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(Continued from p. 667, vol. xiv.)

THE PETRO-SQUAMOSAL SINUS: ITS ANATOMY AND PATHOLOGICAL IMPORTANCE.

BY ARTHUR H. CHEATLE, F.R.C.S. (London).

As little or nothing is written in even the best works on otology concerning this sinus, which has most important connections with the middle ear, both from anatomical and pathological standpoints, I have thought the subject of sufficient interest to bring before the Congress. The following British authors have written on the subject: J. F. Knott, of Dublin (*Journal of Anatomy*, vol. xvi., p. 27), who quotes C. Krause, Luschka, Otto, and Sir Charles Bell; Henry Morris ("Anatomy," p. 661), Professor MacEwen ("Pyogenic Diseases of the Brain and Spinal Cord," pp. 2 and 8), and Quain ("Anatomy").

Comparative Anatomy.—In some lower animals—dog and calf, for instance—this sinus runs across the roof of the middle ear, making its exit by means of a large foramen between the base of the zygoma and the bony meatal wall, and serves almost entirely for the exit of the intracranial blood, taking the place, in fact, of the sigmoid portion of the lateral sinus.

(Mr. Cheatle here demonstrated on the canvas a photo of the outer aspect of a dog's skull, showing the opening in front of the meatus; one showing the canal which leads from the interior of the skull to the external opening laid open; then the outer aspect of a calf's temporal bone, showing the external opening; the inner aspect of a calf's temporal bone, showing internal part of opening; the outer aspect of temporal bone of a *Cebus* monkey (*v.* Fig. 1), showing the external opening; and the inner aspect of preceding (*v.* Fig. 2), showing the groove and opening.)

In the higher forms of monkeys, such as the chimpanzee, gorilla and orang-outang, the sinus closely resembles the human.

In the *Macacus* group, the young often have the groove which runs along the petro-squamosal suture, and the anterior external opening, well marked, while in the adult the opening is usually closed or rudimentary, leaving the groove which runs forward to the foramen spinosum. In other varieties, notably in Baboons,

Chrysothrix, Cebus, Midas, Hapale, Lemuridæ and Indri, both the groove and the external opening are well marked, the latter piercing the bone between the large post-glenoid tubercle and the bony meatus. In these the sinus does not take the place of the sigmoid portion of the lateral sinus, as it is also present and well marked.

Human Anatomy.—In early foetal life, before the formation of the internal jugular vein, the petro-squamosal sinus carries all the intracranial venous blood, emerging in front to open into the primitive jugular (afterwards the external jugular). It is not to be wondered, then, that this channel, which serves such important



FIG. 1.—The Outer Aspect of a Temporal Bone of a Cebus Monkey, showing the External Opening.

FIG. 2.—The Inner Aspect of Preceding, showing the Groove and Opening.

duties in early foetal life, should persist in some form or another in later life. The anterior opening usually closes, the sinus or its remains at its anterior extremity forming a connection with the middle meningeal vein. The sinus dwindles to a small size, while the opening into the lateral sinus often persists.

With regard to the persistence of the anterior opening in front of the meatus in adult life, I examined 2,585 skulls in the Royal College of Surgeons' Museum, and among this number I found in twenty-three rudimentary remains, three in the glenoid cavity, three in the zygomatic process itself, six in the base of the zygoma, and eleven just external to the Glaserian fissure, with sometimes a fine groove running outwards, and occasionally bridged over by the junction of the post-glenoid tubercle with the bony meatus. These twenty-three skulls are now, owing to the kindness of the College of Surgeons, in the Congress Museum. I must here say that it is the rule rather than the exception for remains of the sinus to be present in some form or another all through life. In this statement, I am supported by my anatomical friends, Mr. Arthur Keith and

Mr. Cadman. Unfortunately, it is impossible in the time allowed for me to describe minutely the different varieties, but in the photographs to be shown directly some idea can be obtained, and some fifty specimens of my own are now in the museum.

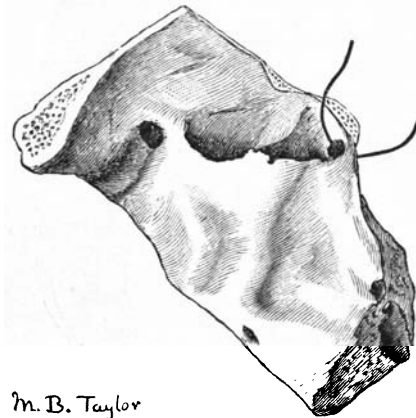


FIG. 3.

In infancy and childhood, the sinus as a rule is well marked, opening into the lateral sinus behind by means of a valve-like opening, and in front joining the middle meningeal vein, while in adult life, although it is often marked, careful search has some-

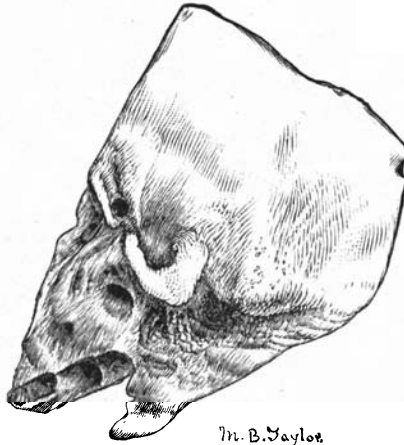
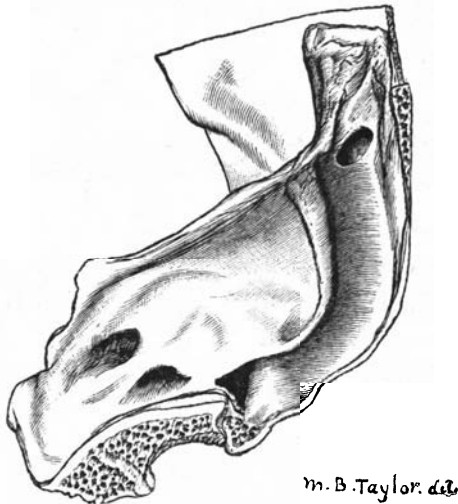


FIG. 4

times to be made. The absence of markings on the bone in the neighbourhood of the suture does not by any means show that the sinus is not present. In infancy and early childhood, in the region of the posterior extremity of the suture, numerous irregularities are often seen; it is at this spot that a bridge often forms over the

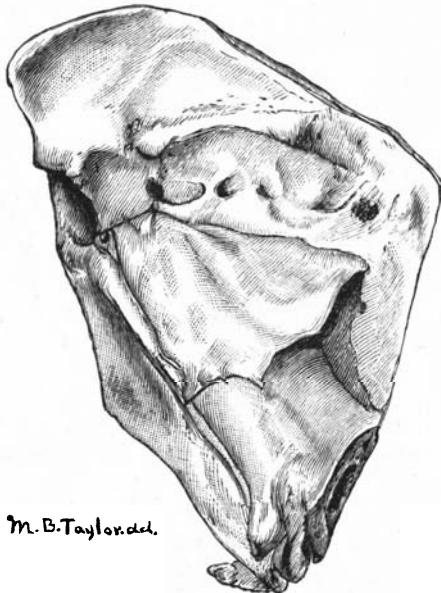
posterior end of the sinus, before it opens into the lateral sinus, a common condition in the adult bone.

Fig. 3.—The superior aspect of left temporal bone of a child



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FIG. 5.



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FIG. 6.

aged about five years, in whom the anterior opening persisted showing well-marked groove and the inner aspect of the anterior opening.

Fig. 4.—External aspect of same bone, showing the opening from an unusually large post-glenoid tubercle and the meatus, with a groove running outwards. This is a very rare specimen. Professor Macewen figures a similar one in his book from a ten-days-old infant.

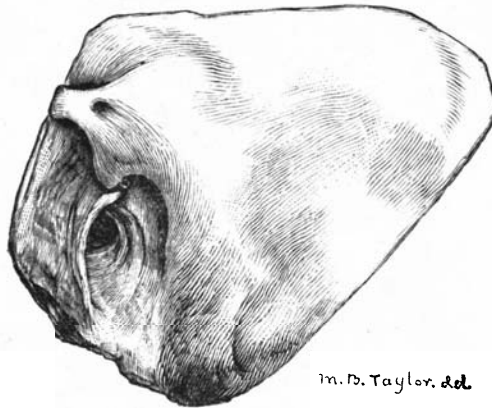


FIG. 7.

Fig. 5.—Right temporal bone of a child, aged five years, showing the valve-like opening in the lateral sinus.

Mr. Cheatle also showed a specimen from a child similar to that in Fig. 5.



FIG. 8.

Fig. 6.—Superior surface of the left temporal bone of a young adult, the dura mater thrown back to show groove for sinus which lies in the dura mater.

Fig. 7.—The outer surface, showing perforation in the zygoma.

Fig. 8.—Posterior surface of the same, showing the opening under bridge into the sigmoid groove.

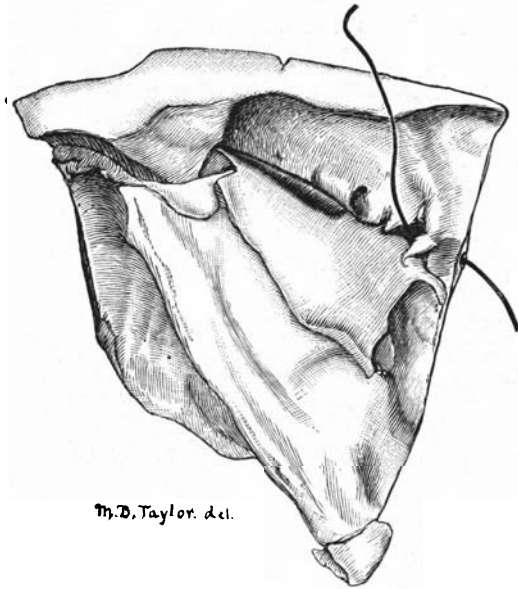


FIG. 9.

Fig. 9.—Superior surface of left adult temporal bone, dura mater thrown back, showing partly-bridged-over groove. The sinus



FIG. 10.

is seen in the turned-back part. There is a wire passed through the anterior opening, which apparently is going to perforate the zygoma.

Fig. 10.—Section through front of preceding specimen, showing canal in the zygoma.

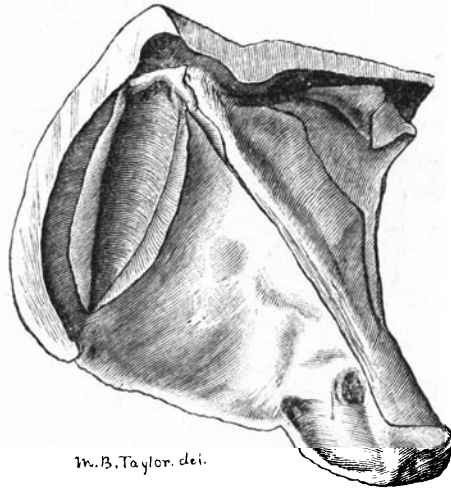


FIG. 11.

Fig. 11.—Posterior aspect of same, showing the opening of the sinus into the lateral sinus.

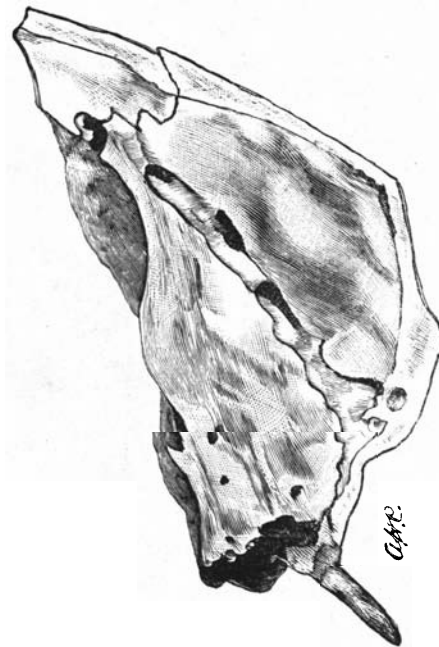


FIG. 12.

Fig. 12.—Adult bone, showing deep partly-bridged-over groove opening into sigmoid groove under bridge ; no anterior opening.

Fig. 13.—Adult bone, showing shallow groove partly bridged over opening into sigmoid groove; no anterior opening.

A photograph of an adult bone in which the sinus lay under tegmen, and opened into lateral sinus, with no anterior opening, was also demonstrated.

Fig. 14.—Adult bone, showing the bridge behind. A common condition; no anterior opening.

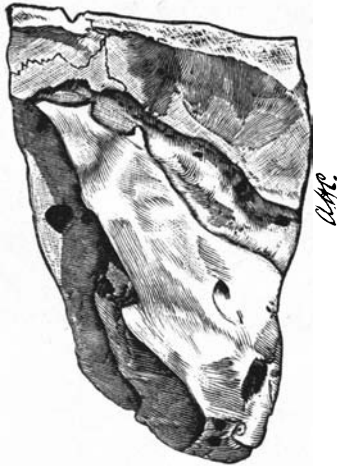


FIG. 13.

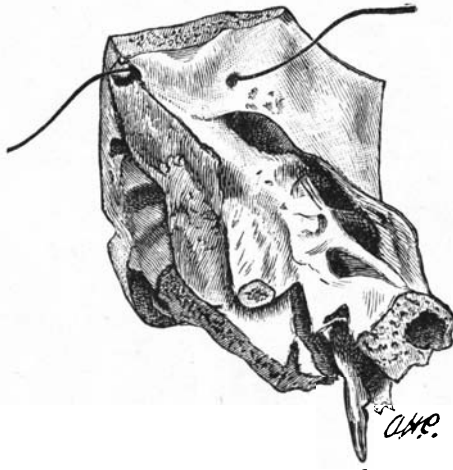


FIG. 14.

Mr. Cheadle, continuing, said: On looking at the roof of the middle ear in a fresh specimen, after the dura mater has been stripped off, a network of rather large veins can be plainly seen immediately beneath the bone. From this network several veins emerge through the suture to empty into the sinus.

In children in which the interval between the suture is wide these are sometimes numerous, especially posteriorly. In the adult a fairly constant one is present, on a vertical level with the membrane; or more may be present at intervals. These emerging veins receive a fine covering representing the meninges.

(Here other two photographs were shown. One represented a section through emerging veins, showing extension from the meningeal covering of the sinus, and the other a section through the petro-squamosal sinus with meningeal covering.)

Occasionally the openings of fairly large veins can be seen on the cerebral side of the sinus, especially at its anterior part.

Pathological Importance.—It is therefore seen that there is a connection between the veins of the middle ear and those of the meninges, and occasionally, at all events, with those of the temporo-sphenoidal lobe; and through the meningeal coverings the middle ear is in communication with those of the middle and posterior fossæ. Under these circumstances the importance of this sinus, with its tributaries and connections, from a pathological point of view, is very evident, and explains how infection may spread from the middle ear to the meninges and brain without macroscopical evidence of the connection. Such a state of things is not uncommon, as we all know, in infants and children, in whom, as I have said, the pathway we are considering is well marked, and in whom the membrane may be intact. There is a specimen of mine in the museum, obtained from the post-mortem room from an infant, aged one year, who died of suppurative leptomeningitis without a known cause during an attack of pneumonia. The middle ear was full of pus, containing all sorts of pyogenic cocci, the membrane being intact. I cut sections of the emerging veins, but was unable to find cocci; but this by no means precludes this as having been the pathway. There was no thrombosis. This is by no means the first case of the sort I have seen. Occasionally it is seen in adults, but as a rule a perforation is present in the membrane. It is astonishing, in the face of this close connection of the middle ear with the meninges, that meningitis is not of more frequent occurrence. The explanation may be that the meninges, like the peritoneum, are able to deal with a certain amount of infection, and only when the dose is excessive that this resisting power is overcome. This pathway will also explain the presence of a cerebral abscess without macroscopical connection with the diseased middle ear. That the sinus may be the pathway for septic thrombosis of the lateral sinus, I have evidence in two cases.

A. H. Cleveland, of Philadelphia, in the *Archives of Otology*,

vol. xxiv., p. 136, 1895, relates the case of a boy, aged six years, who died of pyæmia. At the post-mortem the petro-squamous sinus was found abnormally large and deep, being at one or two points almost entirely bridged over by bony processes. At its anterior extremity necrosis had taken place, and pus had entered the sinus, causing a thrombus, which extended backwards into the lateral sinus. Meningitis was present on the same side.

In St. George's Hospital Museum (No. 33a), and exhibited in the Museum of the Otological Congress (*v.* Catalogue, No. 696), is a specimen of the dura mater with the lateral and longitudinal sinuses from a man, aged twenty years, who, after suffering with discharge from the right ear for three months, died with symptoms of meningitis. At the post-mortem examination suppurative meningitis was found over the right side, with septic thrombosis of the lateral and longitudinal sinuses. A vein was found which made a direct communication between the tympanum and the lateral sinus, and which would admit the passage of an eye probe.

It may be that we have here one of the pathways which will solve some of the unaccountable intracranial affections met with by the physician, such as the posterior basic meningitis of infants, cerebro-spinal meningitis, and perhaps some cases of tuberculous meningitis, especially when the lining membrane of the middle ear is like the following photograph shown.

It is taken from a section of the lining membrane of the middle ear of an infant who died of tuberculous meningitis and general tuberculosis. Tubercle bacilli can also be seen in another section (to be seen in the museum).

I should like to draw attention to the condition of the middle ears of children who have died of general tuberculosis, including meningeal tuberculosis. There is thin purulent matter in the cavity, often with an intact membrane, and irregular thickening of the lining membrane, which shows on section patches of small-celled infiltration, but no tubercle.

In conclusion, I wish to give my best thanks to the Council of the College of Surgeons, to Professor Charles Stewart, F.R.S., and Mr. Arthur Keith.

Professor KNAPP said he was sure he was speaking the sense of the convention if he expressed his most hearty thanks to Mr. Cheatle, not only for the instructive demonstration and his important remarks on the petro-squamosal sinus, but also on his untiring efforts in bringing about such a unique otological museum, which they had all admired and studied with keen interest.

His attention was first drawn to the significance of the petro-squamosal sinus by the case of Dr. Cleveland, of Philadelphia, which Mr. Cheatle quoted, and of which Dr. Cleveland had sent the speaker his manuscripts, with the remark that in text-books of aural surgery, and also in those of descriptive anatomy, nothing, or almost nothing, was to be found. He looked up the subject and found only a short, but very good, description (about fifteen lines small type) in Quain. Now that authoritative attention had been directed to this sinus they should hear more about it. He felt sure that by its knowledge they should be able to understand many symptoms *in vivo*, and at autopsies conditions would be clear to them which thus far had been obscure.

THE TOPOGRAPHY OF THE FACIAL NERVE IN ITS RELATION TO MASTOID OPERATIONS.

BY ROBERT DWYER JOYCE, M.R.C.S. (Dublin).

In connection with this subject I have made a systematic examination of thirty temporal bones, with the object of ascertaining the precise relations of the facial nerve to the surface of the adult skull; its depth, as well as that of the external semi-circular canal from the surface; and the relation of both these structures to the operations on the mastoid region.

For the material upon which the examination was conducted, as well as for many valuable suggestions, I am greatly indebted to Professor Birmingham, in whose laboratory the work was carried out.

Method.—Each temporal bone was cut vertically from before backwards, beginning in the angle between the petrous and squamous portions, so as to expose the aqueduct of Fallopius in its entire extent; the external semicircular canal was also cut across by the same section in every case.

Then I projected the facial canal on the surface by drilling from the exposed canal outwards. In order to do this correctly, it was necessary to make the holes accurately at right angles to the sagittal plane, and of course parallel to one another. For this purpose I constructed the following simple contrivance: A wheel-drill was fastened down on a sliding bed, so that the drill was capable of backward and forward movement only. An end-board was then fastened at right angles to the end of the base-board in which the drill-bed moved. This end-board was so fastened that it could be shifted about in a vertical plane perpendicular to the line