged twenty. 1908.—Left frontal sinus opened; Ogston-Luc. 1909.—Sinus re-opened. August, 1910.—Killian radical on left frontal sinus; œdematous middle turbinal removed; left antrum opened. A few days later right antrum opened under cocaine. Five weeks later, discharged well.

January, 1911.—Returned with subcutaneous abscesses of the scalp and frontal region. Abscesses opened and carious bone found. Two injections of staphylococcus vaccine tried; no obvious difference. Wounds healed. Patient discharged well.

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Addendum.

Since the above article was written I have found an allusion to osteomyelitis in "Nasal Polypus," by the late Edward Woakes, which, in view of the early date of the remarks (1887), I quote in full. Speaking of the tendency of ethmoidal disease to involve the orbital wall, he says (p. 24):

"Instances are reported, though their occurrence is rare, in which abscess of the orbit, with or without consecutive necrosis of the frontal bone, followed by fatal meningitis, has accompanied the advance of the disease in this direction."

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