

Mucocele of the accessory nasal sinuses / by A. Logan Turner.

Contributors

Turner, A. Logan 1865-1939.
Royal College of Surgeons of England

Publication/Creation

Edinburgh : Young J. Pentland, 1907.

Persistent URL

<https://wellcomecollection.org/works/ffk27nqp>

Provider

Royal College of Surgeons

License and attribution

This material has been provided by This material has been provided by The Royal College of Surgeons of England. The original may be consulted at The Royal College of Surgeons of England. where the originals may be consulted. Conditions of use: it is possible this item is protected by copyright and/or related rights. You are free to use this item in any way that is permitted by the copyright and related rights legislation that applies to your use. For other uses you need to obtain permission from the rights-holder(s).

With kind regards.

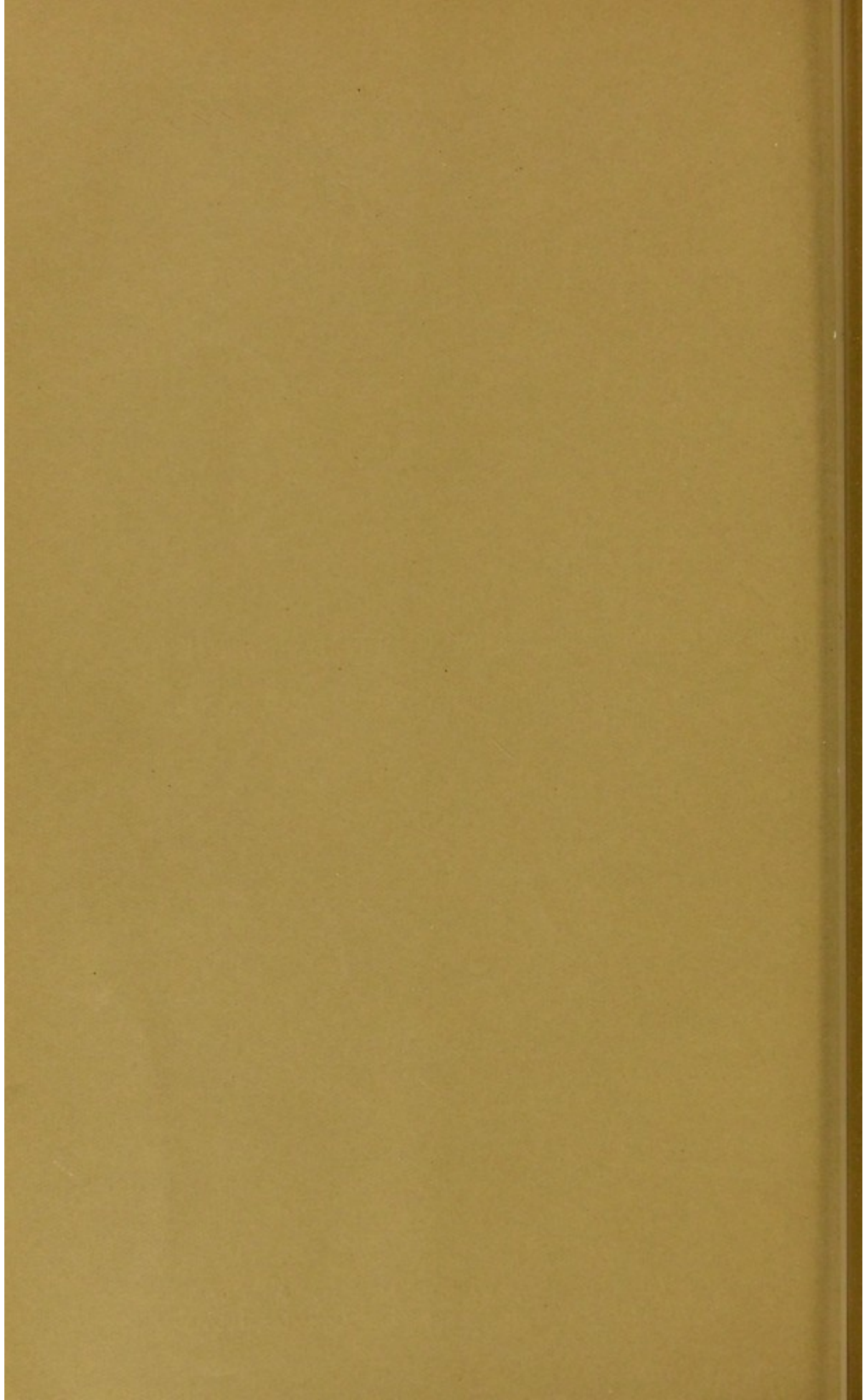
15

MUCOCELE OF THE ACCESSORY NASAL SINUSES.

By A. LOGAN TURNER, M.D., F.R.C.S.E., F.R.S.E.



*Reprinted from the EDINBURGH MEDICAL JOURNAL. Edinburgh and
London, Young J. Pentland, November and December, 1907.*



MUCOCELE OF THE ACCESSORY NASAL
SINUSES.



MUCOCELE OF THE ACCESSORY NASAL SINUSES.

By A. LOGAN TURNER, M.D., F.R.C.S.E., F.R.S.E., *Surgeon, Ear and Throat Department, Royal Infirmary, Edinburgh; Lecturer on Diseases of the Ear, Nose, and Throat, Edinburgh University.*

(PLATE VII.)

IN the *Edinburgh Medical Journal* for October, November, December 1903, and January 1904, I contributed an article upon the "Pathology of 'Bone Cysts' in the Accessory Sinuses of the Nose." Since its publication I have had the opportunity of treating several additional cases of a similar nature, and it is my intention, therefore, to record here all the cases of this kind which have come under my care.

By the term "mucocele" of a sinus, we understand a distension of one or more of the walls of the cavity, and an accumulation within it of a mucous secretion resulting from obstruction of its outlet. The accessory sinuses which may be thus affected are the frontal sinuses, the ethmoidal cells (usually the anterior group), including the air space in the inferior ethmo-turbinal or middle turbinated bone, and the maxillary sinus or antrum of Highmore. Mucocele of the sphenoidal sinus does not appear to have been

described, and no case of the kind has come under the writer's notice. The distension of the antrum with occlusion of the ostium maxillare is a very rare condition, the possibility of its occurrence, indeed, being disputed by some.

Cases of mucocele of the accessory nasal sinuses naturally fall into two groups. First, those in which the chief clinical phenomena are associated with the orbital cavity; and, secondly, those in which the symptoms are mainly referable to the nasal cavity. To the former belong the affections of the frontal sinus and the anterior ethmoidal cell labyrinth situated in the lateral mass of the ethmoid bone. In the latter must be placed mucoceles of the inferior ethmo-turbinated bone and the maxillary sinus. Only the cases contained in the first of these subdivisions will be dealt with in this paper.

They are ten in number. Of these, the frontal sinus was affected in seven, the ethmoidal labyrinth in three; the right frontal sinus was the seat of the affection in six, and the left sinus in one; the right ethmoidal labyrinth in two, and the left in one instance. The preponderance of the frontal sinus affection in this series merits special notice, as a study of the literature of the subject goes to show that mucocele of the ethmoidal air cells forms the larger proportion of recorded cases.

Of the ten patients, seven were females and three males; their ages varied from 18 to 52 years. Five were met with in early adult life, at the ages of 17, 18, 19, 28, and 33 respectively. These figures, however, do not accurately represent the age at which the affection first showed itself, as the three patients aged 17, 18, and 19 respectively, when first examined—each of them with ethmoidal mucocele—had noticed the orbital swelling so characteristic of the condition, five, one and a half, and nine years prior to seeking advice. There was clinical evidence, therefore, of the existence of the affection at 12, 16½, and at 10 years of age. The ages of the remaining five were 37, 43, 44, 51, and 52 respectively. In the first two the orbital swelling was observed two and a half and four years before the patients were examined; hence, in at least seven of the whole series there was actual evidence of the mucocele before the age of 40.

CASE 1.—*Mucocele of right frontal sinus.*¹—J. K., a married woman, æt. 37, was admitted into the Eye Department, Royal Infirmary, under the care of Dr. George Mackay, in June 1903, complaining of a swelling in the right orbital cavity, and displacement of the eyeball. She had first noticed the swelling two and a half years before admission, and, with the exception of the increasing disfigurement caused thereby, she had had little or nothing to complain of. She had never had any pain or discomfort, nor had she felt any tenderness when touching the swelling. She had occasionally noticed the presence of slight mucous discharge from the right nasal cavity. Two years before her admission,

¹ Case published *Edin. Med. Journ.*, 1903.

Dr. Mackay of Aberfeldy, under whose care she then was, incised the orbital swelling, evacuated its mucoid contents, and allowed it to drain for a few days before closing the wound. As a result of this, the swelling was considerably reduced in size, but at a later date it again commenced to increase.

Examination, on admission in the month of June, showed that the right upper eyelid was considerably swollen throughout almost its whole length; the two palpebral fissures were no longer on the same plane, that on the right side being at a lower level. The patient could not raise her right eyelid, while the examiner, too, had some difficulty in lifting it from the underlying globe. The more prominent part of the swelling was situated below the middle and inner thirds of the supra-orbital margin, and it was covered by skin of a normal appearance. On palpation, it was found to be soft and fluctuating; there was no parchment-like feeling on palpation, nor could any bone be recognised as forming its wall. When the finger was carried downwards from the supra-orbital margin, it passed at once on to the soft fluctuating swelling in the upper eyelid. Pressure in this situation did not cause any discharge to pass into the nose, nor was any pain associated with digital examination.

The right eyeball was displaced downwards, outwards, and forwards, and the movements of the globe were to some extent restricted. Although light perception was present on the affected side, the patient had practically no vision in the right eye, owing to the presence of a well-marked staphyloma of the cornea.

Examination of the right nasal cavity showed nothing abnormal. There was no trace of pus or other secretion in the middle meatus, or elsewhere in the nose or in the naso-pharynx. A more searching investigation, with the aid of cocaine and adrenalin, revealed nothing further. The right middle turbinated body presented a somewhat large anterior extremity, and was certainly larger than that upon the left side, but the mucous membrane covering it was not hypertrophied. A fine probe could not be passed upwards in the direction of the naso-frontal canal.

The history of the case, in conjunction with the local appearances, led us to believe that the condition in all probability was one of mucocele of the right frontal sinus. Through a skin incision one inch in length, beneath and parallel to the supra-orbital margin, the sinus was explored. After division of the subcutaneous and muscular tissues, a quantity of purulent fluid escaped; no bone was met with in the dissection. The finger introduced through the wound entered a cavity which was evidently the frontal sinus, and it was found that the floor of the sinus had entirely disappeared. The supra-orbital margin formed a free bony edge above, and in a similar way the frontal process of the superior maxilla was unattached along its posterior margin, the lachrymal bone having evidently also been absorbed. The orbital tissues, therefore, constituted, so to speak, the floor of the sinus. On the posterior or cerebral wall the dura mater

was exposed over an area the size of a sixpence, the bone in this situation being destroyed. The sinus appeared to be of average dimensions, extending about half-way back along the orbital roof, while in its vertical direction it reached about three-quarters of an inch above the supra-orbital margin. The lining membrane of the cavity was thin and vascular, and did not present the appearance of a surface covered with granulations; it was very unlike the œdematous, almost polypoid character of the mucous membrane so frequently observed in cases of chronic suppuration of the frontal sinus. The normal communication with the nasal cavity could not be detected with the probe. An attempt was made to obliterate the cavity after curetting the lining membrane, but this did not prove successful. I therefore removed the middle turbinated bone, and made a large opening sufficient to admit the little finger between the sinus and the nasal cavity, and inserted a drainage tube through it. The condition was eventually cured, the eyeball returning to its natural position.

An examination of the fluid contained in the sinus was made by Dr. C. J. Lewis, who reported the presence of pus cells and streptococci in small numbers. Inoculation experiments proved the latter to be non-pathogenic.

CASE 2.—*Mucocele of the right frontal sinus*.—C. S., female, æt. 43, was admitted into the Royal Infirmary on 6th April 1905, complaining of swelling over the right eye, and a heavy sensation in the same situation. The history obtained from the patient was that four years ago she had first noticed a small swelling in the inner and upper part of the right orbital cavity, which slowly increased in size, without causing her any inconvenience. She could ascribe no cause for it, nor was there any history of nasal trouble. A few months after noticing the swelling, she consulted Dr. George Mackay, who prescribed an ointment for local application, and iodide of potassium internally. During this treatment the swelling in the orbit became less. She returned, however, to Dr. Mackay in February 1905, when she was referred to me from the Eye Department.

On admission to the Ear and Throat Department in the month of April 1905, the right eye was found to be displaced forwards, downwards, and outwards (Plate VII. Fig. 1). The swelling lay beneath the middle and inner thirds of the right supra-orbital margin in the position of the floor of the frontal sinus. At its peripheral part it presented a hard bony feeling, there being considerable thickening, probably due to periostitis. The centre of the swelling, on the other hand, was soft and fluctuating over an area the size of the end of the little finger. On palpation, one obtained the distinct impression that there was a gap in the bone. There was no pulsation detected either on inspection or on palpation. The patient had no disturbance with her vision; no diplopia was complained of. There was an entire absence of pain or any acute inflammatory phenomena. Examination of the nose revealed nothing abnormal.

Under general anæsthesia, an incision was made along the line

of the eyebrow, and when the soft parts were reflected downwards a clear serous-like fluid welled out. A large cavity, the right frontal sinus, had been opened into without the necessity of removing any bony wall. The fluid as it escaped pulsated markedly, as indeed did the whole eyeball. The frontal cavity passed for a very considerable distance upwards, also to the left across the mesial line, while its extension backwards along the roof of the orbit measured $1\frac{1}{2}$ in. A considerable area of the bony floor of the sinus had been absorbed. The cerebral wall of the sinus also showed a large area—at least the size of half a crown—from which the bone had disappeared. The dura mater was plainly seen pulsating, a fact which accounted for the marked pulsation of the fluid contained in the frontal sinus. The lining membrane of the cavity was thin. It was decided to postpone for a few days the making of an opening into the nose. The sinus was therefore lightly packed with iodoform worsted. It was found necessary to change the dressings over the wound twice daily at first, owing to the copious flow of blood-stained fluid which saturated them.

After an interval of eight days the patient was again anæsthetised, and a large opening was made between the sinus and the nasal cavity, a drainage tube being passed through the opening. The after-treatment of the case presented no special points of interest. The external wound was allowed to close after ten days. The tube was maintained in position for six weeks, and then removed through the nostril, the patient being instructed to wash out the sinus by means of a curved cannula. Six months after the operation she reported that there was no discharge from the nose, and that her eye was in good position.

The fluid which escaped from the sinus in this case closely resembled in appearance cerebro-spinal fluid. Fehling's test applied during the operation was negative. From a culture made on agar, the *Staphylococcus pyogenes albus* was obtained. No chemical report was, unfortunately, obtained, but the fluid presented none of the physical characters of mucus.

CASE 3.—*Mucocele of the right frontal sinus*.—C. K., a female, æt. 33, was admitted to the Ear and Throat Department on 18th April 1904, complaining of a more or less constant discharge from a small opening in the inner part of the right upper eyelid. The history obtained was as follows:—Eight years ago, in 1896, she had noticed a small swelling, the size of a pea, occupying the inner third of the right upper eyelid, just above the inner canthus. She did not suffer any pain; there was no discoloration of the skin; there was no nasal discharge. The swelling increased somewhat in size during the next three years, and some displacement of the eyeball was observed. She then consulted her medical attendant, who incised it. A thickish non-purulent fluid was evacuated. The wound, however, did not heal. Six months later a free incision was made under chloroform, and the con-

tents of the cavity evacuated. The wound still remained unhealed, the patient neglecting to take any care of herself.

When admitted under my care, in April 1904, there was a small circular opening in the right upper eyelid situated immediately above and slightly external to the inner canthus. A granulation protruded through it and a drop of pus oozed out beneath the granulation. A slight swelling, which was of bony consistence, was observed above and internal to the canthus (Plate VII. Fig. 2). The eyeball was slightly displaced downwards, forwards, and outwards. A probe could be passed through the opening for a distance of three-quarters of an inch, and impinged upon bone covered with granulation tissue. On its withdrawal, a considerable quantity of pus oozed out. There was no pus seen in the right nasal cavity. The anterior end of the middle turbinated body was in contact with the septum, which was slightly deflected to the right. The uncinatè process was visible, but there was no bulging of the ethmoid labyrinth into the cavity of the nose.

Under chloroform anæsthesia the anterior end of the right middle turbinated was removed. An incision was made in the line of the eyebrow, and the upper eyelid turned down; the floor of the frontal sinus with an opening in it, was in this way exposed. This opening was considerably enlarged by the removal of the greater part of the floor and a portion of the anterior wall of the sinus. The cavity, which was a frontal sinus of average dimensions, contained pus and granulation tissue, two short pieces of gauze, and a thin drainage tube rather more than 2 in. in length. The sinus was carefully curetted. The ostium frontale could not be found with a probe, so that it was necessary to make a large communication with the nasal cavity by the aid of the burr. A large drainage tube was inserted. The skin incision was accurately stitched, after packing the cavity with iodoform worsted, and bringing the end of it out through the old fistulous opening. A cure resulted without any incident of note.

CASE 4.—*Mucocele of right frontal sinus.*—J. S., æt. 44, a golfgreen keeper, was admitted to the Royal Infirmary on 1st November 1905, complaining of a stiffness and swelling above the right eye, some discharge from both nostrils with obstruction on the right side, and impairment in the sense of smell. During the last two months he had also been conscious of seeing double. The history did not throw much light upon the etiology of the condition. The patient had always been a healthy man, but he suffered from typhoid fever five years before his admission. He had never had any lung trouble. For some years before the attack of typhoid fever he had suffered from severe pain over the right eye at intervals. In June of the present year his right eye commenced to water, especially after reading, and in August (that is about three months before his admission) he first noticed the displacement of the right eyeball. After his attacks of pain in the eye he would notice a slight discharge of somewhat thin watery secretion from the right nostril.

Examination revealed considerable proptosis of the right globe, with

outward and downward displacement. The swelling in the orbit occupied the inner and part of the middle third of the upper lid, extending outwards to just beyond the supra-orbital foramen. It was soft and fluctuating. There was no discoloration of the skin. Examination of the nose showed an enlargement of the bulla ethmoidalis, the uncinata process being visible immediately below and external to it. There was no pus. Dr. W. G. Sym reported that there was no ocular paralysis, but that diplopia was present in both the vertical and horizontal planes. Vision was otherwise normal.

On 6th November an eyebrow incision was made, and the right frontal sinus was opened into without the necessity of removing any bone, as the whole of the floor of the sinus had been absorbed. The fluid which escaped was slightly opalescent and of a sticky, mucoid character. There was no absorption of the cerebral wall of the sinus, which was a cavity of more than moderate dimensions, the horizontal portion indeed extending backwards almost to the apex of the orbit. A probe was readily passed down through the ostium frontale into the nose. This opening was enlarged and a drainage tube inserted. The cavity was lightly packed with iodoform worsted, and the greater part of the skin incision was sutured. A fortnight after the operation the eyeball was in better position, and the patient no longer complained of double vision. The external wound was allowed to close, and the cavity was washed out by means of a cannula passed up through the drainage tube. The drainage tube was kept in the cavity from three to four months, the patient continuing to wash upwards through it. In April 1906 there was little or no disfigurement as the result of the operative procedure. He still complained of some discharge from the right nostril, but was otherwise well.

The examination of the fluid in this case was made by Dr. Stuart M'Donald, who reported that it consisted mainly of blood-stained mucus in which there were practically no cells or any bacteria. Cultures proved to be negative, no growth being obtained. Some caseous-looking material which was removed from the cavity close to the orifice of the sinus consisted of inspissated pus infiltrated with lime salts, apparently carbonates. There were also some degenerated leucocytes present. The lining membrane of the sinus was thin except in the neighbourhood of the ostium.

CASE 5.—*Mucocele of the right frontal sinus.*—M. S., æt. 52, was seen with Dr. M'Bride on 23rd January 1907. There was little or no history bearing on the origin of the case. The patient had always considered herself as particularly free from nasal trouble. She had never been conscious of any discharge from the nose, and had received no injury. Apparently she had only noticed a swelling of the right upper eyelid for six weeks before she consulted Dr. George Mackay, who told her that there was no ocular trouble. There was no diplopia, no ocular paralysis, and no impaired vision; nor was any pain complained of.

When first seen by Dr. M'Bride there was merely some œdema of the right upper lid in its middle and inner thirds; this narrowed the palpebral fissure; no change could be noted in the deeper parts. There was no tenderness and no pain on palpation, nor had she been conscious of any discomfort in the right eye.

Examination of the right naris showed the middle turbinated region to be narrowed, the septum being deflected to the right with the middle turbinated pressed against it; there was no secretion visible in the middle meatus. At this time Dr. M'Bride could see the uncinatè process. The left nasal cavity presented no abnormal appearances. Five weeks later there could be detected, in addition to the œdema, a soft semi-fluctuating swelling occupying the outer part of the inner third and the inner part of the middle third of the orbital roof. It lay altogether below the supra-orbital margin. There was no discoloration of the skin, and no pain on palpation. There was no thin bony wall covering the softer area, careful palpation giving the impression that a defined bony edge could be detected at its periphery. There was no periosteal thickening round about it. The soft swelling gave the impression that the floor of the frontal sinus had given way.

The illumination of the right side showed a larger sinus area than on the left, and the intensity of the former was rather greater than on the left side.

The outer wall of the middle meatus now bulged slightly into the nasal cavity, making it impossible to pass the thin blade of a pair of Luc's forceps or the wire of a snare between it and the middle turbinated. There was no abnormal secretion.

On 23rd January an external operation was performed. An incision was made through the soft parts immediately below and parallel to the right eyebrow; through this there welled a greenish-brown, thick slimy fluid; after turning down the upper eyelid, a large aperture was found in the floor of the frontal sinus; indeed, with the exception of a narrow ledge of bone forming the most posterior and deepest part of the floor, the lower wall had been absorbed. The aperture was at least the size of a shilling, and was bounded anteriorly by the supra-orbital margin. The sinus was of more than average size, its dimensions corresponding very accurately to the area of illumination. Notwithstanding the thick consistence of the fluid, the illumination was good. There was no absorption of bone on the cerebral wall of the sinus; there was no pulsation of the fluid as it escaped. The lining membrane of the cavity was rather thicker than what is usually seen in these cases, and gave the appearance of being slightly inflamed.

The opening in the floor was enlarged in the direction of the ostium frontale, and a small portion of the anterior wall of the sinus was also removed to facilitate after-treatment. The lining membrane was not interfered with. The ostium frontale could not be found with the probe, so that it was necessary to force an opening into the nose by means of burrs.

A drainage tube was passed down into the nasal cavity; the external wound was closed with the exception of the inner third, through which was brought the end of a gauze packing. The after-treatment consisted in washing out the cavity daily through the inner end of the skin

incision for a fortnight. The wound was then allowed to close. The drainage tube was kept in the ostium of the sinus for six weeks, irrigation being carried out through it. At the end of this period there was merely a trace of discharge, which finally disappeared.

CASE 6.—*Mucocele of the right frontal sinus.*—Mrs. C., æt. 51, was recommended to the Ear and Throat Department by Mr. George Berry on 14th June 1905. She complained of a swelling above the right eye, slight pain, and double vision. The history obtained was that she had been struck above the right eye by a cap which was thrown at her. The accident occurred five or six months before her admission, and was followed by the swelling now noticed above the right eye. The patient was certain that there was nothing of this kind visible before the accident. Occasionally she had had slight discharge of mucus from the right nostril, but it was not followed by any change in the size of the swelling.

Below the inner third of the right supra-orbital margin, and occupying the upper and inner angle of the orbit, there was a swelling. The skin covering it was not discoloured; there was no tenderness. On palpation it presented a somewhat tense elastic feeling, but fluctuation could be detected. The eyeball was slightly displaced downwards and outwards. Dr. W. G. Sym reported that there was some fulness of the veins of the disc on the right side. He did not regard the diplopia which the patient complained of as being due to weakness of the right superior oblique muscle. Examination of the nose showed very little that was abnormal. There was slight deflection of the septum to the right; the middle turbinated body was not enlarged; there was no pus, nor were any polypi visible.

The right middle turbinated was removed under local anæsthesia, and on 16th June an external operation was performed. A curved incision through the soft parts was followed by an escape of bad-smelling yellowish-green pus. The floor of the frontal sinus was found completely absorbed, there being no bone left below the supra-orbital margin. There was no absorption of bone either in the posterior or anterior wall of the sinus. A probe could be readily passed down into the nose through the normal opening. This was enlarged, and a drainage tube inserted through it into the nasal cavity. The sinus was one of average dimensions.

During the after-treatment the drainage tube was prematurely removed and had to be reinserted from above through the sinus, as it was found impossible to wash out the cavity by way of the nose without it. At a later date the tube was removed, and the patient taught to wash out the sinus by means of a cannula passed through the nostril. After a few months of treatment, the condition was cured.

The fluid, which was undoubtedly purulent, was found to contain some very minute cocci, some in pairs, others in chains, and a number of irregularly staining bacilli. A culture examined after forty-eight hours' incubation contained no cocci, but a large and pure growth of a bacillus indistinguishable from the Klebs-Löffler bacillus was present.

Exception might possibly be taken to the inclusion of this case

under the above title. We are of opinion, however, that it may justly be included, and that it is an example of a mucocele the contents of which had become secondarily infected. The possibility of such was increased by the patent condition of the ostium frontale. The blow from the soft cap was not an etiological factor, but served to draw the patient's attention to her eye. The absence of all acute inflammatory phenomena, the negative character of the nasal examination and the complete absorption of the bony floor of the sinus lead us to classify this case along with the others described in this paper, on account of the similarity which it presents to them in its clinical features.

CASE 7.—*Mucocele of the left frontal sinus.*¹—C. H., a married woman, æt. 28, was sent to me in October 1901, at the Eye, Ear, and Throat Infirmary, by Dr. G. W. Sym, whom she had consulted on account of a swelling in the inner angle of the left orbit. She had first noticed it about nine months before seeking for advice. It had slowly increased in size, but had never caused her any pain or inconvenience, with the exception of what was associated with the displacement of the eyeball. With the gradual increase in the size of the swelling, the left eyeball had become displaced forwards, outwards, and slightly downwards, and a certain degree of diplopia or double vision was then complained of. At no time, either before the appearance of the swelling or since it was first noticed, was there any discharge from the left side of the nose; there was no interference with nasal respiration.

On examination, one was struck with the amount of protrusion of the left eyeball. The exophthalmos was the most marked feature in the case, as the swelling in the upper and inner angle of the orbit was only slightly visible on inspection. There was no discoloration of the skin. About 5 mm. below the inner third of the supra-orbital margin, in the area corresponding to the thinnest part of the floor of the frontal sinus and extending downwards to the inner canthus, there could be felt a small oblong swelling. It was impossible from its small size to palpate it with more than the end of one finger. It was of a soft, semi-solid consistence, yielding slightly on pressure, but no crackling sensation could be detected. Manipulation caused no tenderness. It was difficult to estimate how far the swelling extended backwards along the roof of the orbit. Transillumination of the frontal sinus was not practised.

Rhinoscopic examination gave negative results; there was no trace of pus or any secretion in the middle meatus, or indeed in the left nasal cavity. There were no polypi and no thickening of the nasal mucous membrane or enlargement of the middle turbinated bone. The absence of any abnormal intranasal condition was in keeping with the patient's own statement regarding her freedom from nasal symptoms. Ophthalmoscopic examination was also negative, and with the exception of the diplopia there was no interference with vision.

The case was regarded as probably one of distension of the frontal sinus with accumulation of mucus within the cavity, and it was decided to explore with the object of ascertaining the exact nature of the condition. Under chloroform anæsthesia an incision was made

¹ Published in the *Edin. Med. Journ.*, December 1903.

immediately below the inner third of the left supra-orbital margin, and carried downwards to the inner canthus. The soft parts having been retracted and the bone exposed, a portion of the anterior wall of the sinus was removed. The bone appeared thin, but there was no reason to suppose that it was otherwise than of normal structure. A white membrane, closely resembling the dura mater in appearance, was exposed; through an opening made in this there escaped a small amount of clear fluid, not unlike cerebro-spinal fluid. On incising the membrane further, a quantity of thick, tenacious, opalescent white fluid, not unlike soft brain matter, was evacuated. A larger area of bone, including that portion which formed the swelling in the orbital roof and which consisted of the thinned bony floor of the frontal sinus, was also removed. The same mucoid-like fluid continued to well out in great quantity; it in no way resembled pus. A probe could now be passed backwards into the cavity for a distance of nearly 2 in. along the roof of the orbit, apparently reaching as far as the apex of that space. In an upward and outward direction the probe passed into the vertical portion of the frontal bone, and the extent of the cavity in this situation appeared to be greater than what we are in the habit of regarding as a sinus of average dimensions. There was no absorption of bone in any of the walls of the sinus. No communication could be obtained by means of the probe with the nasal cavity; consequently it was decided to make no attempt, in the meantime at any rate, to establish one. The lining membrane of the sinus hardly appeared to be altered, forming a very thin structure. It was carefully curetted, and the cavity was then packed with iodoform worsted, the end of the dressing being brought out through the external opening, which was sutured in its outer part. So large was the cavity that it was possible to introduce from 4 to 5 ft. of worsted dressing.

Great improvement in the position of the eyeball immediately followed the operation. The external strabismus disappeared, although some protrusion of the globe still remained. In the course of a little time it became evident that satisfactory healing would not take place, consequently a second operation was performed. A large opening was then made into the nose; the eyebrow incision was allowed to heal in a few days, and irrigation of the cavity was carried out for a considerable time through the nose until all discharge had ceased. The patient reported herself in June 1903. The orbital swelling had disappeared, the axis of the eyeball was correct, and vision was normal. A small scar and some tucking in of the skin in the line of the cicatrix was the only evidence of previous interference (Plate VII. Fig. 3). There was no nasal discharge.

The fluid evacuated was unfortunately not preserved for examination in this case.

CASE 8.—*Mucocele of the right ethmoidal labyrinth*.¹—J. S., æt. 18, was admitted to the Royal Infirmary in June 1903, complaining of a swelling at the inner angle of the right eye. He stated that, about eighteen months before admission, he had noticed a small lump about the size of a pea in this situation, and that it had gradually increased until it had reached the size of a bean. It had never caused him any pain or the slightest inconvenience. At a later period than that at

¹ This case was published in part in the *Edin. Med. Journ.* for November 1903.

which the orbital swelling was first noticed, he was conscious of some discharge from the right side of the nose, a condition which was not present on the left side. He described it as being like pus, but the history with regard to this point is somewhat indefinite.

Examination of the patient showed that a small swelling occupied the inner third of the right upper eyelid, immediately above the inner canthus (Plate VII., Fig. 4). The skin covering it was of normal appearance and was freely movable upon it. At its anterior part the swelling was firm to the touch and apparently of osseous consistence; it formed in this situation a vertical ridge, which was somewhat sharply defined. Behind and external to this a semi-fluctuating elastic sensation was readily obtained on palpation, which did not produce any pain.

The eye movements and the vision were perfectly normal, and there was no proptosis noticeable, nor was the globe displaced in any direction. Examination of the right nasal cavity did not reveal any abnormal condition. There was no purulent or muco-purulent discharge. The right middle turbinated bone was somewhat larger than its fellow on the opposite side, but its size was not inconsistent with a normal condition; its appearance did not suggest any cystic distension. The mucous membrane covering the middle turbinated was slightly thickened, and lay in contact with the outer wall of the middle meatus. Transillumination of the sinuses gave the following appearances:—The right antrum and right frontal sinus failed to transmit the light, while the left antrum and left frontal sinus were brilliantly illuminated.

Mr. Berry, under whose care the patient was at that time, decided to open the orbital swelling. This was done through the fluctuating area, and the knife at once entered a cavity without encountering bone. There escaped from the opening thus made a quantity of somewhat sticky, white, opalescent fluid resembling the contents of a mucous cyst. There were no glistening particles observed in the fluid, such as one notices when cholesterin crystals are present. The probe passed into a bony cavity of very considerable dimensions, which extended both in the direction of the nasal chamber and also into the roof of the orbit. In this latter situation, the probe passed outwards and backwards for a distance of nearly 2 in. along the orbital roof. It could not be directed upwards towards the frontal sinus.

There was a slight mucous discharge from the wound for a few days; the orbital swelling for the most part disappeared, but the bony ridge, which we have described as lying anteriorly, persisted. Microscopic examination of the fluid showed that it consisted almost entirely of mucus, no pus cells being detected, nor were any cholesterin crystals found. No bacteriological examination of the fluid was made.

In this case the mucoid character of the contents of the cavity and its situation and limitations justified us in considering it to be a mucocele of the anterior ethmoid cell labyrinth. The fact that the probe could not be passed upwards into the vertical portion of the frontal bone in the region of the frontal sinus excluded the participation of that cavity. The marked extension of the bony cavity into the roof of the orbit was quite consistent with the

normal anatomy of the ethmoidal air cells in a certain proportion of skulls.

Some months later the swelling again formed in the inner angle of the orbit. At this time the outer wall of the middle meatus bulged somewhat into the lumen of the nasal cavity. By means of forceps a portion of the nasal wall of the ethmoidal labyrinth was removed. This was followed by an escape of thick mucoid fluid and the disappearance of the orbital swelling. There has been no recurrence.

CASE 9.—*Mucocele of the right ethmoidal labyrinth.*—A. T., æt. 17 years, was admitted into the Royal Infirmary in October 1905. The following history was obtained. At the age of 10 she had had scarlet fever, which was complicated with suppuration in both middle ears. Two years later she began to be troubled with tears running over the right cheek, and she noticed at the same time that the right side of the nose became blocked. A probe at that time was passed down the tear duct, but shortly after this a swelling showed itself at the inner canthus of the right eye. No further treatment was sought until two years later, when she again had probes passed down the tear duct, and indeed one was kept in the duct for six months. The obstruction in the right nostril had passed off, but had been followed by a good deal of nasal discharge.

Examination of the patient revealed the presence of a swelling in the region of the right inner canthus. There was no discoloration of the skin. The swelling was of hard, bony consistence, save at its most prominent part, where there was a soft fluctuating area. There was no displacement of the eyeball, nor did she complain of any visual trouble. Examination of the nose showed that the interval between the right middle turbinated and the outer wall of the middle meatus was filled up by a bony swelling which projected downwards and inwards. The probe could not find any entrance in this situation. There was no pus visible either on anterior or posterior rhinoscopy.

Under local anæsthesia, Dr. M'Kenzie Johnston made an opening through the nose into the bulging area above described by means of Grünwald's forceps, and a considerable quantity of non-purulent fluid was evacuated. At a later date, in Dr. Johnston's absence, owing to the persistence of the orbital swelling, I made an incision beneath the right supra-orbital margin, and turned down the upper lid structures. A small opening about the size of a sixpence was found in the bony wall of the ethmoid labyrinth, and a probe passed through it entered a cavity about the size of a partridge's egg. This cavity was apparently limited to the anterior ethmoidal region, as the probe could not be passed upwards behind the supra-orbital margin. The opening in the bone was considerably enlarged by means of forceps. The lining of the cavity was scraped and a large opening made into the nose, through which a drainage tube was passed. The secretion evacuated presented a somewhat opaque appearance and was gelatinous in consistence, and did not give the appearance of pus. Microscopical examination showed that it contained a little fibrin and clusters of polymorpho-nuclear cells and a few mononuclear cells; no pus cells were present. The skin incision

was not completely sutured, a small piece of gauze being inserted at one end. After removal of this, however, a fortnight later, the wound closed and the patient was taught to wash out the cavity through the tube in the nose. After removal of the nasal tube at the end of another month, she was able to wash the cavity out by means of a curved cannula. A year after the operation the patient reported herself as very well; there was no nasal discharge and no longer any swelling in the orbit.

CASE 10.—*Mucocele of the left ethmoidal labyrinth.*—W. R., æt. 19, first noticed a hard swelling at the inner angle of the left orbit nine years before admission to the Royal Infirmary. He consulted Mr. George Berry one year after the swelling appeared. It was then punctured, and, according to the patient's statement, fluid was evacuated. At that time he did not complain of any difficulty in his sight. When seen by me on 30th March 1905, eight years after his visit to Mr. Berry, the left eye was found to be considerably proptosed and also displaced outwards and somewhat downwards (Plate VII. Fig. 5). The swelling, which had never disappeared from the inner angle of the orbit, had increased markedly during the previous four days, and there was very considerable œdema of both upper and lower eyelids, with reddening of the skin. On palpation the swelling was painful, of soft consistence, and fluctuating. It was evident that an abscess had formed in the orbital fossa.

Examination of the left nasal chamber revealed the presence of a large globular-like middle turbinated filling up the nasal cavity to a considerable extent, and making it impossible to see the outer wall of the middle meatus. There was no pus seen in the nasal cavity. The right nasal chamber showed no abnormality, and there was nothing pathological to be noted on posterior rhinoscopy.

Under cocaine and adrenalin anæsthesia the left middle turbinated was removed; this was followed by a copious flow of pus, and when pressure was made upon the orbital swelling externally, there was an increased flow of discharge into the nose, and diminution in the size of the external swelling. Under a general anæsthetic, a curved incision was made just below the left orbital margin down to the periosteum. An abscess cavity was opened, and on investigation it was found that a large opening existed in the inner bony wall of the orbit. The lachrymal bone and almost the whole of the os planum of the ethmoid was found to be wanting. The finger passed upwards through the nose readily reached this aperture in the bone. The ethmoid cell labyrinth appeared to have been converted into one large abscess cavity. There did not appear to be any evidence of a left frontal sinus; after curetting, a large drainage tube was passed down into the nose. The incision in the skin was sutured in part, some gauze packing being left at one end of the wound, and dressings were applied.

At first the after-treatment was carried out through the external wound, the abscess cavity being syringed out daily, but later the incision was allowed to close, all further treatment being carried out from the nasal side. After removal of the drainage tube at a later date, it was found necessary to remove more of the bony wall of the ethmoidal labyrinth by way of the nose, as the nasal opening had tended to close. Eventually a cure was obtained.

We must regard this case as one of long-standing mucocele of the ethmoid labyrinth, which had become acutely inflamed a few days before the patient's admission to hospital. The pain, with œdema and redness of the upper eyelid, was of sudden onset, and contrasted markedly with the condition which had existed for so many years.

CLINICAL FEATURES.—*The orbital swelling.*—These cases present many points of clinical and pathological interest which merit careful study. As a rule, a swelling in the orbital region is the first thing which draws the patient's attention to the existence of some abnormal condition, and consequently leads him to seek the advice of the oculist. Associated with the swelling, vision may be interfered with. One is at once struck with the slowly progressive character of the swelling, and with the almost complete absence of pain and local tenderness, or indeed with any alteration in the normal appearance of the skin in the orbital region. Inflammatory phenomena, whether in relation to the orbit or to the nasal cavity, are conspicuous by their absence. The occurrence of an acute pyogenic infection, however, such as had evidently taken place in Case 8, will alter the typical clinical picture and convert the mucocele into a pus-containing cavity. Pain, local tenderness, and œdema may then manifest themselves. Although the absence of orbital pain is a characteristic feature of these cases, the symptom is occasionally met with. In Case 2 the patient was conscious of a heavy sensation in the region of the eye; in Case 4 there was severe pain at intervals above the orbit, while in Case 6 occasionally slight pain was complained of. In the remaining seven cases, however, the patients expressed themselves as free from any such discomfort. Onodi⁽¹⁾ reports a case of ethmoidal mucocele in which there was sometimes slight pain in the frontal region, while Guisez's⁽²⁾ patient experienced a dull ache, which was increased when the head was bent forward. In Eversbusch's⁽³⁾ case there was considerable pain in the eye and in the head, but probably in Sprenger's⁽⁴⁾ patient this symptom was more strikingly marked than in any of the others, as the writer described it as a characteristic feature of the affection. In Kuhnt's patient neuralgic pain formed a prominent feature in the case.

The orbital swelling varies in its situation and size. It occupies the internal and upper part of the orbital cavity, lying immediately below the inner and sometimes even the middle third of the supra-orbital margin; this will depend to some extent upon its size, but mainly upon its origin in the frontal or ethmoidal sinus. The difference in the situation of the frontal and ethmoidal swelling may be too slight to be of any real differential diagnostic value. The extension of the ethmoidal cells in some instances into

the orbital plate of the frontal bone, that is to say, into the area usually occupied by the horizontal portion of the frontal sinus, must naturally weaken the diagnostic value of position. In distension of the anterior ethmoidal air space, however, the swelling as a rule occupies that part of the upper eyelid which lies immediately above the inner canthus and beneath the inner third of the supra-orbital margin. In Cases 8 and 9 (ethmoidal mucocele) it is described as occupying the inner third of the upper eyelid immediately above the internal canthus. In the frontal sinus cases, on the other hand, the swelling extends as a rule upwards and outwards in the upper eyelid, involving its middle and inner thirds. Plate VII. Figs. 4 and 1 illustrate the two conditions; Fig. 4 being an ethmoidal and Fig. 1 a frontal sinus mucocele. At the same time it is not always possible by external examination alone to arrive at a definite conclusion as to which sinus is affected; until the cavity has been opened and explored, the surgeon may remain in doubt.

While in the majority of cases,—and this remark applies to all of those recorded above,—the swelling is limited in its distribution to the upper eyelid, it must not be forgotten that in a few exceptional instances the area involved has been considerably greater. Thus, alteration in the shape of the nose may be met with. Lambert Lack⁽⁵⁾ describes a case of mucocele of both frontal sinuses, in which, in addition to a swelling in each upper eyelid, the bridge of the nose was much broadened, producing considerable disfigurement. L. Mayer⁽⁶⁾ quotes a case of very large cystic distension of the right frontal sinus, in which the swelling occupied the whole right half of the forehead. In Guisez's case of ethmoidal mucocele there was slight enlargement of the root of the nose, more marked on the side corresponding to the affected ethmoidal cells. In a case of a similar nature described by Moure⁽⁷⁾, the root of the nose, especially upon the left side, gave the appearance of the nasal bones having been pushed outwards. The external appearance in Moure's patient raised the suspicion in his mind that he might be dealing with a malignant tumour. From these observations it is evident that, while the swelling is confined as a rule to the upper eyelid, it may extend even further and involve both the forehead and the root of the nose.

Differential diagnosis.—The skin covering the swelling presents a normal appearance. An exception to this was found in Case 10, where, on account of an acute inflammatory infection of the mucocele, the eyelids had become reddened and œdematous. Even in this case, however, previous to the onset of the inflammation, the cutaneous covering showed no change from the normal. On palpation the following points may be recognised. One is at once struck with the absence of tenderness associated with the handling of the parts, differing in this respect from those cases of frontal and ethmoidal sinus affection in which an acute

inflammatory condition is present. The consistence of the swelling varies somewhat in different cases. In all the ten cases recorded here, a soft, elastic, or semi-fluctuating swelling was palpated; this varied in size from an area which could be covered by the end of the little finger to one upon which the ends of two fingers could be placed. It is sometimes possible to define a distinct bony edge at the margin of the softer portion of the swelling, clearly giving the impression that a gap exists in the bony wall of the sinus. Towards the periphery a thickened zone of osseous consistence is sometimes felt, resembling to the touch an exostosis. In four of the ten cases (2, 3, 4, 9) this could be easily felt at the anterior or nasal margin of the swelling, while at its centre or most prominent part the finger could palpate the softer elastic portion. The nature of these changes will be dealt with when we are considering the pathology of the affection. In a case of frontal sinus mucocele published by Luc⁽⁸⁾ the base of the swelling was of the nature of a hyperostosis; Hulke⁽⁹⁾ describes the local condition in one of his cases as follows:—"The swelling had a bony firmness, and its nasal border was continuous with the nasal process of the superior maxilla . . . above this hard prominent part of the tumour, between it and the eyeball, a deeper, rounder, elastic portion could be felt." Griffiths⁽¹⁰⁾ states in the description of his case, that the swelling was hard and craggy, resembling an exostosis, save in one situation where fluctuation was felt; and Jessop⁽¹¹⁾ notes that the bone both at the upper and lower margins of the swelling was thickened and nodulated. It is evident from this description that a difficulty may arise in differentiating the orbital swelling from an exostosis, especially in the earlier stage of the affection before a fluctuating area can be palpated. The exostosis too may have its attachment within the frontal sinus. The presence of the soft elastic area, however, is a valuable aid in the diagnosis of a mucocele of the sinus, indicating as it does that the bony wall of the cavity has become absorbed, and that its contents are in contact with the orbital tissues. Even before the bony shell has disappeared, there may be a slight degree of compressibility not apparent in an exostosis or fibrous tumour, which also assists in the diagnosis. In Case 7 the swelling was of a soft, semi-solid consistence, yielding slightly on pressure. It was found at the operation that the floor of the frontal sinus was very thin, but had not given way. The parchment-like crackling of the thin bony wall, which has been described in connection with dental cysts, was not present in this case, the only one of the series in which absorption of the bone had not taken place.

Cystic dilatation of the tear sac may occur, and simulate to some extent a sinus mucocele. In the former the swelling may be made slightly smaller by pressure, the mucus being expressed into the nose. Again, the tears do not escape normally and tend to flow over on to the cheek, though, as we shall see, epiphora may

occur in connection with a mucocele of the sinus. Dermoid cysts occur rarely in this region, being more common in the outer angle of the orbit; as they are of congenital origin, the history of the case will assist in clearing up the diagnosis. The dermoid cyst, however, may be incorporated with the periosteum and invade and absorb the bony wall of the sinus, finally expanding it. Steiner refers to a case of the kind which is reported by Gilibert; but the meagre account that is given does not seem to justify any conclusion being drawn as to its exact nature.

It is questionable whether all the cases which have been described and figured as simple distensions of the frontal sinus are really such, and whether a diagnosis of malignant disease would not have been more applicable to the condition. Luc⁽¹²⁾ has published a case which presented appearances more or less identical with those of mucocele of the frontal sinus; but, after opening the distended cavity, he found, in addition to a small quantity of opalescent colloid fluid, a substance which proved to be of a sarcomatous nature. Prochnow⁽¹³⁾ also has related two cases of distension of the frontal sinus, both of which are of very considerable interest in this connection. In the first case, the after-history went to prove that a malignant condition was present. In the second, operation disclosed the presence of an osteoma growing from the interior of the frontal sinus. In Langenbeck and Barchhausen's patient, a young girl, æt. 17, the swelling extended upwards on to the forehead as high as the coronal suture; the final history of this case would be one of considerable interest. Brun describes and figures a case of enormous distension of the left frontal sinus in a very young girl. At the operation a quantity of bloody serum escaped from the cavity. The swelling continued to increase in size, headaches supervened, the eye became implicated, and the patient rapidly lost health and succumbed. Although no microscopic data are furnished, the clinical history of the case suggests the existence of a malignant condition.

Displacement of the eyeball.—A varying but by no means infrequent result of the accumulation within the frontal and ethmoidal sinuses is to be found in an alteration in the position of the eyeball upon the affected side. In seven of the ten cases here detailed this was observed. Displacement was present in six of the seven cases of frontal mucocele, being absent only in Case 5, in which the orbital swelling had merely been noticed for six weeks; in the cases in which there was displacement, the swelling had existed for a much longer period. Displacement of the eyeball was observed in one of the three cases of ethmoidal mucocele, namely, in Case 10, in which the acute inflammatory phenomena had developed. In five of the seven cases the displacement was forwards, downwards, and outwards; in one forwards and downwards, and in one outwards and downwards. Alteration in the

position of the eyeball depends primarily upon the size of the orbital swelling; the variety of the displacement will be influenced by the position of the swelling in the wall of the orbit and by the extent to which the affected sinus is developed along the roof of that cavity. In the three cases in which there was no displacement, the orbital swelling was a small one. The forward displacement or proptosis, which is rather a characteristic feature, and which was observed in six out of the seven instances, is undoubtedly due to the fact that the affected sinus extends backwards for a considerable distance along the roof of the orbit, so that when the mucous contents escape into the orbital cavity after the bony floor has given way, the eyeball is projected forwards. In all the cases with proptosis, the backward extension of the sinus towards the apex of the orbit was clearly evident at the operation. Proptosis is not confined to the cases of frontal sinus mucocele. It occurs too where the ethmoidal cells are affected. It was present in Case 10, and has been noted in other recorded cases as a frequent phenomenon. We have already indicated how the ethmoidal cells may extend outwards and backwards into the roof of the orbit, so that it is not difficult to understand how proptosis of the eyeball may accompany both the ethmoidal and frontal affections. One must be careful, therefore, not to attach too much diagnostic importance to the variety of displacement met with in these cases. Undoubtedly in frontal cases a downward displacement is usually present,—it accompanied all the six cases in this series,—while in ethmoidal mucocele it has been much less frequently noted. As a consequence of the orbital swelling and displacement, the palpebral fissure is narrowed and occupies a lower plane than that of the opposite non-affected side. In a case recorded by Silcock⁽¹⁴⁾ the pupil upon the affected side lay upon a plane corresponding to the mid point between the root of the nose and its tip. Killian⁽¹⁵⁾ quotes the cases of Barckhausen and Garreau, in which the eyeball was displaced downwards to the level of the tip of the nose.

Notwithstanding the swelling and the alteration in the position of the globe, the movements of the eyeball may not be interfered with at all, or only to a slight extent. In Case 1, where there was forward, downward, and outward displacement, the movements of the globe were slightly restricted, but in none of the other cases was any limitation in movement noted. Even in Silcock's case the ocular movements were remarkably good, with the exception of upward rotation.

Disturbance in vision. — When interference with vision is met with in these cases it takes the form of diplopia, but even when there is considerable displacement of the globe this functional derangement may not be present. Of the ten cases of mucocele recorded here, seven were associated with an alteration in the position of the globe, yet in only three of them was double

vision complained of. This percentage is a little fallacious, because it must not be assumed that in the remaining four there was no diplopia; in one instance the patient was blind on the affected side as the result of a staphyloma, while in another no note had been made as to whether diplopia existed or not. In the remaining two, however, there was no diplopia associated with the displaced eyeball. In none of the three cases in which there was no displacement was any double vision complained of. We have not met with any other disturbance of vision. The fundus does not show any pathological change as a rule. In only one of the series Sym noted some fulness of the veins of the disc on the affected side. In Ewetzky's⁽¹⁶⁾ patient the papilla was œdematous, and the veins hyperæmic. Eversbusch noted a greater tortuosity of the veins, especially in the lower half of the papilla. The normal condition of the fundus in the cases of proptosis due to distension of the air sinuses is of assistance in diagnosis. In retrobulbar tumours associated with exophthalmos there is implication of the optic nerve with alteration in the ophthalmoscopic appearances. Consequently, when there is some doubt as to the cause of the proptosis, the normal appearance of the fundus would be against the presence of a retrobulbar tumour.

Epiphora.—I wish to draw attention to an early symptom complained of by two of the patients, the one with a frontal and the other with an ethmoidal mucocele (Cases 4 and 9). In the former, the eye upon the affected side commenced to water especially after reading, three months before the patient noticed any change in the position of the eyeball, indeed it was the first definite symptom complained of. In Case 9, a mucocele of the right ethmoidal labyrinth, the patient first sought advice on account of the tears running over her cheek. Probes were passed down the tear duct, and not very long afterwards she observed a swelling at the inner canthus of the right eye. In both these cases, therefore, epiphora preceded the appearance of the orbital swelling. It is possible that more careful questioning of the other patients might have elicited the fact that watering of the eye had been noticed in the earlier history of their complaint. A search through the literature dealing with this form of sinus affection supplies us with further reference to this clinical phenomenon. In a case of ethmoidal mucocele described by Gibert⁽¹⁷⁾ watering of the eye was the first symptom. In one of Hulke's patients epiphora had been an early symptom. Killian, however, in his description of this affection, makes no reference to the symptom. Guisez's patient, however, also with an ethmoidal mucocele, complained of the eye on the affected side watering; this was not the first symptom, as the patient had already noticed that the upper eyelid had become swollen at its inner end, and that sometimes the vision in the corresponding eye was impaired. In Gibert's case epiphora seemed to be coincident with the appearance of a very

small swelling at the inner angle of the orbit. This case also was one of ethmoidal mucocele. As the orbital swelling increased in size, the watering of the eye became more profuse. In Baurowicz's⁽¹⁸⁾ case of ethmoidal mucocele there was a considerable degree of epiphora, but this was associated with pretty marked displacement of the eyeball outwards and forwards. The same remark applies to Farlow's patient⁽¹⁹⁾, in whom the eyeball was displaced outwards, forwards, and downwards, and the eyelids were swollen and œdematous. There had been an overflow of tears for some time. In Compaired's case⁽²⁰⁾ there was also watering of the eye. The main interest of this symptom lies undoubtedly in its existence in those cases in which there is no other clinical sign suggesting a sinus affection. The cause of the epiphora at this stage is not so easy to understand. At a later stage, when a swelling has already formed at the inner angle of the orbit in the region of the canthus, the association of epiphora with the swelling might very naturally lead to a diagnosis of cystic dilatation of the tear sac, the result of a catarrhal inflammation. In the latter condition, the swelling may very often be made smaller by pressure, the mucus being expressed downwards into the nasal cavity, or outwards through the puncta.

EXAMINATION OF THE NASAL CAVITY.—A routine examination of the interior of the nose must be made in all these cases. This may prove entirely negative, or may be of assistance in diagnosis. Careful inquiry into the history sometimes elicits the fact that the patient has been conscious of discharge from the nostril upon the affected side at some period in the course of the affection. Thus in five of the ten cases in the series, a mucous discharge had been noticed. In only one of these apparently was the discharge observed before the swelling appeared in the orbit; this occurred in Case 4, that of the patient to whom special reference has already been made in connection with the occurrence of severe attacks of pain above the eyes. The discharge of mucus was noticed after such an attack. In the remaining four cases, occasional slight discharge occurred at intervals. In none of them, however, was any alteration apparent in the size of the orbital swelling. In no instance did it appear to be of a purulent nature. In none of the ten cases of the series was any nasal discharge observed on rhinoscopy; the absence of any abnormal nasal secretion is indeed one of the characteristic features in these cases.

The intranasal appearances vary in cases of mucocele. The nasal examination may be quite negative and give no additional information regarding the diagnosis. In six of our cases no abnormality was observed, the interior of the nose upon the affected side presenting a perfectly normal appearance. In the remaining four, however, the following points were noted. There was a distinct bulging of the outer wall of the middle meatus into

the nasal cavity in three of the cases, one a frontal, the other two ethmoidal sinus affections (Cases 5, 8, 9). In the two latter, the removal of a portion of the bony wall of the nasal swelling was followed by an escape of the mucoid contents of the affected cavity, with consequent diminution in the size of the orbital swelling. In the fourth case (No. 10) upon the removal of the large globular middle turbinated bone, a quantity of pus was evacuated. Attention has already been drawn to the acute pyogenic infection of this ethmoidal mucocele. It is probable that here, just as in a case reported by Bayer, the middle turbinated air space was involved along with the cells of the anterior ethmoidal labyrinth.

A study of the various reported cases emphasises the points to which we have just drawn attention. In some, the nasal examination is negative; in others, again, there is a definite relationship between the swelling in the orbit and that in the nasal cavity. Lothrop⁽²¹⁾ records a case of frontal mucocele in which the middle turbinal was pushed inwards against the nasal septum. On removal of a portion of the former, a polypoid-like mass protruded, consisting of a thin sac containing about an ounce of thick, viscid fluid. The escape of this was followed by a diminution in the size of the orbital swelling. In another case reported by Dunn⁽²²⁾, pressure upon the orbital prominence caused a flow of sticky secretion into the nose. Baurowiez describes a case of ethmoidal mucocele, in which the relation between the orbital swelling and a bulging of the outer wall of the middle meatus into the nasal cavity was very clearly defined. Pressure upon the latter with a probe gave a sensation of elasticity, and without the application of any undue force the instrument passed into a cavity from which some greyish-looking fluid escaped. On the following day a quantity of mucoid secretion passed from the nose when the patient sneezed, and very soon all trace of the orbital swelling had disappeared. In Moure's patient there was obstruction of the affected nostril, the nasal cavity containing a smooth, immobile swelling. In Onodi's case there was an occasional nasal discharge throughout the whole period of the affection. A small, round, fluctuating swelling occupied the middle meatus; when this was punctured, a thick mucoid secretion escaped. It is evident, therefore, that an examination of the nasal cavities may be of considerable assistance in the diagnosis of these conditions. On the other hand, the absence of nasal symptoms and signs must not be taken to imply that the orbital swelling is not connected with the nasal cavity or its accessory sinuses.

ETIOLOGY AND PATHOLOGY.—In discussing this part of the subject, we must take into consideration a number of points which will assist us in explaining the clinical phenomena already described, and which may throw some light upon the causation of the condition. Operative interference in these cases makes it quite clear that we have to deal with a similar affection in both

the frontal and ethmoidal cavities, and consequently the pathological changes and the causative factors which induce them are probably the same whichever sinus is affected.

Notwithstanding the clinical material which has accumulated, and a careful inquiry into the history of these cases, it is still difficult to establish proof of an etiological factor which can be regarded as common to all of them; while it is not easy to assign the exact cause of the condition in individual cases. It is probable, however, that we are justified in regarding a pre-existing catarrh as the cause of the chronic inflammatory changes which take place in the affected sinuses. In consequence of the catarrh the ostium of the sinus becomes temporarily or permanently obstructed, and there is an accumulation of the mucous contents of the cavity, and gradual thinning and absorption of one or more of its bony walls.

It must be admitted that it is not easy to obtain evidence of a nasal catarrh which may have initiated the changes in the walls and ostium of the sinus. This is doubtless due to the fact that the affection pursues an extremely slow and painless course, making it almost impossible for the patient to recall any event from which he might justly date the commencement of the condition. The analysis of the clinical features in our cases has already shown us that the patient's attention is usually first drawn to the condition by the presence of a swelling in the orbit. The duration of the swelling from the time it was first observed to the date of operation varied in these cases from six weeks—the shortest period—to nine years—the longest period. In the remaining eight, the orbital swelling had been observed, six months (in two cases), nine months, one and a half years, two and a half years, four, five, and eight years respectively. When we remember that the visible swelling is due to a gradual thinning and giving way of one of the walls of the sinus, an alteration which must of necessity occupy some time, the commencement of the condition must considerably antedate the external evidence of its existence. In regard to this point, Killian states that the swelling may show itself from one to two years after the catarrhal condition of the sinus has started, or as long as ten, fifteen, or twenty years, and even, as in one of Kuhnt's⁽²³⁾ patients, twenty-three years. Under these circumstances, it is easy to understand the difficulty that the patient must experience in assigning the initial cause. In our opinion it is equally difficult for the surgeon to draw a correct conclusion as to the duration of the affection in the sinus prior to the appearance of the swelling in the orbit, except in a case in which the cause might be definitely ascribed to an injury.

In eight of our ten cases, no cause was assigned by the patient, nor were we able to find a reason for the condition when inquiring into the history. In Case 5, where the swelling had only been

observed for six weeks, the patient was a very intelligent woman, who repeatedly asserted that she had been remarkably free from any nasal trouble. In one (Case 9), the patient had scarlet fever two years prior to the appearance of the orbital swelling. The scarlet fever was complicated with suppuration of both middle ears. The occurrence of one of the exanthemata in connection with the previous history has been mentioned by some of the writers. Thus Eversbusch's patient, a young man of 20, with an ethmoidal mucocele, had measles when 13 years of age; he dated his sinus affection from that time, having observed that his left eye sometimes protruded further than the right one. He had previously suffered, however, from whooping-cough and scarlet fever. Gibert's patient, a girl of 19, with ethmoidal mucocele, had measles at 8 and whooping-cough at 11 years of age; when 17 years old her eye symptoms were first noticed. Farlow regarded an attack of scarlet fever as the etiological factor in his case; the swelling in the left orbit appears to have followed immediately upon the fever. Other instances might be quoted, and if we are to accept the catarrhal theory, as we are certainly prepared to do, it is perfectly reasonable to associate its onset with one of the exanthemata. The occurrence of so many of the cases of mucocele in early life is an additional reason for ascribing them to the exanthemata.

Killian appears to consider that an injury may be an important etiological factor in the production of inflammatory changes in the walls of the sinus. We are unable to bring forward any evidence in support of this from our own experience. In one of the ten cases (Case 6), the patient was struck above the right eye with a soft cap, subsequent to which she observed the swelling in the upper eyelid. It is difficult, however, to conceive any relation in this case between cause and effect, such as a blow from a soft cap and the formation of a mucocele. The injury merely drew the patient's attention more closely to her eye. Although the absence of any traumatic history is a noticeable feature in our cases, several authors are satisfied that they have been able to trace the onset of the symptoms to injury. Thus, in two cases reported by Langenbeck, there was a previous injury; in one, the patient struck her right temple against the edge of a table; in the other, the youth received the stroke of a tennis racket upon the left side of the nose and the left eye. In the latter case, the swelling in the inner angle of the orbit commenced to show itself two years after the blow. Hulke⁽²⁴⁾ describes a severe injury in one of his cases, with very considerable bruising and swelling of the forehead accompanied by concussion of the brain. A small swelling was first noticed in the inner angle of the orbit two years later. Jessop has recorded the case of a girl who at the age of 8 received a blow in the region of the left eye; two months later a swelling was observed in the inner part of the left upper eyelid.

Guisez and Moure both assign an initial trauma in connection with their cases of mucocele. In the case described by the latter writer, the orbital swelling became evident four years after the blow. Three cases reported very recently are attributed to a similar cause. Compaired reports the case of a young man, *æt.* 19, who dated his symptoms to a severe blow which he had received upon the root of the nose. It was of such a nature as to cause marked giddiness for some hours, accompanied by dulness in the head, which persisted for several days. There was also profuse hæmorrhage from the nose. About five years later a swelling appeared. Gagen-Torn⁽²⁵⁾ describes two cases in which a kick from a horse over the lower part of the forehead was regarded as the probable initial cause of a frontal mucocele. Further evidence might be brought in support of a traumatic history, but enough has been said to show that some authors regard an injury as the causal factor. From the severity of the injury in some of these cases, it is possible to conceive that an inflammatory condition might be induced in the lining membrane of the underlying frontal or ethmoidal air cavity, with subsequent obstruction of the nasal outlet.

If an injury be justly regarded as a causative factor in certain cases, it becomes possible to derive some information as to the probable duration of the affection before the orbital swelling is visible. From the foregoing facts in connection with the cases of trauma just quoted, we find that the blow antedated the swelling, in one case by two months, in another by five years, while in two other cases two years had elapsed, and in another four years, between the injury and the appearance of the swelling.

Lambert Lack calls attention to the possibility of a congenital developmental anomaly being the cause in rare instances, and in support of this view cites the case of a boy, *æt.* 12, with a mucocele of both frontal sinuses. Both cavities had reached an enormous size. The bilateral nature of the affection and the absence of any sign of ethmoidal disease led him to favour this view of the case.

Age and sex.—Reference has already been made at the commencement of this paper both to the age and to the sex in our cases, and emphasis has been laid upon the frequency of the occurrence of the condition in youth and early adult life. This observation is supported by an examination of the cases scattered throughout literature, especially in connection with the ethmoidal affections. In an analysis of twenty-three cases of ethmoidal mucocele which I have been able to investigate in this connection—and this total includes the three cases detailed above—the age of the patient was stated in twenty-two. The majority of them occurred during adolescence. Sixteen were observed between the ages of 12 and 20; five were between 21 and 30; and one, the oldest in the series, was only 32 years of age. As regards the sex in the same series of ethmoidal cases, fourteen of the patients

were males and eight were females, the sex in one not being stated.

While a considerable number of cases of frontal sinus mucocele have been met with in early life, there are several reported as occurring at a much later period than any of the ethmoidal cases which we have noted. Two of the patients in our series presented themselves for treatment at the ages of 51 and 52 respectively. Mayer⁽²⁶⁾ publishes notes of a patient aged 53. Luc's⁽²⁷⁾ patient was 56, Bellingham's⁽²⁸⁾ 46 years of age. On the other hand, Kuhnt describes an interesting case (Case 10 in his series), which came under examination at the age of 28. The patient suffered from mucocele of the right frontal sinus, and the history indicates that the orbital swelling was first observed in the sixth year of life. If the observation be a correct one, the case must be regarded as the youngest hitherto reported. It is not definitely stated, however, that the swelling was observed at that time by a medical man, so that the observation lacks corroboration. Steiner reports a similar condition in a girl, *æt.* 7. Walter H. Jessop's patient was 10 years of age. When she was 8 years old a small swelling was noticed in the inner upper angle of the left orbit. Lack's patient with bilateral frontal mucocele was a boy, *æt.* 12 years.

In connection with affections of the frontal sinus at such an early period of life, it is necessary to refer here to the development of the cavity. The sinus is not present at birth, and it is generally held that its development commences at the end of the first or at the beginning of the second year of life, as an upward expansion of the ethmoid cell labyrinth into the diploë of the frontal bone. In the sixth or seventh year the sinus reaches above the supra-orbital margin, and can be recognised at that age as a distinct cavity in the vertical portion of the frontal bone. Symington⁽²⁹⁾ was unable to find a sinus in the vertical part of the bone in children under 6 years of age, but two fairly well-developed cavities were found in a child of 9 years. In the light of these facts it is somewhat difficult to accept the observation made in Kuhnt's case.

Pathological changes in the walls of the sinus.—As a result of the chronic inflammatory process in the mucous membrane lining the cavity of the sinus and in the subjacent osseous wall, various changes may be observed. The normal mucosa of the frontal and ethmoidal cells forms a thin, delicate membrane, covered with a layer of ciliated epithelium. In the subepithelial tissue clusters of mucous glands are found at intervals. In neither of the cavities, however, are the glands so numerous as they are in the pituitary membrane. The deepest layer of the mucosa forms the periosteum of the underlying bone.

In a few of the published cases of mucocele the authors have described the microscopical changes met with in portions of the wall which has been removed. A detailed account of this has

been given by Onodi in a case of ethmoidal mucocele. While the ciliated epithelium was preserved upon some parts of the surface, in other situations it was apparently replaced by several layers of pavement cells. Beneath the epithelium there was a fibrous connective tissue layer with small-cell infiltration, consisting of spindle cells and polynuclear leucocytes. A number of blood vessels were present, and scattered groups of mucous glands were also observed. External to the connective tissue layer there was a thin lamella of bone covered with a periosteum consisting of three to four rows of cells, and loosely connected with the mucous membrane. The periosteum on both sides of the layer of bone was rich in cells, those next to the bone being of the nature of osteoblasts. The wall of the medullary spaces as well as the surface of the osseous layer was smooth, and only in places was there evidence of absorption of the lacunæ. In the wall of one of the medullary spaces an osteoclast cell was seen. Changes of an inflammatory nature therefore were present.

As the microscopical material in connection with mucoceles of the frontal and ethmoidal sinuses is somewhat scanty, reference may fitly be made here to the changes which have been observed in a precisely identical condition of the middle turbinated air cell. The appearances observed in the wall of a mucocele of the middle turbinated bone clearly indicate that a chronic inflammatory process exists both in the lining membrane and in the subjacent bone, the latter undergoing erosion and absorption. Cases reported by Sundholm⁽³⁰⁾, Stieda⁽³¹⁾, Kikuchi⁽³²⁾, and Harmer⁽³³⁾, amongst others, illustrate this. Patches of erosion in the bone are evident, and large bone cells probably of the nature of osteoclasts are seen in considerable numbers in some of the specimens. In one of Sundholm's cases sections made through the wall of a large middle turbinated air cell revealed changes of an inflammatory nature. In the periosteum on either aspect of the bone there were a number of large cells visible. They were especially numerous upon the inner surface, that is to say, upon the inner aspect of the air space, and as the osseous lamella showed patches of erosion, the large bone cells were probably osteoclasts. In several areas the continuity of the bone was destroyed, and the gaps were filled partly by osteoclasts and partly by connective tissue cells. The mucous membrane covering the outer or nasal surface of the bone was thickened. It was fairly rich in small cells, the mucous glands were numerous, while the blood vessels were large and their walls somewhat thickened. Gibert describes the histology of that portion of the wall of an ethmoidal mucocele which occupied the upper eyelid, and in which the osseous lamella had been absorbed. On the surface there were the remains of an epithelial layer consisting here and there of two or three layers of cells partly destroyed; external to this there was a thin zone of connective tissue fibres, and outside that again a denser layer

of the same. The wall, therefore, was a fibrous one with some epithelial elements persisting but in great part degenerated.

It is interesting to analyse at this stage the situation and extent of the bone absorption in the series of cases described in this paper. Of the seven cases of mucocele of the frontal sinus, absorption of a part or of the whole floor of the cavity had taken place in six. In one only (Case 7) was the bony floor still intact. In four of the six cases the whole of the floor had been destroyed; in one the greater part of the bone had disappeared, while in the sixth only a small area had been destroyed. In two of the cases, in addition to the disappearance of the inferior or orbital wall of the sinus, absorption of bone had taken place in the posterior or cerebral wall of the cavity. In one of them the bone had disappeared over an area with a diameter of 2 cms., while in the other, the deficiency was considerably larger, representing an area the size of a half-crown piece or rather more than 3 cms. In both these cases the dura mater was exposed, the pulsations of the brain being quite visible in the second one after the frontal sinus had been opened (Case 2). The fluid contents of the mucocele in this case closely resembled in its physical characters cerebro-spinal fluid, and as it pulsated during its escape through the external wound, it was not surprising that it was at first regarded as possibly escaping from the subarachnoid space. Fehling's test applied during the operation did not, however, give any reaction.

Other cases of frontal sinus mucocele have been reported, in which absorption of the posterior wall of the cavity has been observed. Mayer has published notes of a case in which the right frontal lobe of the brain showed a very deep depression due to a cystic condition of the right frontal sinus, the cerebral wall of which had been absorbed. After the operation the brain again expanded. A year later the fluid had reaccumulated, and at the second operation the cyst wall was found adherent to the dura mater.

In none of my cases was there any absorption of the anterior wall of the frontal sinus. This has, however, been described by other writers. In Lack's case the anterior wall of the left frontal sinus was entirely absorbed, and in Kelling's⁽³⁴⁾ case both anterior and posterior walls had in great part disappeared.

In the three cases of ethmoidal mucocele detailed above, the os planum or lamina papyracea had been more or less destroyed. In two, the whole of the orbital wall of the large cystic cavity appeared to have been absorbed, and in the third there was a hole in the same wall having a diameter of 2 cms.

The absorption of areas of bone in cases of mucocele raises an interesting point in connection with the involvement of more than one sinus in the same patient. In some case, at any rate, there is evidence to show that a communication has been established between the sinuses by absorption of the bone in a contiguous wall.

Goris⁽³⁵⁾ reports the case of a young man in whom a mucocele involved the left frontal sinus, left anterior ethmoidal cells, and part of the right frontal sinus. Compaired has published a case of bilateral mucocele of the ethmoidal labyrinth. The pathological conditions found in it were of exceptional interest. The mucocele involved almost the whole of the anterior ethmoidal region on both sides. From the history of the case it was evident that the condition had started in the right ethmoidal labyrinth. At the operation a small perforation was found in the perpendicular plate of the ethmoid, evidently the result of erosion and destruction of the bone, and through this the left ethmoidal labyrinth had also become involved. In addition to the perforation in the ethmoidal plate, it was found that the cyst in its growth had perforated the right nasal bone in the neighbourhood of the lachrymal sac. In Moure's case of ethmoidal mucocele, the nasal septum was also perforated. The latter was deflected to the left, that is, to the side of the mucocele. In its growth it had perforated the central plate of the ethmoid, and through this opening, which had a diameter of a one franc piece, the cyst wall projected into the right nasal cavity after the manner of a hernial protrusion. Farlow describes a case which he regarded as one of left fronto-ethmoidal mucocele. The facial deformity was very great, owing to the marked displacement of the eyeball and the œdematous condition of the eyelids. The removal of the middle turbinated was followed by an escape of 3 to 4 oz. of yellowish, tenacious, mucoid fluid, and in order to obtain more efficient drainage, the walls of the ethmoidal cells were broken down. Farlow regarded both the left frontal and ethmoidal sinuses as the seat of the mucocele.

Condition of the ostium frontale and ostium ethmoidale.— Although the appearances observed in the nasal chamber upon anterior rhinoscopy have already been considered, it is necessary to briefly refer here to the condition of the anatomical communication between the mucocele and nasal cavity at the time of the operation. In nine of the cases in the series an external operation was performed; in two of them, unfortunately, no note was made as to whether the communication between the sinus and the nose was patent or occluded. In the remaining seven, no communication could be found in four cases, notwithstanding that a careful search was made with a fine probe passed into the sinus, aided by good illumination. In the remaining three, a probe was easily passed from the sinus downwards into the nasal cavity. It is evident, therefore, that the ostium is not completely occluded in every case, although the accumulation of the contents of the mucocele appears to be as great in the one instance as in the other. There was an entire absence of nasal discharge on rhinoscopy, not only in the cases in which the ostium was found occluded, but also in those in which it was undoubtedly patent. If we carry the analysis a little further and compare the condition

found at the operation with the history given by the patient, we find that out of four cases operated upon, in which the patient had complained of occasional discharge, the ostium was readily found in two and could not be found in one, while in the fourth the notes on this point were deficient. On the other hand, of five cases operated upon, in which the patient never complained of discharge, the ostium could not be found in three and was quite patent in the fourth, while in the fifth there was no information regarding it.

Perusal of previously reported cases furnishes evidence to the effect that sometimes a free communication exists between the mucocele and the nose. In one of Knapp's⁽³⁶⁾ patients, it was found that, immediately after opening the distended ethmoid cavity and evacuating its contents, lotion syringed through the external opening passed downwards into the nasal cavity, and in other cases again no difficulty has been experienced in finding the normal ostium. The explanation of the retention of the contents of the mucocele in those cases in which the ostium is evidently patent, is probably to be found in the fact that it is too thick and viscid to escape through the orifice.

A study of the various pathological changes just described will help to elucidate the clinical phenomena observed. The inflammatory process is a chronic one, and the absorption of bone takes place very slowly, and hence the long-standing history which we obtain in these cases. The soft or fluctuating swelling in the orbit is the result of partial or complete destruction of the bony wall forming the floor of the frontal sinus, or the orbital wall of the ethmoidal labyrinth, with consequent escape of the fluid contents of the mucocele into the orbital cavity. The firm, dense area of osseous consistence which can be palpated in some of these cases in the region of the inner canthus, and which has sometimes been mistaken for an exostosis, is the result of a formative process which is taking place beneath the periosteum covering the outer surface of the bony wall of the mucocele in that situation.

When the term mucocele of an accessory sinus is defined, it is usually stated that there is a distension of the cavity associated with the accumulation of its contents. From personal observation of these cases, I am inclined to regard the so-called distension as more apparent than real, at any rate in some of the cases, as I have been unable always to find positive evidence of it. Knowing as we do the great anatomical variations in the size of the frontal sinus, it becomes very difficult, if not impossible, for us to say, when a mucocele is opened, whether we are dealing with a cavity which can be classed as one having merely anatomical dimensions, or one which has become abnormally increased in size from expansion of one or more of its bony walls. Reference to the notes of the seven cases of frontal sinus mucocele shows that three were regarded as being cavities of average dimensions, while the remaining four are

described as exceeding the average size. I have elsewhere given the average measurements of a frontal sinus of normal dimensions, and must refer the reader to them⁽³⁷⁾.

Again, is not the apparent distension sometimes only the result of the absorption of one or more of the osseous walls of the cavity, and the consequent extrusion of the contents through the deficiency in the bone? In six of the seven cases of frontal mucocele, the swelling in the upper eyelid was due to the accumulation of some of the contents of the sinus within the orbit. In Mayer's case, where there was compression of the frontal lobe of the brain, the posterior wall of the sinus had been entirely absorbed, the pressure being directly due to the contents of the cyst itself.

The secretion within the mucocele. — In the majority of cases the contents of the mucocele are of a thick, tenacious, mucoid consistence. The secretion does not, however, present a uniform appearance in all cases, varying alike in consistence and colour, so that its physical characters vary. The ten cases in this series may be subdivided into two groups, the first numbering eight, in which the contents were found to be of a mucoid character when the sinus was opened. The second group contained two cases in which the contents were distinctly purulent when the sinus was first opened, evidently the result of infection through the nasal cavity. Purulent infection of the cavity may follow upon an incomplete operation, as was the case in two of the patients in this series.

In the eight cases in the first group the fluid was thick, tenacious, and gelatinous in seven; its sticky character sometimes rendering its evacuation from the cavity difficult. Silcock states that it was necessary to use forceps in one of his cases in order to remove lumps of inspissated mucus. In the remaining case, the fluid was of a clear serous-like character, presenting none of the physical characters of mucus, but more resembling cerebro-spinal fluid. The colour is also subject to variations; it is usually of a white, opalescent appearance; in one of my cases it closely resembled white brain matter, while in another the fluid was of a greenish-brown colour. To the naked eye the secretion may resemble pus, but on microscopic examination such is not found to be the case. In several cases it has been described as having a greenish appearance, and hence the readiness of mistaking it for pus. In Kelling's case the fluid was of a greyish-brown colour, in Farlow's yellow,—in both being of a sticky, mucoid nature.

Histological, bacteriological, and chemical examinations of the contents of the sinuses have been made in a large number of cases. In none of my cases, however, was any chemical examination made of the fluid. In four cases the fluid was examined microscopically, and in all of them it was found to

contain mucus. In only one of the whole series were cholesterin crystals observed. In another, some caseous-looking material removed from the neighbourhood of the ostium frontale was found to consist of inspissated pus infiltrated with lime salts, probably carbonates, and also of some degenerated leucocytes. In this case no bacteria were found, and no growth was obtained on culture media. In another of the cases, from a culture made upon agar, the *Staphylococcus pyogenes albus* was obtained, but this was probably an accidental inoculation made when the fluid was being collected. In another of the cases (Case 5), however, cultures of diplococci were obtained upon broth after twenty-four hours' incubation. They were Gram positive, but there was no growth either upon serum or agar. Under anaerobic conditions there was no growth upon any of these media. The diplococci were non-pathogenic, as proved by inoculation of guinea-pigs.

Brief reference may be made to what has been found by some other observers. Thus, in Moure's case, in which the contents were mucus, there were polynuclear leucocytes present; the fluid was sterile. Onodi describes degenerated epithelial cells filled with fat. Cholesterin crystals were also noted. In Farlow's case there were numerous desquamated cylindrical epithelial cells, a few fatty degenerated cells, and a few leucocytes. No micro-organisms were found. Kelling had the contents of a frontal sinus mucocele examined chemically. It was alkaline to litmus, and contained mucin, alkali-albumin, cholesterin, and fat. There was no sugar, glycogen, or peptone. In Knapp's case, as in one of my own, the fluid was of a serous character. It contained cholesterin. In Gibert's case there were no micro-organisms.

It is not without interest to consider the source of the mucous secretion in this affection of the sinuses. As a rule, it is copious in amount, filling the cavity, and, as we have seen, causing a swelling in the upper eyelid when the bony wall has been destroyed. It is difficult to accurately estimate the amount of fluid contained in a mucocele, as some of it is usually lost at the operation. Grossmann⁽³⁸⁾ obtained 2 oz. from a frontal sinus, Langenbeck a cupful of secretion, and Keate⁽³⁹⁾ 4 oz. of fluid. The lining membrane of the ethmoidal and frontal sinuses contains mucous secreting glands, but apparently they are not numerous. Sieur and Jacob⁽⁴⁰⁾ state that in the ethmoidal cell labyrinth they are much less numerous than in the pituitary membrane itself. Zuckerkandl figures the lining membrane of the ethmoidal cells, and shows how the mucous glands are scattered, being absent altogether in some parts, while in the frontal sinus they are not numerous. Gibert and Moure, in their description of the histology of the wall of the mucocele, do not refer to the presence of mucous glands. Onodi, however, states that glands were met with in his case, but that they were either empty of secretion, or that their epithelial cells were becoming

loosened and detached. When operating upon cases of mucocele, one is struck with the thinness of the lining membrane of the sinus, differing in a marked degree from the thick, often polypoid, appearance of the mucous membrane which is observed in cases of chronic suppuration of the sinus. The explanation of the increase in and accumulation of the secretion in the mucocele is probably to be found in an increased function of the glands in consequence of the inflammatory changes. At a later stage, however, there are atrophic changes in the lining membrane, resulting from the pressure of the accumulation within the cavity, and in these changes the mucous glands participate.

TREATMENT.—In discussing the question of treatment, we must consider the two routes which may be adopted, that is to say, through the nasal cavity or through an external incision. The former procedure should only be undertaken in the event of the swelling showing itself in the nasal cavity, and it will probably be found that such cases are ethmoidal in origin. Care should be taken to establish a large nasal opening by the removal with forceps of as much bone as possible, otherwise the permanence of the drainage is not maintained. Of the ten cases forming this series, only one (Case 8) was treated in this way, and the result proved quite satisfactory, as no reaccumulation had taken place after an interval of four years. In a case of mucocele of the ethmoidal sinus treated by Baurowicz, a cure resulted after an opening had been made in the swelling which presented in the middle meatus. Farlow's case of combined frontal and ethmoidal mucocele, to which reference has already been made, was cured in a similar manner.

In the majority of cases, however, an external operation is to be preferred. This resolves itself into the adoption of one of two methods: either to open the sinus and obliterate the cavity without attempting to make any communication with the nose, or, after opening the sinus, to establish a large communication with the interior of the nose and drain through it, so that a permanent nasal opening remains. Of these two methods, preference must be given to the second. Obliteration of the cavity which necessitates curetting of its lining membrane, and the removal of the anterior bony wall, and probably also the floor, if that has not already been absorbed, is followed in these cases by a good deal of deformity. It is true that paraffin may be injected to overcome this. Delsaux⁽⁴¹⁾ reports a case of mucocele of the frontal sinus which he treated successfully in this way. Luc also successfully treated a case of this kind along somewhat similar lines, and made no attempt to open into the nose, and Knapp curetted the interior of an ethmoidal mucocele, inserted a drainage tube through the inner end of his incision, removing it on the seventh day. Recovery was complete and permanent. If the sinus should prove to be a small and shallow one, then obliteration

tion may prove a very satisfactory method of dealing with it. A simple incision into the external swelling without any attempt to effect obliteration will only prove a failure. Either reaccumulation takes place when the opening is allowed to close, or a discharging sinus remains in the upper eyelid, a suppurative condition being set up. A perusal of Hulke's cases, in which treatment was limited to an orbital incision, shows that the openings remained and continued to discharge.

From my experience of these cases, I would advocate the establishment of a large opening between the sinus and the nasal cavity. In the nine cases in which this procedure was carried out, cure resulted in all of them with a minimum of disfigurement. As a preliminary step the middle turbinated bone is removed in some of them. An incision is then made parallel to and beneath the eyebrow, which is left unshaved; the upper eyelid is detached and turned downwards. After the contents of the mucocele have been removed, any portion of the floor of the frontal sinus, or of the outer wall of the ethmoidal labyrinth, which has not already been absorbed, is removed. In some of the cases a small area of the anterior wall of the frontal sinus is also removed. The lining membrane of the cavity is left untouched. The communication with the nasal cavity is then sought for with a fine probe; as already stated, no ostium may be found. Whether the normal ostium be found or not, a large opening into the nose is made by means of burrs, and through this a rubber drainage tube is passed, being held in position in the lowest part of the sinus by a collar formed by turning over its upper end. The lower end of the tube does not quite reach the vestibule of the nose. The sinus is next lightly packed with gauze, the end of which is brought out through the inner end of the incision which is sutured with the exception of this small area. The gauze is removed at the end of four or five days, the cavity is washed out, and if the nasal drainage tube is found to be working satisfactorily, the skin incision is allowed to close in a week or ten days. The bandage is then removed, and the patient can be instructed to wash out the sinus daily by introducing the fine nozzle of a syringe into the nasal end of the drainage tube. The success of the operation will largely depend upon the maintenance of a permanent opening between the sinus and the nose, therefore it is necessary to keep the drainage tube in position for a considerable time. It should not be removed until at least six weeks after the operation. I have found the ordinary rubber drainage tubing prove quite satisfactory, but if it is removed too early there is a tendency for the communication between the sinus and the nasal cavity to close.

I wish to express my great indebtedness to my colleagues in the Eye Department, Mr. George Berry and Drs. George Mackay and W. G. Sym, for their kindness in transferring their cases to my care.

LITERATURE.

1. ONODI.—*Arch. f. Laryngol. u. Rhinol.*, Berlin, Bd. xvii. 2.
- GUISEZ.—*Ann. d. mal. de l'oreille, du larynx, etc.*, Paris, 1904, February.
3. EVERSBUCH.—“*Graefe-Saemisch Handbuch*,” 1903. 4. SPRENGER.—*Arch. f. Laryngol. u. Rhinol.*, Berlin, Bd. xix. 5. LACK.—*Proc. Laryngol. Soc. London*, 1901, February. 6. MAYER.—*Journ. méd. de Bruxelles*, 1903, No. 51. 7. MOURE.—*Rev. hebd. de laryngol.*, Paris, 1905, January 7. 8. LUC.—*Ann. de mal. de l'oreille, du larynx, etc.*, Paris, 1888, April. 9. HULKE.—*Ophth. Hosp. Rep.*, London, 1860-61. 10. GRIFFITH.—*Trans. Ophth. Soc. U. Kingdom*, London, 1901. 11. JESSOP.—*Ibid.*, 1901. 12. LUC.—*Arch. internat. de laryngol.*, Paris, 1897, p. 131. 13. PROCHNOW.—*Deutsche Ztschr. f. Chir.*, Leipzig, 1891-92. 14. SILCOCK.—*Practitioner*, London, 1899, March. 15. KILLIAN.—Heymann's “*Handbuch der Laryngol.*,” Bd. iii. 16. EWETZKY.—*Russ. Ophth. Ztg.*, Bd. i. S. 252. 17. GIBERT.—*Ann. d. mal. de l'oreille, du larynx, etc.*, Paris, 1903. 18. BAUROWICZ.—*Arch. f. Laryngol. u. Rhinol.*, Berlin, 1902, Bd. xii. 19. FARLOW.—*Trans. Am. Laryngol. Ass.*, 1898. 20. COMPAIRD.—*Arch. internat. de laryngol.*, Paris, 1907, May-June. 21. LOTHROP.—*Ann. Surg.*, St. Louis, 1899, February. 22. DUNN.—*Virginia Med. Month.*, Richmond, 1894, November. 23. KUHN.—“*Ueber die entzündlichen Erkrankungen der Stirnhöhlen*,” 1895. 24. HULKE.—*Ophth. Hosp. Rep.*, London, 1863, vol. iv. 25. GAGEN-TORN.—*Russk.-Vrach.*, St. Petersburg, 1906, September 16. 26. MAYER.—*Centralbl. f. Laryngol.*, 1904, June. 27. LUC.—*Ann. d. mal. de l'oreille, du larynx, etc.*, Paris, 1888, April. 28. BELLINGHAM.—*Schmidt's Jahrb.*, Leipzig, Bd. lxxxiii. 29. SYMINGTON.—“*The Anatomy of the Child*,” Edinburgh, 1887. 30. SUNDHOLM.—*Arch. f. Laryngol. u. Rhinol.*, Berlin, 1901. 31. STIEDA.—*Ibid.*, 1895. 32. KIKUCHI.—*Ibid.*, 1903. 33. HARMER.—*Ibid.*, 1902. 34. KELLING.—*Wien. med. Wchnschr.*, 1902, No. 32. 35. GORIS.—*Soc. belge d'otol. et de laryngol. C.-r.*, Bruxelles, 1905, December 10. 36. KNAPP.—*Arch. Ophth. and Otol.*, N.Y., 1893. 37. LOGAN TURNER.—“*Accessory Sinuses of the Nose*,” Edinburgh, 1901. 38. GROSSMANN.—*Liverpool Med.-Chir. Journ.*, 1889, July. 39. KEATE.—*Trans. Med.-Chir. Soc. London*, 1819, vol. x. 40. SIEUR AND JACOB.—“*Les Fosses nasales et leurs sinus*,” Paris, 1901. 41. DELSAUX.—*Journ. méd. de Bruxelles*, 1906, No. 50.

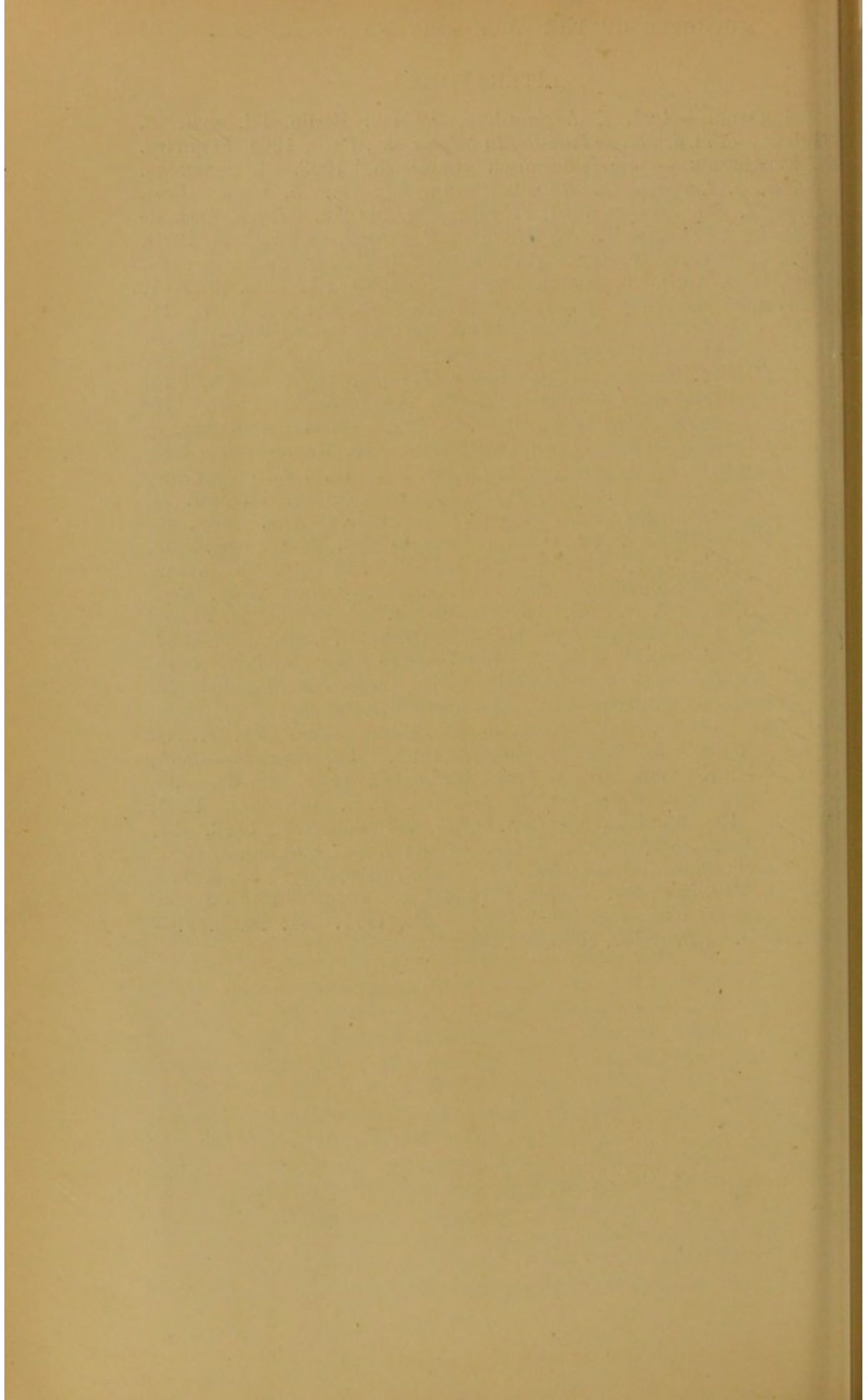




FIG. 1.



FIG. 4.

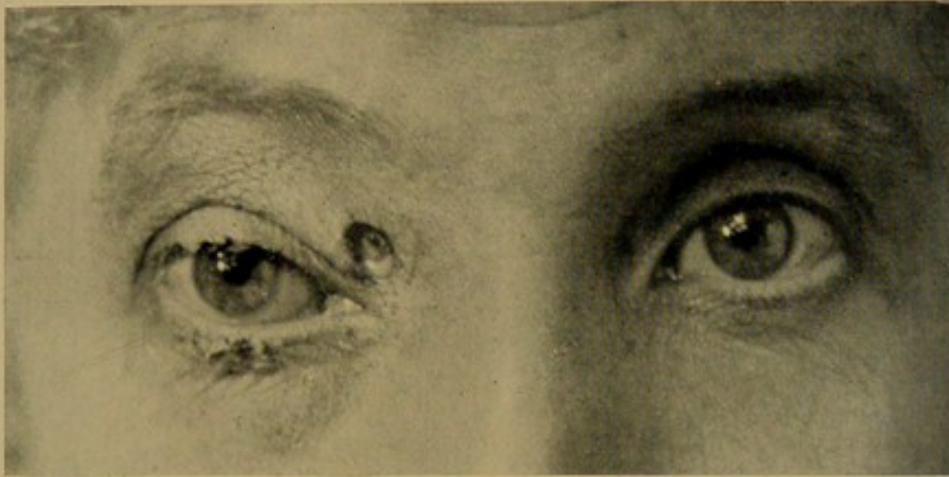


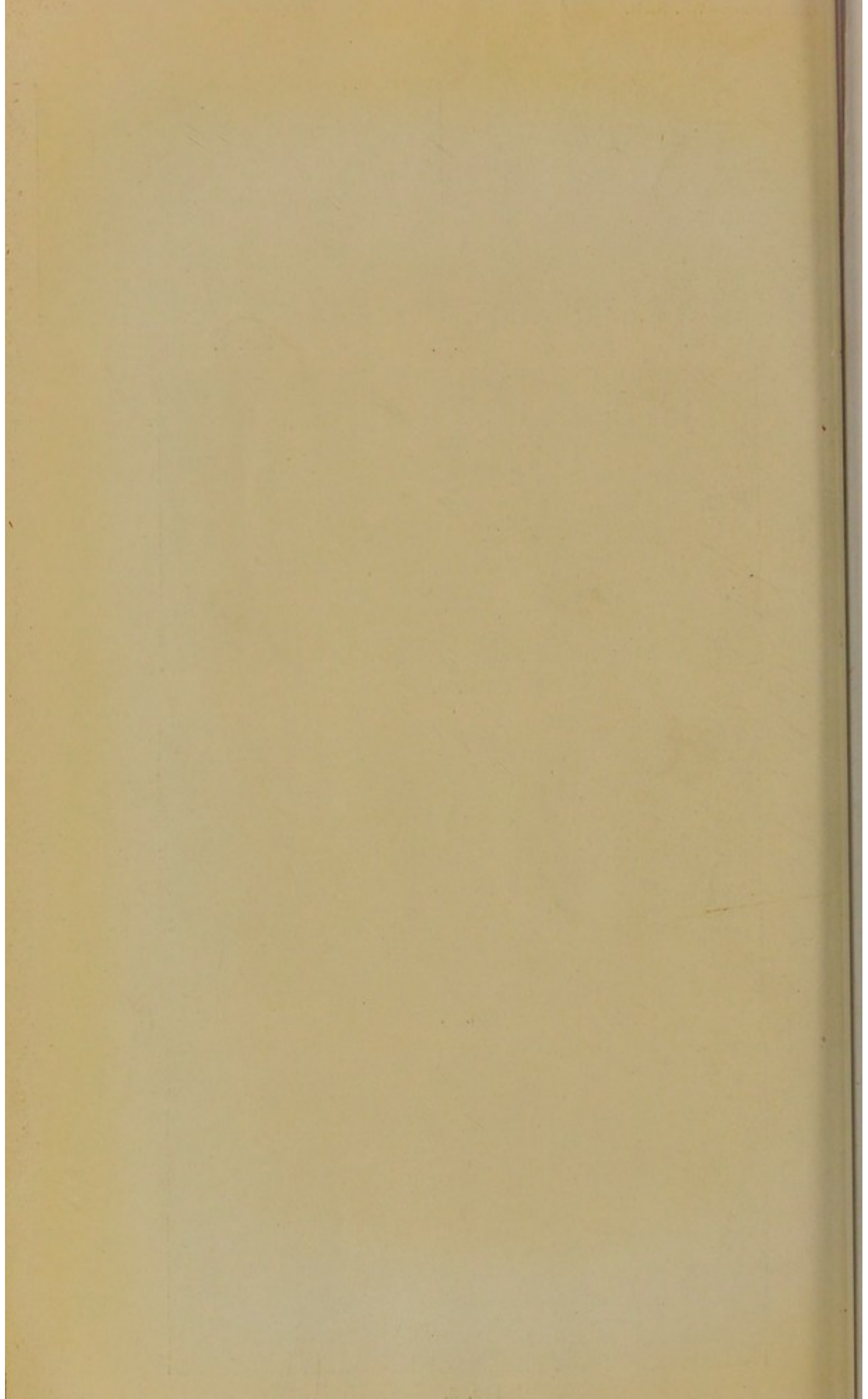
FIG. 2.

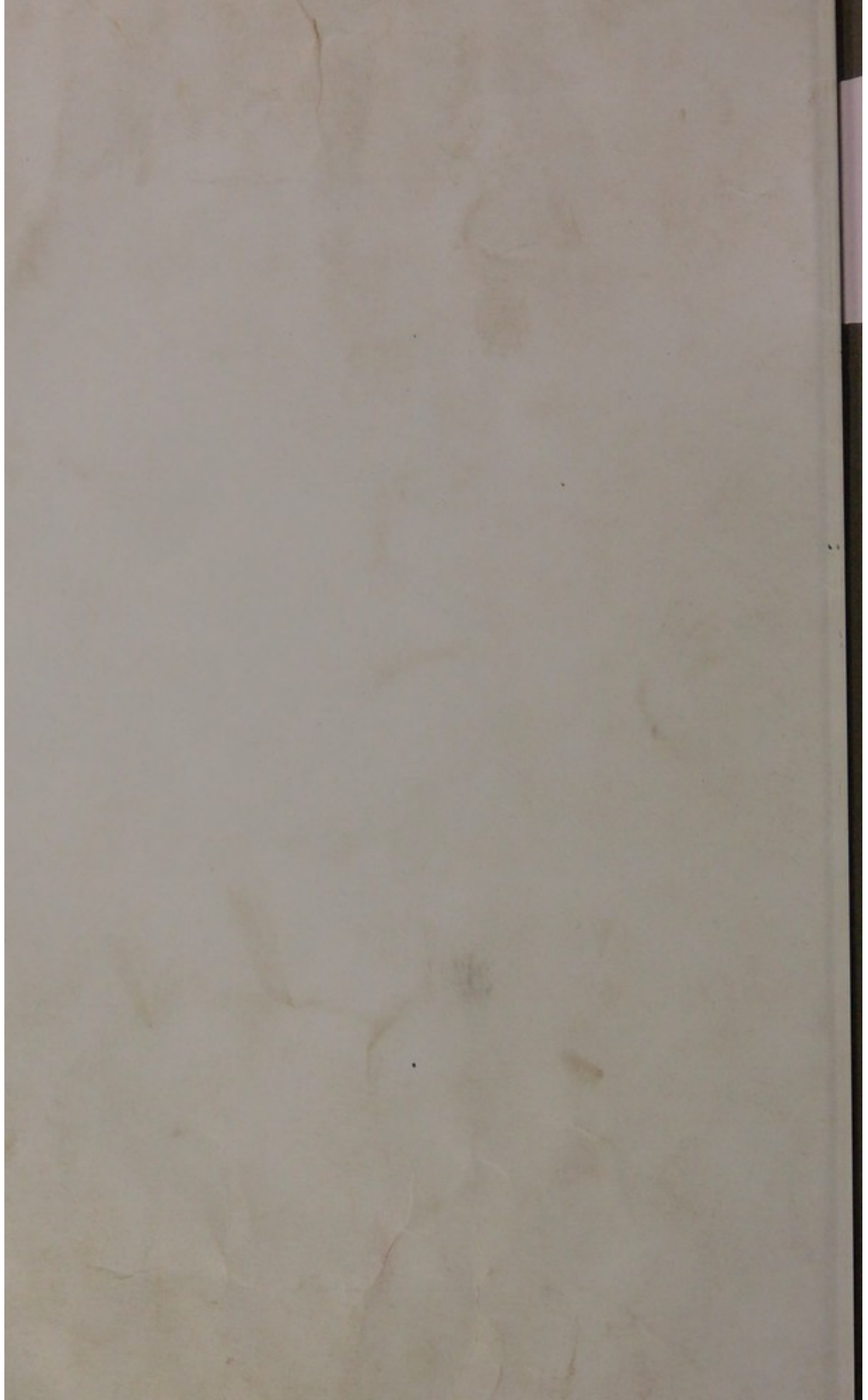


FIG. 3.



FIG. 5.





IRREGULAR PAGINATION
P. 482 FOLLOWS P. 410