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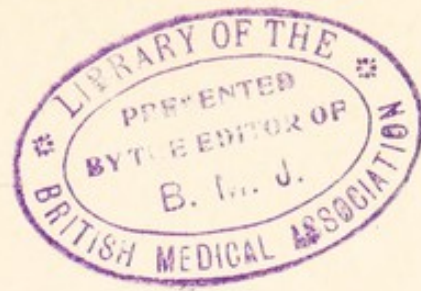
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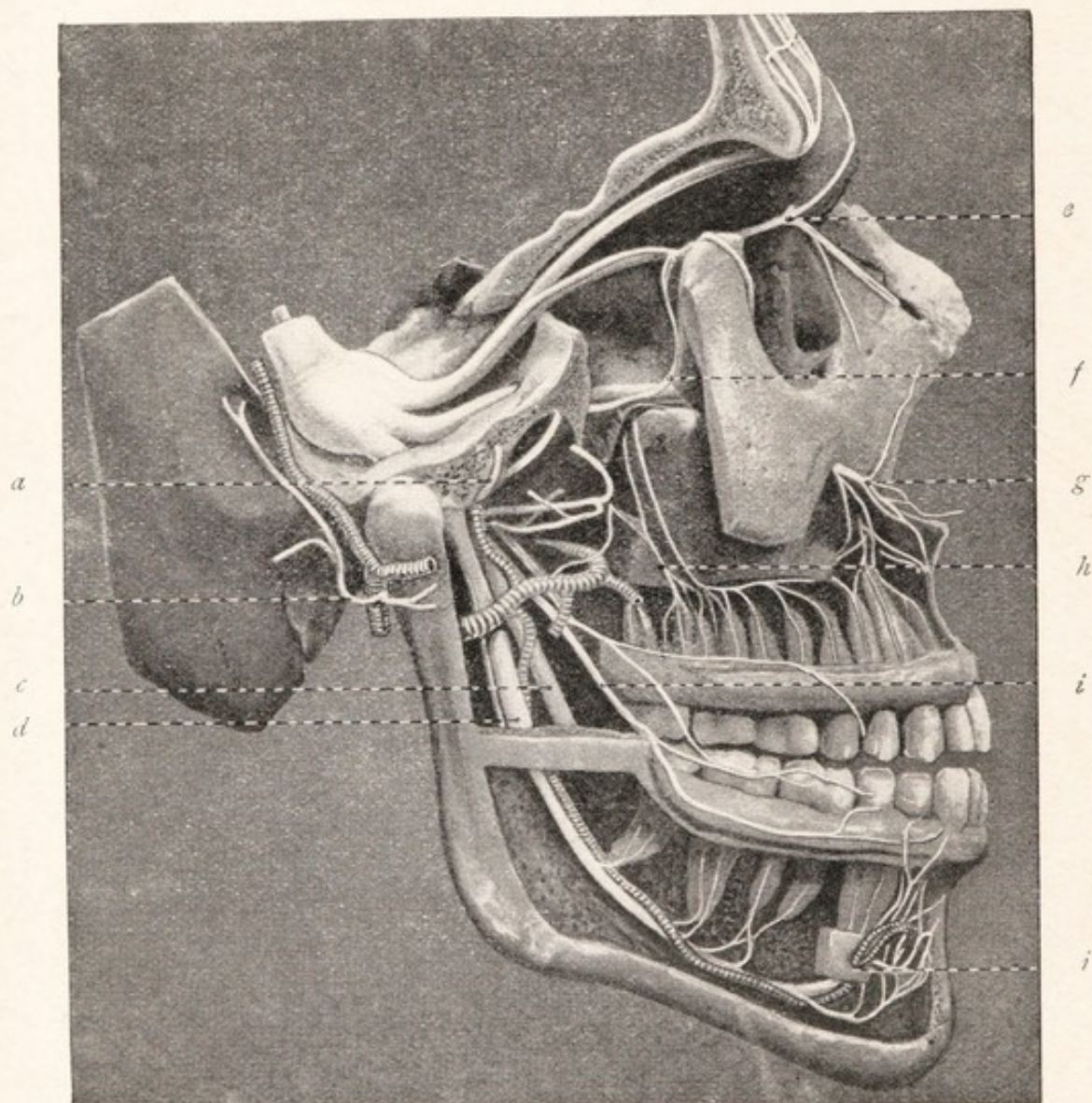


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ON FACIAL NEURALGIA AND ITS
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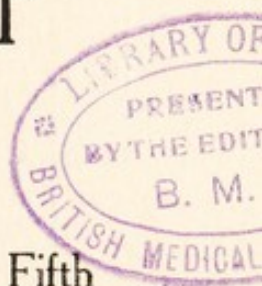


The fifth or trigeminal nerve, with the Gasserian ganglion and most of the branches, showing their relation to the cranial bones. *a*, masseteric; *b*, auriculo-temporal; *c*, lingual; *d*, inferior dental; *e*, nasal; *f*, temporo-molar joining with lachrymal; *g*, infra-orbital; *h*, posterior superior dental; *i*, buccal; *j*, mental.

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ON FACIAL NEURALGIA AND ITS TREATMENT

With Especial Reference to the Surgery of the Fifth
Nerve and the Gasserian Ganglion



BY

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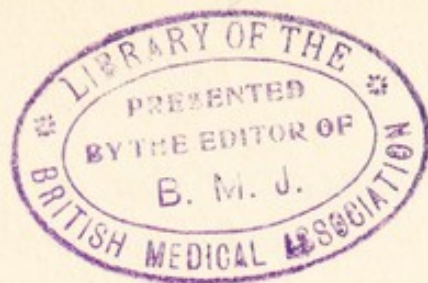
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PREFACE.

THIS work is to some extent a second edition of a monograph on the subject published many years ago. In 1915 an Essay bearing the same title was awarded the Jacksonian Prize at the Royal College of Surgeons. This Essay, revised throughout and much enlarged, is now published with the hope that it will be found useful by those physicians and surgeons who are called upon to treat one of the most distressing maladies met with in practice. The delay in publication has been due to conditions caused by the War.

As will be seen by reference to the list of papers on the subject, given at the end of this book, their number is large, and this fact testifies to the diverse opinions held and procedures adopted in the treatment of Facial Neuralgia. With the exception, however, of the admirable monograph by Professor Fedor Krause ("Die Neuralgie des Trigemini," published so long ago as 1896) there is no book dealing with the subject. During the last few years the treatment by alcohol injections into the nerves as a substitute for surgical operation in these cases of tic douloureux has come into use, and has been very widely tried. This is fully discussed in the

present edition, and reasons are given for the belief that, whilst of real value, this method will not displace operation on the Gasserian ganglion as a permanent curative measure.

Much has been gained in the last twenty years by discarding a variety of operations on peripheral branches of the fifth nerve which have been proved to be useless, and by the modified operation on the ganglion introduced by the author all fear of subsequent damage to the patient's eye can now be avoided. Finality may not yet have been reached, but the evidence adduced will show what great advances have been made since Professor William Rose's pioneer operation in 1890.

An apology need hardly be offered for the length and detail with which the subject is here treated. A successful operation for trigeminal neuralgia, one which will effect a lasting cure, is probably the most delicate, difficult, and arduous procedure in the whole of surgery. Few if any, in return, are better worth doing. The reader will therefore excuse at least the fulness of detail met with in this work, in preparing which no labour has been spared.

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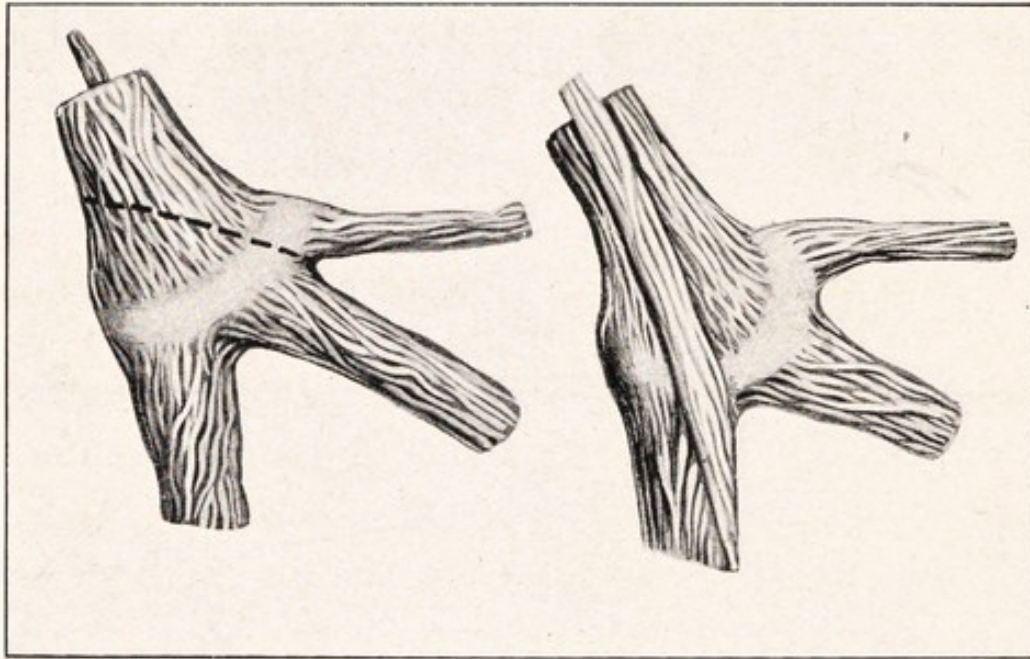


FIG. 1.

The Gasserian ganglion, viewed from the external and internal surface. The motor root is seen to lie on the median aspect of the sensory one to which it closely adheres, becoming completely incorporated with the front of the inferior maxillary division. The dotted line on the left figure shows the section advised to spare the ophthalmic division. (Modified from Rüdinger.)

ON FACIAL NEURALGIA AND ITS TREATMENT

CHAPTER I.

THE SURGICAL ANATOMY OF THE FIFTH NERVE.

IT is not necessary here to describe in detail the trigeminal nerve, its many branches and their intricate course. Such a description is to be found in Quain's Anatomy, probably the best in any language, whilst in Swan's Atlas of the Nerves and Hirschfeld and Leveillé's plates artistic and yet accurate representation has been carried to the highest possible level. There are, however, certain points in the anatomy which are of special interest to the surgeon who operates on the Gasserian ganglion or its branches which may well be considered, especially as some of them find no mention in even the best text-books.

A—The Gasserian Ganglion and its Immediate Relations.

The small rounded motor root of the ganglion can be traced through the pons varolii to a group of cells on either side of the middle line and just

below the corpora quadrigemina, in addition there is a "descending root" which joins it from cells placed under these bodies (the mesencephalic bundle). The broad, laterally flattened, sensory root has a remarkably extensive termination in cells which reach from the outer side of the motor nucleus downwards into the medulla oblongata and the spinal cord.

As seen in a section of the pons this ascending bundle of the fifth nerve is in contact with the facial or seventh nerve and very close to the nuclei of origin of the latter in the substance of the pons. As will be illustrated later in this work an occasional complication following removal of the Gasserian ganglion is paralysis, usually only partial and transitory, of the facial nerve *on the same side*. It is difficult to explain this occurrence, of which I have met with at least three examples, as the facial nerve trunk cannot be pressed upon or directly injured during any stage of the operation. No one, so far as I can ascertain, has suggested any explanation, and one is tempted to seek it in the close relation of the root fibres of the two nerves in the pons. But another suggestion may be made with more probability.

The Gasserian ganglion rests on the petrosal nerves; as the operator lifts up the dura mater from the region of the hiatus Fallopii the large superficial petrosal nerve may be torn and blood may be extravasated into the canal of the facial (the

aqueductus Fallopii) which lies very close to the surface of the middle fossa. If this be the explanation, and I can think of no other, it behoves the surgeon to deal cautiously when near the hiatus Fallopii. It should be remembered also that a small petrosal artery from the middle meningeal and a companion vein enter the hiatus, and they will be torn as well as the nerve if the dura mater is thoroughly reflected from the bone around this opening.

Since my attention was drawn to this regrettable complication, *i.e.*, facial paresis or paralysis after operation on the Gasserian ganglion, and since the explanation given above occurred to me, I have taken special care not to detach the dura from the hiatus, and have met with no further instance. It is curious how easily the facial nerve becomes paralysed, and all the causes of this are not yet understood. Entirely apart from operations on the ganglion it is unfortunately a common occurrence for facial paralysis to result from injury or inflammatory swelling of the nerve in its narrow bony canal—and a little blood passing through the hiatus may possibly lead to it, as suggested above.

To return to the roots of the Gasserian ganglion. The motor root comes off from the pons, separated by a minute interval from the sensory one, in front and to the inner side of the latter. It then enters the dural opening over the apex of the

petrous bone, lying beneath and in the same sheath as the sensory root. Quain states that "after leaving the cranial cavity by the foramen ovale it joins the sensory part of the mandibular nerve." From this one would infer that inside the skull the motor and sensory parts remain distinct, but repeated dissection has convinced me that this is not the case. *The motor root when beneath the ganglion is so intimately blended with the latter that it is rarely possible to distinguish or isolate the former.* It is obvious that if the motor root could be separated and spared whilst the sensory part were divided, some advantage would be gained, as the muscles of mastication on that side would retain their power. Several surgeons have claimed to have done this (*e.g.*, Frazier and Spiller¹ Jaboulay and Cavaillon).² The only possible method of performing this delicate isolation of the sensory root from the motor one consists in opening the dura above the ganglion and cutting through the sensory part there, leaving the ganglion intact. The difficulties are great in securing this isolated division of the sensory root, and Delbet and Chevason³ in a recent review of the subject

¹ Frazier and Spiller, *Philad. Med. Journ.*, October 25, 1902, *t alia*.

² Jaboulay and Cavaillon, *Lyon Médicale*, June 14, 1908.

³ Delbet and Chevason, "Affections Chirurgicales de la Face," 1911, p. 319.

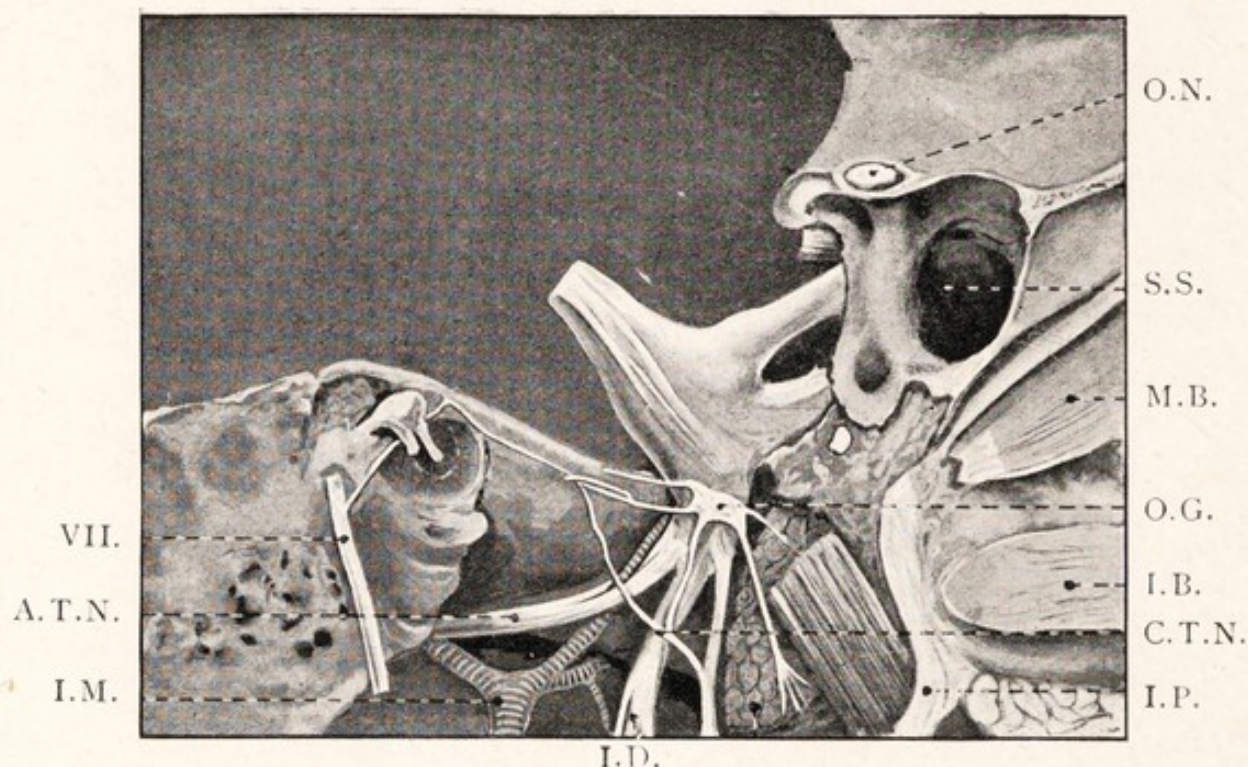


FIG. 2.

View (from the median aspect) of the Gasserian ganglion, its roots, and the three trunk-branches diverging from it. The inner, bony margin of the foramen ovale, has been cut away. The position of the foramen is shown immediately above the otic ganglion (O.G.). The lower edge of the ganglion is close to the foramen, whilst just below it the inferior maxillary breaks up into its peripheral branches—the auriculo-temporal (A.T.N.), the inferior dental (I.D.), the lingual or gustatory joined by the chorda tympani (C.T.N.), the nerve to the internal pterygoid muscle, &c. The blending of the motor root of the fifth with the under surface of the third division is well shown. Most of the muscular branches come off from its outer side, and are therefore not seen in the figure. O.N.—Optic chiasma, cut across. S.S.—Sphenoidal sinus or antrum. M.B.—Middle turbinated bone. I.B.—Inferior turbinated bone. I.P.—Internal pterygoid plate. I.M.—Internal maxillary artery. VII.—Facial nerve. Drawn from a dissection in the Museum of the London Hospital College.

go so far as to affirm that "jusqu'à présent, la section chirurgicale a toujours porté *sur les deux racines*."

The semilunar ganglion is a greyish-pink flattened body encased in thin dura mater, resting on a depression in the apex of the petrous bone, on the fibrous tissue covering in the middle lacerated foramen, the groove for the large petrosal nerve, and the sphenoid bone adjacent to the foramen spinosum and the foramen ovale. The ganglion slopes downwards and outwards but it is more horizontal than vertical, it varies a good deal in size, from fourteen to twenty-two millimetres in width, about four millimetres in height (Henle). I cannot agree with Krause's statement that the lower border of the ganglion is five millimetres from the foramen ovale, this would give an appreciable length for the intracranial course of the third division, whereas such rarely if ever exists, the ganglion at its lower border lying close to the foramen ovale.

It is important to remember how thin is the dural investment of the ganglion, and a useful rule may be laid down on this point. The older the patient the thinner in most cases is the dural sheath; the younger the patient the thicker, more vascular, and more closely connected is it.

Erroneous inferences have been drawn from the degree of adhesion between sheath and ganglion. Some operators have found the

ganglion "fibrosed" or "nævoid" and have attributed the neuralgia to this condition—the true explanation being that the patient happened to be a comparatively young adult with a naturally thick and vascular sheath of dura mater.¹

In every case of this kind, namely, patients under forty or forty-five, I have noticed trouble in separating the upper layer of dura from the ganglion, together with persistent capillary hæmorrhage. Indeed before operating on a comparatively young subject it may be a wise precaution to ligature the external carotid artery, although the effect of this in controlling the bleeding is variable and uncertain.

In separating the upper layer of the dural sheath from the ganglion, however carefully this is done, it may easily happen that the sheath is penetrated, cerebrospinal fluid will then escape, but this is of slight importance, in fact it may lessen the bulging of the dura and facilitate the isolation of the ganglion. As Krause points out, the ganglion adheres more to the under than to the upper layer of its sheath, and great care must be taken in lifting the ganglion from over the middle lacerated foramen, as a thin partition only exists

¹Delbet and Chevason, "Neuralgies du Trigumeau," p. 279, may be quoted as among the writers who describe "abnormal adhesions between the ganglion and its sheath," and think that they imply an inflammation of the ganglion itself. This is a mistaken view.

between it and the internal carotid artery. I do not however know of any reported cases in which the latter has been opened; such an accident would certainly prove fatal.

B—*Of the three divisions of the fifth nerve* the largest one, the inferior maxillary, has practically no intracranial course, it enters the foramen ovale immediately below the ganglion (see fig. 2). The foramen itself varies a good deal in shape, being sometimes more round or even triangular than oval, but its long axis is usually directed backwards and outwards, measuring about seven millimetres, rather less in female skulls (see fig. 6). It transmits a small meningeal artery which may cause troublesome oozing when the nerve is cut across, as well as minute veins. Its relation to the foramen spinosum (transmitting the middle meningeal) is of great importance. The foramen spinosum is invariably behind and to its outer side (see fig. 3), but the distance between the two may vary from one to five millimetres, averaging three millimetres.

The three foramina — rotundum, ovale and spinosum—which are of such importance to define in operating on the ganglion, are placed so that a line sixteen to twenty millimetres in length connecting the three openings curves backwards and outwards. Measuring a large number of skulls I found the centre of the foramen ovale was distant, on an average, fourteen millimetres from the foramen rotundum. The distance was

never less than eleven millimetres, but in some skulls was as much as seventeen millimetres. The foramen rotundum is almost always placed on a higher level than the oval one, the foramen spinosum is always nearer the temporal fossa than

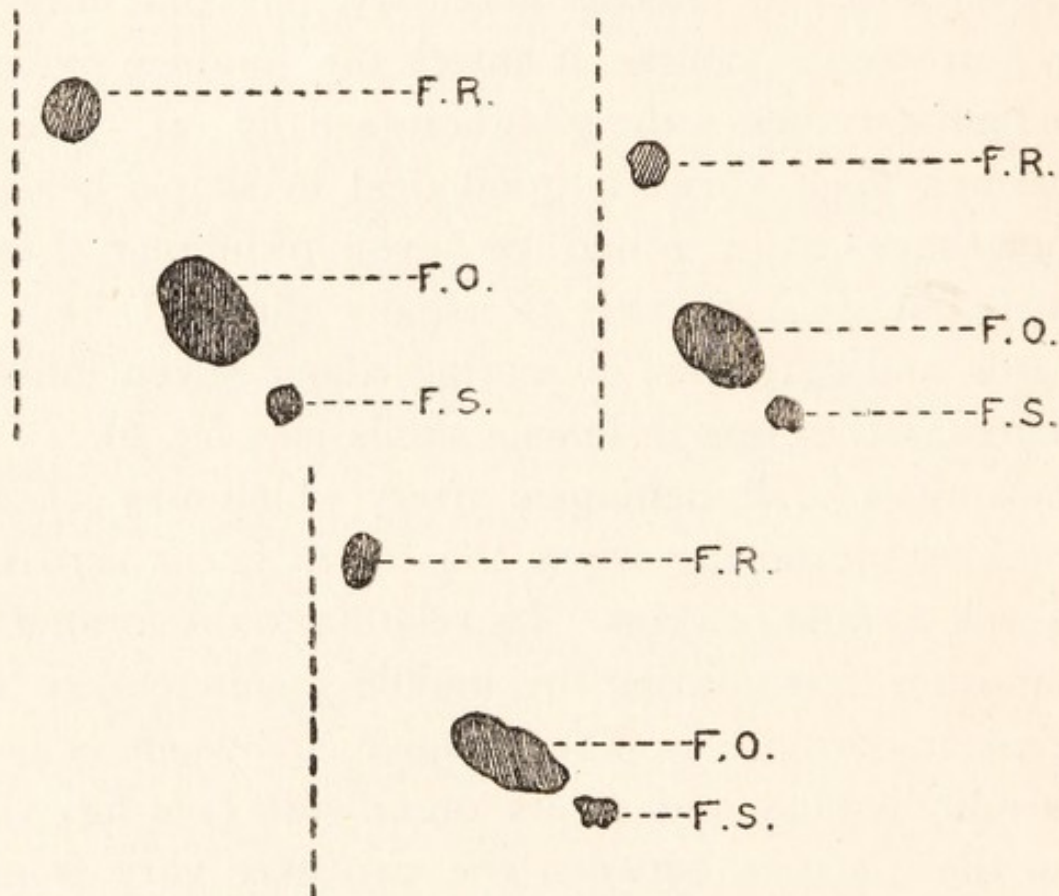


FIG. 3.

The relative positions of the three openings in the base of the skull in different subjects. F.R.—Foramen rotundum. F.O.—Foramen ovale. F.S.—Foramen spinosum. Note the variation with regard to the antero-posterior plane (dotted line), and the different sizes of the apertures. These were selected from the examination of many adult skulls as representing the chief variations that are to be met with.

either. Hence in operating by the temporal route the surgeon first defines the middle meningeal artery as it comes through its foramen; after ligaturing and dividing the vessel he seeks the

inferior maxillary trunk a few millimetres *in front and internal* to the former, and finally follows up the superior maxillary trunk to the foramen rotundum, a centimetre or more in front and at a slightly higher plane. In this way the whole lower edge of the ganglion and its two chief trunks are exposed. It may be thought that such precise directions are needless, but experience teaches that when operating it is essential to keep in one's mind the exact relative position of the foramina referred to, and it is certain that many operators have failed in the attempt to make out the ganglion at all. The external landmarks are discussed in another chapter ; it may be noted here that the pre-glenoid tubercle at the root of the zygoma is exactly opposite the foramen ovale, separated by a distance of four centimetres.

Both the foramina ovale and rotundum are really canals with bony walls rather than mere apertures in the bone, this is especially marked in the case of the rotundum—moreover the superior maxillary nerve before entering this canal frequently rests in a deep groove in the body of the sphenoid.

This is of especial interest with regard to the cavernous sinus, injury to which during operation on the ganglion has been sometimes the cause of serious trouble, or even of a fatal result.

The ganglion itself is in contact by its deep aspect in front with the outer wall of the sinus, the superior maxillary division lies against the

lower angle of the sinus but, as just noticed, is often protected by a bony ridge. With due care the superior maxillary trunk can be isolated right up to the foramen rotundum with the aid of a blunt dissector without fear of injury to the cavernous sinus. But with regard to the ophthalmic trunk it is an entirely different matter. Fig. 4 shows how closely it lies to the cavernous sinus, with the fourth nerve immediately above and the sixth nerve on its inner side. The attempt to isolate the ophthalmic division is therefore attended with much risk of wounding the cavernous sinus as well as damaging the oculomotor nerves, both accidents have happened in many cases. As Prof. Krause remarks : " I therefore when operating avoid isolating this branch, as one would almost inevitably open the cavernous sinus in so doing" (writer's translation).

In the form of operation advocated in this work, and satisfactorily carried out in nearly all the cases I have operated on, the ophthalmic division is not touched and thereby risk of the complications just mentioned is avoided.

It should however be noted that communicating veins pass through the foramen rotundum to join the pterygoid plexus with the cavernous sinus, and Krause describes an occasional prolongation of the latter as far forwards as the foramen. Experience proves that the venous oozing when the second division is divided varies greatly in amount, it may be

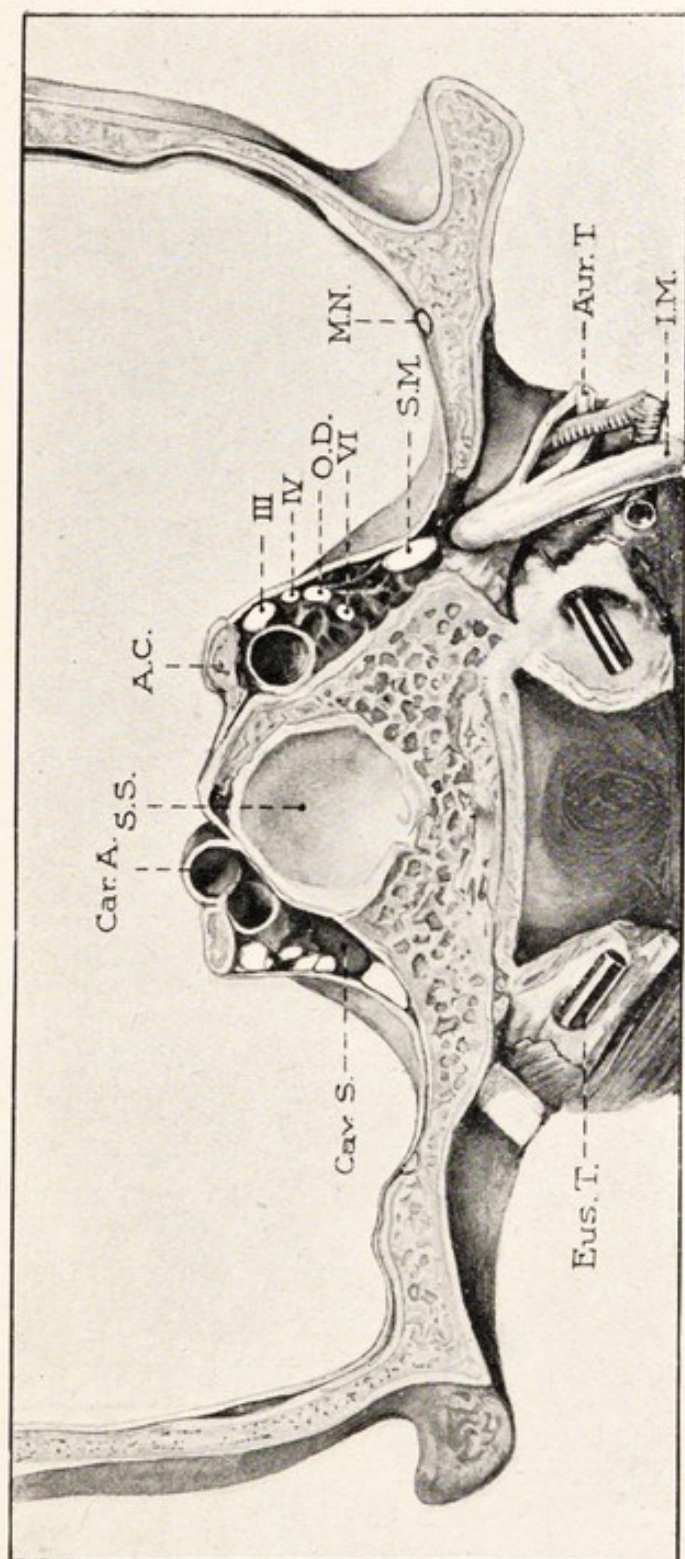


FIG. 4.

Transverse, vertical section in front of the Gasserian ganglion to show the relation of the three divisions of the fifth nerve and their relation to the cavernous sinus. (From a dissection in the London Hospital Museum.) S.S.—The posterior wall of the sphenoidal sinus. Car.A.—Carotid artery. A.C.—Anterior clinoid process. Cav.S.—Cavernous sinus. Eus.T.—Eustachian tube with a glass rod inserted on each side. M.N.—Anterior branch of middle meningeal artery lying in the dura mater lining the middle fossa. III.—Third nerve. IV. and VI.—Fourth and sixth nerves. O.D.—Ophthalmic division of the fifth nerve (drawn rather too small). S.M.—Superior, and I.M., inferior maxillary divisions of the fifth nerve. Aur.T.—Roots of auriculo-temporal nerve, enclosing the middle meningeal artery.

insignificant or very troublesome. A distinguished American surgeon, Abbe, advises that the two lower divisions of the fifth nerve should be simply cut across and that their respective foramina, rotundum and ovale, should then be plugged. I doubt if this is the best procedure, and I have never felt inclined to adopt it, as I have known the neuralgia to return severely within a year after complete section of the two branches beyond the ganglion. Moreover it is by no means easy to plug the foramina. "Horsley's wax" is useless for the purpose, plugs of bone are difficult to insert and are readily displaced; perhaps the best material is gold foil pressed into the foramina with an aneurism needle. Abbe's method is fully discussed on pp. 142 to 147.

We have now to notice the variations in shape and size of the foramina. The accompanying illustrations will render full description unnecessary.¹ From an examination of a large number of skulls in the Royal College of Surgeons Museum I can state that the foramina rotundum and ovale differ considerably both in exact shape and size, not only in different individuals but on the two sides of the body. Asymmetry is frequently met with. Some writers (Schuh and Sicard for example) have brought forward the view that narrow or small foramina may be the cause of epileptiform neuralgia. In support of this theory Sicard states that the

¹ See fig. 3 on p. 8 and fig. 5 on p. 12.

foramina are usually smaller on the right side, and that trigeminal neuralgia is also more common on this side. The narrowing of the foramina is



Foramen rotundum.



Canal and Foramen ovale for the 3rd division.



Foramen spinosum.

From an exceptional skull in which the Foramina rotundum and ovale were only 4 mm. apart.

Left side.

Right side.



Cup-shaped, much larger on L. side.



Different shapes on the two sides.



Marked inequality and difference in shape.



Exceptionally large, 10 mm. in long diameter, on R. side.

FIG. 5.

Examples of asymmetry and peculiarity in shape of the *Foramina ovalia*. Drawn (*exact size*) from skulls of various races in the Royal College of Surgeons' Museum.

attributed to a congenital condition, or to a diminution which is supposed to come on in old age (Rose).

Many arguments of weight could be brought forward against this mechanical view of trigeminal neuralgia, which has in fact nothing whatever to support it. It would be a waste of time to discuss it further.

C—The Foramen Spinosum and Middle Meningeal Artery.

This vessel is of great importance in all operations on the ganglion. When the surgeon follows the temporal route (Hartley-Krause operation) it is occasionally possible to expose the ganglion without dividing the artery, but as a matter of routine this is not to be recommended. It has been claimed for the pterygoid route with division of the zygoma (Poirier's and Cushing's operation) that thereby trouble with the middle meningeal artery is avoided, but I believe that in the great majority of cases operated on by the pterygoid route this vessel has had to be dealt with by ligature. A brief discussion of the anatomical conditions will show why this is so.

The foramen spinosum lies on an average three millimetres behind and external to the foramen ovale (it is occasionally a double aperture)—the artery adheres immediately to the dura mater, and is usually described as dividing into anterior and posterior branches a few millimetres outside the foramen spinosum. The anterior branch, always the larger of the two and by some regarded as the

trunk vessel, runs in a straight course forwards and outwards towards the tip of the great wing of the sphenoid and the anterior inferior angle of the parietal.

In this course, which is practically invariable, the artery may deeply groove the bone. The greatest distance of this groove from a line joining the foramina rotundum and ovale (*i.e.*, the lower border of the Gasserian ganglion and its main branches) will be found to measure not more than two centimetres, often less. This space would be inadequate to allow of proper exposure of the ganglion from below, hence the Poirier-Cushing operation must trench upon the middle meningeal area and compel the surgeon to ligature the vessel at the foramen spinosum. It is remarkable how this procedure, with division above the point of ligature, allows the dura to be displaced upwards and the ganglion to be properly displayed. In fact as Krause points out, it is one of the chief steps in the operation.

As already noted, the direct course of the chief branch of the middle meningeal artery, from the foramen spinosum across the middle fossa to the anterior inferior angle of the parietal bone is remarkably constant, but in other respects the artery is liable to variation. (1) It may very rarely be double at the foramen spinosum (Krause has met with this in operating). (2) The posterior branch may come off at or close to the foramen (in

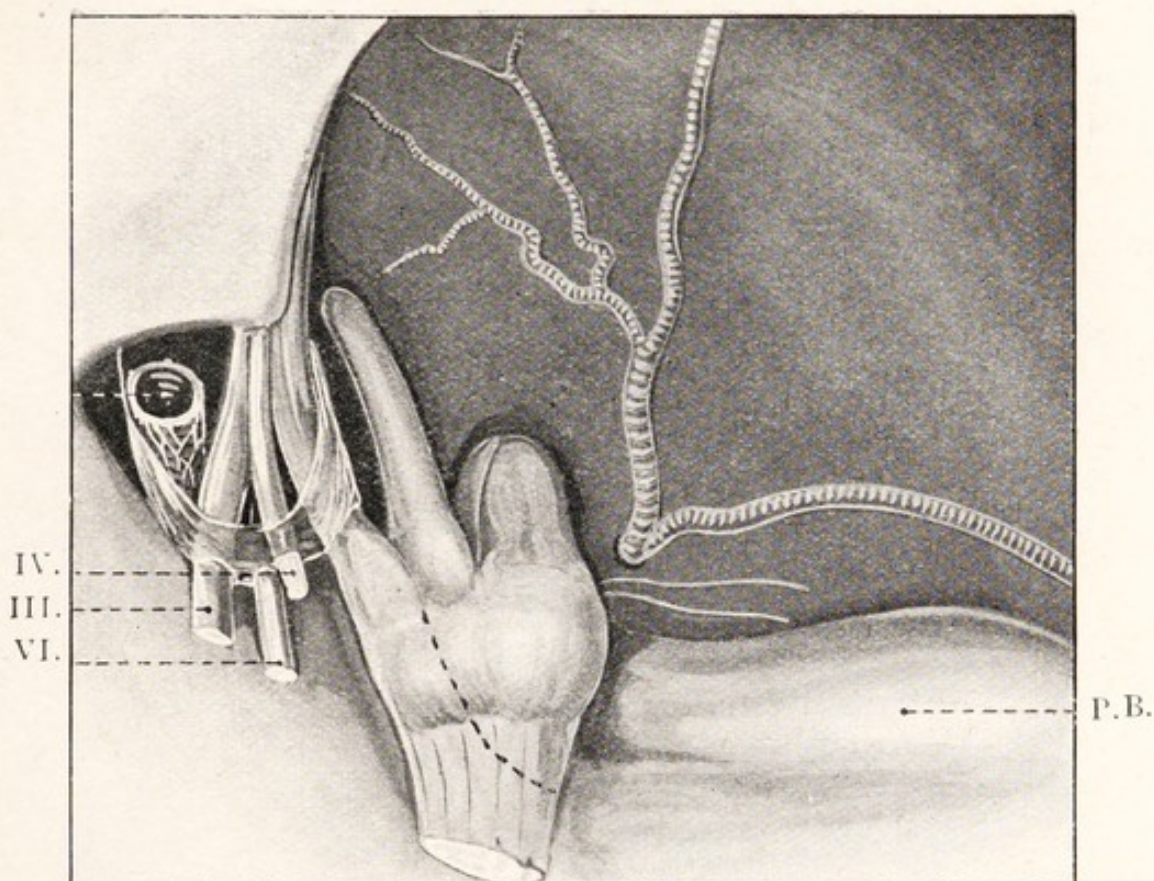


FIG. 6.

This figure, made from a wax model in the London Hospital Museum, gives an enlarged and diagrammatic view of the nerves in the cavernous sinus (III, IV and VI, in close relation to the ophthalmic trunk of the fifth nerve), the superior maxillary division running outside the sinus (the distance between them is exaggerated), the Gasserian ganglion, and the inferior maxillary division (too much of this is represented above the foramen ovale). The two branches of the middle meningeal artery are seen crossing the middle fossa of the skull, but, as stated in the text, the anterior one as a rule is proportionately larger and runs nearer to the main divisions of the fifth nerve. The dotted line running backwards from the angle between the first and second divisions indicates the upper line of section advocated in the writer's method of operation on the ganglion. Although the wax model is not quite correct, it gives a useful view of the relative position of the main structures concerned in the operation. P.B.—The petrous bone.

over fifty per cent. according to Steiner), or even as far as five centimetres external to it. (3) The artery may be small or practically absent, a large branch from the ophthalmic artery which runs backwards through the sphenoidal fissure taking its place. More important for the surgeon to remember than these varieties is the fact that in old people the artery deeply grooves the bone, and even if great care is taken in trephining and in reflecting the dura mater it may on this account be impossible to avoid tearing it. Hæmorrhage from this cause can always be controlled by passing a fine suture on a small curved needle through the dura, and so underpinning the vessel.

Anastomosis between the meningeal arteries of the two sides is remarkably free. In two cases of my own reported in this work recurrent hæmorrhage of serious amount came on a few hours after the ganglion operation and necessitated re-opening the wound. The bleeding had recurred solely from the distal end of the middle meningeal, *i.e.*, from the peripheral anastomosis only, the proximal end having been securely tied. Fortunately both these patients recovered. Subsequent evidence showed that one of them was a "bleeder," though not a true hæmophilic.

D—*Of the peripheral branches and extra-cranial course of the fifth nerve* it is unnecessary to say much here.

The anatomical points in connection with alcohol

injection of these branches and with the very few other operations on them which may be justified in exceptional cases of neuralgia, are discussed later. The anæsthesia left after complete removal of the Gasserian ganglion, or after removal of all but the first division, will be illustrated in diagrams from actual cases. It has, moreover, been discussed in detail in the works of Krause, Horsley, Bardeleben, Cushing and others. Experience has taught me, with regard to the supply of skin, &c., by different branches of the fifth nerve, that there exists a considerable variation in the exact areas supplied in different individuals, that overlapping of sensory areas is always present, and after operation on the ganglion this becomes still more marked as time goes on.

A few practical points are worthy of note. (1) The skin over the masseter area (extending forwards for a variable distance towards the chin) is mainly supplied by the superficial cervical plexus, and will hence always retain sensation after operation on the ganglion.¹ (2) In a similar manner the skin over the side of the nose is mainly supplied by the nasal branch of the ophthalmic and will hence retain sensation although the two lower divisions of the fifth have been completely divided. (3) The cornea, iris and the conjunctiva are supplied by the ophthalmic division. Hence if this division is

¹ See, for example, fig. 35, on p. 161.

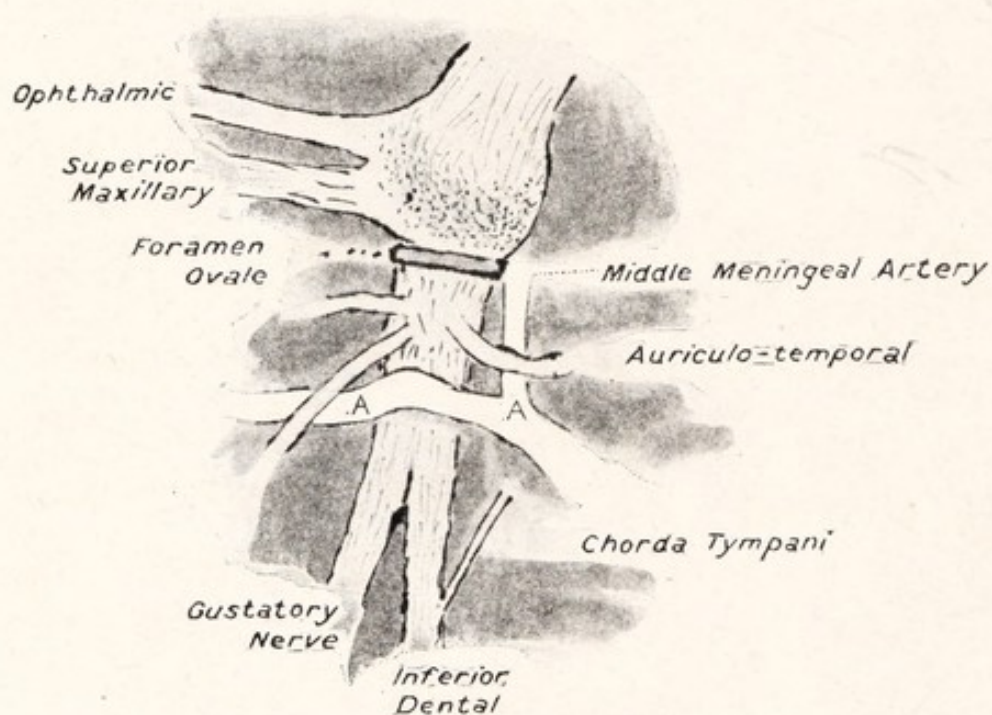


FIG. 7.

From a dissection in the Museum of the Royal College of Surgeons. To show the very small interval between the foramen ovale and the crossing of the nerve trunks by the internal maxillary artery.

included in the ganglion operation the patient will always be exposed to the risk of so-called "trophic" ulceration, and perhaps even loss of the eye. Krause makes the interesting observation that the anæsthesia of the eye left after operation on the whole ganglion does not diminish in the least with lapse of time—in this respect differing from that of the skin and mucous membrane.

All the main branches of the fifth nerve are accompanied by arteries. The close proximity of the internal maxillary trunk to the foramen ovale and (further on) its terminal branching in the pterygo-maxillary fossa appear to make the insertion of a sharp needle (in alcohol injection) of considerable risk in these regions. Fig. 7 shows the internal maxillary trunk crossing the chief part of the third division just below the foramen ovale and it is a marvel that it should escape penetration by the needle aimed at the foramen itself. That arterial hæmorrhage does not more often follow the physician's injection is purely a matter of good fortune.

The close relation of the inferior dental artery and nerve and of the infraorbital vessels and nerve in their respective bony canals is of surgical interest when operations are carried out on these peripheral branches.

The frontispiece shows practically all the peripheral branches of the fifth nerve, together with the Gasserian ganglion and its roots.

CHAPTER II.

THE CAUSES AND DIFFERENT FORMS OF FACIAL NEURALGIA.

THE subject of facial or trigeminal neuralgia includes some of the most interesting problems in the whole realm of pathology and physiology. The surgeon, however, is chiefly concerned with the question: "What cases of neuralgia are suited for operative treatment, and what are the best methods to employ?" The answer, obviously, should depend upon a scientific classification, based solely upon the causes of neuralgia; to make such a classification with our present knowledge is almost impossible. We can distinguish the pain due to errors of refraction from the more intense neuralgia set up by a peridental abscess, and the pain caused by a syphilitic node of the skull from that accompanying an attack of herpes frontalis.

Yet, of the gravest form of all, epileptiform or major neuralgia (*tic douloureux*), with which this work is mainly concerned, the pathology and causation are practically unknown. What evidence exists on the subject and what theories have been devised will be briefly discussed later.

The following classification of the neuralgias of the face and head may be suggested :—

(1) The neuralgia due to anæmia, gout, malaria, or other abnormal conditions of the blood. In this group must provisionally be included the cases of so-called hysteria and neurasthenia in which neuralgia happens to be a marked symptom. In none of these cases is the neuralgia of a very severe or persistent type, and in none of them is an operation ever advisable for its relief.

(2) That due to a true neuritis, *e.g.*, the neuralgia accompanying or following herpes of the face or (very rarely) syphilitic inflammation of the fifth nerve. Probably post-influenzal neuralgia is of this nature.

(3) The pain referred from some local cause, such as a carious tooth, a buried molar, an inflamed iris, a syphilitic node of the skull, eye-strain due to errors of refraction, &c.

The forms of neuralgia thus grouped have definite causes, the removal of which when possible is the aim of the physician or surgeon. For none of them is an operation indicated on the nerve-trunks which are apparently involved, though destruction of the terminal twigs may be occasionally indicated, as in the neuralgia due to a hollow carious tooth. Moreover, in many of these cases the neuralgia is favoured or induced by certain known conditions ; it is more or less continuous, or if spasmodic, the patient has intervals of

only comparative, and not complete, absence of pain.

It is evident that the three groups mentioned above, which together are known as neuralgia minor—in contrast with epileptiform neuralgia—include pain due to a multitude of causes, some of which can be removed whilst in others this is impracticable. It would be easy to extend the list, and the statement that when the pain is of the continuous form (not spasmodic or epileptiform) operation on the main nerve-trunks or the Gasserian ganglion is never of value must be slightly qualified. Thus Dr. W. Harris states that he has met with decided success in the treatment of minor neuralgia of the continuous type with alcohol injections. This applies especially to frontal neuralgia or “neuritis” following influenza, in which injection of the supraorbital nerve is said to give relief or to effect a cure. It may be that a few cases of *continuous* facial neuralgia without known cause are so severe as to justify removal of the Gasserian ganglion.¹ I am, however, convinced that the ultimate result of such operations proves less satisfactory than when performed for true epileptiform neuralgia, and personally should not recommend it. Cases of intense neuralgia of the fifth due to tumour pressure on the nerve are usually of the

¹ Dr. Crawford Renton and others have recorded examples of such operations being followed by cure.

continuous type; their treatment by operation is very unsatisfactory.

In (4) epileptiform neuralgia, neither local cause nor favouring conditions can as a rule be assigned; the pain occurs in spasmodic and intermitting attacks with shortening intervals. In this form of neuralgia any attempt of the surgeon to remove some peripheral exciting lesion is worse than useless, whilst excision of the central part of the fifth nerve (the Gasserian ganglion) is followed almost always by a permanent cure.

The statement made above has several important bearings. In the first place the attempt to assign a peripheral cause to epileptiform neuralgia—such as neuritis set up by carious teeth—has completely failed. We constantly see cases in which many useful teeth have been extracted from such patients without the slightest benefit, indeed much to their detriment. Secondly, all operations on the peripheral branches of the fifth nerve, and all varieties of alcohol injection of these or of the ganglion itself, afford only temporary relief to the neuralgia.¹ Thirdly, the cure effected by a successful excision of the ganglion lasts for many years, and indeed with few exceptions has a right to be termed permanent.

It will be seen that the great distinction laid down between (A) minor neuralgia of the fifth nerve (with all its many causes and varying degrees of

¹ With regard to successful injection of the ganglion itself with alcohol this statement is perhaps too absolute.

intensity and duration), and (B) major neuralgia with its epileptiform and progressive character, and its complete absence of known cause, is an important one. The treatment differs widely. But in regard to few branches of medicine or surgery can precise demarcations be laid down, infallible definitions given, or invariable rules as to diagnosis and treatment be followed. Here, as elsewhere, we meet with ambiguous or "border-line cases"; for example patients with neuralgia of a spasmodic type in whom the removal of a local cause such as a buried wisdom-tooth may possibly effect a cure.

Before considering tic douloureux or epileptiform neuralgia in its various aspects it will be well to illustrate such varieties of minor neuralgia as are likely to come under a surgeon's notice, or may be confused with the early stages of the major disease. Into such purely medical provinces as malaria, anæmia, tabes, hysteria, &c., we will not trespass; neuralgia associated with these has been discussed exhaustively by Trousseau, Graves, Anstie, T. Buzzard, Sir William Osler and other physicians.

FACIAL NEURALGIA DUE TO OCULAR AND NASAL CAUSES.

The neuralgia due to *eye-strain* from hypermetropia, presbyopia, or astigmatism, is well-known; it is almost always frontal and ocular in distribution, and is brought on by use of the eyes in near vision. Its relief, by correcting the error of refraction with

suitable glasses, is usually complete and immediate. Iritis and acute glaucoma are often attended with more intense neuralgia, having much the same distribution. The importance of recognizing the reflex nature of the pain and of instituting the proper treatment for its cause cannot be over-estimated.

The neuralgia from glaucoma and iritis may also affect the temporal region, and, in the former case, the upper or lower jaw may be the seat of varying tenderness and pain.¹ Such a distribution and intensity are rarely if ever met with in the neuralgia due to errors of refraction. It should not be forgotten that the latter form may be aggravated by systemic conditions. Thus, it may be necessary to treat anæmia as well as hypermetropia, &c., or the cure will be imperfect; and Dr. Henry Head points out that in some cases in women the climacteric may share with the onset of presbyopia in inducing troublesome neuralgia.

Another important point is that increased ocular tension may lead to paroxysmal attacks of headache of considerable intensity accompanied by vomiting. Many a case of acute glaucoma has been diagnosed as one of "bilious headache" during the first day or two, until it was too late to save the sight by the prompt use of eserine or by iridectomy, &c.

It will be noticed that the neuralgia having an ocular cause is nearly always referred to the

Head, "Allbutt's System of Medicine," vol. vi, p. 746.

forehead. True epileptiform neuralgia hardly ever begins in the first division of the fifth (see p. 47). Herpes frontalis is usually preceded by considerable pain in this nerve, and after the eruption has subsided, neuralgia may be very persistent, lasting in the worst cases for several months. It however subsides ultimately, especially under careful treatment. The pathology is now well established, largely owing to the work of Dr. Henry Head; there is a definite inflammation of the Gasserian ganglion or of the ophthalmic trunk.

Another cause of severe frontal neuralgia remains to be noted, namely, catarrhal or suppurative inflammation of the air sinuses in the frontal, maxillary, ethmoid, or sphenoid bones. It is not merely distension of the sinuses with pus which causes the intense pain, for an attack which clears up entirely may be attended with such severe throbbing neuralgia that at the time the presence of pus may be strongly suspected.

In some cases congestive swelling of the middle and inferior turbinated bones suffices to cause nasal obstruction and consecutive headache or neuralgia. The actual pressure of the swollen middle turbinated bone against the septum is held to account for them, and it is important to remember that posterior rhinoscopy alone may reveal the condition.¹ Influenza is a fertile source of such neuralgia, as also of

¹ A. L. Whitehead, *Brit. Med. Journ.*, January 28, 1905.

empyema of the frontal or other sinuses. Disease of the antrum of Highmore usually produces dull throbbing pain in the cheek, though it may extend up to the forehead, and in neglected cases the whole trigeminal area may be concerned. The grave mistake may then be made of treating the case as one of neuralgia alone, and of ignoring the real cause. The following is an example:—

A young and previously healthy officer became subject to one-sided "facial neuralgia" of increasing intensity. He was then in India, and was treated in hospital with all kinds of sedative drugs without avail. Becoming steadily worse he was invalided home to England. On the voyage he became hemiplegic, and was landed in an extremely exhausted condition. For the first time the nature of his disease was ascertained, namely, suppuration in the antrum of Highmore, from which disease of the bone had spread up to the base of the skull, with consecutive meningitis and cerebral abscess. Operative measures were unfortunately too late to save the patient's life.

Cases such as the above are very exceptional; as Dr. Head remarks, "even in those nasal affections that cause pain, it is rarely acute enough to be spoken of as neuralgia." Suppurative inflammation of the frontal sinus, especially if its infundibular exit is blocked, and the cavity becomes distended with pus, is the most likely to produce pain of a high degree of severity.

Unfortunately from the point of view of diagnosis the position of the neuralgic area is rarely useful in determining what part of the nose or its accessory sinuses is involved. Thus the pain due to frontal

sinusitis is usually felt in the forehead, but it may be chiefly occipital ; that due to empyema of the maxillary antrum is mainly infraorbital, but may be limited to the forehead or extend over the head. As a rule if the air-sinuses on one side are concerned the pain is unilateral, though not always so. There is one striking feature about the neuralgia of nasal origin, namely that *it comes on in the morning and is at its worst at that time*. The reason is probably that nasal congestion and catarrh are usually aggravated or commence in the morning hours owing to the peripheral circulation of blood not having adapted itself to the altered temperature and physical conditions from those of repose in a warm bed.

These morning exacerbations in neuralgia from nasal causes are remarkably constant in most cases, and have been noted by many observers.

The nasal trouble may have been produced by an attack of influenza, and the supraorbital neuralgia left as a sequel of this disease usually is worst or occurs only between about 10 a.m. and 5 p.m.¹

In the neuralgia due to eye-strain the converse is often but not always true, it comes on as a rule in the afternoon or evening when the ciliary muscle or the recti have been overtaxed.

During the last twenty years attention has been continually called to the importance of diagnosis in

¹ Dr. W. Harris, *Med. Soc. Trans.*, 1910, p. 53.

chronic catarrh and suppuration in the accessory sinuses of the nose. In spite of the considerable help we can now obtain from the radiographic plates, it remains very difficult to be certain whether or not one or other of these cavities is diseased. Hence we should expect that needless operations are liable to be performed. As regards facial neuralgia this must often have occurred. The writer has known of several examples of exploration—interesting but without result—of the normal antrum of Highmore or frontal sinus in the subjects of epileptiform neuralgia.

NEURALGIA OF HEAD AND FACE DUE TO SYPHILIS.

Headache and neuralgia due to syphilis are of great importance, since in most cases they can be cured or greatly relieved by appropriate treatment; moreover, their cause is often overlooked.

Their various forms and the circumstances under which they occur will be best illustrated by the following examples:—

I.—Persistent Cephalalgia in the Secondary Stage from Neglect of Treatment.

The writer once examined a man who was claiming damages on account of a contusion of the head, which had been followed by persistent and intense pain, with loss of sleep, and a torpid mental condition. His pain was largely occipital, with radiations down the cervical spine. The headache was, as a rule, worse at night, but it never left him, and his doctor had prescribed various sedatives without giving any relief. He complained only of this continuous ache, which had entirely prevented his working for several weeks;

in fact, he was confined to his room and looked a physical wreck. There was no optic neuritis or vomiting, but giddiness came on at once if he attempted to walk.

On making a thorough examination I found a copious blotchy syphilitic eruption, which had appeared within three weeks of the accident. Six months had elapsed, but no anti-syphilitic treatment of any kind had been attempted, nor would his doctor admit the diagnosis of syphilis. The man, however, did not get damages, but took a mercurial course instead. It may be noted that persistent headache or neuralgia occasionally results from head-injury (cerebral concussion), with or without fracture of the skull, but in this case the injury was certainly not the main cause.

II.—*Iritis attributed to Injury. Severe Neuralgia of Head. Secondary Syphilis Overlooked.*

This case bore a strong resemblance to the one just noted. A man working in the docks was struck by a rope, which swung round his head. For four months after the accident he attended Moorfields hospital for slight iritis in both eyes, and he also was treated by no fewer than six medical men in addition, on account of severe headache. The neuralgia was constant, but worse at night; it was chiefly localized in the forehead and top of the head. During these four months the man was receiving compensation from the Dock Company, but Dr. Finlay, its medical adviser, being dissatisfied, sent the patient up to me. There was no syphilitic eruption present, nor could I obtain any history of chancre of the penis, but the evidence as to syphilis was conclusive.

It consisted in: (1) a well-marked bald patch on the dorsum of the tongue, with two small ulcers; (2) chronic enlargement of the glands in the right groin and on both sides of the neck; (3) uveal deposit from iritis in each eye; and (4) the persistent cephalalgia with characteristic nocturnal exacerbations. The man was urged to take a proper mercurial course, and I believe that his symptoms entirely subsided under its influence. Both the above cases occurred before the Wassermann blood test had been discovered. This test is of course of extreme value in the diagnosis of cephalic neuralgia of doubtful origin, and its use should on no account be omitted.

III.—*Headache due to Periostitis and Nodes of the Skull in the Late Stages of Syphilis.*

Many examples of this could readily be quoted. In some there may be one or more definite tender swellings on the skull, accompanied by radiating pain; in others the distribution is more general, and no isolated node can be distinguished. There may be sclerosis of large areas of bone, or a node situated entirely within the cranium. Pericranial gummata are usually soft and free from tension, and therefore cause little pain, but occasionally a localized necrosis occurs beneath them. Should an abscess then form between dura mater and bone, very severe cephalalgia may be produced. Operation under such circumstances is urgently called for. As a rule, however, the symptoms yield to increasing doses of iodides of sodium and potassium, or to mercurial inunction, or to intravenous injection of salvarsan.¹

Syphilitic necrosis, when it involves the base of the skull, may cause intense suffering, of which the following case is an example:—

About ten years after contracting syphilis, a man became the subject of aggressive necrosis, which destroyed the whole of the palate and the nasal septum. It spread to the turbinated

¹ In the most extensive case of syphilitic necrosis of the skull-vault and extra-dural suppuration that I have ever seen there was strangely no headache or neuralgia from first to last, the man continuing his duties as a postman for practically the whole time.

and sphenoid bones, until a chasm was left, through which the roof of the naso-pharynx was exposed. The disease progressed in spite of all kinds of mercurial and iodide treatment, the latter drug being the more effective, but causing considerable depression.

Piece by piece the bone of the skull came away, the separation being attended with horrible pain which destroyed sleep for weeks together. The neuralgia was referred to both temples and to the forehead, there being little doubt that the fifth nerve about the Gasserian ganglion was affected on both sides.

It was one of the most obstinate and deplorable cases of tertiary syphilis I have ever seen. In the pre-iodide days they appear to have been not very sore.

This case occurred long before salvarsan was introduced and it would have been interesting to see if that drug succeeded where iodides, mercury, arsenic by the mouth, and all kinds of sedatives had failed.

In the more frequent cases of "cephalalgia" (the term is of French origin and a useful one), where obstinate aching pain occurs over the whole vault of the skull in syphilitic subjects, salvarsan and neo-salvarsan have scored many triumphs. The following is a typical example :—

A farmer, aged 63, contracted a chancre of the mid-dorsal region of his tongue, how it was derived did not appear. The strange mistakes in diagnosis which these uncommon lesions give rise to was illustrated by the treatment employed for this lingual chancre by two well-known consultants. One persevered for several weeks with X-rays and radium, evidently believing the sore was epitheliomatous, the other employed ionic medication.

The patient developed severe secondaries, including a deeply pigmented eruption of the lower limbs, bald patches

on the tongue, and a pustular eruption on the scalp. All his finger-nails were shed. The worst symptom, however, was iritis, which fortunately was cured by mercurial treatment internally (hyd. c. cretâ, gr. iv in die) and atropine. He was not considered a suitable case for salvarsan and went on well enough under mercury until about twelve months after contagion, when for the first time he became subject to neuralgia, at first localized in both temples, then in the forehead and occiput. The pain never really left him, was bilateral, throbbing at times, very severe at night. It was relieved at first by good doses of iodides, but both these and mercury seemed to lose their effect.

I insisted on his trying neo-salvarsan, and a single intravenous injection of 0.9 gramme had a wonderful effect as the pain cleared off "from that day." The patient was seen from time to time during the next six months, during which he had not the smallest return of the neuralgia.

IV.—*Intracranial gummata* may cause severe neuralgia, which, as a rule, is curable by iodides.

"The anterior part of the temporal fossa is a not uncommon situation for a syphilitic gumma. In this position it causes neuralgia over the whole of the temporal fossa, accompanied by marked tenderness of the superficial structures, not only over the actual gumma itself, but over a wide area in front of it, spreading out above and in front somewhat like a fan. This area corresponds to the distribution of the ascending branches passing from the deep parts of the fossa forwards and upwards to the scalp. It does not correspond to any area or combination of areas of referred pain. . . ."

In this observation Dr. H. Head¹ apparently

¹ Head, "Allbutt's System of Medicine," vol. vi., p. 736.

limits the gummatous periostitis, which causes the fan-shaped area of neuralgia, to the outside of the skull. But an intracranial lesion of similar nature may occasionally be present, and the following cases prove that the fifth nerve and the Gasserian ganglion are sometimes involved in syphilitic inflammation of the cavernous sinus region.

Fig. 8 shows two vertical sections through the carotid artery and cavernous sinus. On the left side the relation of the various nerves and the Gasserian ganglion are clearly shown. On the right side of the figure all traces of the cavernous sinus have disappeared, the nerves are distorted by inflammation and pressure; the carotid artery is much narrowed, and contains an organized clot, which does not block the lumen. The wall of the sinus is greatly thickened and was adherent to the temporo-sphenoidal lobe (syphilitic infiltration). I reported this case several years ago,¹ and it was, I believe, the first one published which demonstrated the pathology of this form of ophthalmoplegia. Brief notes of the case are as follows :—

F. S., a man, aged 53, under care for a tertiary syphilitic ulceration of one leg. In September, 1885, radiating pain came on in right temple and occiput, also in the eye. This persisted for seven months, being somewhat relieved by iodides, and having the fan-like distribution alluded to above. There was also present with it complete ophthalmoplegia, which improved from time to time under iodides. In April,

¹ Ophthalmological Society's Transactions, 1887, vol. vii., p. 250.

1886, he contracted cellulitis of his leg from infection of the ulcer and died of septicæmia.

It will be seen from fig. 2 that all the nerves in the wall of the cavernous sinus (motor and sensory) were so inflamed and degenerated as to be almost unrecognizable as such. The apex of the temporo-sphenoidal lobe was affected with gummatous softening and was adherent to the thickened dura. It is of interest to note that, although the opposite sinus looked normal to the naked eye, microscopic examination proved that the inflammatory process had spread across and would doubtless have produced similar paralysis had iodides not been given freely.

In the same volume of the *Ophthalmological Society's Transactions*,¹ I recorded an exactly similar case of ophthalmoplegia and neuralgia (fan-like distribution over the side of the head) which was entirely cured by iodides and which doubtless had the same pathology. It should be noted that in both the neuralgia was accompanied by marked impairment of sensation, thus resembling the cases due to pressure by a new growth in the region of the cavernous sinus (see p. 79 *et seq*). The pain produced by tumour pressure in this region is usually more severe than that set up by syphilitic infiltration and inflammation of the nerves, though the difference may be chiefly due to the relief given by iodides in the latter class.

The occurrence of spasmodic neuralgia in the limbs and trunk in those afflicted with ataxia is very common, and Dr. Buzzard² pointed out, over

¹ Vol. vii., p. 256.

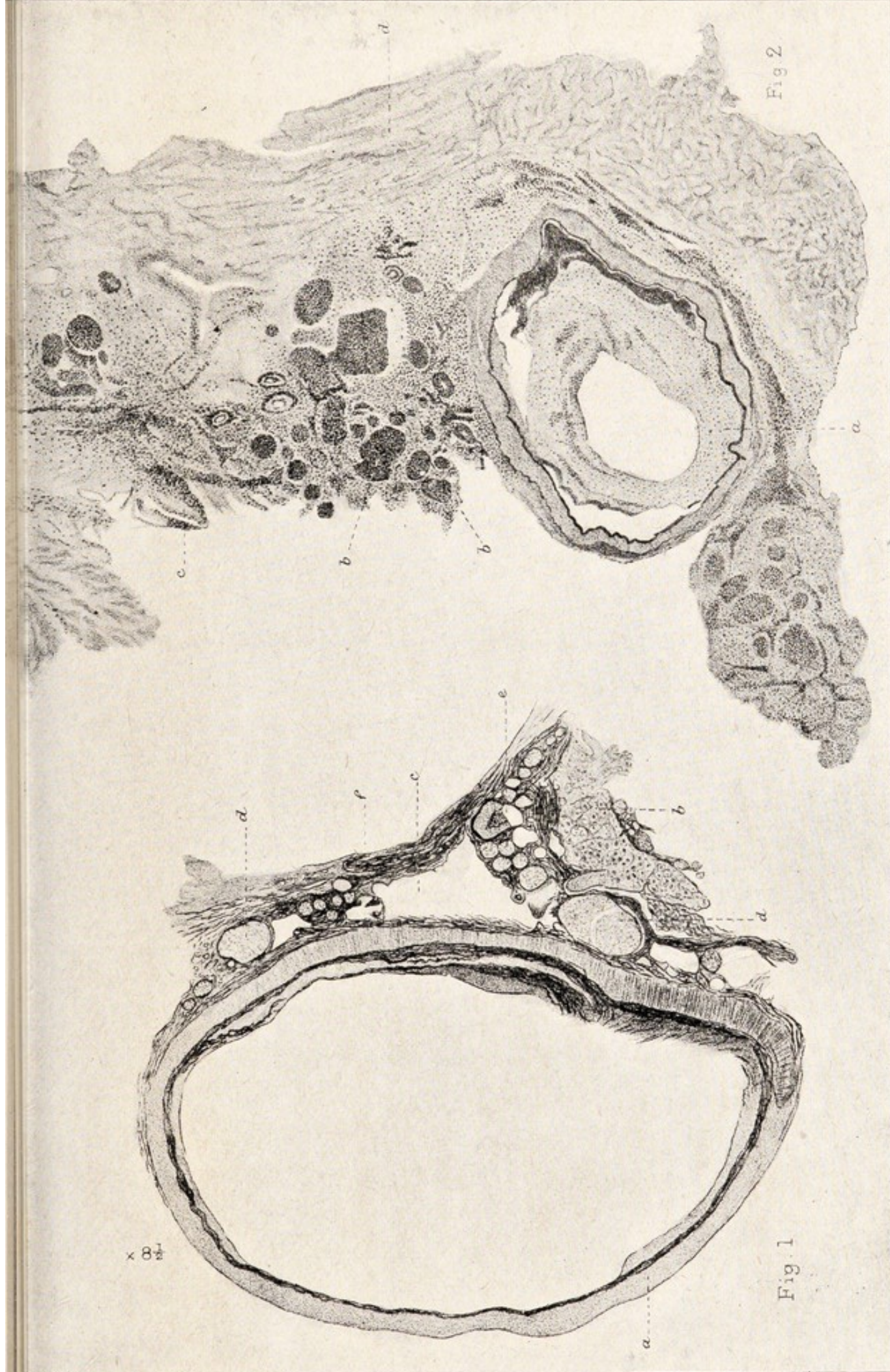
² "Clinical Lectures on Diseases of the Nervous System," 1882, p. 143.

FIG. 8. (Described in the ext.)

VERTICAL SECTIONS THROUGH NORMAL AND DISEASED CAVERNOUS SINUS.

Fig. 1. Normal section. *a*, The carotid artery lined by a little *post-mortem* coagulum; *b*, innermost part of Gasserian ganglion; *c*, part of the cavernous sinus; *d*, large nerve trunks; *e*, smaller bundles of nerves; *f*, dural wall of the sinus.

Fig. 2. Diseased section. *a*, The carotid artery much narrowed and partly blocked by organized clot; *b*, nerves distorted and much inflamed; *d*, great increase of fibrous tissue, containing at parts (as at *c*) collections of round cells. Hardly any trace of the sinus itself could be detected.



thirty years ago, the important relation that sometimes exists between facial neuralgia and tabes dorsalis. He showed that the first symptoms of tabes may be severe shooting pain in the fifth nerve area, that the tabetic neuralgia may be followed by anæsthesia, and he concurred with Pierret¹ in thinking that sclerosis of the descending spinal root of the fifth nerve was probably the cause. The diagnosis is a matter of much importance. Dr. Buzzard writes : "In an ordinary case of trigeminal neuralgia it is most common to find the pains limited to the district of one or more of the three divisions of the nerve. . . . But in the pains . . . which occur in the region of the fifth nerve in tabes this accurate mapping out of the district of one or other division of the nerve is not, according to my experience, observed." Too much must not, however, be made of this point. More important is the fact that true epileptiform neuralgia is always one-sided ; that due to tabes may affect both sides of the head. "Flying, so-called, neuralgic pains in the head, *when they attack both sides and do not map out the district of one or other division of the fifth nerve*, should lead to attentive examination for symptoms of tabes." (Buzzard).

¹ "Essai sur les Symptomes Céphaliques de Tabes Dorsalis." Paris, 1876.

FACIAL NEURALGIA DUE TO DENTAL CAUSES.

The acute pain caused by carious teeth, alveolar suppuration, and the like is well-known. Although the cause may be limited to one tooth, the neuralgia is frequently wide-spread, and may be paroxysmal in character, though very rarely epileptiform in the sense of having intervals of complete relief. Besides the two common and easily recognized causes just mentioned, there are others, such as acid fermentation around the neck of a tooth, ulceration of gums (sometimes due to mercurial stomatitis), caries or necrosis of bone set up by injury in tooth-extraction, or the crowding out of the wisdom teeth. A very severe neuralgia may be set up in the following manner; a hollow tooth is stopped with a heavy metal stopping before the cavity has been thoroughly disinfected or the nerve destroyed. In such cases weeks or months of suffering may ensue, only to be relieved by the removal of the stopping or the extraction of the tooth.

Without doubt, the worst and most persisting cases of dental neuralgia may simulate *tic douloureux*, and even lead to the discussion of operation upon the fifth nerve; but careful examination of the teeth and gums, and consultation between dentist and surgeon, should guard against either of two errors being committed. The first is one too commonly made, namely, the useless extraction of

normal teeth in cases of true epileptiform neuralgia. The performance of neurectomy, or even excision of the Gasserian ganglion, in a case where dental extraction, &c., would suffice is a mistake less likely to be made, though it is not unknown.

The following case well illustrates how difficult it may be to decide as to the dental origin of facial neuralgia.

Violet R., aged 25, came under medical treatment early in 1913 for neuralgia of the left side of face and head, attributed to a "nervous breakdown." She stated however that as long as she could remember she had migratory pain in this region. In the summer of 1913 she was fairly free, but in September a sudden attack of severe pain occurred over the left eyebrow and in the malar region. Since that time until June 1914, i.e., for nine months, the pain was continuous, involving the cheek, the lower jaw, and the forehead. It was *not spasmodic*, and was *not brought on by taking food or light touch*. There was no excessive lachrimation and no facial spasm. These negative features clearly distinguished the case from one of epileptiform neuralgia. On the other hand she said the pain was not like that of toothache, indeed all the teeth had been removed from the lower jaw on that side behind the canine. Her frontal sinus and maxillary antrum were examined by transillumination and found to be normal.

A "rest cure" of many weeks was tried in vain, and all possible forms of medical treatment were resorted to without avail before surgical measures were undertaken. The alcohol injection treatment was then tried, with the result that the pain became much more severe, and operation on the Gasserian ganglion was advised. Before submitting to this measure she sought other advice and came under the care of my friend and colleague, Dr. Lewis Smith, in the London Hospital. On examining the lower jaw a small elevation was detected under the gum at the angle between the horizontal and ascending rami on the left side—this was tender to the

touch. An X-ray photograph (see fig. 9) proved that this elevation was due to an unerupted and deeply buried wisdom tooth.

I saw the patient and confirmed the diagnosis. Under an anæsthetic the dense fibrous layer overlying the tooth was incised and turned back so that the tooth could be dug out of its bed with an elevator. The result was apparently successful, as after a few days the neuralgia cleared off.

The tooth was free from caries. It was placed obliquely in the jaw so as to point forwards quite as much as upwards, its crown was well shaped but its fangs were fused into one.

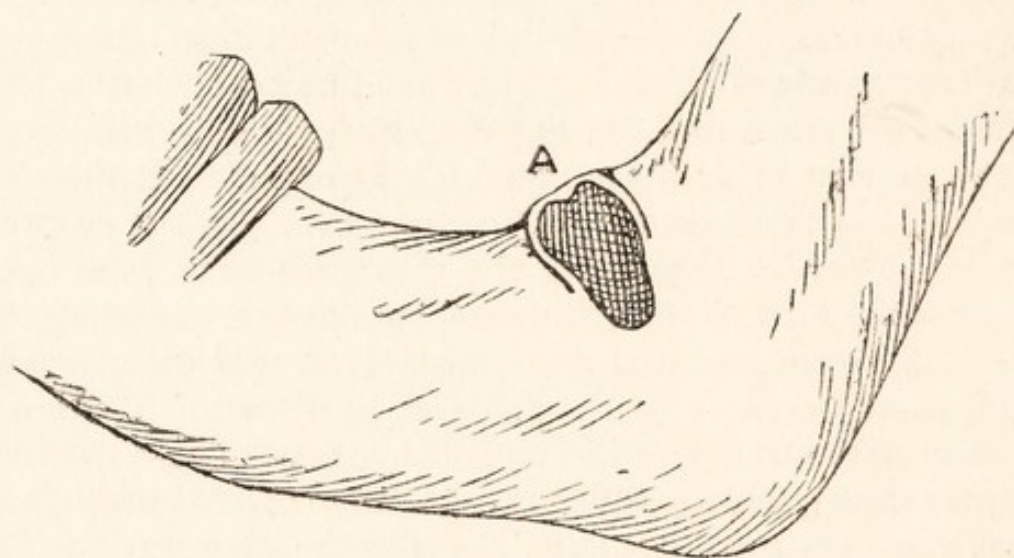


FIG. 9.

Shows unerupted wisdom tooth (A) in angle between ascending and horizontal rami of lower jaw. This was thought to be the cause of severe neuralgia, and its removal was for a time followed by cessation of pain. Later on the neuralgia returned, became more intense and epileptiform in character, and necessitated operation on the Gasserian ganglion. Thus the buried wisdom tooth was merely a coincidence, not a cause. This sketch was made from the X-ray plate.

Our pleasure at relieving the patient's neuralgia was short-lived. After a few weeks' respite, back came the pain in the same regions, as severely as before. Alcohol injection had already been tried and had completely failed (indeed the patient considered herself to have been made worse by it owing to stiffness of the jaw muscles), excision of the Gasserian ganglion was therefore performed. As noticed elsewhere, in young subjects (this patient was only 26)

the hæmorrhage from small vessels accompanying the second and third divisions and in the dura mater is always troublesome, and the operation took two hours to complete. But all went well after this, and the patient left hospital free from neuralgia. About two years later she had some return of pain. Whatever some writers may say, it is certain that the prognosis of operation on the ganglion in such cases of *continuous* neuralgia is less hopeful than in the epileptiform type, and such operation should be therefore resorted to with more hesitation. But in a case like the above it was the only hope remaining, and the patient's misery from pain was so great that it seemed death would have been preferable to further endurance of it. For two years she remained free from any pain and improved in health, though she was always a delicate "high-strung" person. At the end of this time pain returned in the cheek (second division) together with some recovery of sensation. As before, the neuralgia was mainly continuous with intermittent spasms. Thinking that some fresh nerve-fibres had grown I again explored the cavum Meckelii and divided a few fibres running to the foramen rotundum, but whether they had escaped in the former operation or not I could not say.

She was relieved of the recurrent neuralgia for another year or so and then came back with doubtful recurrence. A similar case, in fact identical, could be quoted—in which also a buried wisdom tooth was detected by the X-rays and extracted—the neuralgia being relieved only for a short time. Operation on the Gasserian ganglion became necessary after alcohol injections had completely failed.

In the foregoing account of "minor neuralgia" the treatment required has been indicated by the varying causes, but in a considerable proportion of cases no cause can be definitely assigned. For these, empirical measures may be of use, the following being a selection from the ever growing list of such remedies.

I.—*Internal Treatment by Medicine.*

The importance of *iodides* (potassium, sodium, and ammonium) in cases having a syphilitic origin is obvious. They may possibly be of advantage in a few other cases, from their influence in lowering blood-pressure, but the depression they are apt to cause is a drawback to their use. The importance of trying intravenous injections of salvarsan in all syphilitic cases has been referred to on p. 29.

Quinine has a great reputation, and amongst the preparations of it may be mentioned the valerianate (in five-grain doses), the hydrobromide (two to five grains), and the salicylate (five to ten grains). The hydrobromide may be given hypodermically.

Cannabis Indica (in doses of one-fourth to one grain) is a more dangerous drug, and should be resorted to only in severe and special cases. In a few cases it appears to be the only remedy which relieves, though its toxic effects may be as bad as the disease for which it is given.

The same objection applies to *Gelsemium* (five to fifteen minims of the tincture).

A far safer and more effective sedative is the aceto-salicylic compound known universally as aspirin. Twenty to thirty grains of this drug may be taken in the day, and toxic effects from larger doses are uncommon.

Even in cases of epileptiform neuralgia it may

prove at least of temporary value, though as a rule it fails to do so.

Butyl-chloral hydrate is a fairly safe and useful analgesic, it may be given in watery solution with glycerine or syrup, or in pills. The dose to commence with should be four to five grains.

Citrate of caffein is comparatively harmless, but only does good in slight cases of neuralgia; *aconite* preparations are dangerous and rarely successful; bromides depress and are of little use.

Morphia will always check pain, but Prof. Krause surely is right in holding that it should be banished from the therapeutics of neuralgia, as from those of intestinal obstruction. The only exceptions, in the former case, are those where the cause of the neuralgia can be recognised and removed (*e.g.*, a carious tooth), but some temporary alleviation is required for the intense pain.

The administration of morphia for epileptiform neuralgia is a grave blunder, or worse. Ever-increasing doses are required,¹ and the patient becomes both a mental and physical wreck. The operation which will alone cure him is deferred, and the patient becomes less and less fit to undergo it.

¹ In one case recorded by Prof. Billroth, the patient, before the end came, was taking nearly half an ounce of morphia hypodermically every day

II.—*Local Treatment of the Nerves and Skin.*

The inunction of various sedatives may be useful, such as equal parts of mesotan (a derivative of salicylic acid) and olive oil, menthol and oleic acid, the unguentum aconitinæ, &c.

Freezing the skin with chloride of ethyl spray has been recommended, but is more likely to do harm than good.

Galvanism and electricity in all forms have had a wide trial, but all that can be said is that they are occasionally useful. X-rays are quite useless in the treatment of facial neuralgia.

The application of warm dry heat is sometimes efficacious.

The hypodermic injection of osmic acid into the nerve-trunk chiefly concerned is most uncertain; it may be put on a level with nerve-stretching in being sometimes of temporary benefit. A two per cent. solution is usually employed, and the attempt made to hit the nerve-trunk with the point of the syringe-needle before the injection is made. The writer has little or no faith in the method. If it is tried it is better to make a short incision over the point of convergence of the nerve (*e.g.*, the supra- or infraorbital) than to blindly inject into the surrounding tissues. The method is in itself a very painful one. It is supposed that the osmic acid solution picks out the nerve bundles and causes a sclerosis, even if it did so the benefit

would be doubtful. Injections with alcohol are better worth trying than with osmic acid.

None of these local measures can be expected to do much, since they only affect as a rule the peripheral endings of the nerve. It is undoubtedly true that they relieve the neuralgia in this way to some extent. In a case of true epileptiform neuralgia which I saw with Dr. Gordon Wilson, the patient had for some years obtained relief by applying powdered cocaine on a brush to the inside of his mouth. So constantly did he keep himself under the influence of this drug that he had the bottle containing it and the brush secured to his clothes, thus they were never out of reach if a paroxysm threatened. For long this patient had got through twenty grains of cocaine every day, in addition to morphia and other sedative drugs. He did not of course swallow all the cocaine, but a large proportion must have been absorbed. It is certain that old subjects (Dr. Wilson's patient was eighty-five years) can tolerate doses of morphia and other sedatives which would kill younger men, though the effect of acquired tolerance in both is extraordinary.¹

In the preceding account it has been shown that many cases of neuralgia of the fifth nerve have a

¹ It has been repeatedly proved that in persons who have not acquired this tolerance so small a dose of cocaine as two or three grains may cause death.

definite local or constitutional cause, and that a careful study of the character and distribution of the pain, &c., will enable us to determine and sometimes to remove this cause by appropriate treatment. The cases referred to are not of the epileptiform type, and should not be subjected to the operations which are of such value in the latter.

The distinguishing features of epileptiform neuralgia will be described in the next chapter, and the rare cases of neuralgia caused by tumours at the base of the skull pressing on the fifth nerve will also be considered later.



FIG. 10.

From photograph taken during a severe and typical attack of trigemina neuralgia. The left fifth nerve was concerned, but it will be noticed there is convulsive spasm of the facial muscles on the right side as well as of the depressors of the lower jaw. The temporal artery becomes prominent during an attack. The expression of agony is fairly well conveyed in the reproduction.

CHAPTER III.

EPILEPTIFORM NEURALGIA : ITS COURSE AND SYMPTOMS.

THE disease to be discussed is also known by the scientific name of neuralgia quinti major and by the inexact but familiar term of tic-douloureux. As the latter is often used to include cases of minor neuralgia it would perhaps be best to discard it entirely.

I believe that the term epileptiform neuralgia was first applied by Professor Trousseau in those admirable Clinical Lectures on Medicine which were translated for the New Sydenham Society, and which deserve to rank as a medical classic if such a thing existed.

"Tic-douloureux" signifies *a spasm of muscle which is painful*, rather than *pain of spasmodic character*. How marked a feature spasm of the muscles supplied by the facial nerve, including the depressors of the mandible, may be during an attack of epileptiform neuralgia, is well shown in fig. 10. But though these attacks are usually accompanied by facial spasm the latter may sometimes be absent, or imperceptible to the skilled observer.

The concurrence of the spasm with the pain is most interesting as bearing out the near relationship between the fifth and seventh nerves, which may be said to correspond with each other like the sensory and motor roots of a spinal nerve, as proved by comparative morphology.

It is important to define the disease "epileptiform neuralgia" as precisely as possible, since in it alone, as a rule, should the Gasserian ganglion be operated upon.

Formerly one would have made this an absolute guiding rule, but now and then a case of continuous rather than epileptiform neuralgia is benefited by the major operation. Crawford Renton and others have reported examples, and I have operated on one or two myself with advantage. These were cases of practically constant neuralgia with spasmodic exacerbation.

The chief features of true epileptiform neuralgia are as follows :—

(1) It is almost invariably unilateral. I have met with two patients in whom the cure of epileptiform neuralgia by excision of the ganglion had been complete for many years and then the neuralgia had developed *on the opposite side*, but I have never seen one in whom the neuralgia was truly bilateral at the same time.

Dr. Head (Allbutt's System of Medicine, 1910, vol. vii, p. 544) writes : "I have seen this bilateral distribution in an old woman of seventy-five, in

whom the disease had lasted twenty-five years. Krause describes one such case."

We must therefore consider the possible occurrence of bilateral epileptiform neuralgia as proved, but it is of extreme rarity, and this is fortunate as regards treatment (see p. 182).

(2) It commences in the distribution of either the second or third division of the fifth nerve, and tends to involve both to the same extent.

(3) The first (ophthalmic) division, so frequently concerned in cases of minor neuralgia, is involved comparatively little in epileptiform neuralgia. Radiations of pain in the ophthalmic distribution and that of the cervical nerves often, however, occur. These secondary areas of pain in parts supplied by the superficial cervical nerves are grouped with that supplied by the ophthalmic branch with a special object. In both, the occasional and slighter radiations of pain cease entirely after removal of the lower and greater part of the ganglion (the operation described on p. 134), although the ophthalmic nerve is carefully spared and left intact, as of course are the cervical nerves. This is a very important point, and will be further dealt with (p. 159). We will here note Dr. Head's observation. "Uncommonly, radiation may take place into the occipital region or into the neck ; although since the pain in this region is removed by ablation of the Gasserian ganglion, there is no reason to suppose the territory of these nerves to be primarily affected."

(4) The attacks of pain are paroxysmal or spasmodic and tend to increase in severity, whilst the intervals of freedom from pain become shorter. In the worst cases *the centre of the area involved* in the spasmodic attacks is the site of constant pain. Hence the neuralgia may be called both continuous and epileptiform.

(5) During each attack there is usually spasm of the facial muscles on the affected side. This spasm may be so limited as to be hardly perceptible to the spectator, or may involve the whole of the muscles supplied by the facial nerve, as shown in fig. 10, facing p. 45.

(6) No cause can, as a rule, be assigned for the onset of each attack, but talking, eating, or exposure of the skin to slight cold or light pressure, invariably bring on the attacks when the disease is well established. It is frequent to find a congested patch of skin after a severe attack, due apparently to vasomotor paralysis, supervening on intense pain and spasm.¹

Another frequent sign is over-secretion of tears on the affected side during the attack, sometimes a profuse flow of mucus from the nose, or of saliva in the mouth.

¹ In one case in which neuralgia involved the distribution of the superior maxillary nerve, ulcers occurred repeatedly on the cheek in the centre of the congested and painful area. These ulcers were even more troublesome before the operation, when the skin was hypersensitive, than after it, when the cheek had been rendered anæsthetic.

(7) The subjects of the disease, at its onset, are usually adults between the ages of *thirty and fifty*. There is no marked disparity between the two sexes as regards incidence of the disease. The earliest age at which I have known it come on was twenty-one years. Sir Victor Horsley recorded a similar case.

The age of most of the patients, at the time of operation, is of course some years greater than that just mentioned. Many endure the neuralgia for five, ten, or fifteen years before they submit to be cured. The oldest patient I have operated on was seventy-two, the youngest twenty-six.

(8) Its progress is one of steadily increasing severity, lasting an indefinite number of years, even up to thirty or forty. Spontaneous cure is almost unknown.

(9) Medical treatment, except increasing doses of morphia, has little or no effect. All kinds of operations on the peripheral branches of the fifth nerve, including injection of alcohol, may give temporary relief.

(10) Partial or complete removal of the Gasserian ganglion alone affords the prospect of a permanent cure.¹

The summary given above will render unnecessary

¹ It may ultimately prove that the ganglion can be so far destroyed or damaged by alcohol injections that the result is equally lasting.

a detailed account of all the symptoms, though a few points deserve further consideration.

Epileptiform neuralgia, unlike the pain due to a true neuritis, is never accompanied by motor paresis or paralysis of the muscles supplied by the fifth nerve. Moreover, it is noteworthy that, however long the duration of the neuralgia, there is never the least impairment of sensation in the affected area of skin (except that produced by neurectomy or other operation). These two facts alone prove conclusively that epileptiform neuralgia is not due to a neuritis of the fifth nerve, as has been affirmed by many writers on the subject. The question of trophic disturbance in the area of the skin and mucous membrane will be discussed later (see p. 61).

During the intervals, which at first may last during some weeks or months, the patient is entirely free from pain; in this respect a striking contrast exists between true epileptiform and most cases of "minor" neuralgia. In advanced cases, however, the attacks occur with only a few minutes interval. Dr. Head describes one case in which the attacks occurred for days together at intervals of only forty seconds! Touching the skin lightly with a handkerchief or feather at first may produce an attack; later, the attempt to bite food or to talk will bring it on. Brushing the teeth may be quite intolerable and hence the patient's mouth and breath become very foul. Night and day the paroxysms

recur; so that, from loss of sleep and impaired nutrition, the patient's condition becomes an utterly miserable one. Billroth graphically pictures such a case: "I can see him now before me, emaciated to a skeleton, with a rigid staring expression, with the saliva dribbling from his open mouth, with

As soon as they do but
thinks I am well enough
I will write
a good one

I am happy to say
that up to the present the
result has been thoroughly
successful, and from being

FIG. 11

white neglected beard and long unkempt hair." It is no wonder that such sufferers seek relief in suicide, or, what is quite as bad, become the slaves of morphia or cocaine.

Fig. 11 illustrates the state of mental degradation

induced in one case by the patient's prolonged suffering and the abuse of morphia, by which alone he was able to get relief from his neuralgia. The upper specimen of handwriting was written by the patient (a man of about fifty), in answer to an appeal to undergo the radical operation. It was the best attempt at writing he could do, and the contrast with his natural hand a year after the operation is most striking.

It is not, however, suggested that operation on the Gasserian ganglion should be resorted to in all cases of illegible handwriting!

It is interesting to note that in this particular case the patient entirely abandoned the use of morphia when his neuralgia was cured, and that the cure was complete ten years after the operation.

Cases of suicide directly due to epileptiform neuralgia are by no means rare, and are charitably referred to temporary insanity. We may, however, fairly ascribe this nervous instability and loss of mental control to the agony so long endured, the want of sleep and rest, and to the grave effects of drug treatment. Sometimes the depressing effect of a series of futile operations has also been taken into account. Epileptiform neuralgia is confined to no class or rank in life. Nothing in diet, occupation, or habits has any influence in bringing it on. Some of its sufferers are men and women of the highest intellect, of the strictest lives; others have never worked hard except with their hands, and

some have lived freely as regards alcohol and the like. The disease appears to be especially prevalent in the United States, but almost every European country furnishes its quota of sufferers. It would be, however, a matter of interest to ascertain its relative prevalence in India and other tropical countries; though I believe it will be found that climate has nothing to do with its incidence.

It has been pointed out as a characteristic feature of epileptiform neuralgia (see p. 47) that it affects first one portion of the fifth nerve and then spreads to another. This holds true of the second and third divisions, and in at least sixty per cent. of the cases *both* are affected when the patient seeks surgical advice. But in only twenty-five per cent. of such patients is the first or ophthalmic division materially involved during the attacks of pain.

It is of small importance to decide whether the superior or inferior maxillary nerve is more frequently the seat of the initial pain, and the experience of different observers varies as to this point.

Professor Billroth, who had much experience in the treatment of facial neuralgia, noted that the nerve affected in the majority of cases was the superior maxillary division. Sir Victor Horsley observed the same fact, and states that "in every case in which a dental origin could be assigned for typical trigeminal neuralgia the upper jaw was the one concerned."

It should, however, be clearly recognised that *true epileptiform neuralgia never has this dental origin* attributed to it by Horsley, although it is hardly necessary to recommend that the condition of the teeth and gums should be seen to in any case of *minor* facial neuralgia.¹ All carious teeth should be carefully attended to, and if they are too far gone for repair they should be extracted. Sometimes a heavy metal stopping is the cause of intense neuralgia, and septic changes are only too apt to occur under an elaborate crown or bridge of gold, and to cause this symptom. But, as a rule, too much attention is paid by the physician to the teeth in cases of epileptiform neuralgia. It sometimes commences in patients with no trace of dental caries or irritation, and the extraction of healthy teeth from them is a useless and should become an obsolete method of treatment. In the majority of patients with epileptiform neuralgia

¹ Some years ago the late Mr. F. C. Wallis exhibited at the Clinical Society of London a patient on whom operation on the Gasserian ganglion was arranged for, but rendered unnecessary by the neuralgia subsiding entirely after the removal of a wisdom tooth. The case was said to have been an example of true epileptiform neuralgia. I have no doubt that if Mr. Wallis' patient had been followed up recurrence within a year or less would have been observed. Attention may be drawn to two similar cases noticed on p. 37, in which apparent cure by removal of buried wisdom teeth proved disappointing in both, and in one of them even excision of the Gasserian ganglion was only partially successful.

on whom the writer has operated a number of such teeth had been previously removed without the least benefit, and the power of subsequently masticating food had been of course much impaired or destroyed. Erroneous views as to the pathology lead here to wrong treatment, and it is to combat these views that, at the risk of repetition, I must recur to the subject more fully in the next chapter.

One striking feature of epileptiform neuralgia is the tendency of the attacks to increase, as time goes on, both in frequency and severity. Another is the age at which the neuralgia first occurs. It hardly ever commences before the age of thirty or thirty-five, often later. In both these respects a striking contrast is afforded to migraine and true epilepsy (which are also paroxysmal diseases of the nervous system); both these latter develop as a rule in early life, tending to gradual diminution or disappearance after the age of fifty. By some observers migraine is held to be a form of neuralgia which is practically confined to the ophthalmic division of the fifth nerve, and possibly started by exposure of the supraorbital regions to cold. In its distribution, the age of its onset, and the character of the attacks, it differs strongly from epileptiform neuralgia, and no careful physician or surgeon should mistake one for the other.

Is true Epileptiform Neuralgia ever Spontaneously Cured?

The late Professor Billroth's experience, which was large, with regard to the peripheral operations on the fifth nerve, led him to say that epileptiform neuralgia was quite incurable; it always returned sooner or later. Since his time, excision of the Gasserian ganglion has altered surgeons' views on this matter, and though the experience of the after-results of this operation does not enable us to judge for more than twenty years, yet we are sure that a permanent cure is not infrequently obtained by it, and by it alone.

But what if the sufferer refuses operation, perhaps from dread of losing an eye as a result, or of the supposed danger to life, or (as I have known more than once) from utter disappointment at the failure of repeated alcohol injections? Can any hope be held out of a spontaneous cure, or will the neuralgia continue to the end of the patient's life?

For some time I considered (as the sequel showed wrongly) that the following case was an instance of spontaneous cure:—

An elderly lady had suffered from effusion into one knee of rheumatic nature as well as from an attack of neuralgia in one arm, she had treatment at Bath and recovered from both complaints. In 1903 she first developed neuralgia of the left cheek which spread to the lower jaw on the same side. The pain rarely left her for a day, it was not brought on by eating, but light touch on the cheek at once produced it. The points of emergence of branches of the fifth nerve were not specially tender. As the neuralgia could hardly be called epileptiform,

and as she continued to have other rheumatic symptoms, I decided against operation and treated her with salicylate of quinine and galvanism to the fifth nerve branches, the latter, after careful trial, was found to be useless and was given up. She continued to suffer from the neuralgia for a year, then an operation for gall-stones became necessary. The stones were removed and the gall-bladder drained. I found that this operation had a temporary effect in freeing her from the head-pain, but the latter recurred, not so severely as to justify an operation.

In 1909 she was for no obvious reason quite free from the neuralgia, but in 1910 it again affected the cheek and the eye (the lower jaw had become exempt). With a return of rheumatic symptoms in the hands, neck, &c., she experienced more neuralgia both of constant and epileptiform type. Much relief was obtained from a combination of aspirin, salicin, and phenacetin.

In 1914 I learnt that for three years she had been practically free from the neuralgia, but in 1917 on enquiry it was found that the attacks had recurred, and that they were "worse than ever."

One hesitates to found any conclusion on a solitary case; the one just recorded was the only example of epileptiform neuralgia in which I thought a cure had been spontaneously established, but the sequel showed this to be wrong.

Professor Billroth's experience has been referred to. He had seen one problematic case of spontaneous cure, but with regard to the patients operated on by him (by various forms of neurectomy of the fifth nerve-trunks and their branches) he made no reservation—the neuralgia always recurred. I believe the same statement holds good for practically all cases treated by alcohol injections, whether of the ganglion or its branches.

Has Epileptiform Neuralgia any relation to true Epilepsy?

Trousseau discusses this point and mentions two cases in which the diseases existed in the same patient, but this does not take one far. He was evidently unwilling to admit their close relation, and rightly so; but he wrote that, if it proved that the family history of the subjects of epileptiform neuralgia revealed "neuroses," he would have to bracket the two.

The evidence hitherto collected shows that the sufferers from true epileptiform neuralgia can neither blame their immediate ancestors for nervous bequests, nor themselves with contributing self-indulgence in their habits of life. Epileptiform neuralgia has no relation to the abuse of alcohol or tobacco, to syphilis, to gout, nor even to that vague entity, "the rheumatic diathesis."

Sir V. Horsley, in enumerating the possible causes, attached most importance to three—alcoholic excess, traumatism, and dental or peridental inflammation. The opinion of such an authority deserves respect, but cases of true facial neuralgia of unsurpassed intensity are met with in those who (1) have been teetotallers all their lives, (2) have sustained no injury whatever to the head, and (3) have never known the pangs of toothache. Horsley's theories on this matter are no nearer proof than when they were first brought forward.

The late Dr. Anstie made the interesting suggestion that in the subjects of epileptiform neuralgia there is apt to be associated the taint of insanity. In many of the recorded cases the patients, before operation, are described as being strange in their manner, perhaps threatening suicide, or actually delirious, whilst delirium has sometimes come on immediately after the operation ; but these symptoms of mental derangement are probably due to prolonged suffering and loss of sleep. Dr. Head attaches importance to the large doses of hypnotics and anodynes, given to relieve the pain, as a factor in causing suicidal melancholia. Krause notes that insanity in such a case, even if of considerable duration, may be cured by a successful operation on the ganglion.

“ Every patient in the later stages of the disease should be looked upon as a possible suicide ” (Head). In my own experience I have had only one instance of insanity come on *after* the operation. This patient was a rather feeble elderly woman who was completely relieved of long-standing neuralgia by the operation, but who passed into a state of mild insanity (delusions of persecution) a week or two later. She very gradually improved, but I am unable to say if her mental state became normal or not. She had undoubtedly been morose and worn out by suffering before the operation, which was an easy and uncomplicated one.

There is really no evidence of the connection

between epileptiform neuralgia and any other nerve-disease; it stands by itself. Before the patient submits to operation there has always been abundant opportunity for the doctor to make an all-round study of the case. If he has found good reason for diagnosing atrophy of the brain, tabes dorsalis, or other degenerative process, or that the patient is very hysterical or neurotic—apart from any neurosis induced by long-continued neuralgia, &c.—then such a case should be rejected for the major operation. Before advising excision of the ganglion the surgeon must ascertain that his patient is the subject of true epileptiform neuralgia, and of nothing else.¹ If this precaution be not taken the result will prove disappointing. The neurasthenic or neurotic element in some patients with neuralgia is discussed on p. 86.

¹ The first fatal case after operation in the writer's personal experience was one in which this rule was broken. The patient, an old man, was worn out with *both* tabes and true epileptiform neuralgia. He died of collapse an hour after the operation had been completed. Such had been his condition before it that there was little to regret, except that the operation had not been given a chance earlier.

CHAPTER IV.

THE NATURE AND PATHOLOGY OF EPILEPTIFORM
NEURALGIA.

It is most improbable that the typical epileptiform neuralgia, for which operations on the Gasserian ganglion are so successful, depends upon a true neuritis. The intervals of complete freedom from pain, which early in the case may be of many weeks' or months' duration, and the fact that neither motor paralysis nor cutaneous anæsthesia ever attends the neuralgia, however inveterate, place the affection in an entirely different category from the well-known peripheral neuritis of the limbs. It is true that some symptoms which might be termed trophic (such as œdema, persistent congestion, or dermatitis) are occasionally met with in the regional distribution of the intense epileptiform neuralgia, but traumatic irritation by the patient in the hope of obtaining some relief is the usual cause of such lesions. In several of my cases the patient, during each spasm of pain, used to violently grasp at the skin involved as though to tear it away, and such a habit could easily produce the supposed "trophic" effects.

W. W. Keen stated that he had seen two cases of corneal ulceration and opacity in conjunction with trigeminal neuralgia, but on reference to his notes of these cases one finds no record whatever of eye trouble in one of them; in the other, the eye concerned had been the subject of chronic glaucoma, and the lens had already been removed! I know of no other instances in which the neuralgia was associated with trophic changes in the eye, and obviously Keen's cases prove nothing. It is, of course, well-known that herpes frontalis and nasalis may be attended with conjunctivitis and corneal ulcers, sometimes even with sloughing of the eye. In herpes the existence of a neuritis involving the Gasserian ganglion has been proved, and the fact that eye changes never occur in paroxysmal neuralgia of the fifth nerve is a strong argument against the latter being due to neuritis.

It is obvious that the term "neuritis" may, in the case of the fifth nerve, include two different processes: (1) an inflammation commencing in the fine peripheral branches and spreading from one trunk to the others by way of the Gasserian ganglion, and (2) a primary inflammation of the ganglion or even of the cerebral roots or nuclei.

As the first of these theories depends entirely upon cases of supposed dental origin to support it, we may consider

The Relation of Dental Caries and Consecutive Neuralgia to the true Epileptiform Neuralgia.

Comparatively few people escape the pangs of toothache, and those who suffer it know well how the pain may be referred to the other teeth, to the whole of the bone in which the peccant stump is lodged, or even all over that side of the face. It is tempting to assume the occurrence of a spreading neuritis, starting perhaps in a nerve surrounded by pus in a closed cavity in the bone. With a powerful imagination one can picture such an ascending neuritis involving, as it must do, mainly the perineural sheaths, travelling through the various bony canals in which the branches of the fifth nerve run, passing the intermediate ganglia until the main Gasserian one is reached, and so lodging there and damaging the structure of the ganglion to such an extent that an effect is produced which lasts for years. Indeed, we must suppose that a fire is lighted in the ganglion that may slumber but never becomes extinct until death or operation relieves the sufferer.

This theory has attracted many investigators and it would be no wild surmise that nine out of ten doctors or surgeons would vouch to the existence of a wide-spread neuritis of the fifth nerve having a dental origin in certain cases of facial neuralgia. Sir Victor Horsley¹ has advocated exactly the view

¹ *Clin. Journ.*, 1897, vol. xi, pp. 8 and 17.

above suggested, and few, if any, of the medical writers on facial neuralgia, including the epileptiform type, have failed to bring it forward. It will be only fair to quote the following brief advocacy of the peripheral neuritis theory by Dr. W. Harris.¹

“The character of the pain is sometimes exactly simulated by other forms of trifacial neuralgia, particularly dental. In this latter form the localization of the pain closely resembles that of trigeminal neuralgia, while it may and often does occur in spasmodic attacks, very suggestive of the more intractable disease. For example, a most severe case I saw recently of spasmodic dental neuralgia in a young lady of twenty-three, which had gone on for three weeks with increasing severity, in the temple, ear, and both jaws, with complete absence of pain between the spasms, proved to be due to an erupting wisdom tooth in the right lower jaw, and lancing the swollen gum over the bulging tooth at once cured the pain. The severity of the pain in dental neuralgia may occasionally be every whit as great as in trigeminal neuralgia, as is evidenced by a case I saw at St. Mary's Hospital two months ago, of a young woman who, some months previously, had been suffering such agonies of pain from her teeth that she threw herself out of the window in the endeavour to kill herself. Indeed, the resemblance between many dental neuralgias and trigeminal neuralgia affecting the second and third divisions of the nerve, is forcing me to the conclusion that the painful spasms of trigeminal neuralgia are set up by a local neuritis of some terminal twig of the nerve, similar to that set up by dental caries in the nerve filaments of the pulp cavity of the tooth. True trigeminal neuralgia affecting the first or ophthalmic division of the nerve alone is much less common than of the second or third divisions, and, indeed, I have only met with one such case.”

In reply to the conclusion drawn above it might be urged with equal force that, in cases of tumour

¹ *Med. Soc. Trans.*, 1910, p. 53.

pressing on the Gasserian ganglion, such as are recorded on pp. 75 *et seq.*, the neuralgia for some time may closely simulate in intensity and in having exacerbations the true epileptiform neuralgia—hence the latter must always have a *central* cause, *i.e.*, at the ganglion itself. The subject is of real practical importance, and its discussion will be helped by dividing it into two parts:—

First.—Is there any evidence of a neuritis which spreads from the minute filaments in or about a carious tooth along the fifth nerve to the Gasserian ganglion? Is it even possible for a true inflammation to spread from one branch of the fifth to another of the three main trunks?

Second.—Granted the possibility of a true neuritis ascending to the Gasserian ganglion along one series of nerves and descending from it along another series, can such a pathology explain the phenomena of epileptiform neuralgia?

(1) Does a neuritis ever spread from the terminal twigs in the alveoli to the Gasserian ganglion?

It is much easier to assume this than to prove it, indeed of sound pathological proof none appears to exist. It is obvious that the remarkable course of the nerves from the teeth and gums through long bony canals is not well adapted to allow inflammatory swelling to travel along them. The nerves do not lie surrounded by a loose lymphatic space in these canals, a space which might conceivably favour transmission of septic germs; on

the contrary they are closely wrapped round by their fibrous sheaths and the bone—except in the infraorbital canal, the upper wall of which is largely deficient.

Now inflammation of a nerve in such a bony canal tends to be sharply limited, to stop by the mechanical obstruction in the canal caused by the swollen nerve. Analogy helps us here in the case of the facial nerve traversing the tortuous aqueduct of Fallopius. In cases of fracture of the petrous bone crossing this canal the nerve may not be torn through but yet paralysis may come on within a few days—a loss of function which is usually recovered from entirely or in great part. I have personally had the opportunity of dissecting the petrous bone in such a case, the nerve was swollen and pink in hue at its second bend, *i.e.*, just where it turns downwards towards the stylomastoid foramen, but the neuritis was strictly limited and the proximal portion showed no sign of inflammation. Other similar cases have been recorded. Two instances of apparent spreading neuritis may be alluded to—sympathetic ophthalmia and “brachial neuralgia,” or neuritis affecting the brachial plexus and occasionally due to a definite peripheral cause.

In sympathetic ophthalmitis no one questions the occurrence of a plastic and destructive inflammation which appears to travel from one eye to the other : does it track along the nerves? In spite of all the

labour and research spent hitherto on the subject of sympathetic ophthalmia, we are still quite in the dark. No theory of nerve transmission can be suggested except that along one optic nerve to the chiasma and so across to the opposite optic nerve, through the lamina cribrosa to the retina. The existence of a well-marked perineural sheath favours this supposition. But however plausible it may seem there is no real foundation for this theory. In the first place, inflammation travelling back within the sheath of the optic nerve would reach the sub-arachnoid space rather than cross to descend the other optic nerve, and that a meningitis ever occurs in these cases of old damaged eyes which are producing sympathetic mischief there is not the smallest evidence. Secondly if the inflammation *did* descend along the opposite optic nerve the retina should be the first structure to suffer, whereas the process is almost always an irido-cyclitis to start with.

I think the nerve transmission theory of sympathetic ophthalmia must be given up, and no support can therefore be derived from it in favour of a neuritis spreading from a peripheral branch of the fifth nerve to the Gasserian ganglion, &c.

The analogy of spreading brachial neuritis is somewhat stronger. Cases are fairly frequent in which long persisting neuralgia occurs with varying disturbance of function, muscular wasting, even anæsthesia (but more frequently hyperæsthesia), in

the parts supplied by different trunks of the brachial plexus. That such cases have often a rheumatic origin is certain, and that the main trouble is seated high up in the neck (where it may be suggested the nerve trunks are readily exposed to cold) is probable. But now and then a peripheral cause can be assigned, injury to or irritation of a nerve (especially implication of it in scar tissue) leading to disease or at any rate disturbance of function in other branches of the brachial plexus. As an example may be quoted the case of a young woman under the writer's observation who had loss of power in several muscles of the arm with pain and tenderness in some branches of the brachial plexus. The condition was of many months' duration, on careful search for a possible cause an ununited fracture of the olecranon was discovered, the broken bone seemed to have irritated the ulnar nerve. Decided improvement ensued after union of the fracture had been secured.

We have had to go rather far afield and to bring in other nerves than the fifth for the purpose of discussion. There are still so many unsolved problems in neurology, and the latter science is at the same time such a specialised one, that it ill becomes a mere surgeon to dogmatize upon the matter. I would simply point out that we have to discuss theories because if the question be bluntly asked : "Has the view that epileptiform neuralgia depends upon a neuritis, spreading from an inflamed

dental nerve to the Gasserian ganglion and so to other branches of the fifth, any proved pathological foundation? One can only reply: "Not the smallest vestige of proof has been produced." It may be noted that oral sepsis is extremely common, epileptiform neuralgia a rare disease, that sufferers

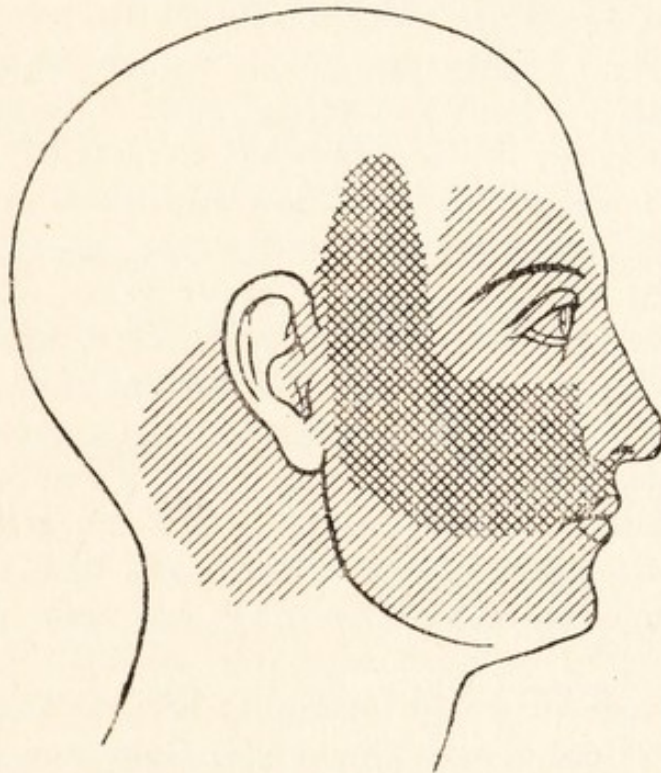


FIG. 12.

The stronger shaded area, including auriculo-temporal (3rd division) and infra-orbital (2nd division), were both severely affected in the neuralgic attacks, the lighter shaded areas including nasal and supra-orbital (1st division), mental and lower labial (3rd division), and small occipital (cervical plexus), were concerned to a lesser and more variable extent. The case is described on p. 70.

from the latter show no evidence of oral sepsis other than the impossibility of cleansing the teeth would induce.

That epileptiform neuralgia in no way depends upon dental irritation is a fact too little recognized. The following case is of interest as the neuralgia

only developed after the last tooth in either jaw had been removed.

John Brewer, a postman, had the last tooth in his head, a central incisor, extracted at the age of 65 years. *Then only* he became liable to neuralgia of the right fifth nerve, which developed shortly after the removal of the tooth. The pain was intermittent, started in the upper lip, ran up to the malar and temporal regions, and in the most severe attacks involved the lower lip, the parts round the eye and the post-aural region. The diagram will show that the pain involved, as a rule, parts of both second and third division, though the third was affected in a somewhat exceptional way, whilst radiations to the ophthalmic and superficial cervical areas were present in the severe attacks (see fig. 12).

During the colder months of the year he was rarely free from an epileptiform attack of pain for a whole period of twenty-four hours, and usually had several in each day. But a most unusual feature was present in his case—namely, that in the summer months he was practically free from pain. I have met with no other case in which the attacks were so modified by temperature conditions, and it is of interest to note that the effect of local heat (*e.g.*, hot bran applications to the face) was of no avail whatever during the attacks. A draught of cold air would invariably bring one on.

Operation (December, 1912).—The Gasserian ganglion was excised, leaving the ophthalmic trunk intact. Everything went well, and the patient left home in ten days. Considering his advanced age the result was excellent.

Enough has been said to show that the theory of major neuralgia being caused by a spreading neuritis started by dental caries has nothing in its support and many strong arguments against it.

We have now to consider what evidence exists of any changes occurring centrally, *i.e.*, in the Gasserian ganglion, to which could be attributed a causal relation to epileptiform neuralgia. We are

at once confronted with the difficulty of imagining any change, inflammatory or degenerative, which could exist for an unlimited number of years without impairing either the sensory or motor functions of the nerve. No such impairment has been met with in any case, if we except the cases of tumour pressure to be shortly described.

It is true that Spiller, who examined the nerves and ganglia in several cases, described "globular degeneration of the myelin-sheaths," but this is no proof of inflammation, and moreover he admits that the same changes may be found in other nerves which are not the seat of neuralgia. Spiller also described thickening of the arterial walls in the Gasserian ganglion, swelling of the axis-cylinders, &c. Keen considered that true pathological changes were proved in six out of seven cases examined by Spiller, but, as during excision of the ganglion it is impossible to avoid a somewhat rough handling of the delicate nerve-structures, this statement must be accepted with great reserve. Peculiar staining methods are also responsible for some of the changes which have been found. This does not, of course, apply to diseases of the blood-vessels in the ganglion (such as extreme narrowing of their lumen). It is doubtless true that arteriosclerosis has been occasionally found, but that it is often present in connection with epileptiform neuralgia is certainly not the fact. How, then, can it be the cause of such neuralgia if it only exists in a small minority of the

cases? Again, typical epileptiform neuralgia is met with at an age when arterial sclerosis hardly occurs ; in thirteen cases out of thirty-two it commenced between thirty and forty years. (Billroth.)

During the last twenty years I have examined many removed ganglia and submitted others to more competent pathologists. The result has been uniform. There are no pathological changes in the nerve structures, in their sheaths or their vessels, that can be made out even in most inveterate cases of trigeminal neuralgia. In fact one is obliged to desist from a useless search.

I believe the theory of vascular degeneration as the chief cause, or even as a cause, of trigeminal neuralgia should be entirely rejected. It is more difficult to disprove the theory of spreading neuritis, which had the strong support of the late Sir Victor Horsley,¹ who regarded "true neuralgia" as being synonymous with neuritis, and suggested that the inflammation often commences in the small dental nerves, and spreads up along the larger branches to the Gasserian ganglion.

Horsley, however, admitted that the only changes in the peripheral branches he had ever found consists in thickening of their fibrous tissue sheaths ; that the nerve tubules are normal ; and further, that the Gasserian ganglion shows no changes except a varying degree of adhesion to its dural

¹ Horsley, *Clin. Journ.*, 1897, vol. xi, pp. 8 and 17.

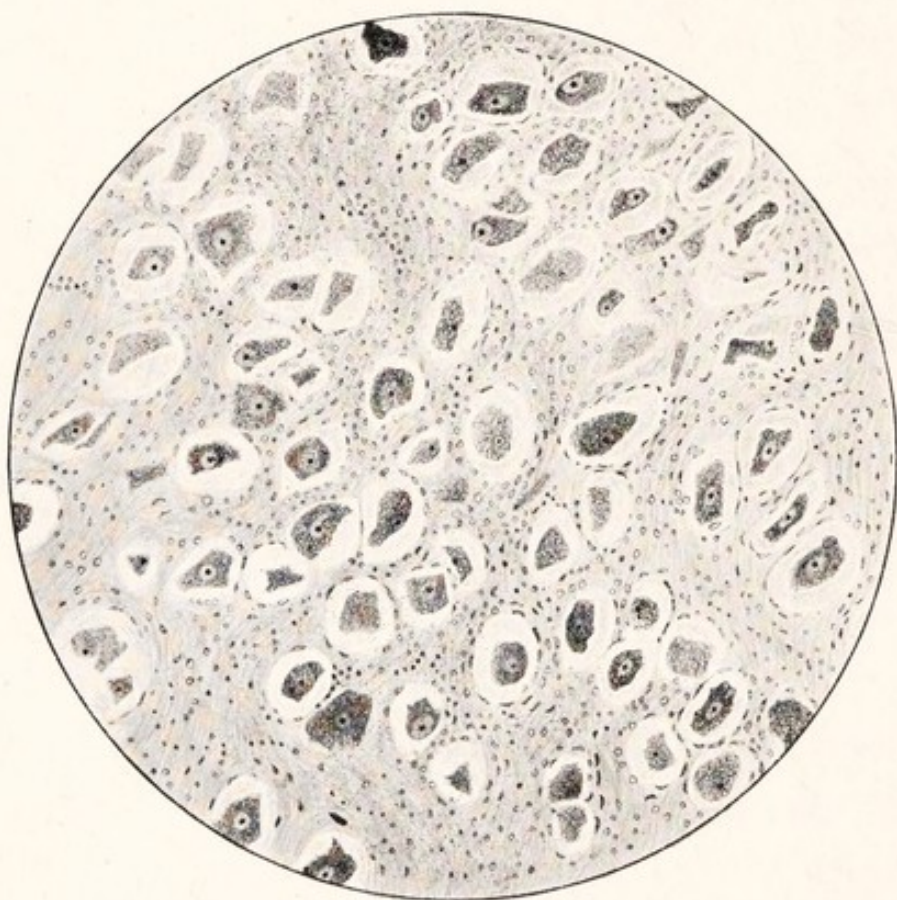


FIG. 13.

Section of Gasserian ganglion removed from a case of inveterate trigeminal neuralgia. The ganglion cells are seen to be perfectly normal.

investment. Spiller and Keen, on the other hand, attach importance to degeneration of the myelin-sheaths of the nerves, whilst Billroth states that microscopical examination of the excised peripheral nerves proved in so many cases absolutely negative that it was given up as useless.

Schwab examined two Gasserian ganglia which had been extirpated, the operation following others which had been performed on the peripheral branches of the fifth nerve. He found slight changes in both ganglia, but in neither case did he regard them as sufficient to account for the neuralgia. However, he attributed the neuralgia to one of three causes, a peripheral neuritis, an interstitial inflammation of the ganglion itself, or a neuritis of the sensory root of the ganglion, of which, he says, there are two instances recorded. It is very doubtful whether such changes have ever been found. Amongst those who have recorded entirely negative results from thorough examination of the removed ganglia may be mentioned Monari,¹ Codivilla (three cases), and Dr. J. Crawford Renton. Professor Krause's observations on both peripheral nerves and ganglia, resected for trigeminal neuralgia, have also been negative, and he suggests that "perhaps the changes escape our detection because they are molecular."

Fig. 13 represents a section through the ganglion

¹ Monari, *Beiträge zur Klinische Chirurgie*, Band xvii, 1896.

from one of the writer's cases. It shows well the ganglion-cells and supporting connective tissue. It will be seen that the ganglionic cells are in no way compressed ; the fact that they differ much in size is due to the section cutting through some at their centres, and others at the periphery. The minute cells of the neuroglia are not more numerous than is normal, and nowhere is there the slightest evidence of inflammation. In fact, the section illustrates the perfectly normal structure of the ganglion. The patient from whom it was obtained had suffered for many years from severe epileptiform neuralgia.

Fig. 13 is taken from a section through one of the main branches of the fifth nerve just beyond the ganglion, also from a case of inveterate trigeminal neuralgia. The dense fibrous sheath is perfectly normal, as are also the nerve-tubules. Attention is drawn to a small artery cut across in the nerve ; its wall is in no way altered from the normal.

It may therefore be taken as proved that in most cases of epileptiform neuralgia of long duration the Gasserian ganglion and its main branches show no pathological change, and that the disease has, moreover, no relation to impaired blood-supply due to arterial narrowing, &c. The few observers who have described abnormal appearances in microscopic sections from such cases vary much in their accounts.

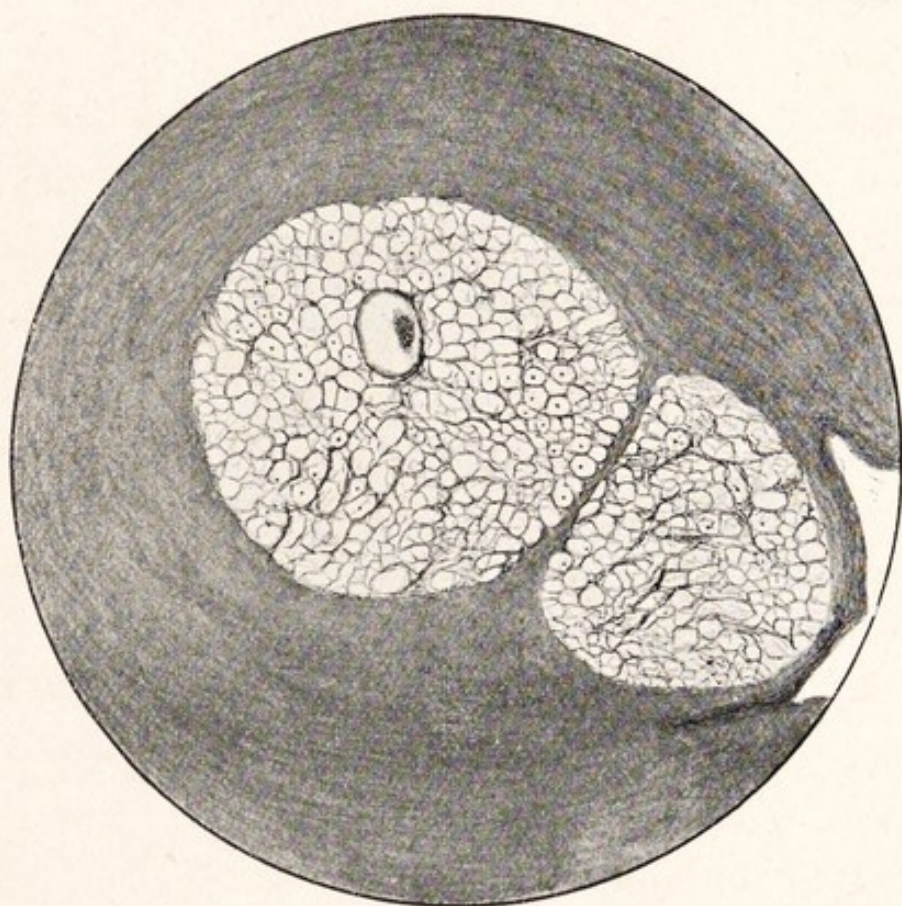


FIG. 14.

Section through a main branch of the fifth nerve, from a case of epileptiform neuralgia.

These facts lead one to the conclusion stated on p. 72, that the pathology of epileptiform neuralgia is still unknown, that neither degenerative changes nor inflammation will account for the disease.

We will now consider, as throwing some light upon the subject, the question of tumours involving the Gasserian ganglion.

Cases illustrating this, though very uncommon, are yet of special interest; they afford the clearest evidence of a central origin for neuralgia of the fifth nerve, and in some instances the pain closely resembles that of "idiopathic" epileptiform neuralgia. Almost always, however, there is evidence of pressure on the neighbouring nerves, the carotid artery, or the cavernous sinus, with marked anæsthesia, and the diagnosis of tumour can usually be made before the operation. The following is a brief account of the chief recorded cases of the kind :—

A man, aged 50, was sent to the writer by Dr. Henry Head, with partial oculomotor paralysis on one side, severe neuralgia of the corresponding fifth nerve, and partial anæsthesia. An exploratory operation by the temporal route showed an extensive ossifying chondroma or chondrosarcoma growing from the apex of the petrous bone and invading the Gasserian ganglion. Partial removal of the growth was alone possible, the patient recovering from the operation.

Kosinski,¹ in a case like the preceding one, attempted a complete removal of the tumour, but with fatal result. His patient was a woman,

¹ Kosinski in Chipault's, "Chirurgie Nerveuse," vol. ii, p. 195.

aged 53, whose right eye was atrophied, and in whom the right facial and trigeminal nerves were paralysed. A tumour could be felt in the right nasal cavity. The upper jaw on that side was resected, and a tumour growing from the base of the skull was removed; it penetrated into the cranial cavity. At the autopsy the tumour was found to have been only partially removed; it was an osteosarcoma and was said to have started from the Gasserian ganglion itself. This, however, must have been a mistake; it was connected with the sella turcica, the sphenoidal sinus, and the bone forming the anterior lacerated foramen. It is obvious that it was impossible to remove such a growth, and it is inconceivable that an osteosarcoma should start in the Gasserian ganglion itself.

This was, however, the origin of a tumour described by R. W. Smith as a neuroma, but which should rather be termed a true sarcoma. The case was of such interest that the drawing and description are here reproduced¹ (see fig. 15).

"In this instance the tumour implicated the Gasserian ganglion, and was the source of more severe and uninterrupted suffering than I have ever witnessed either in this or any other affection.

"In the year 1836 an emaciated and unhealthy-looking female, about 40 years of age, was admitted into the

¹ R. W. Smith's "Monograph on Neuroma" was published in 1849, and reproduced in 1898 by the New Sydenham Society. This case was probably one of the first recorded of tumour of the Gasserian ganglion.

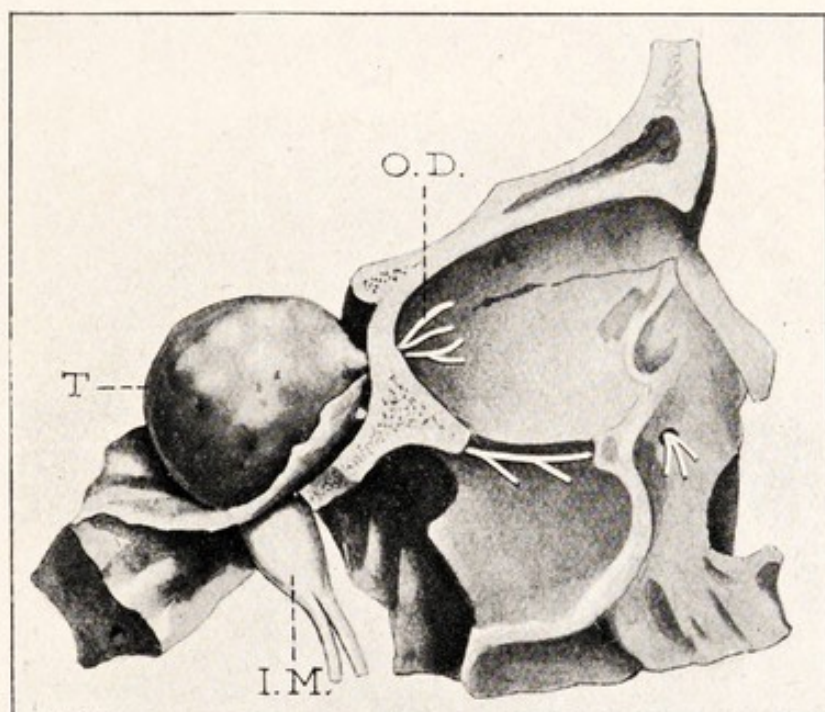


FIG. 15.

Tumour involving Gasserian ganglion (R. W. Smith's case). The growth T is seen to be mainly within the dura mater, but a prolongation extends through the foramen ovale along the inferior maxillary nerve (I.M.). O.D. The ophthalmic division.

Richmond hospital, under the care of Dr. Hutton, complaining of neuralgia of the right side of the face. She stated that the pain had commenced several months previously, had gradually increased in severity, and had now become almost unsupportable; she had lost flesh, her sleep was broken, and her appetite had failed. Her countenance indicated extreme suffering; the pain (which, although subject to exacerbations, never altogether ceased) was accurately limited to the right side of the face and forehead, and when indicating the situations in which it was most severe the patient marked with her finger the course of the branches of the fifth pair of nerves, and more especially the point of exit of the superior maxillary from the infraorbital foramen. Her sufferings were so much increased by mastication that she ate but little, and speaking aggravated the pain to such a degree that she always remained silent unless when interrogated, and even upon these occasions she frequently replied by signs. She had no respite from suffering during the day, and at night sleep seldom came to her relief, nor did any of the numerous remedies employed succeed in affording even temporary ease. After having endured more severe and more uninterrupted pain than I have ever witnessed in any other instance, death terminated her protracted agonies, four months subsequent to her admission into the hospital.

Autopsy.—When the cranium was opened and the brain removed, a tumour was seen in the right division of the sphenotemporal fossa. It was somewhat of the form and size of a walnut, and occupied the situation of the Gasserian ganglion; it extended across the inner extremity of the great wing of the sphenoid bone, as far forwards as the foramen lacerum orbitale, and was covered by the superficial lamina of the dura mater, which was attenuated to a remarkable degree. The trunk of the fifth nerve appeared to enter the posterior part of the tumour, the interior of which, however, presented no trace of nervous structure; the ophthalmic division crossed the anterior part of its superior surface; the superior maxillary emerged from it at the foramen rotundum; and the third division seemed to be identified with a remarkable prolongation of the tumour, which passed through the foramen ovale, the circumference of which was increased to more than double its natural extent.

"The surface of the petrous portion of the temporal bone, which supported the posterior part of the tumour, was absorbed, as well as the superior wall of the horizontal portion of the carotid canal; between this rough and denuded portion of the bone and the deep surface of the tumour ran the Vidian nerve, which throughout its whole course, from Meckel's ganglion to the hiatus Fallopii, was much larger than natural. The tumour was solid, and of uniform consistence; its section exhibited a cellular structure, without any trace whatever of nervous tissue; nerve-fibres could, however, by the assistance of the microscope, be seen upon various parts of its surface. The non-ganglionic portion of the nerve was compressed, but not enlarged."

It is obvious that, whilst this case was recorded by Dr. Smith as being an example of neuroma, modern pathologists would consider it as a sarcoma.

Caponotto, in a case of neuralgia for which he excised the Gasserian ganglion, found at the autopsy a "Cholesteatoma" the size of a nut, growing from the pons Varolii, at the point of exit of the roots of the fifth nerve. Lampiasi¹ operated by the temporal route on a case of neuralgia of the second division of the fifth nerve, and found a small sarcoma growing from the dura mater, which adhered to the bone and pressed on the nerve. He was able to remove the tumour, and improvement resulted, both as regards the neuralgia and the oculomotor paralysis on the same side, which had been present for a short time before the operation. It is, however, most unlikely that a cure was obtained.

¹ Lampiasi. Twelfth Congress of Italian Surgeons, 1897.

A detailed account is given¹ of a case of endothelioma (or plexiform sarcoma) with a remarkable clinical history.

The patient, a man of 32, suffered for a year with severe pain in the lower limbs, violent neuralgia in the left fifth nerve and increasing weakness and somnolence. A glandular tumour developed rapidly in the left side of the neck; on removal, it was pronounced to be an endothelioma. The facial neuralgia increased in intensity, but differed from the ordinary type in not being paroxysmal and in being accompanied by diminished sensation; all three branches of the fifth were moreover equally concerned. In November, 1899, Professor Keen performed the Hartley-Krause operation and removed piecemeal a considerable tumour occupying the position of the Gasserian ganglion. The ganglion itself could not be made out, and the pain persisted as before. In a second operation a month later more of the tumour, which destroyed the upper edge of the petrous bone, was removed. The dura mater was opened in both operations and small granulations of the tumour were seen growing on it. The patient recovered from the operation, and this is doubtless all that can be said with regard to a cure. It is of interest to note that he had for long suffered from chronic median otitis, and it might be suggested that the primary growth was a cholesteatoma of the petrous bone. The glandular tumour in the neck was certainly secondary to the growth in the middle fossa of the skull.

Hagelstan records the autopsy of a case of endothelioma which infiltrated the left Gasserian ganglion; Trénel, a case of "angiolithic sarcoma," which also was not operated on.

Homen and Krause observed two cases of pressure-atrophy of the ganglion, due to endothelioma and cholesteatoma respectively. Krause's

¹ Dercum, Keen and Spiller, in Chipault's "Chirurgie Nerveuse," vol. iii, p. 714.

patient died of meningitis two weeks after operation, owing to leaking of cerebrospinal fluid through the wound. There is no object in separating the small series of cases into those where the Gasserian ganglion is pressed upon and those in which it is infiltrated or destroyed by the tumour, for the distinction has no practical importance. The tumour may arise in connexion with the apex of the petrous bone, the pituitary fossa, the wall of the cavernous sinus, the dura mater elsewhere in this region, and possibly even from the temporo-sphenoidal lobe.

The writer operated in the London Hospital on a man, sent to him by Dr. Cecil Wall, who had intense neuralgia of one fifth nerve with some anæsthesia and interference with the oculomotor nerves on that side of the head. A tumour was diagnosed, and at the operation this diagnosis was confirmed, a firm oval nodule was seen to displace and press on the Gasserian ganglion from below, the tumour growing from the bone. After removal of the tumour it was found to be carcinomatous in structure. The man died some weeks later from basic meningitis and on making a vertical section of the skull the growth was found to start from the epithelium of the pharyngeal roof and to have softened the bone in its upward extension. There was neither ulcer nor swelling on the pharyngeal side, and hence during life it was quite impossible to have detected it.

The cases given above, and others published elsewhere, may be classified according to their nature as follows:—

(1) Sarcoma or fibrosarcoma of the ganglion itself—R. W. Smith's case.

(2) Sarcoma of dura mater, including endothelioma, invading the ganglion—Hagelstan, Keen, Trénel, Homen, and Lampiasi—five cases in all.

(3) Ossifying chondroma, or chondrosarcoma growing from the petrous bone—Hutchinson and Kosinski.

(4) Cholesteatoma—Krause, Caponotto, Romberg, Schuch, and Benda.

(5) Neuroglioma — eight recorded, including seven collected by Verger and Grenier de Cardeau, were apparently of this nature.

(6) Carcinoma of pharyngeal roof invading the cavum Meckelii—Hutchinson.

It will have been noticed in these cases of tumour pressure on the ganglion that, besides the neuralgia produced, there is always some degree of anæsthesia; further, the oculomotor nerves are sooner or later involved, and there is frequently obstruction of the orbital circulation giving rise to proptosis, &c. In these respects there is a striking contrast to true epileptiform neuralgia.

We can hardly doubt that the latter is caused by a morbid condition of the Gasserian ganglion itself, though not one so far revealed by any methods of microscopic research. Hence it must be regarded

as a central functional disorder, allied to epilepsy, but whose sole manifestation is pain, radiating in the branches of the fifth nerve.

It may be noted, in conclusion, that in some cases in which pathological changes have been described in the ganglion, severe and repeated operations have been performed previously on its main extracranial branches. It is conceivable that such operations may have led to ascending neuritis, they cannot have been without effect upon the severed nerve-trunks which have been forcibly dragged upon at the time of operation. Again one must be careful not to draw conclusions from cases in which alcohol injections have been employed. Although the effect of the latter is somewhat limited in range there is no doubt that a local neuritis and sclerosis may be produced by it.

Coenon, in reporting the result of examination of fifteen ganglia removed by Lexer, came to the same conclusion as that stated above. In two cases the ganglia were perfectly normal; in these no previous operation had been performed. In the remaining thirteen some changes were found, but all these had been previously subjected to alcohol injection or other destructive interference, and the reporter rightly urges that the changes he saw were to be ascribed to *secondary degeneration*

CHAPTER V.

THE TREATMENT OF EPILEPTIFORM NEURALGIA.

AT the commencement of the disease, and even during the first few years of its progress, it is only natural that both patient and physician should try medicinal and other forms of treatment before resorting to operation. It is no injustice to the physician to say that invariably the case is first treated as one of *minor* neuralgia. Although the spasmodic or epileptiform character of the pain is well marked and the intervals of freedom from attacks are conspicuous, yet the physician is prone to conclude that a local cause for the neuralgia must be present, and that it is his duty to discover and to remove it. Hence the useless extraction of healthy teeth, or of normal turbinated bones, or operations on innocent sinuses about the nose, &c. In addition most of the recognized anodyne drugs will be tried in turn, to be discarded one by one (unless the morphia or cocaine habit becomes inveterate), and of course X-rays and various forms of galvanism are likely to be resorted to, together with alcohol injections of the nerves. In this way much time is lost before the physician concludes

that he can do nothing more, and that the patient had better resort to operative treatment on the Gasserian ganglion, such operation having been kept in the dark background and spoken of, if at all, as a measure attended with grave risk to the patient's life, or to the eye on the affected side, should he be fortunate enough to survive.

It is a surprising fact that at the present time many patients with epileptiform neuralgia will endure its tortures (Avicenna nearly one thousand years ago well named it *tortura oris*—facial agony), for five, ten or even more years, rather than seek relief from an operation which is in most cases free from risk to life or eyesight (if performed by the method here described) and which offers the strongest hope of a permanent cure.

It must be granted that it is well to wait a few months until the epileptiform nature of the disease is thoroughly established, but no longer.

Meanwhile the patient's teeth have been attended to, and any carious stumps removed. *But on no account should healthy teeth be extracted.*

In spite of the statement made by some writers that galvanism or exposure to X-rays does good, experience has shown that they are absolutely useless, and may even increase the pain.

With regard to drug treatment there is not much to be said. Many of those enumerated on p. 40 are sure to be tried, but they are all disappointing, and some are apt to produce serious harm. There

is only one that is safe and that occasionally gives marked relief, namely aceto-salicylic acid or aspirin. Thirty to forty grains of this in the day may be given to most patients without danger. Dr. Head attaches some importance to constipation in the sufferers from trigeminal neuralgia, much more than the writer is inclined to. In former times free purgation was a recognized treatment for this complaint, and the views held by some as to the baneful effects of "intestinal stasis" in causing all manner of symptoms or diseases are sufficiently well-known. We cannot therefore be surprised at hearing that Sir Arbuthnot Lane claims to have cured a case of epileptiform neuralgia (for which excision of the Gasserian ganglion had previously been advised) by his operation of short-circuiting the large intestine. If the patient was really cured of true epileptiform neuralgia the writer ventures to suggest that the case will long remain unique!

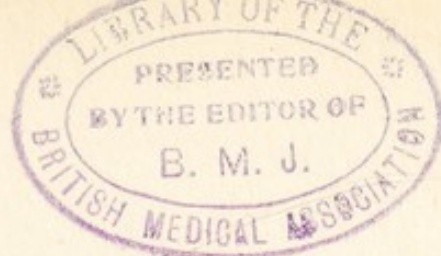
Of the host of hypnotics and sedatives, new and old, it can be said that temporary relief may follow the use of any one of them, but that only disappointment results from their prolonged administration. Sir Victor Horsley stated that he had only seen marked benefit from tincture of gelsemium pushed to poisonous doses. Opium and morphia alone will dull the pain, or even for a time remove it, but at what a cost! In some of Trousseau's patients it was pushed up to drachm doses of sulphate of morphia, or half an ounce of opium each

day. In some patients such prodigious doses cause no marked bad effects, not even drowsiness; but with many it is far otherwise: the mental and physical condition both suffer; constant torpor and dull headache are induced; the digestion fails, and the patient may emaciate to a marked degree.

Terrible as is the suffering caused by epileptiform neuralgia, relief obtained by increasing doses of morphia is only too dearly bought. When once epileptiform neuralgia is well established the right treatment consists in operation, and we have now to consider the exact form that this should take. Before doing so, however, a word of warning is necessary with regard to hysterical or "neurotic" patients.

The Neurasthenic Type of Facial Neuralgia.

There are certain cases which may simulate epileptiform neuralgia in which operation will prove wholly disappointing. It is perhaps unfair to apply the term hysterical to these patients, as to them nothing could be more real than their sufferings, but it is important for the surgeon to recognize that the measures which are followed by such brilliant success in true epileptiform neuralgia will be useless or even worse in them. One obvious difficulty arises from the fact that when this disease has lasted for long, partly owing to the impaired general nutrition, partly perhaps from abuse of morphia or other nerve sedatives, a condition of



neurasthenia may be produced, the patient becoming "a nervous wreck." This, however, is quite exceptional, and it is usually possible by a careful study of the symptoms, the localization of the pain and its radiation, to pick out the true neurasthenic cases—those in which operative treatment should be sedulously avoided.

The following example will serve to illustrate this statement :—

A young lady about the time or soon after an operation for adenoids began to suffer from headache and neuralgia—mainly but not entirely on the right side of the face. This neuralgia was never spasmodic though better at times, it was felt about both upper and lower jaws. She underwent the following operations : (1) Removal of the inferior turbinated bone ; (2) exploration of the maxillary antrum (found to be healthy) ; (3) resection of the right infraorbital nerve ; (4) injections of alcohol about the foramina ovale and rotundum. I believe the frontal sinus was also explored.

Relief from these procedures was always temporary or none at all, and ultimately, nine years after the onset of her trouble, she was urged by a distinguished surgeon to have the Gasserian ganglion removed. The writer then saw her for the first time, and expressed the strongest opinion that good was not likely to result from the proposed operation for the following reasons :—

(1) Her chief complaint was of "a crushing weight on the top of the head, the latter felt too heavy for the neck, which wants an iron band to support it." This is not a symptom of epileptiform neuralgia.

(2) She stated she was never free from pain of some sort, now in her neck (she could not tell which side), now between her shoulders, sometimes even in the arms and hands.

(3) Complaints of blockage of the right nostril (which was in reality quite free), of bleeding or discharge from the nose or throat, of nervous upset on hearing an electric bell, &c., seemed to be frankly hysterical. They certainly were

proved by the doctors who attended her, and who had examined her repeatedly, to have no real basis.

(4) In addition, after some of the operations already enumerated she had hysterical symptoms, thus after resection of the infraorbital nerve she had complained of numbness and pain in the *opposite* cheek, after alcohol injection trismus and "swelling on the left side of the tongue" followed.

As she had shown such willingness to undergo operations the writer did not expect an emphatic warning against removal of the Gasserian ganglion would have much effect on her mind, and so it proved.

It was duly performed (by the late Sir Victor Horsley) and was said to have been a very prolonged operation (two and a half hours) and that "a nævoid condition around the ganglion with firm adhesions" was found. The roots of the ganglion were dealt with, but though the cornea was left insensitive, the resulting facial anæsthesia was not so complete as one would have expected.

The eyelids were sewn together—but before she left the nursing home the eye became inflamed, and on account of corneal ulceration and recurrent head pain she spent the next three months in one or other home. In her own words her pain was not relieved for a single day, she complained as before of constant "nightmare" at night-time and of "maddening pressure" during the day. The operator had employed his usual large bone-flap method—the scar for which came well on to the face in front of the scalp. In addition to this disfigurement the eyelids had still to be kept sutured at the end of three months, and for the rest of her life she would be liable to the risk of relapses of corneal ulceration.

It is quite possible that with improved general health and nerve-control this patient might subsequently be comparatively free from her neuralgia and might put this down to the operation, but the case bears out the rule to avoid such treatment in obviously hysterical or neurasthenic subjects. The writer himself has removed the Gasserian ganglion

from three patients whose subsequent progress proved that their neuralgia had been only a part of their nervous trouble, and in each case the result was disappointing. In one it turned out that the patient's domestic conditions were the cause of profound nervous worry, and in this case the operation must be put down as a complete failure. In one other, also a woman, the persistence of headache and vague nerve disorders rendered it comparatively useless. These cases are not entirely confined to the female sex, though mainly so. Professor Krause records an example of complete failure to relieve the neuralgia by operation, his subject being an hysterical and neurasthenic doctor.

F. X. Dercum¹ points out that there is an "hysterical" form of sciatica, and he warns the surgeon against being induced to operate on such patients, as the result is certain to be disappointing. Alike in sciatica and trigeminal neuralgia, careful preliminary investigation will, as a rule, enable us to detect the cases in which the hysterical or neurotic basis is present and to avoid operating on them.

That such cases may simulate true epileptiform neuralgia closely is undoubted. A good example of this was the case of a woman sent to the writer by Dr. R. C. B. Wall.

¹ *Therapeutic Gazette*, April, 1914.

She was a pallid and ill-nourished Jewess, aged 44, who had borne eleven children. For the last three years she had had attacks of neuralgia in the right side of the head and face, strictly limited, according to her statement, by the median line. These attacks came on shortly before each menstrual period, recurred during the succeeding two or three weeks, and left her with a free interval only of a week or so; but the attacks were not increasing in intensity, nor were they of the explosive character of epileptiform neuralgia. On the other hand, the pain would last for some days continuously, and sometimes numbness or pain of one side of the body would accompany it. The case was evidently one in which, in an anæmic woman, neurasthenia, due to poor living and repeated pregnancies, was to blame, and one in which operation was quite out of the question.

Again, any case of persistent neuralgia, in which there is a strong history of inherited tendency to neuroses is unlikely to benefit by operation. The following is an instance :—

A man, aged 30, was seen by Dr. Henry Head and the writer on account of severe pain in the left side of the forehead. It was not typically epileptiform, but came on at intervals, and appeared to be situated in the frontal bone itself. His wife stated that he was strange in his manner during the attacks, and she feared he would become homicidal. The patient had a dull, heavy expression, and the history was that his mother had died insane. He had never suffered from syphilis, and nothing abnormal could be found on examination of the forehead, eye, or nose. The region of the frontal sinus was, however, specially tender, and in the hope that some cause might be found for the neuralgia, the writer trephined the anterior wall of the sinus and thoroughly explored it. No disease of the sinus was found, and the patient was but slightly relieved. Subsequently some operation was performed by Mr. Hunter Tod on the upper cavities of the nose, but with the same disappointing result. The man was last seen two years after this second operation, he was neither better nor worse, and he was dissuaded from any further operation; there is little doubt that his trouble was really cerebral.

Amongst the published records of operation on the Gasserian ganglion are to be found other instances of "hysterical neuralgia," and in every one the result was failure. Leaving these aside, a very important question arises with regard to the genuine epileptiform or major neuralgia. It has been already noted that of the three divisions of the fifth nerve the superior and inferior maxillary are the most severely affected, and that often the pain is for long periods confined to one only—perhaps to a single branch of them. This is especially true of the inferior dental and the infraorbital nerves. The tendency is for the disease to spread, but when the neuralgia has for years been practically confined to one division, it seems only reasonable for the surgeon to limit his interference to that division or branch only. In Trousseau's time such interference consisted, as a rule, in a simple neurotomy or nerve-stretching. In many of his cases repeated operations had been done on a single patient. There is no more candid or masterly account of the disease than is contained in his great work.¹ He sums up his experience in these words: "Even now, after more than thirty-six years of practice, *I have never known it to be cured in a single case radically.*" At the same time, in most cases, relief for a few weeks or months was afforded by each operation.

¹ Trousseau's "Lectures on Clinical Medicine," *New Syd. Soc. Trans.*, 1868, vol. i, pp. 105 to 116.

Professor Billroth paid great attention to the subject, and in his time resection of the nerves and operations on the main branches nearer the base of the skull were practised. Better results were obtained, and it is a striking phenomenon that the neuralgia in several cases entirely disappeared for a few years, but then returned in aggravated intensity and widened area. Billroth, from his experience of over thirty cases operated on by neurectomy, stated that recurrence happened sooner or later in every one. The method of avulsion of the exposed nerve, which was advocated by the late Professor Thiersch, proved no better than neurectomy. The same may be said for many elaborate operations on Meckel's ganglion, and it is no longer necessary to refer to them in detail. There are two or three peripheral operations which, in isolated cases, are perhaps still worthy of trial, such as resection of the inferior dental nerve, and these will be briefly described. Before doing this it will be best to consider a method which its advocates claim as being a successful substitute for the excision of the Gasserian ganglion, namely the injection of the nerve trunks with alcohol. This is so generally known as Schlösser's method that it will be of little avail to point out that priority is wrongly claimed for him. Certain it is, however, that whereas Schlösser's first paper was published in 1903 (Ophthalmological Congress at Heidelberg) a year previous to this MM. Pitres and Verger had

brought forward the alcohol injection method for facial neuralgia.¹ It is therefore obvious that the two French surgeons were the first in the field, and that if any name be attached to the method it should be theirs.

*The Treatment of Trigeminal Neuralgia by
Alcohol Injection.*

This method, as already noted, was introduced by Pitres and Verger in 1902 and by Schlösser, an ophthalmic surgeon of Munich, in 1903. Previously the injection of branches of the fifth nerve with solutions of osmic acid had been advocated by Sir William Bennett and others, but only after the nerves had been exposed by open operation. It does not appear that before 1902 anyone had attempted to hit the main divisions of the fifth nerve, as they emerge from the foramina rotundum and ovale, by plunging the syringe needle through the side of the face. It may be noted that the ophthalmic trunk is quite out of reach of all treatment by injection, the most one can do is to inject its supraorbital branch.

If the *second division* at the foramen rotundum is aimed at, the needle must be entered at the lower edge of the malar bone where the latter slopes upwards and backwards, and must then be directed behind the bulging posterior wall of the antrum of

¹ *Soc. de méd. et de chir. de Bordeaux*, July, 1902.

Highmore into the pterygomaxillary fossa; it should be given an upward inclination of about fifteen to twenty degrees (with regard to the normal horizontal plane of the skull), but if the needle be sloped too much upwards the foramen rotundum will be missed and the alcohol injected into the nerves coming through the sphenoidal fissure.

The caution is given "not to pass the needle deeper than five centimetres or more than seven millimetres past the anterior edge of the external pterygoid plate."¹ The writer has examined a large number of skulls with reference to this matter, and finds that the average depth of the foramen rotundum from the outer edge of the malar bone (one may here disregard the thickness of the skin) is 4·6 centimetres, four millimetres less than Dr. Harris gives. In only 25 per cent. of those examined was the depth of the foramen as much as five centimetres, and in 50 per cent. it was 4·5 per cent. or less. These measurements were very carefully made, and the writer therefore recommends that 4·5 centimetres should be regarded as correct, rather than five centimetres *if the path through the cheek below the malar bone be selected*. But anyone who investigates the subject will find that by this route it is difficult and sometimes impossible to be sure of reaching the foramen

¹ Dr. Wilfred Harris, *Brit. Med. Journ.*, June 11, 1910.

rotundum. The pterygomaxillary fossa is often only a narrow chink, the sphenoidal crest may be in the way of the needle, there is no guide to the foramen, which in any case must be approached *laterally*. Dr. Harris considers that practice on the dead subject renders the proceeding easier, this may conceivably be the case, though it cannot remove the anatomical difficulties which exist in many crania. This is sufficiently proved by the fact that in the hands of those with the most experience undesirable accidents have occurred. Thus Dr. Harris (*loc. cit.*) injected seventeen cases, in one "he failed to hit off the nerve in three separate attempts." In another temporary diplopia and partial loss of colour sense followed, "indicating that the alcohol had been injected too far upwards and inwards towards the sphenoidal fissure and optic foramen." In a third case diplopia also resulted, showing that the motor oculi nerve had been reached with the point of the syringe.

Personally, for the reasons given above, the writer has selected a different and possibly a surer method of approaching the foramen rotundum with the needle, namely, by the orbital route *along the sphenomaxillary fissure*. If the junction of the lower and outer borders of the orbit be taken as a guide it is easy to pass the needle into the fissure and along it, with an oblique inward and slightly upward direction, towards the foramen rotundum which forms the apex of this narrowing cleft or

space. The foramen is thus attacked *en face* and in some skulls it is possible if the needle be passed too deeply to traverse the whole canal for the second division (it is more correct to speak of a canal rather than a foramen) and to enter the region of the cavernous sinus. The depth of the foramen from the orbital margin is 4 to 4.5 centimetres, and there is but little variation as to this. Hence the needle may safely be passed in for 4 to 4.5 centimetres and it is practically certain to hit the margin of the foramen rotundum. If it be sloped too much upwards and made to leave the sphenomaxillary fissure there is a chance of injecting the muscles arising from the bony margins of the sphenoidal fissure, but this would probably do no harm. The motor oculi and still more the optic nerve should be in no danger, if reasonable care be employed to keep the needle in the sphenomaxillary fissure.

The writer first used this method of approaching the foramen rotundum along the floor of the orbit several years ago, and believes it to be original; but does not claim it to be infallible, though it is certainly better than the one ordinarily employed (from below the malar bone). Its advantages are, (1) a slightly shorter and more direct access to the nerve, and (2) the foramen is attacked *en face* and therefore more surely reached with the point of the needle. Moreover, if the latter is made to travel along the sphenomaxillary fissure it will probably

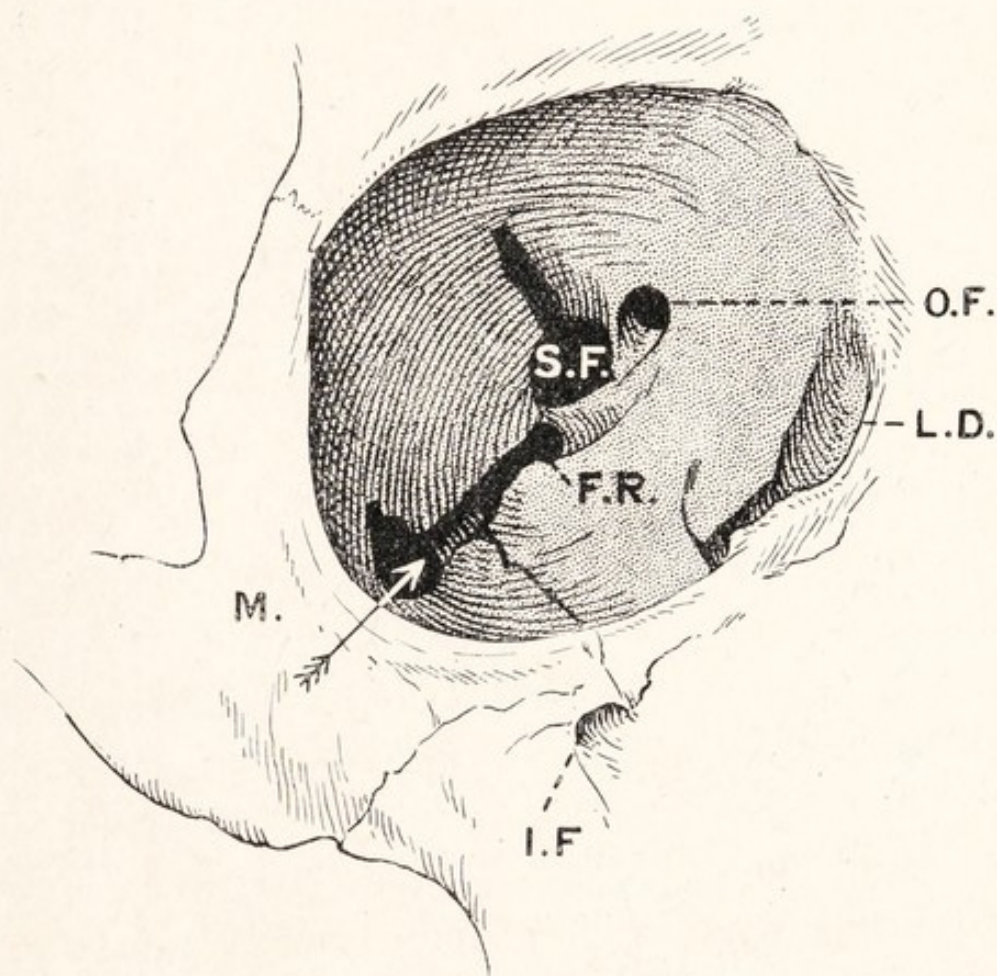


FIG. 16.

Diagram to show the method of reaching the foramen rotundum (F.R. with the needle of the syringe. The arrow indicates the path followed by the needle along the speno-maxillary fissure. M.—The malar bone. I.F.—The infra-orbital foramen.

hit the nerve even though it may not enter the foramen rotundum. Access to the latter may in some skulls be hindered by a crest of bone in the superior maxillary border of the fissure.

It will be noticed that by the ordinary "lateral" route the needle must traverse the masseter and pterygoid muscles whereas along the spheno-maxillary fissure there is no muscle, only loose cellular tissue. Branches of the internal maxillary artery run a slight risk from the needle in either method, but in the writer's cases there has been no bleeding to give trouble. Slight œdema of the lower eyelid or cheek is sure to follow the alcohol injection, but it clears off in a few days.

As to the *third division of the nerve* at the foramen ovale there are two ways of approach. The first advocated was below the zygoma just in front of the eminentia articularis. The needle is best introduced at least a centimetre below the zygoma and should be directed inwards and slightly upwards. How deeply should it be passed?

From an examination of a large number of skulls the writer has found that the outer edge of the foramen ovale is exactly four centimetres (on the average) distant from the lower border of the zygoma, the extreme being 4·3 centimetres and 3·1 centimetres. As in the case of the foramen rotundum these measurements will usually be greater in the male than the female subjects. Dr. W. Harris (*loc. cit.*) warns against passing the

needle too deeply, "more than 4.75 centimetres," for fear the Eustachian tube or wall of the pharynx be entered. It will be noted that as in the case of the foramen rotundum, Dr. Harris is more liberal in his measurements than the writer considers wise. The needle should be introduced not just under the zygoma, but a centimetre or so lower down, in order to pass it obliquely up towards the foramen ovale. This makes a trifling difference in the depth traversed by the needle—but even so Dr. Harris's 4.75 centimetre limit is a dangerous one. As anyone can easily prove, this length of needle would bring its point in many skulls well beyond the foramen ovale and would reach the Eustachian tube or the pharynx—the very structures we are warned to avoid. Indeed 4.75 centimetres would in some cases take one to the middle lacerated foramen, though it would probably be impossible to wound the internal carotid artery as it is protected by a fibrocartilaginous shelf. An artery more in danger from puncture by the needle is the middle meningeal branch of the internal maxillary, and Dr. Harris warns the operator against inclining the needle too far back on this account. But the close relation of the foramina ovale and spinosum, or rather of the inferior maxillary trunk and the middle meningeal artery are too well known to require emphasis—the artery being often surrounded by the roots of the auriculotemporal branch—where they come off from the main trunk. In

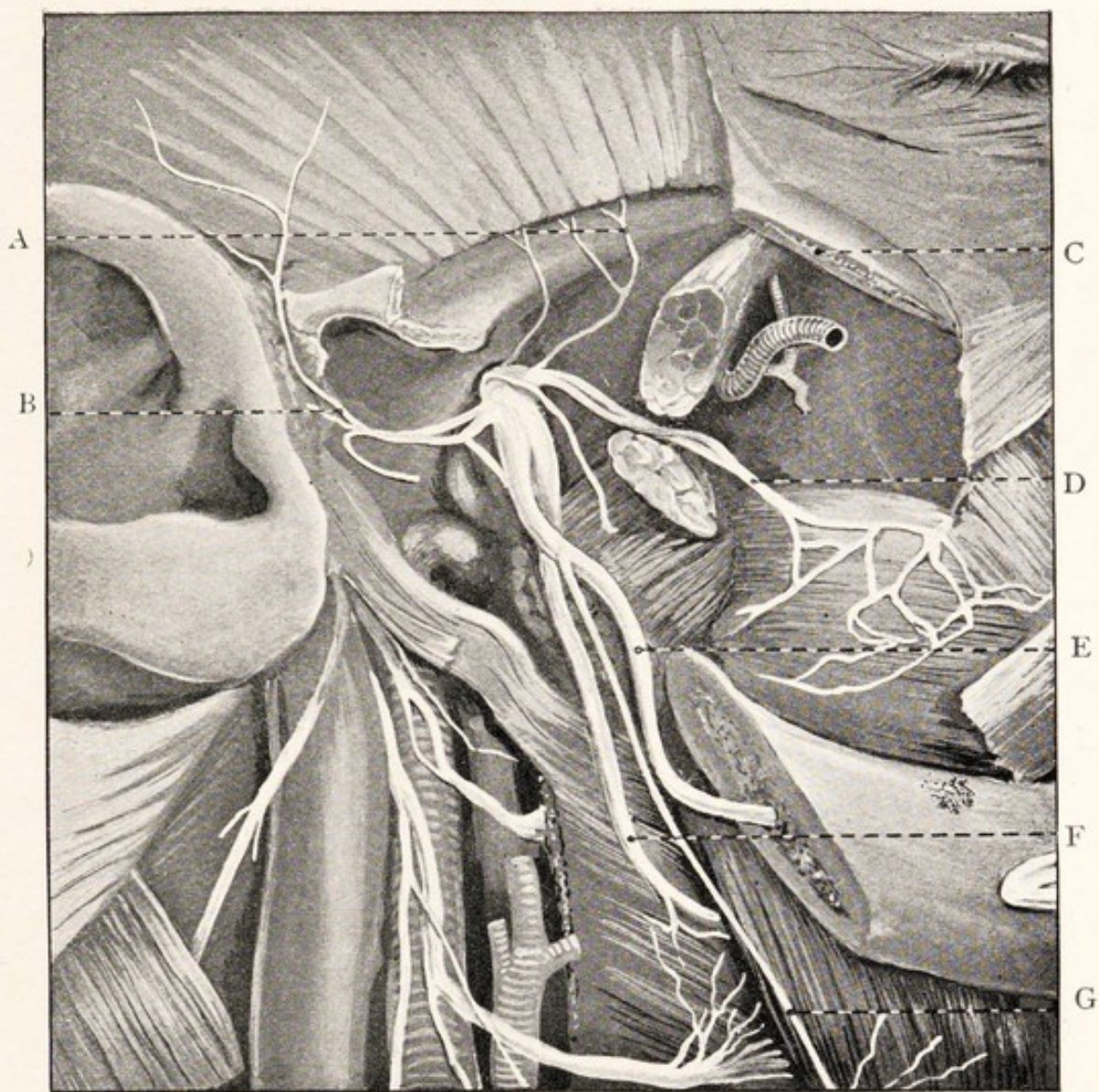


FIG. 17.

Deep dissection to show the inferior maxillary division as it emerges from the foramen ovale and its branches. Both the zygoma and the ascending ramus of the lower jaw have been cut away, and the parotid gland removed together with the masseter, internal pterygoid and other muscles. The cut surfaces of the temporal and external pterygoid (C) are exposed; between the two heads of the latter the buccal nerve (D) is passing downwards and forwards. The internal maxillary is cut and turned forwards. (A) Branches to temporal muscle; (B) auriculo-temporal nerve; (E) inferior dental; (F) lingual nerve; (G) branch to mylohyoid and digastric. The difficulty of injecting the third division of the fifth nerve with alcohol, or of resecting it outside the skull will be appreciated from this figure. (Dissection in the London Hospital Museum.)

other words, *no amount of practice or skill in the use of alcohol injections can obviate the chance of the needle entering the meningeal vessels instead of the nerve.* Fortunately the artery is not easily punctured at this depth, the chances are against it—that is all one can say. The writer has knowledge of a case of serious hæmorrhage following injection of alcohol in this region at the hands of an experienced physician, the patient's temporal fossa became filled with blood which worked its way up the side of the skull and required drainage.

It may be noted that the needle is made to pass through the temporal muscle over the sigmoid notch of the mandible, and it is usually desirable to have the patient's mouth open in order to enlarge this space. It is impossible, at least in most skulls, to make the needle enter the foramen ovale through the sigmoid notch as it cannot be made to slope upwards sufficiently. But largely owing to the disappointment attending injections of the extra-cranial branches of the fifth nerve, many have endeavoured to inject alcohol into the ganglion itself, and to some extent have succeeded. This procedure has only come into vogue during the last ten years or less (since 1909) and its results and risks can hardly yet be judged.

The difficulty of *injecting the ganglion* is considerable. The zygoma in most skulls has its inferior border lower than the level of the foramen ovale, which is directed horizontally. If the surgeon

takes the usual guide for the third division of the nerve, the pre-glenoid tubercle, and passes his needle in front of this tubercle directly inwards for about 4 centimetres the point of the needle should be just below the foramen ovale. A little further and it will be into the Eustachian tube, but in hardly any case can it be inserted into the foramen ovale and cavum Meckelii. To effect this it is necessary to adopt the second method and to pass the needle obliquely through the side of the cheek, in front of the ascending ramus instead of above the sigmoid notch, to start well below the zygoma and malar eminence and (at a distance of at least seven centimetres from the surface, *i.e.*, nearly three inches) to hit very obliquely an opening only a few millimetres in size. The point of the needle should be aimed at the slightly rounded surface of bone immediately in front and outside the foramen ovale, beyond which it should be made to glide into that opening. The manœuvre must be controlled by having a skull alongside the patient's head for comparison. It will be noticed that the root of the external pterygoid plate is close to the foramen ovale, and the needle may possibly strike against this part of bone as it gropes its way to the aperture. It is important that the needle should first touch the bone close to the foramen, otherwise there is nothing to tell the physician when it enters the latter, and there are dangers enough from pushing the point too far—one of them being the internal

carotid artery! The risk of wounding the internal maxillary vessels *en route* for the foramen ovale is always present, and from one or two cases the writer has seen subsequently, it was certain that the alcohol injected had reached the oculomotor nerves.

The average surgeon, still more one who has known the difficulties of exposing the Gasserian ganglion to sight after trephining, who has seen the actual dimensions of the ganglion and realizes the structures in its close vicinity, may well be amazed at the temerity displayed in this procedure. He may indeed question the possibility of thus infiltrating the ganglion with alcohol by a blindfold guidance of the needle through a small foramen situated at such a depth.

Certainly it has often failed, for example:—

W. Alexander and E. Unger¹ record their attempt to inject the ganglion from below, they failed to find the foramen ovale with the needle. Seeing the futility of this they operated by the temporal route in another case, exposed the Gasserian ganglion and injected the lower part of it with alcohol. The ophthalmic division escaped, as proved by the subsequent retention of sensation in the forehead and eye. The operators reported the case within two months, but admit "that the permanence of the result was not yet assured." They claimed, how-

¹Aléxander and Unger. *Berliner klin. Wochenschrift*, Jan. 27, 1913.

ever, that "among the advantages of their procedure over extirpation of the ganglion is the accuracy with which its destruction may be limited." How baseless is this claim will be proved later in the discussion of the pathological results of alcohol injection.

I know it to be a fact that in some cases in which the operator has claimed to inject the ganglion, practically no anæsthesia has resulted and very temporary relief, if any, has been afforded. But it must be admitted that in some the alcohol has undoubtedly worked in or about the ganglion, for in one woman whom the writer saw on account of failure of the procedure to relieve the pain, a severe kerato-conjunctivitis had come on quickly after the injection. Only the eye on the injected side was involved, and the sole explanation possible was that the ophthalmic trunk had been reached by the alcohol. There was partial anæsthesia of the face. After the eye had recovered the writer operated on this case by excision of the ganglion, fortunately with success.

Another case of injection into the ganglion itself is recorded by J. Flesch,¹ in which it is certain that the alcohol was effectually got into the ganglion, as "*the whole of that side of the face was anæsthetic for several weeks.*" Flesch frankly admits that the result of the injection in this case was bad. "The patient could eat and speak only with difficulty, and

¹ *Wiener med. Woch.*, Feb. 21 and 28, 1914.

the risk of ulceration of the cornea necessitated the constant use of bandages over the eye."

The shortest route for injecting the ganglion is not through the cheek but from inside it. Following up the outer aspect of the superior maxilla and the external pterygoid plate, from inside the mouth, it will be seen that the reflection of the mucous membrane is very near to the foramen ovale. The latter opening is situated above, immediately behind, and a trifle external to the top of the external pterygoid plate—at its posterior border. Hence the needle has a very short distance to traverse before striking the sphenoid bone just outside the foramen ovale or entering the latter. In passing through the foramen the needle should be inclined inwards, otherwise it may go through the dura mater into the sub-arachnoid space or the brain.¹ With practice on the dead subject it is undoubtedly possible to become expert in reaching the foramen ovale with the syringe-needle, and to inject alcohol into the Gasserian ganglion, or some part of it. One grave drawback, however, of such injection is that it is obviously impossible to prevent the ophthalmic trunk from being involved. In one case, unusually successful in that freedom from return of the neuralgia was secured by the injection for at least three years, the eye was lost and had to be excised.

¹ I do not know whether the route from inside the cheek has been tried by other surgeons or not. The risk of sepsis from the mouth has to be considered and guarded against so far as is possible.

To sum up the discussion of anatomical points connected with injection of the second and third divisions :—

(1) The second division (foramen rotundum) is best approached at the outer and lower angle of the orbit along the sphenomaxillary fissure ; the needle should be passed 4 to 4·5 centimetres deep—not more.

In the other method of approach, the one usually recommended, namely, from the cheek below the malar bone, the needle should be passed 4·6 centimetres deep or less.

(2) The inferior maxillary division is reached by entering the needle a short distance below the zygoma immediately in front of the eminentia articularis and the condyle of the lower jaw, which latter should be depressed. The neighbourhood of the foramen will be reached at a depth of 4·5 centimetres or rather less. It is risky to go deeper.

(3) In most skulls it is practicable to make the needle enter the foramen ovale by the route described on p. 100. What subsequently happens to the needle-point and the alcohol injected is the concern of Providence equally with the physician's skill.

Note.—The operator should always have a dried skull by his side to refer to when injecting. This help should be combined with previous practice on the dead subject.

There is not much that need be said about the method of injection. A fine steel needle, marked in centimetres along its course (two or three marks made about the 4 centimetre limit, *i.e.*, 3.5, 4, 4.5 centimetres will suffice), is employed with the ordinary wire stilet in place nearly up to the point. The stilet is bent at the other end of the needle so as to prevent its going beyond the point.

The needle and syringe have been boiled in weak soda solution, and the usual aseptic precautions carried out as regards the operator's hands and the patient's skin. When it is believed that the needle point has penetrated close to the desired foramen (and no certainty can be obtained as to this) the stilet is withdrawn, the syringe fitted on and a few drops of alcohol injected. This should cause a burning pain in the distribution of the nerve attached, after a short time this diminishes and the full amount of alcohol, 15 to 30 drops (*i.e.*, 1 to 1.5 centigrammes are injected. The needle is then withdrawn and a small gauze and collodion dressing applied. Severe pain may continue for some hours, and it is difficult to judge of the result until a few days have elapsed. Of course anæsthesia in the peripheral area of the injected nerve is to be desired, but even though this may not be obtained relief to the neuralgia may follow.

We have assumed that the injection has been made with the help of novocaine, or of freezing the skin with ethyl chloride and not with a general

anæsthetic. But, as Dr. Harris points out, many patients require a general anæsthetic to face the ordeal. Both he and the late Sir Victor Horsley tried the method of giving an anæsthetic, but of not injecting until the patient has partly come round. This was not found to be satisfactory. The idea underlying it was that the partially restored sensation of the patient will enable him to confirm the penetration of the nerve by the needle by a start of pain, especially spasm of the facial muscles. Unfortunately this spasm will probably occur whether the nerve has been reached or not. To attempt to inject the Gasserian ganglion itself without the use of a general anæsthetic would be inviting disaster of the gravest kind.

Has the Method of Alcohol Injection any claim to be considered a Cure in Trigeminal Neuralgia?

The answer to this question depends upon one's definitions. One of the chief advocates of the method uses this strong statement: "This treatment of injection of the nerve trunks with alcohol is, I am absolutely convinced, a sure cure for pain in tic douloureux . . ." but he goes on to add, "not a permanent cure as with excision of the Gasserian ganglion."

The writer's experience is unfortunately opposed to the statements of Dr. W. Harris that the freedom from pain after each succeeding injection

becomes longer,¹ the exact reverse is the case. Moreover, the intensity of the pain, as a rule, becomes greater after each unavailing attempt to cure by injection.

For example, an elderly woman travelled from the North of Ireland to London no less than fifteen times in order to be injected with alcohol for epileptiform neuralgia. She underwent this treatment each time at the hands of one of the leading advocates of the method. Although the neuralgia regularly recurred with equal or greater intensity, yet the patient's endurance only gave out after the fifteenth successive failure! The writer saw her in Belfast at the end of several years, when she was completely worn out by her suffering, and it is not perhaps to be wondered at that she then refused to undergo the operation of excision of the ganglion.

Such a case throws a startling light on the claim that alcohol injection is a cure, as is stated for example by W. Alexander.² It is unfortunate that so many reports on the effect of alcohol injection have been made without allowing sufficient time to elapse to test the method. A striking example of this is Dr. W. Harris's paper, already quoted. He injected thirty-three patients with true epilepti-

¹ Dr. W. Harris. *Brit. Med. Journ.*, June 10, 1910.

² W. Alexander. *Berliner klin. Wochenschrift*, November 30, 1908.

form neuralgia, and admits two complete failures. "The remaining thirty-one were all completely relieved . . . for periods varying from two months to eleven months and more." But nine, *i.e.*, about thirty per cent., had recurrence within nine months, and of the remaining twenty-two only three had been followed up for nine months or more. "The remaining nineteen cases, which were injected between the end of August, 1909, and May 14, 1910, have *so far* had no recurrence." This sounds satisfactory, but it will be found that the latter date is actually *within a month of the publication of the paper*, and that the *large majority of the total thirty-one had not been tested by the lapse of even nine months from the date of injection*.

Probably the best record so far published on the subject is a recent one by an Austrian physician, Dr. Flesch, quoted elsewhere. He followed up sixty-two cases treated by him with alcohol injections and found that eight could be claimed as cures, *i.e.*, there had been no recurrence during several years. Particular attention must be drawn to the fact that all of these eight cases had been merely injected in one or other peripheral branch—*i.e.*, neither in the main trunks nor the Gasserian ganglion. Is it not fair therefore to claim that all these cured cases were examples of minor neuralgia and not of the epileptiform type—since the hopelessness of effecting a permanent cure in the latter by any possible form of peripheral operation is

universally admitted? In the remaining fifty-four cases the neuralgia returned after varying intervals in every one, and in fifty of these the interval was eighteen months or less—often much less.

It will probably be found that injection *through* the foramen ovale, *i.e.*, into or in the neighbourhood of the Gasserian ganglion, whilst more dangerous to the eye than the other methods, will be found to offer a better prospect of real cure.

There is small reason to think that alcohol produces a neuritis of sufficient intensity to destroy the nerves entirely—regeneration always ensues. It appears that the motor function of an injected nerve is more likely to suffer permanently than the sensory one—and the serious laming of the lower limb that has resulted from injection of the great sciatic nerve for sciatica should render this treatment obsolete so far as this form of neuralgia is concerned.

To speak of alcohol injection “rendering the necrosis of the nerves or the Gasserian ganglion complete,” as some have done, is to go far from the mark.

It is well-known that alcohol taken to excess as a beverage leads to a widespread chronic neuritis, and it is equally certain that when injected directly into a nerve it may cause an acute aseptic neuritis. One would expect sometimes, as a result of this neuritis, an increase in the intensity of the pain suffered. This result is never alluded to by the

advocates of the method, but the writer has known many examples of it. More than once in discussing the question of excision of the Gasserian ganglion with a patient it has been suggested that the latter might wish to try first injection with alcohol, the patient replying : "But I have had that done already, and it caused such intolerable pain that I could not undergo it again."

In conclusion it may be noted with regard to alcohol injection that relief to pain and the anæsthesia which nearly always accompanies it in a successful case may not come on immediately after the operation but only some days afterwards. After a varying number of weeks or months sensation in the affected area is usually recovered, and sooner or later recurrence of the neuralgia is practically invariable.

OPERATIONS ON BRANCHES OF THE FIFTH NERVE.

In no part of surgery has so much ingenuity and elaboration been employed, and in none unfortunately with such poor success. Of all the methods devised for approaching the superior maxillary nerve, Meckel's ganglion, or the branches of the third division, methods whose illustration and description filled a large section of works on operative surgery, how few are worth remembering or practising at the present time! No sooner has a surgeon's name become identified with a particular method than the latter has been given up

as obsolete. A decided objection to most of these operations on the face was the disfigurement produced, and this applies equally to the (pterygoid) method of approaching the Gasserian ganglion introduced by Wm. Rose.

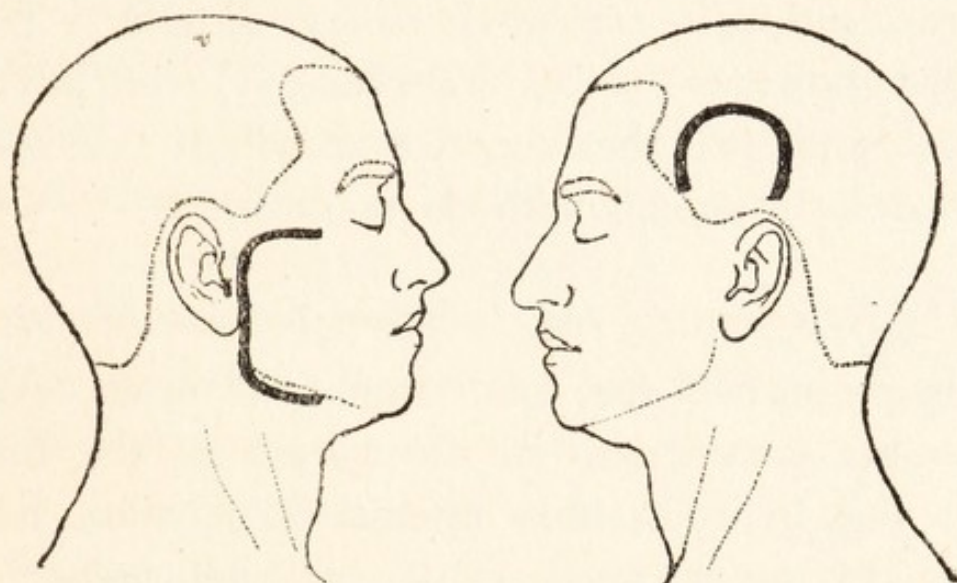


FIG. 18.

The diagram on the left shows the incision for the original pterygoid operation of Wm. Rose. The method is now entirely obsolete, the deformity resulting from such an incision being great.

The right hand diagram shows the incision, placed entirely within the hairy scalp, which suffices for the modern operation.

Fortunately we can now say that excision of this ganglion may be performed so as to leave no deformity whatever as a result.

It would be useless to describe operations which are never likely to be revived ; for

“ they anon,
Like Snow upon the Desert's dusty Face
Lighting a little hour or two—are gone.”

It must be admitted that the illumination afforded by most of them was trifling in amount.

In a few cases of epileptiform neuralgia, limited to one main branch or division, the surgeon may be tempted to perform resection of the nerve most affected, with the knowledge that, at the best, temporary relief will follow. In the case of such branches as the infraorbital and supraorbital the operative details are obvious and simple. With regard however to two nerves—(1) the inferior dental and (2) the superior maxillary nerve—a brief description of methods is desirable.

(1) Resection of the Inferior Dental Nerve.

In about half the total number of cases, major neuralgia commences in the nerves of the lower jaw, and in such this operation may be tried, especially as it need cause no deformity. If successfully carried out, in suitable cases a respite from pain of eighteen months or more may be hoped for.

There is only one reasonable method of approaching the inferior dental nerve, namely by trephining the outer table of the lower jaw. Paravicini's intrabuccal method is difficult, allows free opportunity for the oral germs to enter the wound, and hæmorrhage in the mouth will much impede the surgeon's attempt to identify the nerve. The writer has performed the following operation several times. Reference to the Frontispiece may be made.

Neurectomy of the Inferior Dental Nerve

through a Trephine Aperture in the Lower Jaw.—

The point of bone to be aimed at is indicated on the ascending ramus by the meeting of two lines—one perpendicular to the lower border of the jaw passing upwards from its angle, the other a continuation backwards of the alveolar margin. This point on the side of the cheek is well below the parotid duct and behind the facial vein; the skin incision of one inch should be mainly horizontal, to avoid injury to the facial nerve, but it is convenient to curve it slightly. The masseter being exposed, its fibres are partly severed, but chiefly separated, until the bone is reached and bared with a periosteal elevator. The pin of a small (half-inch) trephine is then inserted exactly at the spot mentioned above, and when the outer table of compact bone is traversed, the disk is removed by means of the elevator and fine chisel.

It is almost certain that the groove or channel containing the inferior dental nerve and vessels will be opened thereby, and this should be carefully cleared on either side with the chisel. The groove should be sufficiently widened upwards and downwards, with due caution not to wound the inferior dental artery, until the nerve can be raised on a hook. Grasping the nerve with a Spencer Wells' forceps, a considerable piece can be drawn out and excised. The bone disk need not be replaced, and two or three fine sutures suffice for the small wound in the cheek. The patient should

be kept on liquid or soft food for a few days. He is sure to complain of aching during this time, due to the traction on the proximal end of the nerve. The success of the operation depends chiefly on following exactly the landmark given above and on avoiding injury to the companion artery (though this, perhaps, is not of great importance). As a rule, the nerve lies just in front of the artery, and is distinguished from it by its white colour.

It is not worth while to give here the full notes of a case illustrating the amount of relief to be expected from this neurectomy, namely, eighteen months complete freedom from pain, and of a subsequent operation on the Gasserian ganglion owing to recurrence of the neuralgia.

(II) *Neurectomy (extra- and intracranial) of the Superior Maxillary Nerve.*

Carnochan's method of approaching this nerve in the pterygomaxillary space, by "trephining" both walls of the antrum of Highmore, had some vogue at one time but has fallen into complete oblivion. Poirier's method of obtaining access from the outer side does not appear to be a practical one. Professor Billroth, an American surgeon named Storrs, and others, have followed back the infraorbital nerve along the floor of the orbit, raising the orbital contents and cutting or crushing bone at the edge of the sphenomaxillary fissure, until (it is claimed) the nerve can be reached close to the foramen

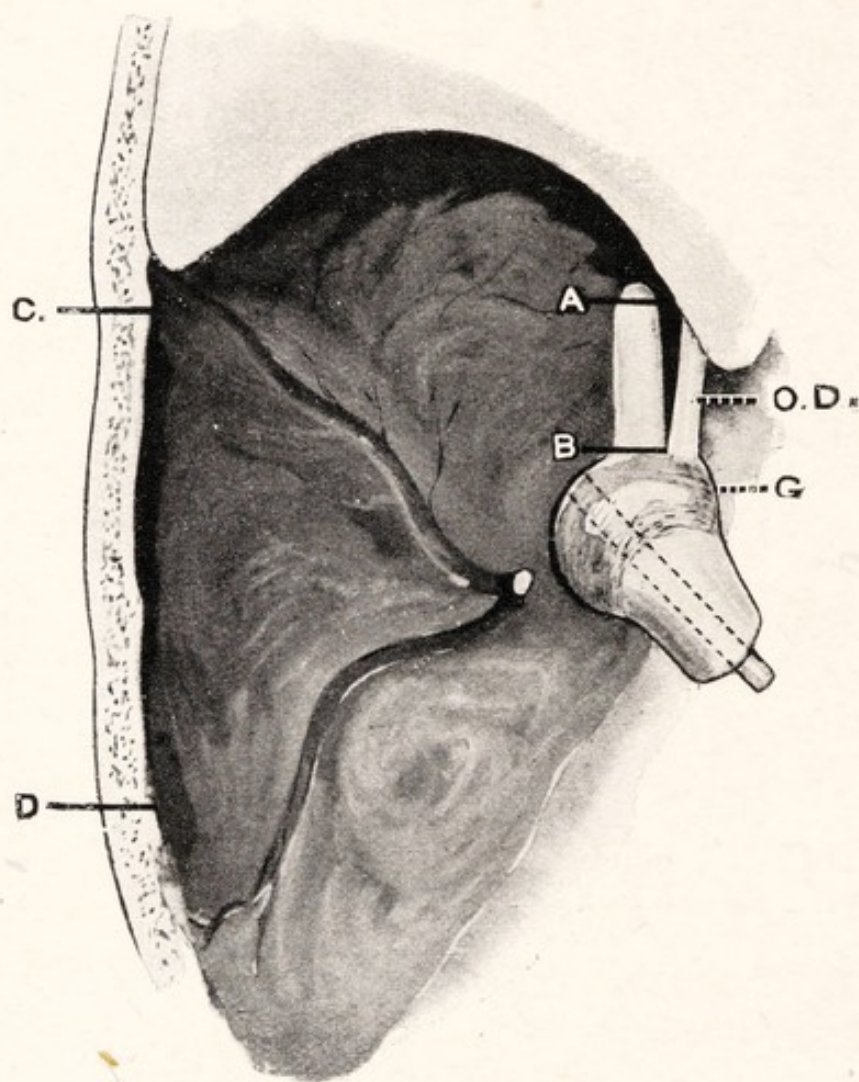


FIG. 19.

Left middle fossa of skull seen from above, showing the middle meningeal artery and the Gasserian ganglion (G.). O.D.—Ophthalmic division. A.B.—Superior maxillary trunk with lines of section. C.D.—Wall of temporal fossa to be cut through. The dura mater has been removed for the sake of clearness.

rotundum. Good results have been recorded from the latter method. But it is improbable that the nerve can thus be dealt with before it gives off the palatine and superior dental branches, and the writer therefore devised the following intracranial method of resection of the entire superior maxillary division *before it has given off any branches*. The writer performed this first in 1902, and has since done it in three other cases.

The late Mr. Stanley Boyd independently operated about the same date by a similar method, and doubtless other surgeons have done the same. It can be described in a few words, as the main details are identical with those for exposure of the Gasserian ganglion.

There is the same trephine aperture in the temporal fossa, the dura mater and temporosphenoidal lobe are lifted up in the same manner, but the operator works towards the foramen rotundum instead of towards the foramina spinosum and ovale. It may be possible to avoid ligation of the middle meningeal artery. When the superior maxillary nerve is defined it is followed back to the ganglion and as much excised as is practicable. As shown in fig. 19, about half an inch of the nerve is available for resection, the exact length varying in different subjects.

In all four of the cases referred to, the resection was carried out successfully, so as to render the cheek, upper jaw, &c., insensitive, and the neuralgia

disappeared. But in two of them recurrence of neuralgia in the area supplied by the third division, after an interval of a few years, compelled a resort to removal of the Gasserian ganglion. It should be noted that this was rendered much easier by the previous operation. In the other two cases sufficient time has not yet elapsed to enable one to judge the effect of the neurectomy. Resection of the superior maxillary division has the advantage over removal of the ganglion that the motor fibres are not involved, hence the masticatory muscles retain their power and there is absolutely no deformity of any kind. But as a curative operation it is certainly inferior.

We have now to consider the method of treatment of epileptiform neuralgia which offers the best prospect of a complete and lasting cure—namely, the excision of the whole or greater part of the Gasserian ganglion. The chief modifications of the operation that have been proposed, the difficulties and complications that may be met with, and the final results, will be treated in the following chapters.

CHAPTER VI.

OPERATIONS ON THE GASSERIAN GANGLION.

THE surgeon who first suggested in print the operation of removal of the Gasserian ganglion was Dr. Ewing Mears, of Philadelphia. In the *Transactions of the American Surgical Association* for 1884, he reported a case of neurectomy of the inferior dental nerve, and at the end of the paper wrote: "If in any case I believed . . . that the morbid condition had invaded the Gasserian ganglion, I would not hesitate to enlarge anteriorly the oval foramen, . . . and by traction draw down the ganglion . . . and proceed in a cautious manner to break it up or remove it by section with small blunt-pointed scissors."

It is plain that the operation proposed, which Dr. Mears had no opportunity of carrying out himself, was identical with Prof. Wm. Rose's pterygoid method which was first carried out in April, 1890, the case being published in the *Lancet*, November 1, 1890. This was the pioneer operation, and was followed next year, 1891, by Sir Victor Horsley's case of division of the roots above the ganglion. This case proved fatal from shock, and it appears that for many years this method was

not again attempted. In 1901 and 1902, however, Spiller and Frazier again brought it forward. It is far more difficult, dangerous, and uncertain than the extradural method. With regard to the work of W. Rose, although for various reasons his cases were not satisfactory and he gave up the operation, yet this English surgeon is entitled to great credit for having shown the way. The methods of Poirier and Cushing, whilst they involve less disfigurement of the face, are merely adaptations of Rose's original one.

In 1892 Dr. Frank Hartley,¹ of New York, and Professor Krause,² of Altona, independently devised the temporal method of reaching the ganglion, and it is only from this date, *i.e.*, twenty-seven years ago, that one can properly estimate the value of the intracranial operation for trigeminal neuralgia. In 1903, Prof. Krause was able to report that he had followed one of his earliest cases for nine and a half years, and that no recurrence had taken place. The writer has followed up many of his own cases with the same satisfactory result for a similar or longer period of years. Krause claims for his "first effective extirpation of the ganglion performed on January 31, 1893, that it was, undoubtedly, the first operation of the kind."

¹ Hartley, *New York Med. Journ.*, vol. lv, 1892, No. 12.

² Krause, *Deutsche med. Woch.*, 1893, No. 15, and a separate work, *Die Neuralgie des Trigeminus*, Leipzig, 1896.

On the other hand, Hartley made the same claim, and it is obvious that his paper had priority of publication over Krause's by one year.

It is a happy compromise to award equal credit to the English, American and German surgeons in the matter, and probably no impartial student of the subject will dispute this.

Professor Krause, in 1901, stated that he was convinced, after trial of the various modifications, his original method gave the best exposure of the ganglion. In a recently published monograph on the Surgery of the Brain (1914) Krause repeats his advocacy of the temporal method of access. With this conclusion the writer is heartily in accord. The temporal route affords free access, and whilst it is necessary to remove the bony floor of the fossa as far inwards as the infratemporal crest, there is no need to go further, as some surgeons recommend.

"After ligation and section of the middle meningeal artery, the second and third divisions of the fifth nerve are fully exposed by lifting up the detached dura mater, the third division is grasped and stretched by narrow curved forceps, whilst the dura is pushed gently off the ganglion itself until its roots are exposed; during this stage the cerebrospinal cavity is usually opened and the fluid escapes. The ganglion is then seized with Thiersch's forceps and drawn out, after section with a tenotome of the roots and the second and

third divisions." (Writer's translation.) Krause says nothing as to section of the ophthalmic or first division, but apparently this was torn or dragged away.

In Krause's book, "Die Neuralgie des Trigemini," he gives two photographs of ganglia removed by him, from which it would appear that the roots are dragged away from the pons varolii, but it does not appear that any of the ophthalmic division has been removed at the same time. It seems that he found it too dangerous to deal with this branch owing to its close relation with the cavernous sinus, but of course in all his cases, as in Sir Victor Horsley's, the ophthalmic division was permanently paralysed by the operation as its root was torn through. In the many figures given by Krause to illustrate the resultant anæsthesia the eyelids and forehead (and also of necessity the eye itself) are shown to be included.

Such is an outline of Prof. Krause's method, which is almost identical with Hartley's operation, and it has served as a model for the many surgeons who have followed them, many of whom have introduced more or less important modifications.

The method which the writer has employed in over sixty cases will now be described in detail:—

(1) *Preparation of the Patient.*—It is unnecessary to shave the whole of the scalp, especially in women who resent this extreme measure. It will suffice to shave that half of the head on which the operation

is to be performed, and to cover the remaining area with a rubber cap and sterilized towel securely fixed by safety pins. It is important for the patient to avoid long fasting before the operation, and a cup of good beef-tea may be taken three hours beforehand. The skin over the operation area should have been thoroughly cleansed with ether, &c., and treated with the following solution: bichloride of mercury 1 part, carbolic acid 25 parts, rectified spirit 500 parts. Or, if the operator prefers, the alcoholic solution of iodine so much in vogue may be used instead of this. The temporal region is a remarkably easy one to render aseptic, and in only one solitary case in the writer's experience has there been the least failure in this respect.¹ Considering the length of the operation this fact is noteworthy. Of course care should be taken not to allow any antiseptic solution to run into the ear or on to the conjunctiva, and the external auditory meatus should be lightly plugged with gauze to prevent blood entering it during the operation. The best anæsthetic is probably the A.C.E. mixture, or one of chloroform and ether without the alcohol.

(2) *The Instruments, &c., required.*—A dentist's chair with suitable head-rest is strongly advised,

¹ This patient was extremely restless and excitable after coming round from the anæsthetic, and continued to be so all the next night. His dressing became displaced, and it is at least possible that the septic infection, which led to fatal meningitis, was due to the post-operative conditions. In no other case has the writer seen any failure in securing asepsis after the operation.

though some surgeons use the ordinary operating table. In the latter case, the shoulders and head should be raised as much as possible. The writer has invariably operated with the patient in the sitting posture in the dental chair. Its advantages are many. The head is less likely to become congested, and the importance of avoiding this is great. The base of the skull can be approached

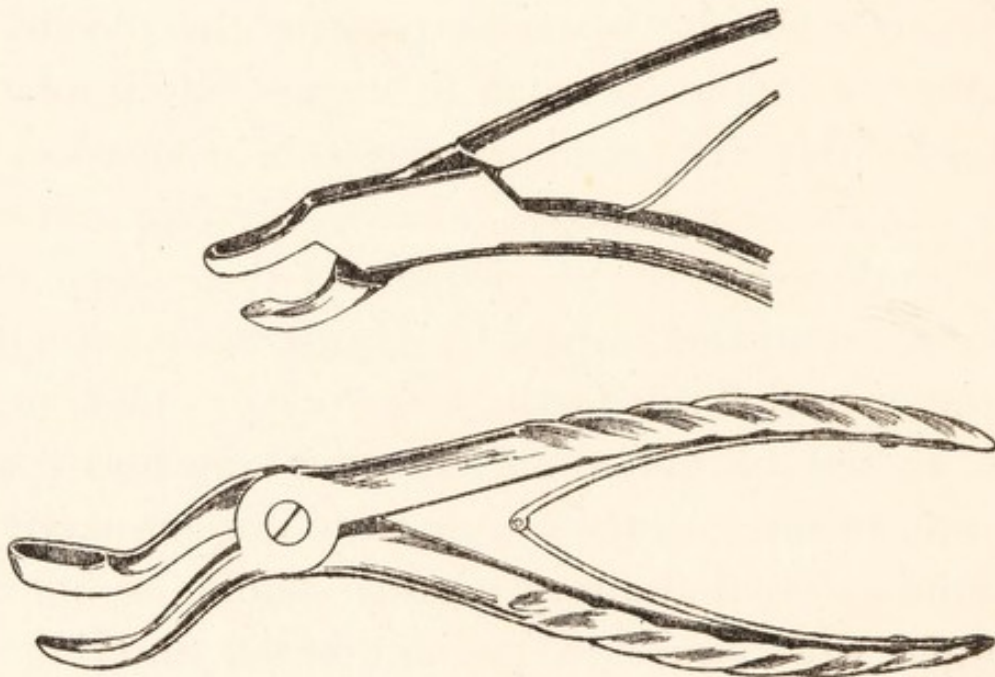


FIG. 20.

Two forms of Hoffmann's rongeur or cutting forceps for enlarging the aperture in the cranium. (Half-size).

in an easy position for the operator's work, whereas if the patient is recumbent the surgeon will have to lean over continually to one side. The dental chair can be raised to any desired level, and at the best the operation will be found sufficiently fatiguing to both operator and assistants. It might be thought that some difficulty would be experienced with regard

to anæsthetising the patient in the sitting posture. With a skilled administrator this is never the case.¹ In the rare cases where signs of temporary syncope appear it is easy to bring the patient into the horizontal position for a time by tilting the chair. The surgeon should, of course, make himself familiar

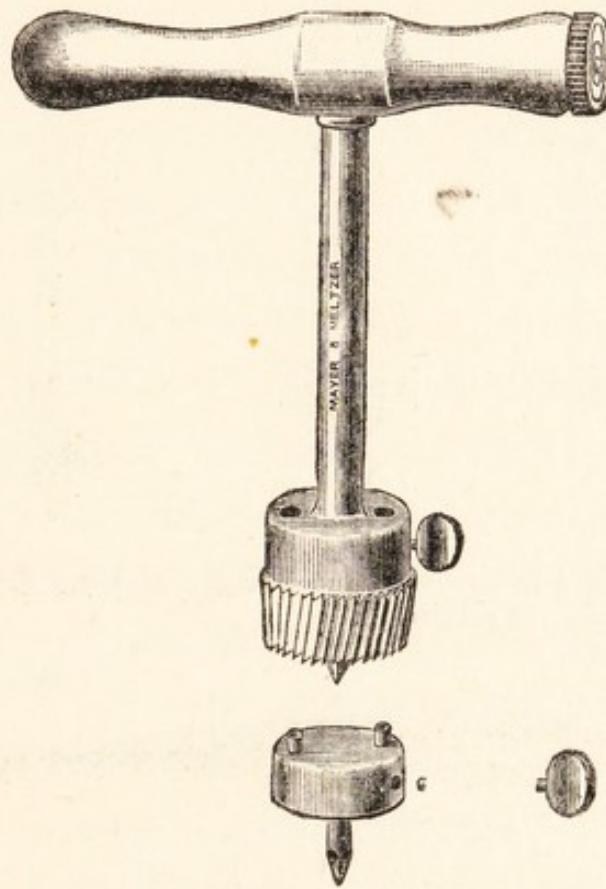


FIG. 21.

Trephine with detachable centre-bit and conical rim. A convenient size is 1 in. diameter, twice that shown in the figure.

with the mechanism of the dental chair before commencing the operation.

A good-sized trephine is required with a diameter of one inch and a quarter; *electric*

¹ I have been much indebted to Dr. Austin Cooper and Mr. Ashley Daly for their care and skill during these often tedious operations.

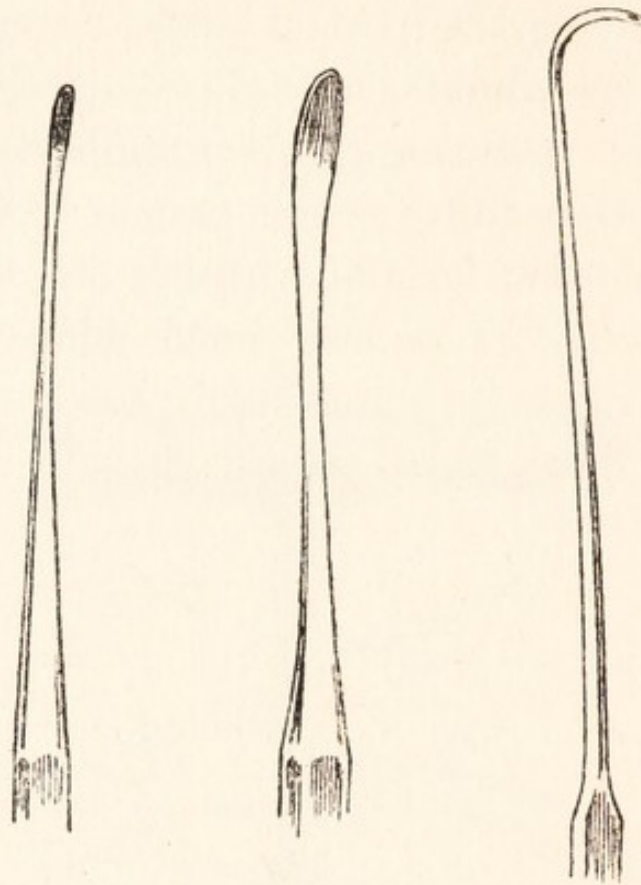


FIG. 22.

Aneurism needle with fine end, and two elevators for detaching the dura mater from the skull. (Full size.)

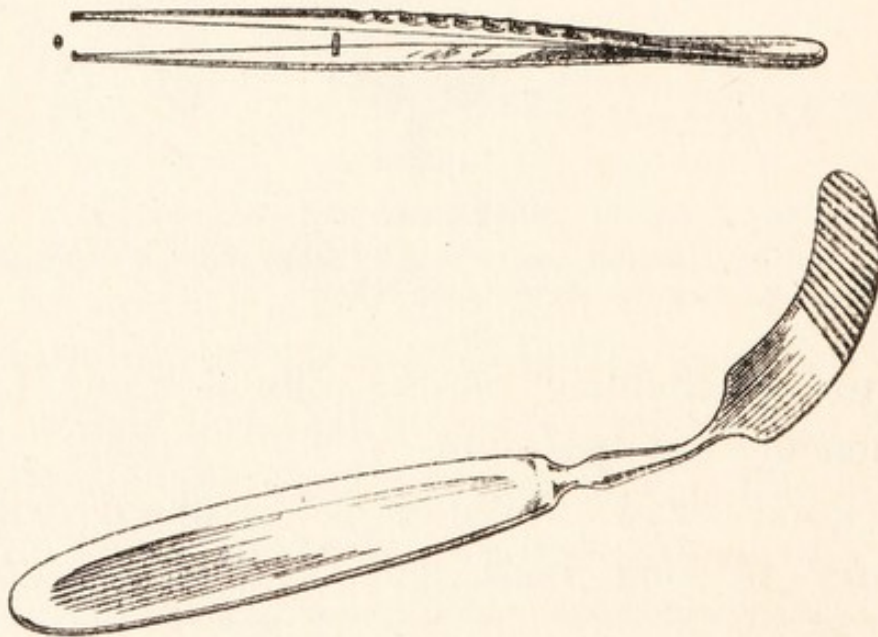


FIG. 23.

Fine-toothed forceps and flexible metal retractor (Krause's form). (Both half natural size.)

head-lamp; two blunt-ended dissectors for use in detaching the dura mater (fig. 22); Hoffmann's bone-cutting forceps for enlarging the trephine hole (fig. 20); two flexible, broad, metal retractors of different width for lifting the dura mater and brain (fig. 23); two aneurism needles, smaller and more curved than the usual pattern (fig. 22); fine-toothed forceps (fig. 23); two or more special knives for use in the neurectomy. These last are as indispensable as the head-lamp and the special retractor. The lamp should be thoroughly tested before commencing the operation. The knives are small and must be blunt-pointed, one should be curved or sickle-shaped, another straight. They are similar to tenotomes with blunt ends.

Small sponge-holding forceps are used with soft Turkey sponge. The other instruments are such as are required for every surgical operation. It is essential to use fine sponge and not gauze pads. The sponge is cut in inch, and half-inch, squares, and it is the duty of one nurse or assistant to keep the operator constantly supplied with these small sponges well wrung out of warm sterile water. The retractor is one of the most important

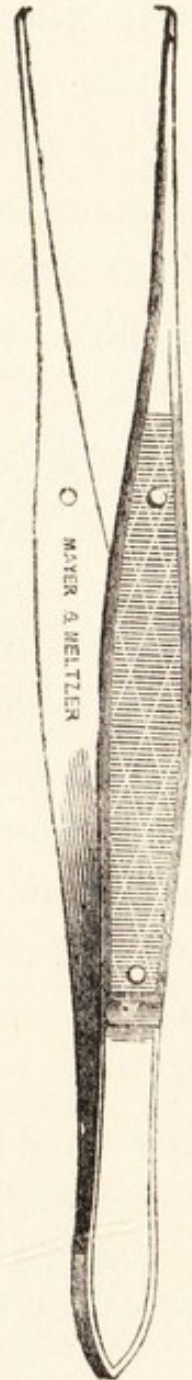


FIG. 24.

instruments used in the operation, its special feature being that the blade must be flexible. The handle should be stiff, broad, and fairly short, so that the assistant can keep a steady grip of it. The angle required between blade and handle varies at different stages of the operation, and a stiff blade will be liable to cause injurious pressure on the brain; hence flexibility is essential.

(3) An oval flap is outlined by the scalpel, having its base at the zygoma, its upper end one inch and a half above this level, and its posterior border running towards the condyle of the lower jaw. The whole of the flap should be made inside the hairy scalp,¹ as the scar will be subsequently concealed by the growth of the hair (figs. 25 and 36).

The scalpel is now made to cut right to the bone, and the flap (including the temporal muscle and the pericranium) is at once reflected downwards by means of an elevator. The severed branches of the temporal artery are secured with Wells' forceps, and after torsion by means of these forceps every bleeding vessel should be ligatured. A suture of silkworm gut is passed through the flap, its two

¹ The disfigurement left after some of the methods of operation may be inferred from illustrations that have been published elsewhere. It may be argued that an extensive scar on the face is a small matter if it has enabled the surgeon to obtain proper access to the ganglion, but as it is perfectly easy to secure this through an incision placed wholly within the margin of the hairy scalp there is no reason for adopting any other. Refer to fig. 33, opposite p. 158.

ends held in Wells' forceps, and thus retraction downwards of the flap (including the temporal muscle) secured.

The pin of the trephine is now inserted midway between the external auditory meatus (its upper

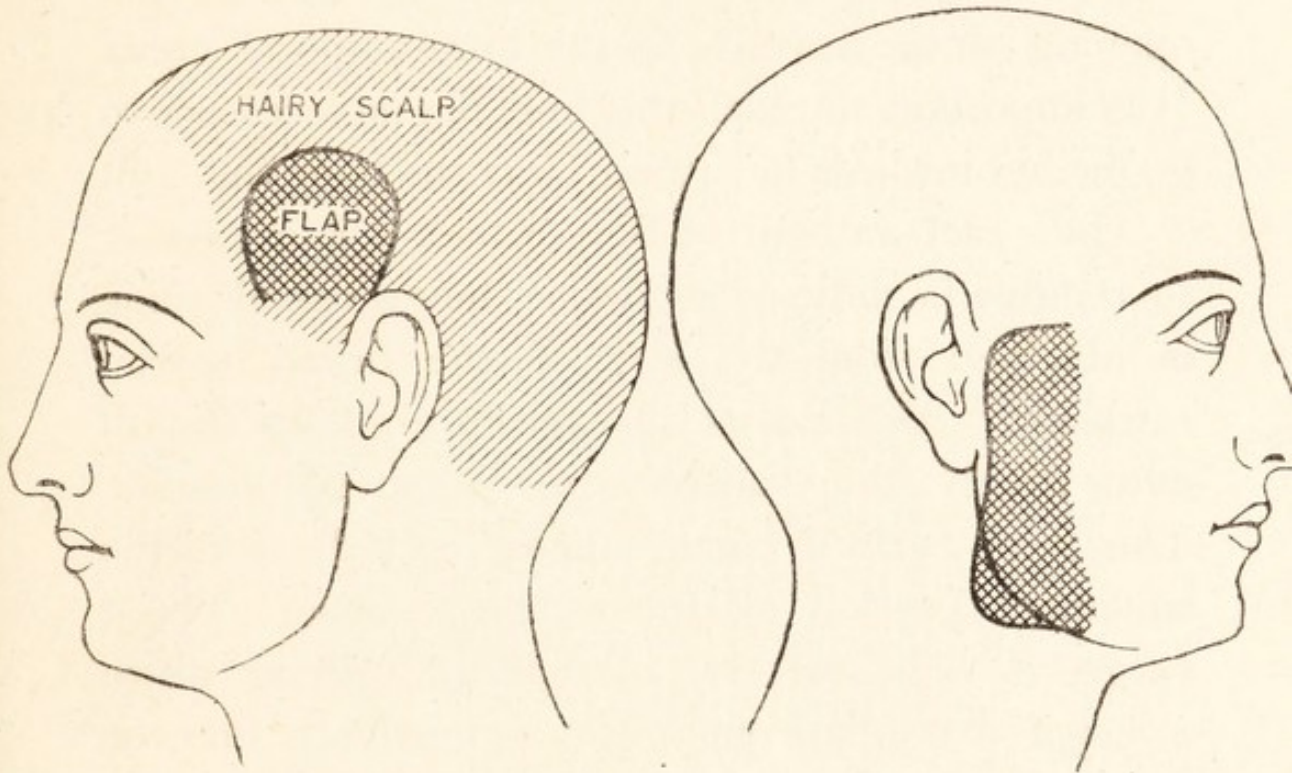


FIG. 25.

Outline of horseshoe flap shown in left-hand figure. On the right-hand figure the facial incision for Rose's pterygoid operation is shown (this is, of course, a wholly obsolete method now).

border) and the external angular process of the frontal bone, and, with every precaution, the disc of bone is cut and removed. It is important not to damage the dura mater or the anterior branch of the meningeal artery with the trephine, and as the operator deepens the groove with his trephine he tests its depth frequently with the blunt dissector. It should be remembered that the thickness of the

bone in this region varies much in different individuals, and will do so at different points of the circle trephined. With a blunt elevator the dura is now carefully detached inwards all round the aperture, but especially at its lower margin.

The rongeur forceps are used to enlarge the opening as far inwards as the infratemporal crest. It is important to reach this line, but unnecessary to go further inwards in cutting away the bone (fig. 26).

The exact amount of bone which it is necessary to remove is difficult to define, but a useful guide is obtained from the size of the broad special retractor. As soon as the aperture allows this to enter freely the surgeon has removed enough. The bone excised comes almost entirely from the squamous portion of the temporal bone. Those surgeons who use the method of turning down a large bone-flap encroach extensively on the parietal bone, but nothing is gained by this procedure (which is discussed on p. 139).

The first stage of the operation is now completed so far as all bone-cutting is required. Hence the larger instruments used in this (trephines, rongeurs, &c.), are put aside; the instrument dish being reserved only for the special elevators or knives, aneurism needles, forceps, &c. At the same time the operator has his head-lamp put on and adjusted so that good illumination may be thrown into the depth of the wound. Even on the brightest days it is rarely possible to dispense

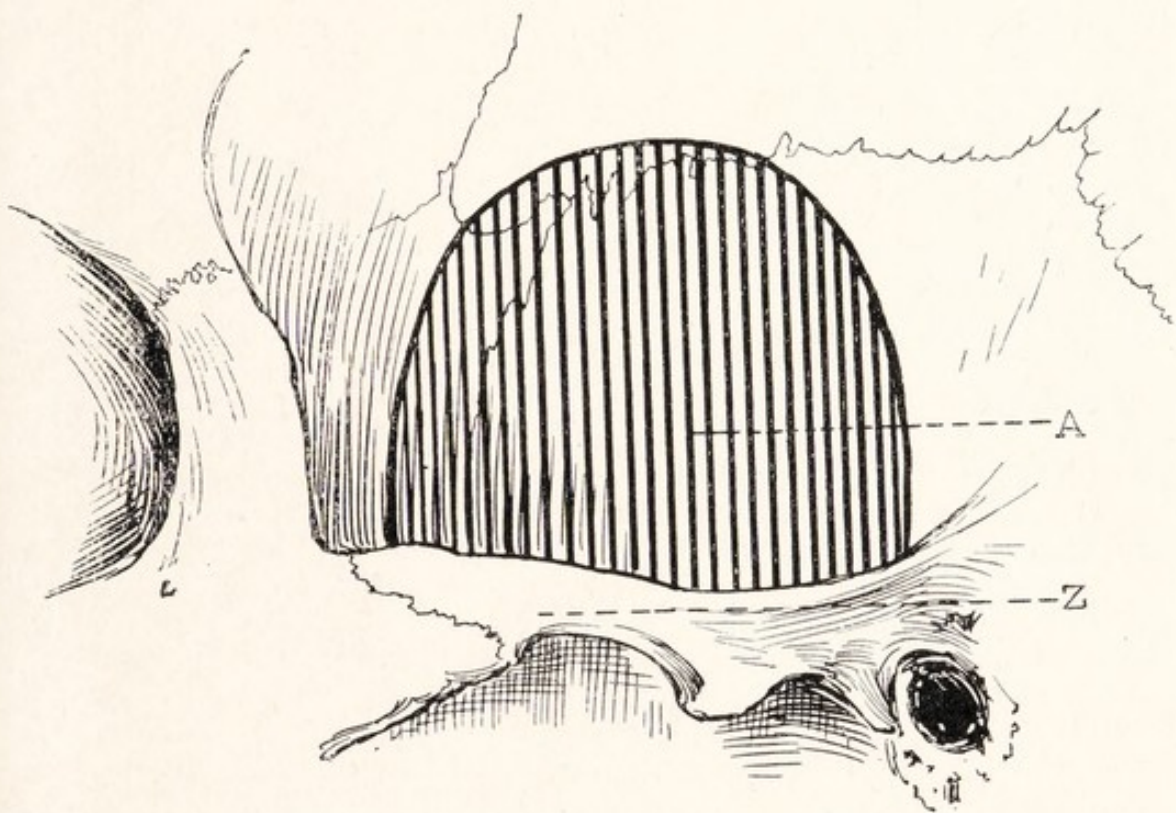


FIG. 26.

The bony floor of the temporal fossa. A (shaded area) represents the part cut away in the Hartley-Krause operation. Z.—The zygoma.

with the electric head-lamp during the later stage of this operation, and the operator should never trust to be able to do so.

The next step is to make for the foramina spinosum and ovale by continual detachment of

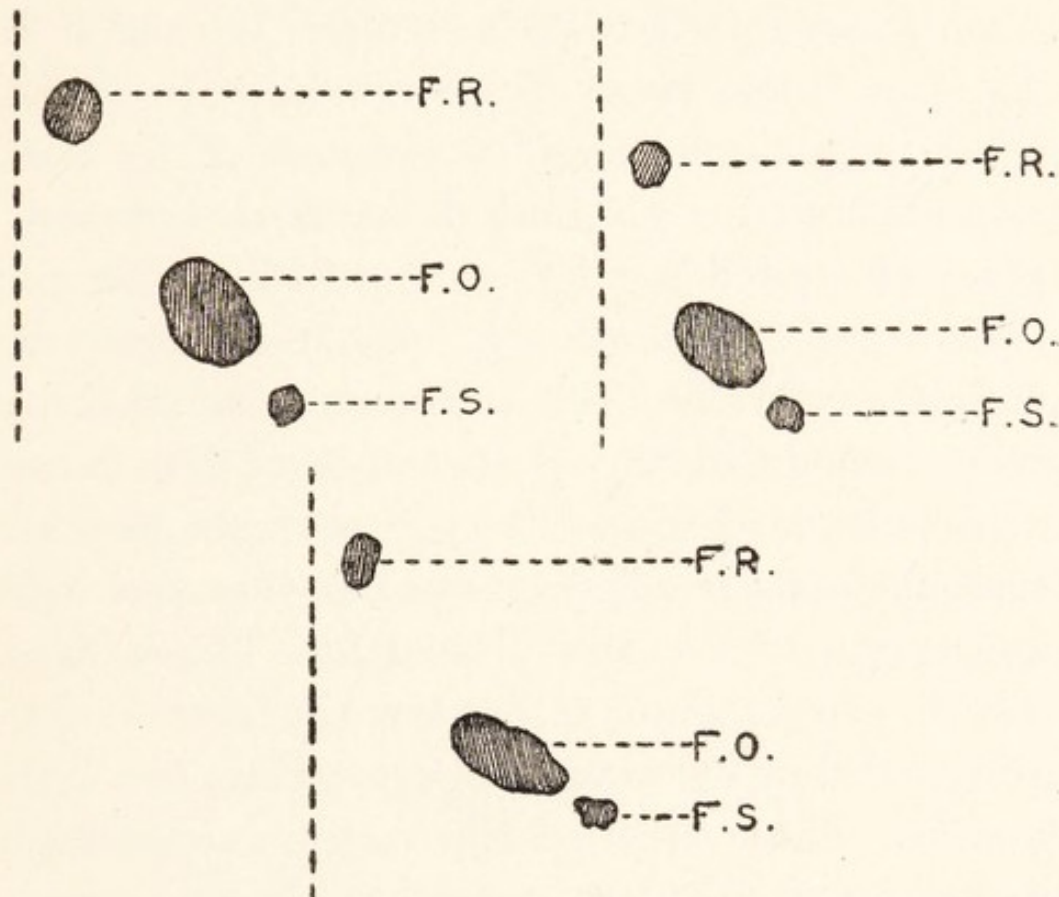


FIG. 27.

The relative positions of the three openings in the base of the skull in different subjects. F.R.—Foramen rotundum. F.O.—Foramen ovale. F.S.—Foramen spinosum. Note the variation with regard to the antero-posterior plane (dotted line), and the different sizes of the apertures. These were selected from the examination of many adult skulls as representing the chief variations that are to be met with.

the dura from the floor of the middle fossa and its elevation by the retractor.¹ A useful land-

¹ For the reasons given on page 3, the operator should carefully avoid detaching the dura mater from the region of the hiatus Fallopii, *i.e.*, too far back on the upper surface of the petrous bone.

mark for the foramen is the preglenoid tubercle on the zygoma. It is almost certain that the point of entrance of the meningeal artery (the foramen spinosum) will be reached first; it lies from 1 to 1.5 millimetres behind, and a little to the outer side of, the inferior maxillary division (see F.O. and F.S. in fig. 3, p. 8, and upper diagram on p. 12).

There is a certain range of variation in the size, shape, and relative position of the three foramina, a point illustrated by fig. 5, p. 12, in which the openings are drawn exactly the natural size.

As soon as the foramen spinosum is reached the middle meningeal artery in its sheath of dura mater should be isolated so that the operator can pass his special aneurism needle (see fig. 22), threaded with a long piece of fine silk, around it. The loop of thread is caught with the forceps, the needle withdrawn, and thus the artery is encircled by two long ligatures. These are tied separately and securely, and the artery divided *above* them both. Sometimes the operator may succeed in dividing the artery between the ligatures, and theoretically this is the best course to adopt. But in practice I have found the latter often impracticable, and the proximal end is the important one to secure. The distal end may be secured later, if desired, by Wells' forceps and a separate ligature.

Although it is sometimes possible to expose the Gasserian ganglion without tying the meningeal artery, this is rarely the case, and the ligature

should be regarded as a routine (and a somewhat difficult) step in the operation. Should the ligatures slip off the artery after its division, and with every care this *may* occur, the foramen spinosum should be plugged with a spicule of bone.

The next step is to define the inferior maxillary trunk as it enters the foramen ovale.

A variable amount of hæmorrhage will have occurred so far from a number of small veins and arteries, and it must be controlled by pressure with small pieces of sponge on holders, and by waiting until it ceases. After the white trunk of the inferior maxillary nerve has been exposed, the foramen rotundum—from 15 to 20 millimetres in front of the foramen ovale—is sought for, and, ultimately the whole superior maxillary division exposed. There must be no undue haste, a few minutes' pause whilst sponge-pressure is applied being of much use, and a strong light must assist the operator's work. Above all, it is essential that the assistant who uses the retractor must be light-handed; the less the pressure upon the temporo-sphenoidal lobe of the brain the better. The assistant should relax the upward pressure from time to time, when the operator is not actually working, either by letting the retractor blade rest against the cranial floor or by withdrawing the retractor. The operator himself will manipulate the retractor with his left hand whilst working with the right during most of the time, but at the most

critical stage of the operation he must rely on his assistant to retract. If one only had the many hands of an Indian god!

Now comes the most difficult part of the operation, the exposure of the Gasserian ganglion, which it is useless to attempt until the bleeding has practically stopped. With the "fine elevator" the thin dural sheath is carefully detached in an upward and backward direction, following the two main nerve trunks (see fig. 28).

It will be understood that the upper layer of the ganglion sheath is alone detached; its adhesion is always close, and cerebrospinal fluid often escapes from a small puncture. This is of no great importance. When the ganglion has been thoroughly exposed, so that the section indicated by the dotted line in fig. 28 can be made, *and not before this*, the superior and inferior maxillary divisions are cut cleanly across just at the foramina ovale and rotundum. The only suitable knife for this purpose is one of the very small blunt-ended ones already described. The ganglion being firmly held by the toothed forceps is now divided high up, as shown in figs. 28 and 31, the ophthalmic division is left intact. The exact order of section to be advised is a matter of some doubt. The third division should, I think, be the first to be cut (as this is done twitching of the masseter muscle is almost always noticed). It is then convenient to make the horizontal section through the upper part of the

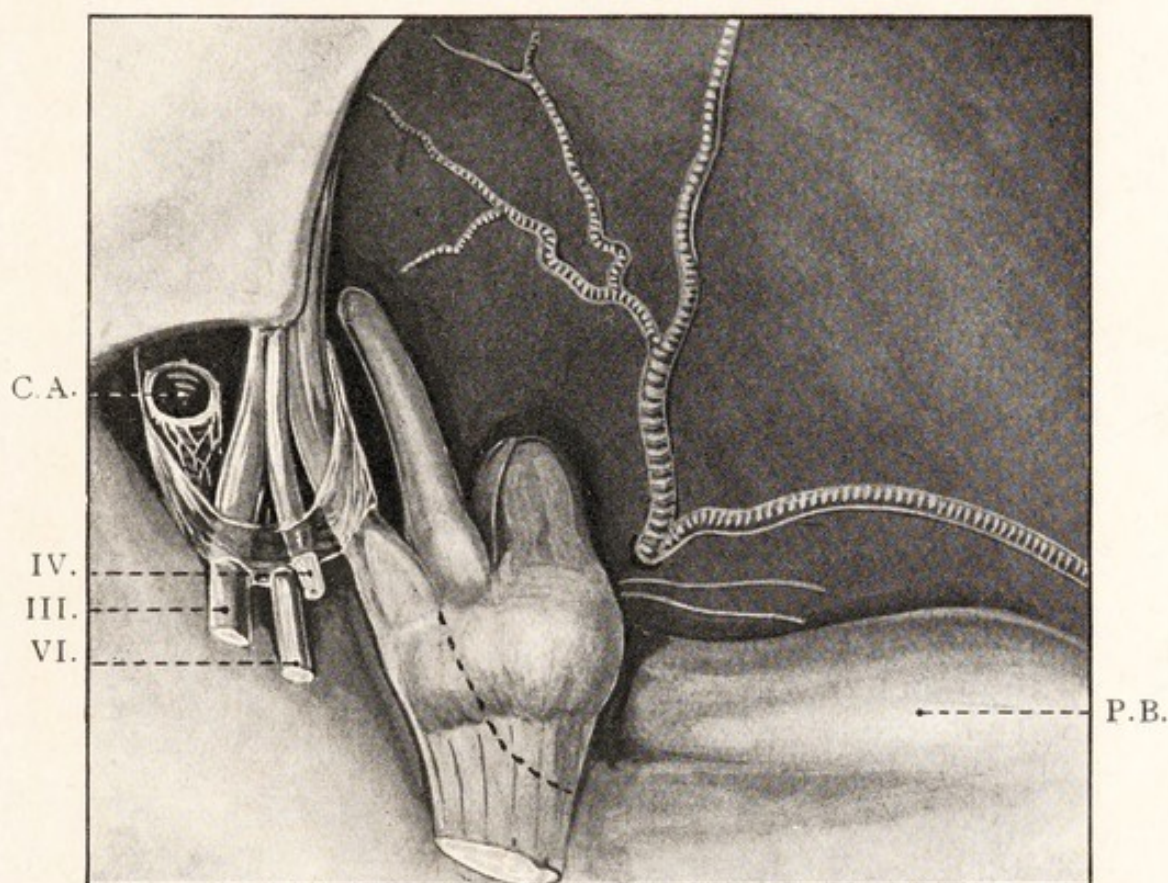


FIG. 28.

The cavernous sinus and Gasserian ganglion seen from above. P.B.—The petrous bone. C.A.—Carotid artery. III., IV. and VI.—The oculo-motor nerves showing their relation to the ophthalmic division of the fifth nerve. The relative position of the middle meningeal artery and the inferior maxillary nerve is shown. The dotted line crossing the Gasserian ganglion represents the section advised in removing the latter, together with the superior and inferior maxillary trunks. (From a model in the London Hospital Museum.)

ganglion, and finally that of the second division. The ganglion is now removed. The hæmorrhage is sure to increase at this point, but all difficulty is over and the retractor pressure should at once be left off. *On no account should the wound be forcibly plugged with sponge or gauze.* A sterilized solution of adrenalin may be of use, the minute pieces of sponge being dipped in it.

Patience and a good light are the chief essentials

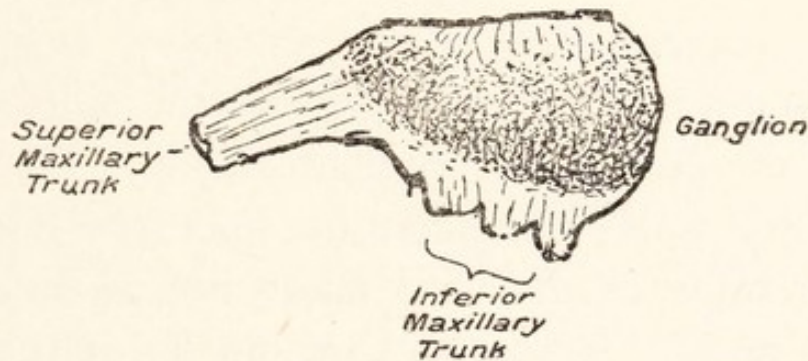


FIG. 29.

Exact drawing, magnified two diam., of Gasserian ganglion removed by operation, showing how the ophthalmic trunk is spared deliberately.

for a proper section and removal of the ganglion; the operator must see exactly what he is cutting, and must remember the close proximity of the cavernous sinus.

The patient's head is now turned a little on the side so that blood can run out easily, one or two small rubber drainage tubes¹ are inserted, and the flap sewn in place; no bone is replaced. A dressing of sterile gauze is then secured firmly to

¹ I have often used the spiral rubber drains, but if there is considerable tendency to ooze, the ordinary ones are preferable.

the head with a muslin bandage ; the tubes should be removed next day.

The reader will pardon emphasis being laid on two points which are most important if success is to be obtained in the operation. The first is the *upright sitting position of the patient*, which in no way interferes with the anæsthetic, whilst it diminishes hæmorrhage and places the base of the skull in the most convenient position for the operator. The second is the *danger of attempting to hurry over the various steps of the operation*, to get the ganglion out in record time or with the more worthy motive of sparing the patient shock. The writer has several times completed the operation under the hour, in some cases it has taken him twice as long or even more. Professor Cushing, I believe, takes two hours to two and a half as a rule. But even if two hours should be required, this does not exceed the duration of certain other major operations, which are not of necessity followed by severe shock. Probably an hour is the shortest time which will be required for the average case, free from complications and done carefully.

After-treatment.—If the patient has been addicted to morphia until just before the operation, it is sometimes advisable to give a hypodermic injection on the night following it.¹ In most of my cases shock has been conspicuously absent, the patient

¹ It is, of course, very important to guard against the patient being restless during the next twenty-four hours. See footnote to p. 121 for a case fatal from this cause.

being able to sit up in bed on the day following the operation. The wound has, in every case, healed by first intention.¹ Suppuration would be, of course, a most dangerous complication, and hence the most sedulous care should be taken in previous disinfection of the scalp, and in all aseptic details of the operation.

Various points in connection with the operation and its modifications require notice. The following are the chief ones :—

(I) *In Exceptional Cases should the Operation be done in Two Stages?*

The long duration of the operation in some cases has naturally led some surgeons to divide it into two stages, separated by a few days' interval. Severe hæmorrhage during the exposure of the ganglion *may* necessitate this course, but in Krause's opinion the operation should be completed in one stage if possible. The risk of failure to procure asepsis is thereby diminished, and the patient spared the shock of two operations and a double anæsthetic. Codivilla, in one case, met with such hæmorrhage from the meningeal artery, that he was obliged to plug the wound, and postpone the conclusion of the operation for three days. On the second occasion the bleeding was again severe, but, fortunately, the operation was brought to a

¹ See note to page 121.

successful issue. It is not only arterial but venous hæmorrhage that may be so severe as to compel the operator to postpone the completion of the operation. Of this Mugnai records an example. Plugging the cavity with gauze or sponge appears to be attended with special risk; the pressure on the brain may cause aphasia or other paralytic symptoms, and the risk of sepsis is certainly much increased.

The answer to the question proposed above therefore is that in practically all cases the operation should be completed at one sitting, but that when exceptional difficulty arises from hæmorrhage in exposing the ganglion, it may be wise to defer its completion for a few days. This course has only been necessary in one of the writer's series of over sixty cases, and that one of the earliest. It will, therefore, be inferred that the operation can be completed at one sitting in practically every case.

(II) *The Section of the Skull.*

With regard to the exact amount of bone divided or removed, a great deal of misplaced ingenuity has been expended, and the long descriptions by various surgeons of "their own methods of operating" only cause annoying and useless confusion in the reader's mind. For example, "Sapersko's method" includes ligature of the common carotid artery (with grave risk of hemiplegia), and division of each end of the zygoma (with the

chance of necrosis—and, in any case, unnecessary). “Doyen’s operation” included an extravagant skin incision, which passed for some inches *on to the face*; division of the zygoma and coronoid process; removal of the skull-wall as far inwards as the foramen ovale—in fact, an increase in the severity of the operation which had no compensating feature. Of Doyen’s three cases reported, two were fatal as a direct result of the operation—a sufficient condemnation in itself.

It is unnecessary to describe the so-called “Quénu’s operation,” and the height of absurdity is reached by such terms as the “Doyen-Quénu-Sébileau-Poirier method,” which is gravely referred to by another French writer on the subject. There is a lack of humour in some surgical authors.

Division of the zygoma has been employed by many surgeons as an aid to the free removal of bone from the side of the skull; it must be quite exceptional for this to be necessary. Prof. Cushing,¹ of Baltimore, advocates the following method.

The usual horse-shoe flap, with its base at the zygoma, is turned down; the zygoma is divided at each end, and also reflected with the masseter muscle. The great wing of the sphenoid and the temporal bone is then cleared as low as the origin of the external pterygoid muscle. A small orifice

¹ Cushing, *Journ. Amer. Med. Assoc.*, April 28, 1900, p. 1035.

is then made in the most prominent part of the sphenoid wing, the opening being enlarged with the cutting forceps until it is three centimetres in diameter. The dura mater being detached and pushed upwards, the surgeon works inwards and backwards so as to expose the foramen rotundum and ovale. Cushing advocates removal of the entire ganglion with the ophthalmic division. The zygoma is subsequently fixed in place (fig. 30).

Cushing's method, it will be seen, is in some respects a reversion to Rose's original operation, in that the opening in the skull is made low down, and the zygoma is divided. He claimed for it two advantages over the Hartley-Krause method ; first, a more direct access to the ganglion, and secondly, the avoidance of the middle meningeal artery. The division of the zygoma is a distinct drawback, and, in addition, the coronoid process of the lower jaw comes in the way. Prof. Cushing claims, however, that if the zygoma sinks inwards the slight deformity caused by wasting of the temporal muscle is thereby lessened—the bone does not stand out so prominently as after the Hartley-Krause operation. There does not seem to be anything in this contention. As regards the meningeal artery I understand that Cushing as a rule secures it, in fact, as already pointed out, unless this is done the dura mater can rarely be raised enough to allow good exposure of the ganglion. The complete removal of the latter, with the ophthalmic division which Prof. Cushing

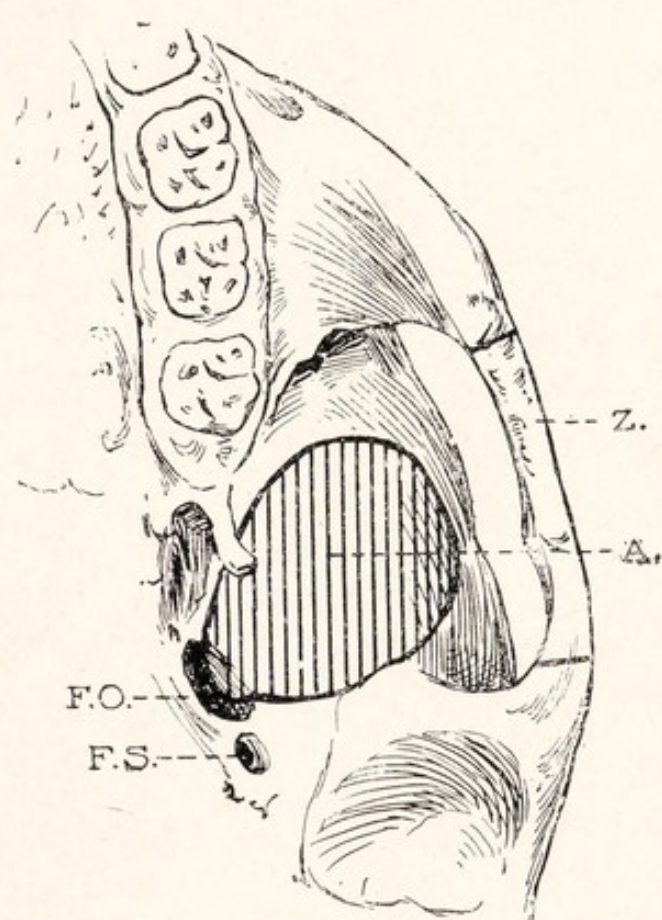


FIG. 30.

Z.—The zygoma. F.O.—Foramen ovale. F.S.—Foramen spinosum. A (shaded area) represents the part of bone cut away in Cushing's or Poirier's operation.

employs, is undesirable, as it may result in damage to or even loss of the eye on that side.

In all essentials what has been described as Cushing's method is identical with the late Prof. Poirier's procedure, details of which were published three years before,¹ *i.e.*, in 1897. There is the same oval flap, the same division and downward displacement of zygoma, section of temporal muscle and detachment of external pterygoid, exposure of foramen ovale, trephining of bone forming the roof of the zygomatic fossa, and removal of the whole ganglion. The only possible difference that the student of the two descriptions will find is that Poirier removes rather more bone, thus giving better access to the ganglion. It was doubtless by oversight that Prof. Cushing and the late Prof. Kocher (who wrote of the former's modification as original, and constituting a great improvement) do not mention Poirier's work.

(III) *The Osteoplastic Method.*

Many surgeons have turned down a quadrangular flap of bone with the soft tissues instead of trephining. This method necessitates making four small apertures in the bone to correspond with each angle of the flap; the sides may be divided with

¹ Poirier's method is figured and described in detail in Chipault, *Chir. Nerveuse*, vol. i, pp. 394-398. It was published before this in the *Trav. Neur. Chir. Chip.*, 1897, ii, p. 213.

a chisel or cut entirely from within outwards by means of a fine Gigli's saw. The advantage of replacing the bone, if as described only a moderate amount is removed, may well be questioned. I have never known the slightest complaint made by the patient with regard to the supposed weak spot. On the other hand, if a large osteoplastic flap is made, more free access to the middle fossa is possibly secured than by trephining. This is the sole advantage that can be claimed.

The following points may be urged against the method:—

(1) In the manipulations carried out with the drill or small trephine, the chisel, and the saw, and in the necessary detachment of the dura mater, the latter is extremely apt to be torn and bruised.

(2) The middle meningeal branches are easily damaged¹ and will give considerable trouble; many cases of this could be quoted.

(3) Even more serious damage may be done to the brain; thus, W. W. Keen, in perforating the skull with a Cryer's drill, experienced free hæmorrhage "from a branch of the middle cerebral artery" and an extensive clot formed. The patient was hemiplegic after the operation, and died on the third day.

¹ E.g., cases recorded by S. P. Weeks, *Trans. Amer. Surg. Assoc.*, 1897, p. 171, and W. W. Keen, *Amer. Journ Med. Sci.*, 1896, cxi, p. 68.

(4) The flap is decidedly in the way during the later stages of the operation.

(5) After all his time and trouble spent in turning down the flap of bone, the operator may decide that it is unsafe to replace it, owing to separation of the pericranium,¹ or other cause.

(6) Probably the replaced bone will survive, but this is not certain, and its necrosis is a most dangerous complication, as septic meningitis is almost inevitable.

For the above reasons it appears best not to employ the osteoplastic flap, though the surgeon's predilections must decide this. Should it be used, the greatest care should be taken in detaching the dura mater so as not to tear the meningeal artery, and the chisel alone should certainly not be used for the entire section of the bone. All forms of electric drills and cutters are unsafe as being difficult to control and apt to slip through the dura mater into the brain. Professor Krause uses Doyen's perforator to make two openings at the upper angles of the flap; with Dahlgren's cutting forceps he then completes the upper section and also divides the bone down to the level of the zygoma. A spatula being passed between the bone and dura, the former is grasped by forceps and bent downwards so as to fracture it transversely, opposite the zygoma. With

¹ As in a case operated on by J. Raum, in 1897, quoted in Chipault's *Chir. Nerveuse*, vol. ii, p. 192.

cutting forceps the portion of squamous bone and great wing of the sphenoid, between the line of fracture and the infratemporal crest, is then excised bit by bit. Krause points out that it is essential to remove the bone as far inwards as the crest, but unnecessary to go further. "As to resection of the zygoma, it is absolutely useless." Chipault, however, writing in 1904, said that, in France, all operators on the Gasserian ganglion then employed some method involving division of the zygoma, and that the simple temporal route finds no advocates there. It is of special interest to note that Chipault spoke of the mortality of operations on the ganglion as being enormous!¹

Extended experience has confirmed the writer's belief that the best method is to cut an aperture in the bone about the size of the skin-flap (as shown in fig. 18) and not to attempt to replace any of it. If this gives sufficient access to the ganglion, which it assuredly does, there can be no reason for more extensive measures.

(IV) *Plugging the Foramina Rotundum and Ovale.*

Dr. Robert Abbe² pointed out that the mortality following the operations on the Gasserian ganglion had been needlessly high, owing to the assumed

¹ Chipault, *Etat Actuel de la Chir. Nerveuse*, 1904, vol. ii, p. 404.

² *Annals of Surgery*, 1903.

necessity for removal of the whole ganglion. He urged that there is no need for removal of the ophthalmic division in the great majority of cases, and he thought that section of the second and third divisions, with the interposition of a small piece of sterile rubber between the dura mater and the foramina rotundum and ovale, will suffice to obtain a cure. The object of the insertion of the rubber disc, which is of course left *in situ*, is to prevent reunion between the nerves and the ganglion. He urged that the method is simple, speedy, and safe. It may be noted that Chipault, in France, had independently tried the method of plugging the foramina with dental amalgam, with the view of intimidating the fifth nerve.

With regard to Abbe's contention, the writer heartily agrees in limiting the interference to the lower part of the ganglion, with its second and third divisions. By this means the mortality from shock will be lessened, as well as the danger of injuring the cavernous sinus and the oculomotor nerves. It must be understood that Dr. Abbe does not remove the ganglion—he divides the two nerve-trunks close to the foramina and then plugs both these with rubber (or gold-foil). As a very striking case in the Appendix of this work will show, section alone beyond the ganglion is a bad operation, for the nerves will join up and return of the neuralgia may occur within a year. Does the interposition of rubber convert a bad operation into a good one?

I do not personally think that is proved, although the method has the support of two such authorities as Dr. Abbe and Sir C. A. Ballance. Before giving reasons for this contention, the following valuable statement by Sir C. A. Ballance¹ should be carefully considered :—

“Dr. Robert Abbe, of New York, who was a pioneer of intracranial neurectomy without interfering with the ganglion, thought that an exceedingly good operation, and Mr. Ballance agreed with him. In three or four of Dr. Abbe's cases pain returned at the end of five years. Dr. Abbe's operation consisted in removal of a portion of the second and third divisions of the fifth, perhaps half an inch of the second division, and then filling the foramen rotundum and the foramen ovale with a solution of india-rubber made liquid by heat. It was a very important matter that in the cases in which pain had recurred it had not returned in the area supplied by the first division of the fifth. This showed that it was unnecessary in a further operation to interfere with the ganglion. The ganglion operation was an intradural one,² which was obviously more risky than an extradural intracranial neurectomy, and if the whole ganglion was removed ulceration of the cornea might ensue. Therefore an intradural

¹ *Proc. Roy. Soc. Med. (Clin. Sec.)*, November 8, 1907.

² This is a mistake. The excision of the ganglion as described by the writer is just as much an extradural operation as Abbe's method.

operation should, if possible, be avoided. In Dr. Abbe's cases in which the pain returned he opened up the flap again, and by careful dissection was able to see tiny filaments of nerve joining the proximal and distal ends of the second and third divisions, so that through or by the side of the rubber plugs the nerve filaments had partly joined together the divided ends of the second and third divisions. The filaments of nerve were divided and the openings in the base of the skull refilled with solution of india-rubber, after which there had been no second return of pain. At the beginning of this year Mr. Ballance had seen a case in which, four and a half years previously, he had performed intracranial neurectomy of the second and third divisions of the fifth for epileptiform neuralgia. The pain had returned in the third division. The flap was reopened, and, following Dr. Abbe's plan, he divided what he thought to be the tiny filaments of nerve coming through the foramen rotundum and foramen ovale, which he had filled with gold leaf. The pain was immediately relieved, and he thought that even if pain did return every five years, it was a safer and better operation to do a neurectomy of the tiny filaments which sometimes joined together the divided ends of the second and third divisions of the fifth nerve rather than to open the intradural space and remove the lower half of the ganglion."

It is worth noting that Abbe considers a vertical incision over the temporal fossa affords, with strong

retraction, as good access as does the usual one employed, and that he regards preliminary ligature of the external carotid artery as being of advantage in controlling hæmorrhage. He believes that in epileptiform neuralgia there is a neuritis in front of the ganglion in some part of the peripheral branches; but, with regard to this point, his evidence is far from conclusive. I have given elsewhere the arguments against this belief, which was originally advocated by Sir Victor Horsley.

(1) It will be noted that *not one but several cases* are referred to in which there was recurrence of neuralgia, after the operation of neurotomy with interposition of rubber, within five years. This was a serious drawback.

(2) It is by no means easy to plug the foramina ovale and rotundum effectively (especially the latter) so that the plug shall keep in place. Abbe's second operations show this clearly, and also that from the ganglion itself there was growth of fresh nerves struggling to emerge towards the surface.

(3) If the ganglion is left intact it is likely to become the seat of neuralgia apart from any question of fresh growth of nerves. If the ganglion is removed by the method I have advocated, it is impossible for fresh nerves to grow towards the periphery (see pp. 153 to 155 for a case of much interest bearing on this point).

(4) As regards severity of the operation or risk to life, I do not believe there is any material

difference between the two methods, nor can there be much, if any, saving of time in the duration of operation.

(V) *Ligature of the External Carotid.*

It is natural to suppose that one of the main difficulties of the operation, namely hæmorrhage, would be diminished by preliminary ligature of the external carotid artery; but so free is the collateral circulation that even the arterial bleeding seems to be but little affected by this procedure. I have more than once employed it in the middle of the operation because of very troublesome hæmorrhage; but no difference was noticed in this respect from the ligature. G. R. Fowler tied the external carotid, as a preliminary measure, in two cases; in one, "abundant bleeding occurred, as the dura mater was separated from the middle fossa," and the completion of the operation had to be postponed. Unfortunately, his patient died from septic infection following plugging with gauze. In the second case the bleeding was insignificant. Keeping the patient in an upright sitting posture is probably more effective than ligature of the external carotid, since it checks both venous and arterial bleeding. I have now tied this vessel as a preliminary measure in five or six cases, but cannot convince myself as to its value.

It is remarkable how much the trouble from hæmorrhage during the operation varies in different

subjects. In the majority it presents little difficulty to overcome, in a few it is most trying, these are generally the comparatively young patients. Ligation of the external carotid is a simple and harmless measure, though it will add another fifteen to twenty minutes to the length of the operation. As this may be counterbalanced by less delay from oozing in the later stages it may be recommended for further trial, at any rate in the younger class of patient (*i.e.*, under fifty years). Temporary clamp compression of the *common* carotid artery has been proposed, but is inferior for obvious reasons to ligation of the *external* carotid.

It is curious that *ligature of the common carotid* should have ever come into vogue as a treatment for intense neuralgia of the fifth nerve. On no physiological theory could the impairment of blood supply be likely to suppress pain, especially if, as Keen has urged, the blood-vessels of the ganglia are already narrowed by disease. A wide experience of the operation has shown that, in some cases, temporary relief is afforded; in the case of one patient¹ the pain only recurred after three or four years' interval, but in the majority there is not even a temporary cure. Moreover, the danger of hemiplegia following ligation of the common carotid artery, especially in old subjects, is too great to

¹ Dr. J. C. Hutchinson's case, briefly reported in *Trans. Amer. Surg. Assoc.*, 1884, p. 489.

justify its being run without the gravest cause. As a method of treating epileptiform neuralgia, arterial ligature should, therefore, never be resorted to.

The same remark holds true for excision of the cervical sympathetic ganglia, which, by certain writers, has been advocated as a kind of surgical panacea. It may be recalled that excision of the cervical sympathetic chain has been practised as a cure for: (1) glaucoma, (2) exophthalmic goitre, (3) epilepsy, (4) trigeminal neuralgia. It would be difficult to say in which disease it has failed the most. It could not be expected to succeed in cases of neuralgia, and experience has shown that it does not succeed. Chipault is one of the very few writers who has tried to make out a favourable case for it;¹ he had been so impressed with the "enormous mortality" of operations on the Gasserian ganglion that, in 1902, he had only performed three such operations and preferred any alternative method. To prove that Chipault's view is mistaken the reader should refer to p. 17.

(VI) *The Pterygoid Route from Below.*

To the late Professor Wm. Rose belonged the credit of having first operated on the Gasserian ganglion, from the under surface of the cranial base. His method, which was followed by a number of other operators, was a most elaborate and difficult

¹ Chipault, *Etat de la Chir. Nerveuse*, 1902, vol. i, p. 443.

one. Undoubtedly, in some cases, the ganglion was reached and excised with success, but the following objections have led to its abandonment in favour of the temporal route:—

(1) The division of bone required—the zygoma and coronoid process—was sometimes followed by necrosis, non-union, or by stiffness of the jaw, with marked deformity.

(2) The hæmorrhage was often severe and difficult to control.

(3) The view afforded of the ganglion was inferior to that obtained by the temporal route. It is certain that many operators failed entirely to deal with the ganglion by Rose's method; hence recurrence of the neuralgia was not infrequent.

(4) The Eustachian tube was in special danger of being injured; this forming a serious complication.

Thus Caponotto, an Italian surgeon, records a case in which the operation was followed by marked rise of temperature, with bleeding from nose and mouth. At the autopsy, five days later, it was found that the Eustachian tube had been wounded and that meningitis had ensued.

It has been already noted that Poirier's or Cushing's operation is a compromise between Rose's and the Hartley-Krause method, and it is curious that a partial reversion to Rose's operation should be advocated after it had been abandoned by the originator, for Professor Rose¹ himself gave

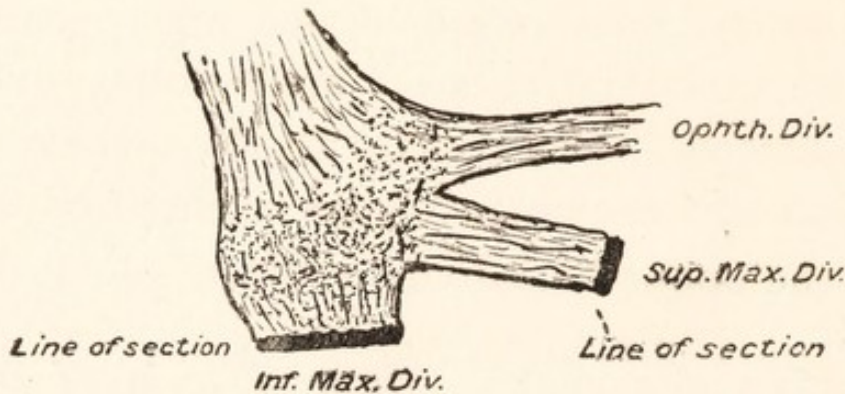
¹ W. Rose, *The Practitioner*, 1899, p. 255.

up operations on the Gasserian ganglion and advocated extensive resection of, first, the superior maxillary nerve, and secondly (after an interval of a few weeks), of the inferior maxillary division. He stated that it was hardly ever necessary to touch the ophthalmic division. This conclusion agrees with those put forward in this work ; only, for two extracranial operations a single intracranial one is substituted, which deals with the Gasserian ganglion and the two main trunks issuing from it, but leaves the ophthalmic division intact.

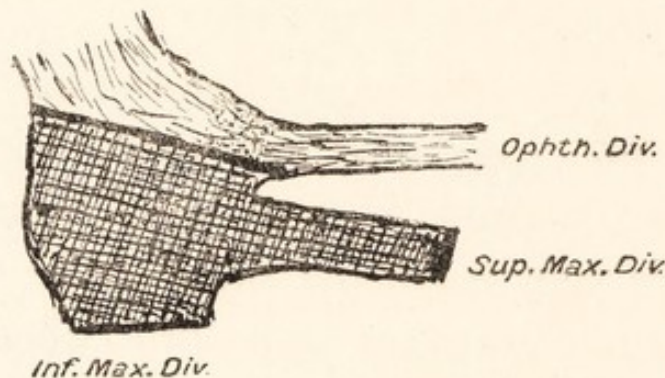
(VII) *On Division of the Main Trunks of the Fifth Nerve, as compared with Excision of the Gasserian Ganglion.*

Some surgeons have contented themselves, when operating for trigeminal neuralgia, with cutting through the second and third divisions of the nerve where they leave the skull. There is ample evidence to show that this procedure is quite inadequate, although it is obviously a more effective measure than injecting them with alcohol. It is certain that reunion of the nerves will take place and the pain will come back as before. In one such case, operated on by a surgeon at one of the chief London hospitals, the skull had been trephined and the main trunks cut through. The neuralgia returned as severely as ever within a few months, and careful testing proved that sensation had been restored over the whole fifth nerve

area. The writer operated later on this patient and found the Gasserian ganglion intact, its continuity with the nerves being quite restored. The ganglion was removed with complete success. Fig. 31 illustrates this interesting case.



First Operation.—Recurrence of severe neuralgia within a year.



Second Operation.—The shaded part represents that removed

FIG. 31.

When the ganglion has been excised, together with the second and third divisions up to the foramina rotundum and ovale, it would seem most improbable that new nerves could grow down from the stump of the fifth nerve, find their way into these apertures, and join on with the peripheral segments. Even supposing such vigorous



growth could occur, why should the new nerve fibres make for the foramina instead of spreading out between dura mater and bone? And is it conceivable that the peripheral severed ends would be in a fit state to link up with such new fibres after some years had elapsed? Surely these ends would be merely fibrous tissue and the nerves themselves degenerated. That wholly new nerve bundles should have the power of finding their way along intricate paths of the fifth nerve terminal branches is frankly incredible. Although the idea of such a re-formation of the fifth nerve seems beyond belief, yet no amount of a priori reasoning should be allowed to weigh against a single proven case of its occurrence.

The following instance helps to explain several cases, reported by various writers, of supposed regeneration of an excised Gasserian ganglion.

Operation on the Gasserian Ganglion for Epileptiform Neuralgia, both second and third divisions supposed to be removed. Return of Neuralgia in second division five years later. Second operation—the superior maxillary division was found to have been left partially intact. No restoration of the lower part of the ganglion or the third division had taken place.

James E. Summersley. At the age of 28 he developed attacks of neuralgia in the right side of the face, starting at the corner of the mouth and radiating upwards towards the eye. As usual in these cases he had several teeth removed from both upper and lower jaws without relief. The neuralgia increased in severity and involved the right temple; at the end of three years he went into the Dorset Hospital. After a course of morphia had been tried, without improvement, the right antrum of Highmore was opened from inside the

mouth and syringed through. No relief following this treatment, he came up to London, and in 1908 I operated on the Gasserian ganglion, leaving the ophthalmic division intact. Complete relief from pain was obtained with anæsthesia in the area of the third division. He returned to the country, and I did not see him again for five years, when he was sent up on account of recurrent neuralgia in the right side of the face. It was then evident that the second division had either not been completely divided at the first operation, or the nerve had been restored, for whilst light touch (with cotton wool)



FIG. 32.

Area of anæsthesia shaded. In the infraorbital area sensation was present with return of neuralgia, spasmodic and continuous.

had gradually returned in the cheek, all sensation was absent in the area of the third division.

Six months before re-admission he began to get attacks of shooting pain which started at the right angle of the mouth and extended up to the nose and forehead. Lately the pain had become continuous. His taste was unaffected on the right side. All forms of sensation—protopathic and epicritic—were lost in the deeply-shaded area and on right side of

tongue; above the angle of the mouth deep pressure, pin-prick, &c., could be distinguished. Tested as to electrical reaction, the right masseter muscle responded only to a strong faradic current and to a continuous current of ten volts, twice as strong as was required by the left masseter muscle.

During his attacks of pain, which made him very miserable, some twitching of the lip muscles was noticed.

Second operation.—A flap was turned down in the temporal region, following the old scar line; the edge of the aperture in the bone was then separated from the dura mater and the former was slightly enlarged. No difficulty was found in reaching Meckel's cave, and it was clearly made out that the ganglion was not regenerated. Some fibres of the superior maxillary division had, however, escaped division, and these were now completely removed.

On testing him later, anæsthesia to light touch and with heat and cold was proved to be present in the cutaneous area of the second division. Firm or deep pressure could still be felt. All pain ceased from the time of the second operation.

It should be noted that the ophthalmic division was left intact at both operations.

I do not believe that there was a true regeneration of nerve fibres in this case, but it is plain that a portion of the superior maxillary division must have escaped division on the first occasion. This fact was suspected when his case was reported in 1909 owing to the recovery of sensation—before any recurrence of neuralgia had threatened.

Since this case of recurrence, apparently due to fresh growth of nerve-fibres from the root of the fifth to the foramen rotundum but really due to some part of the second division having escaped, I have met with one similar case. The evidence of fresh fibres having grown *after section above the*

ganglion was here very slight, and the details of the case resembled the preceding one so nearly that it is not worth while to narrate them.

We may accept it as fully proved that simple transverse section of either main trunk of the fifth nerve beyond, *i.e.*, on the distal side of the ganglion, will be inevitably followed by reunion, growth of new fibres, restoration of sensation, and of neuralgia; that is if no firm interposing barrier has been placed between the distal and proximal parts of the nerve. But it is a very different matter if the ganglion has been removed in the manner described on p. 140 and illustrated by fig. 28, p. 132, and it would indeed be marvellous if new fibres restored continuity with the peripheral branches in this case. At present, without denying its remote possibility, we may regard it as not proved.¹

(VIII) *Removal of the Entire Ganglion with its Roots, inclusive of the Ophthalmic Division.*

As is well known Professor Krause, the late Sir Victor Horsley, and Professor Cushing have advocated and practised this method, in which, after section of the second and third divisions, the ganglion is drawn downwards and its roots severed

¹ Amongst the papers included in the list at the end of this volume will be found several in which the recurrence of neuralgia after operation in the ganglion is to be explained as given above.

or rather torn from the pons varolii. After this operation, as after complete division of the sensory root of the ganglion (Frazier and Spiller), not only the skin of the forehead but the ocular conjunctiva and cornea are left insensitive. It is one object of this work to urge that this is unnecessary in the treatment of epileptiform neuralgia, and that it involves grave drawbacks.

It is a well established fact that in most cases of such neuralgia the ophthalmic division is not involved, or only very slightly so. In these cases if the ganglion be dealt with so as to spare the first division, there need be no fear of the neuralgia returning in it at a subsequent date. Even if the neuralgia has to some extent involved the first division before operation there is but little risk. In the writer's experience of over sixty cases one solitary exception was met with—a woman who was entirely free from recurrence for eight years after operation, and who then for the first time experienced shooting pains in the forehead. These were so well controlled by aspirin that it was probable no further operation would be required. It is to be noted that the nerve-bundles forming the ophthalmic division only run through the upper edge of the ganglion, and by the section described already it is practicable to remove almost the whole of the latter, and yet to preserve the sensitiveness of the eye. No one will question the advantage of such preservation—the need for

suturing together the eyelids, for constant protection of the corneal surface from dust, &c., is done away with. In a word, all risk to the eye is avoided. Compare figs. 33 and 36.

The question arises, is this form of excision of the ganglion, so as to leave the ophthalmic fibres intact, always possible? It is undoubtedly difficult, probably more so than tearing away the roots. But in only two or three cases has the writer failed to effect it, and in those of course the patient's eye and forehead lost sensation. In two or three other cases where the neuralgia had involved these parts to a pronounced degree, the ophthalmic division was deliberately sacrificed. *In each one of these cases there was subsequent trouble as regards the eye.* The subject will be referred to further in the next chapter.



FIG. 33.

Tic douloureux. Physiological extirpation of the Gasserian ganglion. Showing site of flap incision for Spiller-Frazier operation, and the blepharorrhaphy of the left eye for trophic ulceration of the cornea.

From the *British Medical Journal*, 1913. In this case the conspicuous scar on the side of the face and the depression left by division of the zygoma are shown. This (without intention) shows the conditions which *should be avoided*. The scar should be entirely hidden by the hairy scalp, the zygoma should not have been divided, and if the ophthalmic division had been spared there would have been no necessity for suturing the eyelids together, &c. On account of this criticism the operator's name is not quoted.

CHAPTER VII.

EXCISION OF THE GASSERIAN GANGLION : RESULTS
AND COMPLICATIONS OF THE OPERATION.

WE have now to consider the conditions which result from a successful removal of the ganglion. The question of subsequent disfigurement is one to which considerable importance should be attached. After the old pterygoid operation from below the face was left extensively scarred, and whenever the zygoma has been divided, it is unlikely to unite in good position. Further, when the ophthalmic division has been destroyed and it becomes necessary to suture the lids (see fig. 33), or when a large bone-flap has been turned down by an extensive incision carried on to the face, considerable deformity must of necessity result. But when the temporal route has been followed and the ophthalmic division carefully spared, as described above, there is remarkably little disfigurement, the scar being usually hidden entirely by the scalp ; there is merely some flattening of the temporal region, due to atrophy of the underlying muscle (see fig. 36).

The amount of cutaneous anæsthesia depends, of course, upon whether the whole ganglion has been removed or its ophthalmic division spared. In the

former case the skin will be anæsthetic from the chin to high up on the forehead, and from the middle line to the temporal fossa. The greater part of the ear and the masseteric region will always retain sensation, owing to their supply from ascending nerves from the superficial cervical plexus. These points are illustrated by fig. 34, taken from one of the writer's cases.

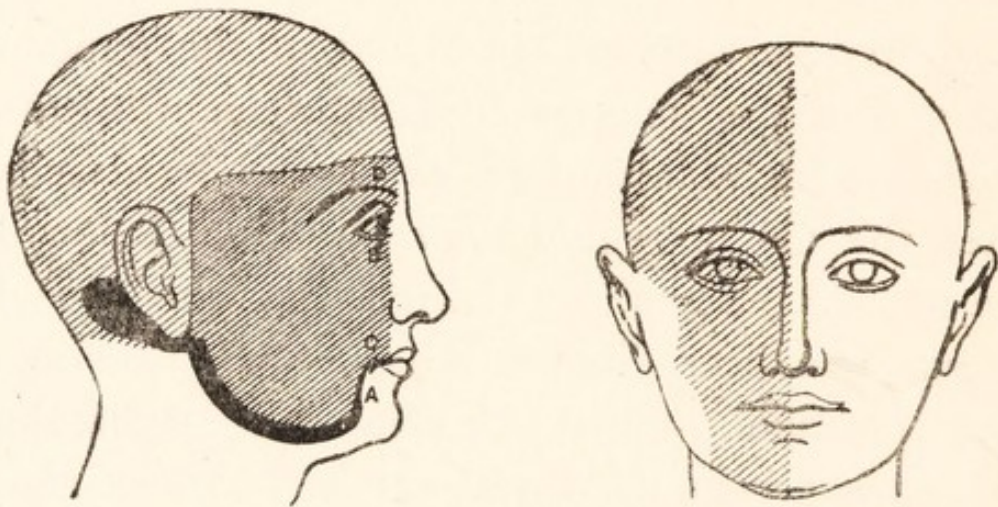


FIG. 34.

Distribution of the neuralgia (left hand figure) and anæsthesia left after complete removal of the Gasserian ganglion (right hand figure). In this case the pain was greatest in the parts deeply shaded; the letters A B C D mark points of especial tenderness. In the right hand figure it is seen that the ear and masseteric regions retain sensation.

If the ophthalmic division has been spared, the forehead and the greater part of the nose, the upper eyelid, and (most important of all) the cornea and conjunctiva will retain their sensation. The anæsthetic area is then as shown in fig. 35. It will be noticed that there is a small prolongation of the insensitive area at the front of the external auditory meatus; this is prolonged on the upper and anterior wall of the meatus itself, and Dr. Cushing states

that this area includes a small portion of the tympanic membrane.

As regards the mucous membrane of the mouth, &c., the anæsthesia will be complete on the inner surface of the lips, the gums, and hard and soft palate. It is less complete on the anterior two-thirds of the



FIG. 35.

Area of cutaneous anæsthesia left after excision of the Gasserian ganglion (the ophthalmic division being untouched). Taken from a case six months after operation.

tongue (owing to the chorda tympani containing sensory fibres), and in the pharyngeal vault. The nasal cavity is insensitive to touch, though of course the sense of smell is retained.

Dr. Cushing¹ has made careful and elaborate investigations of the anæsthetic area in cases of

¹ *Johns Hopkins Hospital Bulletin*, 1904.

extirpation of the Gasserian ganglion. As might be expected, there is a small range of variation in different subjects, but his main results agree with the statements made above.

Does the area of anæsthesia decrease? In some cases, probably in all, a decided reduction in the anæsthetic area of skin and mucous membrane can be proved after some months or years have elapsed. This is of no great importance, as the numbness is rarely complained of. The paralysis of the masticatory muscles, which must follow complete division of the inferior maxillary trunk, might be expected to cause more inconvenience. The masseter, temporal, and the two pterygoid muscles are, after removal of the Gasserian ganglion, entirely deprived of their nerve-supply, and their subsequent wasting can easily be proved. It is strange how little trouble is caused thereby, as the muscles of the opposite side amply suffice for mastication. In every case the patient eats better than before the operation, since no longer does the attempt at chewing the food bring on spasms of pain. When questioned on the point the patients, as a rule, state "they can now eat anything." They may have been handicapped by the customary but harmful extraction of all the teeth on the affected side before operation, but after the neuralgia has been cured it becomes possible in many cases to wear artificial teeth.

Is the sense of taste impaired by the paralysis of the so-called "gustatory" nerve?

It is certain that the "gustatory" nerve has nothing to do with the sense of taste in the posterior third of the tongue (the region of the circumvallate papillæ), the glosso-pharyngeal transmitting it from this part. With regard to the anterior two-thirds of the tongue, it is generally admitted that the taste-organs are supplied by the chorda tympani nerve, which reaches the facial, and undoubtedly ascends to its geniculate ganglion. After this point the further course of the fibres is doubtful, the most probable being the pars intermedia of Wrisberg, and so to the brain. Dr. Cushing, in an elaborate paper, with many references,¹ discusses the question and comes to the following conclusion: "That the perception of taste is unaffected on the posterior portion of the tongue, and never permanently or completely lost on its anterior two-thirds after removal of the Gasserian ganglion."

Dr. Cushing noted in one or two of his cases that the sense of taste was dulled for a time in the front part of the tongue after the operation, and suggested that this was due to "some interference with chorda transmission, brought about by a mechanical or toxic disturbance, due to degeneration of the lingual or gustatory nerve." Cushing's view is, however, directly opposed by the evidence of several observers.² In one case in which the

¹ Cushing, *Johns Hopkins Hospital Bulletin*, March, 1903, p. 71.

² E.g., A. Guinard.

writer had removed the lower two-thirds of the ganglion some months previously, the patient had certainly lost the power of distinguishing quinine, salt, &c., on the anterior part of that side of the tongue. It was not merely that the sense of taste over this region was dulled (in Cushing's words): it was entirely lost.

To sum up, after excision of the Gasserian ganglion permanent anæsthesia over a large area of skin and mucous membrane is left; the sense of taste is impaired on the side operated on; the masticatory muscles on that side waste. Nevertheless, the patient experiences little if any discomfort from the loss of sensation; he is able to take food far better than before, and the disfigurement (if the temporal route has been followed) is trifling (see fig. 36, p. 186). There is, however, one point with regard to *complete* extirpation of the ganglion that deserves special consideration, namely, the risk of subsequent keratitis, and even loss of the eye.

Neuro-paralytic Keratitis.

This is a serious drawback to the operation of complete removal of the ganglion, the danger of which is entirely avoided by following the method advocated in this work.

How frequently it occurs can hardly be estimated from the cases recorded, especially when they have been reported soon after the operation. In the

only one of my cases in which the eye was ultimately lost, owing to spreading ulcer of the cornea, the trouble developed first several months after the patient had left the hospital.

The patient was a man, aged 64, who was sent by Dr. F. C. Simpson; he had suffered for five years from severe epileptiform neuralgia. His paroxysmal attacks started in the lower jaw, spreading to the whole side of the cheek, the lower part of the forehead, and temple; they involved also the region behind the ear, and (in a severe attack) the whole of the right side of the scalp. This radiation of the pain to parts beyond the area supplied by the fifth nerve has been noticed in many cases, and does not contraindicate excision of the ganglion, by which operation it is put an end to.

During the attacks there was usually marked lachrymation, and more than once there had been conjunctivitis on the affected side. The pain was not controlled even by opium, and the patient's condition was a very miserable one. Excision of the Gasserian ganglion was performed in June, 1899, the chief difficulty met with being due to the extreme thinness of the dura mater. In raising this membrane from the middle fossa it was unavoidably torn, with the result that the cerebrospinal fluid escaped. Owing probably to this fact, the pressure of the broad retractor exerted more deleterious effect on the brain than usual, and he had for some little time after the operation partial paralysis of the opposite arm and leg, which slowly improved. The wound healed perfectly, and the neuralgia has been completely cured. His anæsthesia involves not only the right side of the tongue, palate, cheek, nose, &c., but also that half of the forehead, the cornea, and conjunctiva. With regard to the eye, all went on well until several weeks after he had returned home. He then developed keratitis, which slowly spread in spite of treatment, and ultimately, as the eye was useless, it was excised. In March, 1905, nearly six years after the operation, Dr. Simpson kindly obtained a report of the patient's condition. "He has been entirely free from the neuralgia, there is of course entire loss of sensation in the area supplied by the right fifth nerve.

There is still some paralysis of the left arm and leg, but he gets a fair amount of use from them, and on the whole he is quite pleased with himself."

In looking back at this case, which was one of the writer's early ones, it should be observed that although the neuralgia had involved the forehead the ophthalmic division ought to have been preserved instead of being deliberately sacrificed. Had this been done the neuralgia would have been cured, in all probability, equally well, and the eye would not have been lost. It may also be noted that excision of the globe was perhaps resorted to too soon, as seen in some of the cases quoted on the opposite page ; partial recovery may follow prolonged ulceration of the cornea in these neuro-paralytic eyes.

It is impossible to state the proportion of cases in which corneal trouble has followed the complete operation. Wilbrand and Saenger, analysing seventy-five cases in 1901, recorded fifteen examples of "trophic" eye trouble—*i.e.*, 20 per cent. But reliance can be placed on such figures only if the patients have been examined *many years* after the operation, though indeed the anæsthetic eye is not safe even then. The proportion (20 per cent.) may be taken as the minimum. Naturally, surgeons do not dwell on this complication when publishing their experience. That the risk is a real one is shown by the following nine instances, which I have collected from various published records:—

(1) Biondi. Central ulcer of cornea with hypopyon two months after operation. The condition of the eye improved after a time, and apparently did not necessitate excision.

(2) G. Andrews.¹ "Ulcers of the cornea appeared after the operation, when the aseptic compresses, which had been placed over the eye, were removed." It is probable that these ulcers were not due to complete corneal anæsthesia, since the ganglion was supposed to have been removed by the curette. The ulcers, moreover, soon healed, whereas the true neuro-paralytic ones are most obstinate.

(3) W. W. Keen.² At the end of the operation the eyelids were sewn together; four days later they were separated, and a corneal ulcer made its appearance. The subsequent history is imperfect, but it would appear that the ulcer slowly improved.

(4) W. W. Keen.³ The eye on the affected side "became blind."

(5) Davis.⁴ Eight months after complete removal of Gasserian ganglion the anæsthetic eyeball had to be excised, owing to corneal ulceration.

(6) Gérard Marchant.⁵ A fortnight after the operation the cornea began to ulcerate, and it remained permanently opaque.

¹ *Internat. Med. Mag.*, Philad., 1892, i, p. 486.

² *Amer. Journ. Med. Sci.*, January, 1896.

³ *Ibid.*, November, 1898.

⁴ *Univ. of Pennsylvania Med. Bull.*, No. 2, 1904.

⁵ *Bull. de la Soc. de Chir.*, 1896, xxii, p. 585.

(7) A. Depage.¹ "The cornea on the operated side ulcerated; there was conjunctivitis, and the sight was almost gone."

(8) S. Coelho.² The ganglion was wholly removed by tearing through its roots. The cornea became opaque but subsequently cleared, "except for a small opacity."

(9) Bouglé.³ Ulceration of the cornea followed with chemosis.

Krause, in his early work, mentions three other cases of corneal trouble amongst those operated on by himself. It would have been easy to extend the list, but no object would be gained thereby.

From the preceding cases it will be seen that whilst the danger is greatest, as Krause points out, during the first few weeks, *yet an anæsthetic cornea can never be really safe*. Septic dust may enter without being noticed and set up a chronic inflammation, which is hard to check or to cure. To this cause must be ascribed the so-called trophic changes in the eye, and if the ophthalmic division has been destroyed and the cornea rendered permanently anæsthetic, the safest plan will be for the patient to wear protective glasses as a continual precaution. Sewing up the lids on the side con-

¹ *Bull. Acad. de med. de Belge*, 1897, ii, p. 687.

² *Révue de Chir.*, 1899, xix, p. 623.

³ *Bull. de la Soc. de Chir.*, 1901, p. 403.

cerned has been carried out by many surgeons, but this is an irksome measure, and, as already pointed out, the temporary closure of the lids affords no guarantee for the future.

Occasionally the eye lesion takes the form of purulent conjunctivitis, leading later to ulcerative keratitis. In such a case it is possible that the use of too strong antiseptic solutions for bathing the eye is responsible for the conjunctivitis—the surgeon's precautions having been too elaborate. A very mild antiseptic lotion may prove destructive to an anæsthetic corneal surface ; but it must be urged again that after the cornea has been rendered completely anæsthetic by removal of the entire Gasserian ganglion or section of its roots,¹ there will always remain some risk of "trophic" ulceration. The fear of eventually losing the eye is an important drawback to such an operation, a drawback which can be entirely avoided by limiting the excision of the ganglion in the manner described.

Finally, the direct mortality of the operation—the actual risk to life which it involves—remains to be considered.

Chipault wrote, in 1902, that the mortality of these operations "is enormous."

In 1909² Sir Purves Stewart described excision

¹ The section of the sensory root *above* the ganglion, as advocated by Frazier and Spiller, is here referred to.

² *Brit. Med. Journ.*, September 25.

of the ganglion as "a grave intracranial operation with a high mortality, even in skilled hands." How far can these statements be justified?

In considering the following figures it must be remembered that the reporters were possibly including some identical cases in their individual lists; at the same time these lists are drawn from France, America, Germany, and England, and will therefore be in the main distinct.

		Year of publication	Number of Cases	Deaths	Per- centage
Tiffany ...	...	1896	... 108	... 24	... 22
(America)			(collected)		
Marchand...	...	1897	... 95	... 17	... 18
(France)			(collected)		
Prat ...	...	1903	... 181	... 34	... 19
(France)			(collected)		
Krause ...	...	1907	... 36	... 8	... 22
(Germany)			(personal)		
Sir V. Horsley	...	1905	... 120	... 6	... 5
(England)			(personal)		
J. Hutchinson	...	1918	... 70	... 3	... 4
(England)			(personal)		

Prat's publication was a thesis, and it may therefore be concluded that it was compiled from cases previously reported by others, and hence it will be best to omit his figures, especially as they occupy a middle position as regards mortality. The total result would then be 429 operations with 58 deaths, a percentage of nearly 14. This is, of course, a considerable mortality for any surgical operation. But it will be noted how that mortality has lessened as experience has taught us

the special dangers to be avoided. We can go further and say that the Gasserian ganglion can be operated on satisfactorily with very slight risk to life.

Up to 1918 the writer had operated on over sixty cases without a death. In that year he lost three. One of these, a man aged 66, was fatal apparently from cerebral œdema following a prolonged, but otherwise uncomplicated operation. The second, an old man, worn out with tabes and his neuralgia, died of syncope. The third, a comparatively young man, died from septic meningitis—probably due to chance infection after the operation (see p. 121).

If Sir Victor Horsley's cases and the writer's be taken together, the total of nearly 200 operations is reached with a mortality under 5 per cent. Seeing that most of the patients are of advanced age, and many of them worn out with suffering before the operation, this is surely satisfactory enough.

What has given rise to the prevailing idea on the subject, which it is most important to dispel? The fact is that, in the past, the mortality has been far too high, owing to inexperience, and still more to needlessly heroic or clumsy methods of operating. The collection of cases made by Keen, Tiffany, and others is easily consulted, and it undoubtedly shows a mortality of 20 per cent. or over. Such a heavy death-rate is, fortunately, quite needless, but it has deterred many physicians from recommending the operation in suitable cases.

The following selection of fatal results has been made solely for the purpose of illustrating the causes of death and the means of avoiding it as far as possible. It would have been easy to extend the list, but for all practical purposes it is long enough. The reader will understand that in every one included the temporal route was adopted.

Fatal Cases. (Hartley-Krause Method.)

(1) Bernandi. Aged 68. Severe hæmorrhage. Complete removal of ganglion. Death on fifth day from shock. Nothing found at post-mortem except slight ecchymosis of the temporo-sphenoidal lobe.

(2) Bernandi. Woman, aged 61. Death from failure of heart's action just at the conclusion of the operation. At the autopsy the heart was found to be fatty.

(3) G. R. Fowler.¹ Severe arterial and venous hæmorrhage during the operation. All three divisions of the nerve dealt with. Death four hours afterwards. Patient aged 45.

(4) G. R. Fowler. Patient aged 50. Severe hæmorrhage during the operation, although the external carotid artery had been tied. Cavity plugged with gauze. Death from septic infection.

(5) A. G. Gerster.² Operation in two stages, owing to hæmorrhage. Gauze plug used. Death from septic meningitis and cerebritis.

(6) J. T. Finney.³ Patient aged 69. Complete removal of the ganglion, "its roots being torn from the pons varolii." Death seven hours after the operation. The middle meningeal aperture had been plugged with gauze.

(7) G. R. Fowler.⁴ Patient aged 45. Very abundant hæmorrhage, arterial and venous. All three divisions were

¹ *Med. Record of New York*, 1894, p. 745.

² *Med. Times*, 1895, p. 518.

³ *Johns Hopkins Hosp. Bulletin*, 1893, p. 91.

⁴ *Med. Record of New York*, 1894, p. 745.

cut. Death (evidently from shock and hæmorrhage) four hours later. This case is specially noteworthy on account of the comparatively early age of the patient.

(8) W. W. Keen.¹ Patient aged 63. Two days after the operation the temperature rose, and within a week the patient died of septic meningitis. "The infection was undoubtedly due to one of the assistants, who had put one of the instruments used in his mouth before the operation."

(9) W. W. Keen. Complete removal of the ganglion; the cavernous sinus was freely opened in dealing with the ophthalmic division. The hæmorrhage was arrested by plugging. The patient was found to be hemiplegic after the operation, did not regain consciousness, and died on the third day.

(10) Lange (reported by Keen in Chipault's "Chirurgie Nerveuse.") Patient aged 63. The operation was attended by special difficulty and accidents, the bone-cutting forceps breaking and injuring the brain. The ganglion could not be removed, and the hæmorrhage was severe. After the operation, hemiplegia was noticed *on the same side*, death resulting from œdema of the lungs. No explanation was found post-mortem for the hemiplegia.

(11) W. Meyer. Patient aged 30. Suppuration in connection with a ligature followed the operation, and death three months later from cerebral abscess.

(12) W. P. Nicholson (reported by Keen, loc. cit.). Patient aged 62. Skull very thick; middle meningeal artery buried in it. Formidable hæmorrhage checked by gauze-plugging. Death four days later. No meningitis.

(13) J. Ransohoff (*ibid.*). Patient aged 50. Excessive hæmorrhage. Death from shock.

(14) L. A. Stimson (*ibid.*). All three divisions dealt with. The patient's breathing stopped during the elevation of the brain; the pulse became very rapid, the breathing again enfeebled, and death ensued in six hours.

(15) L. M. Tiffany.² Patient aged 71. Paralysis of the

¹ *Amer. Journ. Med. Sci.*, January, 1896.

² *Annals of Surgery*, March, 1895.

opposite arm followed the operation. The wound healed quickly, but had to be reopened at the end of a week in order to remove blood-clot. In the third week septic infection proved fatal.

The main risks of the operation are seen to be three: shock (sometimes caused by injurious pressure on the brain), hæmorrhage, and septic infection; it may be said these three are one. Severe hæmorrhage is generally due to opening the cavernous sinus during the attempt to completely remove the roots of the ganglion and its ophthalmic branch; to check the bleeding the operator resorts to plugging with gauze, which causes injurious pressure on the brain and increases the risk of septic infection.

If the patient be operated upon in the vertical posture, seated in the dental chair, the bleeding is rarely severe. In all cases plugging with gauze should be avoided; one or more drainage tubes should invariably be left in the wound for twenty-four hours, and, of course, the greatest care should be taken to avoid sepsis. It may be noted that the latter ought never to occur, the temporal region being a most favourable one to render aseptic, and wounds made here heal very kindly.

The danger of causing injurious pressure by the retractor during the operation should be borne in mind throughout the operation. In one of my cases it was the cause of temporary hemiplegia, and several other examples of it have been recorded. Thus,

Krause records one case in which "an extravasation of blood occurred into the right cerebral hemisphere," the patient ultimately recovering. Biondi noticed temporary aphasia in one case, and in two others slight auditory defect, due, doubtless, to pressure on the temporosphenoidal lobe during the operation, the defect persisting for some six months.

An instance of severe "pressure-paralysis" following operation on the Gasserian ganglion is recorded by Dr. Howard D. Collins.¹ The hæmorrhage during the operation was severe, and as the osteoplastic flap method was used it is possible that an accumulation of blood-clot may have been to blame for the subsequent paralysis; Dr. Collins, however, attributes it solely to the retraction employed during the operation. For days afterwards the patient was drowsy and lethargic; there was partial paralysis of both opposite arm and leg, and complete paralysis of all the oculomotor muscles on the same side. After some weeks all the paralytic symptoms improved and ultimately cleared off, though the patient's memory was said to be permanently affected.

The conclusion drawn above that the mortality has been due to three causes—shock, hæmorrhage, or septic infection—and that "these three are one," or rather closely related, is borne out in the main

¹ *Annals of Surgery*, 1903, vol. xxxviii, p. 665.

by M. Prat's analysis of twenty-six fatal cases occurring in 137 operations collected by him.

Deaths from shock, collapse or hæmorrhage...	11
„ „ meningitis or septic infection ...	7
„ „ injury to brain (with consecutive softening of temporosphenoidal lobe)	3
„ „ cardiac, pulmonary, or renal complications	5
	26

Oculomotor Complications following the Operation.

These rarely occur except when the whole ganglion, including the ophthalmic division, has been removed; they vary much in degree, and may be either temporary or permanent. In some cases merely ptosis or impaired movement of the globe in one or other direction results; in others the paralysis may be for a time complete. Of the latter Mugnai records an example; in this case at the end of three weeks movements of the eye were regained, but ptosis persisted. Other instances of temporary paralysis are recorded by G. Andrews¹ (two cases out of five operated on by him); by F. Hartley,² and others. In a case recorded by Davis,³ the third and fourth nerves were paralysed

¹ Andrews, quoted by Keen in Chipault's "Chirurgi Nerveuse," vol. iii, p. 691.

² Hartley, *Annals of Surgery*, 1893, vol. i, p. 512.

³ Davis, *Univ. Pennsylvania Med. Bull.*, 1904, No. 2.

for a time, and the sixth nerve was probably destroyed." As, however, the affected eye had to be excised later, owing to keratitis, the oculomotor paralysis did not matter very much. Lexer observed paralysis of one or other oculomotor nerves in four out of twelve cases operated on by himself; in three, the paralysis passed off, but in the fourth case paralysis of the sixth nerve persisted.

Professor Krause noted temporary paralysis of ocular muscles in five out of twenty-five of his cases.¹

It is obvious that this complication used to be a frequent one, if, in the hands of so experienced an operator as Krause, it occurred in 20 per cent. ; but it may be avoided with almost complete certainty, provided that the ophthalmic division is spared. The close relation of the latter to the fourth and sixth nerves in the wall of cavernous sinus is well shown in fig. 4, facing p. 10.

In the solitary case of the writer's where oculomotor paralysis resulted (temporary only) severe recurrent hæmorrhage had necessitated opening up the wound on the day after operation. The case is detailed in the Appendix. There was good reason to consider the patient as "a bleeder."

In no others was there any trouble as regards the oculomotor nerves, another strong argument in

¹ Note that all the surgeons quoted above removed the ganglion *and its roots*, making no attempt to spare the ophthalmic division.

favour of excluding the ophthalmic division from the scope of the operation.

The writer has had however three cases in which some paralysis or paresis of the *facial nerve* resulted for a time. This curious complication, which is difficult to explain, is discussed in Chapter I (p. 2).

Laceration of the Dura Mater.

This has often occurred during the operation: indeed, during the last stage, when the thin covering of the ganglion itself is being reflected, it can hardly be avoided in some cases. The cerebrospinal fluid escapes and, for a time, may hinder the completion of the operation, but, provided asepsis is secured, no other harm will result. During the early separation of the dura from the temporal fossa, every care should be taken not to perforate the membrane, which, however, varies greatly in toughness and degree of adhesion to the bone. Occasionally, it tears at the slightest touch, but in other subjects it is firm and readily detached.

Laceration of the Wall of the Cavernous Sinus.

This happened in two of Krause's twenty-five cases; in both, the severe hæmorrhage was ultimately stopped by compression (plugging with sponge). Several other instances have been recorded, and it is noteworthy that, where plugging with gauze or sponge has been resorted to, death

from septic infection, &c., has not infrequently resulted. Wound of the cavernous sinus is a most serious complication for this reason, and also, because it renders the proper completion of the operation impossible. There can be little doubt when the cavernous sinus is wounded, the blood pours over the field of operation. But Delbet makes the extraordinary statement that Dollinger (a German surgeon) "pretends to have found no great inconvenience from opening the cavernous sinus in twenty-four cases of removal of the Gasserian ganglion." This would indeed be strange were it true.

In concluding this review of the various accidents that may occur during and after excision of the Gasserian ganglion, it must be pointed out that provided the modified form of the operation be carried out (removal of the superior and inferior maxillary trunks, with the greater part of the ganglion, but sparing the ophthalmic division), the risks are diminished in the following respects: *First*, there will be no subsequent anæsthesia of the cornea, and hence no risk of loss of the eye. *Second*, there should be no danger of injuring the oculomotor nerves, nor of wounding the cavernous sinus. *Third*, the severity of the operation is rendered less, the degree of hæmorrhage, and the chance of injurious pressure on the brain being all materially diminished.

Those who advocate the complete removal of all

three divisions of the nerve with high section of the roots will, no doubt, reply that by leaving the ophthalmic trunk recurrence of the neuralgia will take place in it. They may fairly be asked to prove that this does occur.

The solitary case the writer has met with has already been mentioned—in which, after eight years of complete immunity from neuralgia, and of perfect health, the patient began to experience occasional shooting pain in the eye and forehead (where sensation had been deliberately spared). Under medicinal treatment the pain practically ceased to trouble her.

On referring to the original notes of this case it was found that the neuralgia had been severe in *all three* divisions, nevertheless after operation it had entirely disappeared from the region supplied by the first for eight years.

It must be admitted that in certain cases, operation on the Gasserian ganglion, whatever form it takes, is to some extent a failure.

There is, of course, no reason why neuralgia should not recur on the opposite side of the head, and were arteriosclerosis one of the causes (as asserted by Keen), one would expect this to occur fairly frequently; but nothing is more characteristic of epileptiform neuralgia than its unilateral nature, even if it exists many years. Amongst the records of several hundred cases, very few can be found in which recurrence on the opposite side has followed

operation. R. Winslow,¹ in 1895, removed partially (by curetting) one Gasserian ganglion. The patient suffered subsequently from diplopia, mental defect, and aphasia ; all these symptoms cleared off. In 1896 she "complained of neuralgia on the other side of the head."

Lexer, out of ten cases, observed recurrence of the neuralgia on the same side in one, and on the opposite side of the head in another case. Salomoni,² after operation on the Gasserian ganglion on one side, records that neuralgia recurred on the opposite one some two months later. The ultimate result is not stated.

Sir Victor Horsley operated on both sides of the head in one patient.

In one of the writer's cases, a woman, severe epileptiform neuralgia *on the left side* was cured by removal of the Gasserian ganglion. Several years later *the right side* of the face became subject to paroxysms of pain, which rendered a second operation necessary. Fortunately the neuralgia was localized to the distribution of the second division, and intracranial removal of the trunk of this nerve was followed by complete relief. A second instance of bilateral operation being required is recorded in detail in the Appendix—see p. 190.

It only remains to notice the cases in which recur-

¹ *Maryland Med. Journal*, May 2, 1896.

² *Clinica Chirurgica*, February, 1893.

rence of epileptiform neuralgia has followed *on the same side* as the operation. These, I am certain, form only a small minority, but naturally they cause most trouble and attract the most attention. As a rule they can be put into two classes: either the patient was neurotic or hysterical (*i.e.*, not really a suitable subject for the operation), or the operation has failed to deal adequately with (perhaps has never even touched) the Gasserian ganglion. Of the former there are a few examples recorded. For instance, Professor Krause observed recurrence of the neuralgia on the side operated on in only one of his thirty-six cases (reported 1903). This case was a neurasthenic medical man, in whom peripheral operations had been fruitless. Removal of the Gasserian ganglion, which Krause was led to perform against his will, had no better result, the cause of the neuralgia evidently being cerebral. This question has been already discussed on p. 86.

Of the second class, that in which an inadequate operation has been done and the neuralgia has returned, many more instances could be quoted; indeed, it is surprising how many have been published. The writer once had the opportunity of proving that in a supposed excision of the Gasserian ganglion, performed by one of the best operators in London, the ganglion had never been reached.

The patient was a man aged 50, the subject of terribly severe neuralgia. He underwent the operation by the pterygoid route (Wm. Rose's method); it was performed in two

stages, and was an extremely protracted affair, owing to hæmorrhage, &c. A short respite from pain followed, and it was fully believed that the ganglion had been dealt with. However, the very limited anæsthesia that followed might well have been due to the division of cutaneous nerves in the extensive skin incisions. The patient's neuralgia returned worse than ever. He took to injecting morphia hypodermically in almost incredible amounts, and became, physically and morally, a complete wreck.

After his disappointing experience, it was naturally difficult to induce him again to undergo surgical interference, and it was expected that the operation would prove unusually difficult, owing to the previous division of the bone round the foramen ovale, &c. This, however, did not prove to be the case. I found that the middle fossa had been perforated about half an inch to the outer side of the foramen ovale, and the ganglion, with its branches, was quite intact. Nothing could be a stronger commentary on the difficulty of really dealing with the ganglion from below (by the pterygoid route). The only trouble I experienced in this operation was due to hæmorrhage, chiefly from the meningeal artery. The attempt to stop this bleeding, by plugging the foramen spinosum with wax or a spicule of bone, failed, and I therefore tied the external carotid in the neck. The two maxillary nerves were then divided and the ganglion excised.

As an instance of the slight nature of the shock following this operation, this patient was sitting up and writing a letter within twenty-four hours of it. Although he had got used to injecting eight or ten grains of morphia per diem, he was fortunately resolute enough to discontinue the practice entirely as soon as he found the neuralgia had left him. He wrote six months after the operation: "From being a hopeless invalid, I have become as strong and well as at any time during my life, with practically no pain. I have never touched morphia since the operation and have not felt the least desire for it."

It is now (1914) sixteen years since the second operation. At the end of this long period of immunity the patient came up on account of supposed recurrence on the same side. He was admitted to hospital, and kept under observation

there for a fortnight, and afterwards from time to time. There was certainly no spasmodic or severe attack of pain, and under tonics, &c., he appeared to be quite well.

I have known of other cases in which, after operation by Rose's method (the pterygoid route), the neuralgia was supposed to have been cured, although subsequent recurrence in a severe form developed. The explanation is, that the ganglion was never properly dealt with, owing to the difficulties due to hæmorrhage and insufficient exposure. The same criticism applies to some cases operated on by the temporal route. The sharp spoon is an instrument which has been used by several operators, who appear to think that the ganglion is readily destroyed by a little indiscriminate scraping in the region of the cavernous sinus. The instrument is unsuitable and dangerous, and should never be employed in this particular operation. Failure is only to be expected if the surgeon relies on this blind groping in the dark, instead of a clean dissection of the ganglion. Equally hazardous and uncertain is the attempt to twist and drag away the ganglion as soon as one of the main divisions is exposed.

It is a curious fact that the extensive surgical interference involved in trephining the skull, with its attendant loss of blood, may cause the neuralgia to cease for days, weeks, or even months, although the ganglion and its main branches have been hardly interfered with at all. The real test of

success is complete anæsthesia in the districts normally supplied by the divisions of the fifth nerve concerned. Unless this anæsthesia be clearly made out after the operation, recurrence is almost certain in the future. Now and then the operator has described division of the roots, whilst sensation was perfectly retained in the skin, which is normally supplied by their branches (*e.g.*, in a case recorded by W. Keen, though not operated on by him, Chipault, vol. iii, p. 694). There must obviously be a mistake on the part of the operator in such cases. Gerster records a case¹ in which, after "destruction of the ganglion," sensation recurred within a month, in both second and third divisions.

In a case published by M. Lardy,² the Gasserian ganglion was supposed to have been extirpated, yet sensation was perfect in the whole area supplied by the fifth nerve. The patient was a woman, and the neuralgia "was entirely cured." It is even possible for the operator to persuade himself that a little piece of dura mater represents the ganglion. It is, however, incredible that removal of the Gasserian ganglion should be attended by no anæsthesia in the skin of the face.

M. Barthélemy, in a thesis, gives a remarkably depressing view of the results of operation (complete

¹ *Annals of Surgery*, January, 1896, p. 58.

² Chipault's "*Chirurgie Nerveuse*," vol. ii.

excision—attempted or accomplished) on the Gasserian ganglion.

Number of cases ...	...	...	...	...	103
Deaths ...	...	...	...	...	15
Completely unsuccessful ...	...	...	...	...	4
Severe recurrence within two years ...	...	...	...	...	15
"Partial cures" ...	...	...	...	...	13
Cures (of which only 13 had been confirmed for two years) ...	...	...	...	...	56

This record is so absolutely opposed to the writer's experience that it must be regarded merely as a damaging criticism of certain methods of operating, in a word of the technique employed. M. Barthélemy's collection of cases was wholly of French origin. Elsewhere in this book I have felt obliged to comment unfavourably on such methods of operation as Doyen's and others, involving turning down a large bone-flap.

The difficulties and drawbacks of the operation have been fully discussed, since it was only fair to do so. But, in conclusion, it may be pointed out that few procedures in the whole range of surgery are so successful as excision of the ganglion for true epileptiform neuralgia. With the improved methods of operating, and the proper selection of cases, the risk to life is very small, and the prospect of permanent cure is great.

By limiting the excision, and sparing the ophthalmic division, all subsequent risk to the eye is done away with.

The deformity which results is hardly worth the

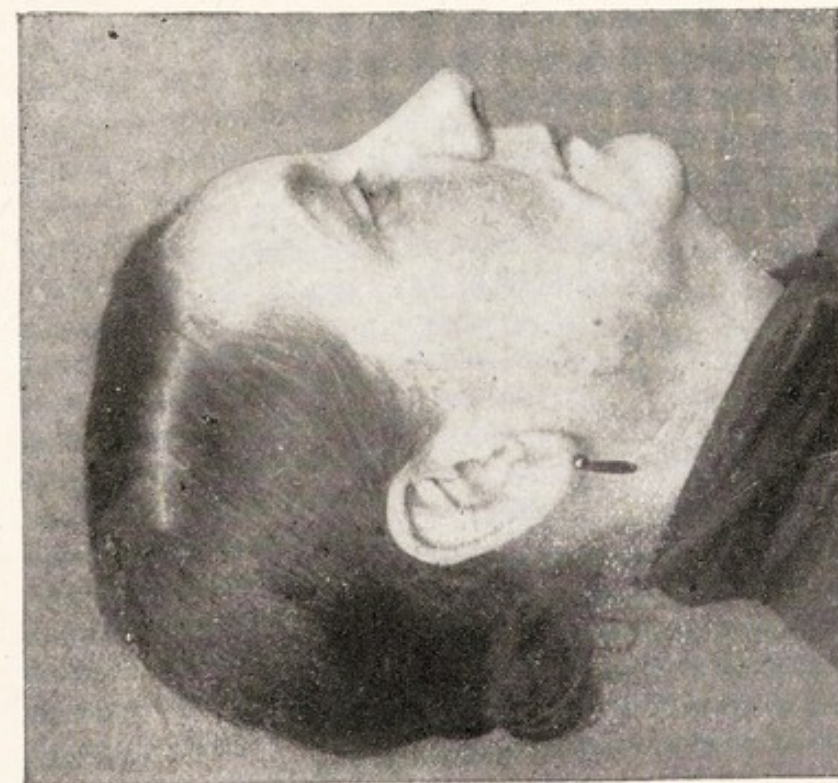


FIG. 36.

Shows the absence of any deformity after excision of the Gasserian ganglion some years previously by the author's method. The scar of the small temporal flap is quite hidden by the patient's hair, and the reader may be left to determine on which side the operation has been done.

name; it simply amounts to slight prominence of the zygoma, due to atrophy of the corresponding temporal muscle.

It may, I trust, fairly be claimed that the method of dealing with the ganglion advocated in this work, a method introduced by the writer, does constitute an advance in the treatment of epileptiform neuralgia. It has stood the test of many years. The risk to the patient's life is exceedingly small, the danger to the eye is entirely removed.

Whether injection by alcohol of the Gasserian ganglion itself will ultimately supersede any form of cutting operation remains to be seen. I would point out that it is impossible to limit the action of the alcohol so as to spare the ophthalmic division, one cannot guarantee this, and hence there must always be some risk to the eye on the side injected.

APPENDIX

NOTES of a few cases are here added to those given in the text. These have been selected to illustrate special points, or because they presented exceptional difficulties or complications.

CASE 1.—*Epileptiform Neuralgia of Left Second and Third Divisions for twenty years. Excision of Gasserian Ganglion at the age of 71. Cure. Death two years later (from old age).*

This case was noteworthy from the long duration of the neuralgia and the advanced age at which the operation was performed.

William N., a minister, became subject at the age of 50 to epileptiform attacks in the left cheek, the pain ultimately spreading to the lower jaw, to the left side of the tongue, and radiating up to the scalp on that side. No cause could be assigned, nor was any medicinal treatment of avail.

Partly because his work kept him in South Africa, he struggled on in spite of the grave interference with his duties and it was only at the age of 71 that he came over to England prepared to submit to operation. The attacks were then worse than ever, and left him without a day's intermission. He was a very feeble subject, thin and worn, owing to the neuralgia, but the risk of operation seemed well worth undergoing as his life was then simply a burden to him.

I performed excision of the ganglion by the temporal route, leaving the ophthalmic division intact, the operation presented no special features to note, the bleeding being readily controlled (ligature of the middle meningeal, &c.). He made an excellent recovery, but complained for a time of loss of power in the right forearm and hand, due no doubt to some

overlooked pressure on or stretching of the right arm whilst he was under the anæsthetic.

He continued quite free from return of pain until his death from senile decay two years later.

CASE 2.—*Patient supposed to be a Bleeder by inheritance. Failure of Alcohol Injection. Gasserian Ganglion excised without trouble from Hæmorrhage.*

Henry H., aged 35, an ex-soldier.

Epileptiform neuralgia of the right second and third divisions started nine years ago (*i.e.*, at the unusually early age of 26), a month after a severe fall from a bicycle when he sustained concussion and probably a fracture of the base of the skull. He bled profusely from the left ear, was unconscious for a week or more and has been totally deaf on both sides since.

Between the paroxysms of pain he suffered from extreme depression and irritability.

His personal and family history were most extraordinary, and there was good reason to suppose that he inherited a tendency to bleed severely, if he was not a true hæmophilic.

His *father* died at an advanced age, he used to have prolonged epistaxis. His *mother* died at 55 owing to "hæmorrhage from piles."

All his six sisters were alive—no particulars could be obtained as to the families of five of them.

His three brothers were dead—one shot himself accidentally, one dropped dead whilst walking (note that he was a comparatively young man), the third died from "hæmorrhage after an operation for hernia."

Patient himself had undergone extraction (no doubt perfectly needless) of various teeth in the Salisbury Hospital, as a means of treating his neuralgia. Each time he had bled for many hours, and the surgeon declined to perform a proposed operation on a branch of the fifth nerve because of the fear of bleeding.

We examined the time of coagulation of a sample of his blood, and found it normal (three minutes and a half). We could ascertain nothing as to bleeding from cuts of the fingers, etc., but in view of the severe hæmorrhage after teeth

extraction I preferred to try alcohol injection. This was done on the second division through the orbit—sphénomaxillary fissure, and from below the zygoma (second and third division) under an anæsthetic.

Although no absolute anæsthesia was produced, his pain was much relieved and he left hospital, but a few months later owing to the complete failure of the method he returned and had a successful extirpation of the Gasserian ganglion performed; no severe bleeding fortunately attended or followed this operation.

CASE 3.—Excision of left Gasserian Ganglion followed by serious recurrent Hæmorrhage, recovery and cure as regards the Neuralgia. A year later onset of Neuralgia on the opposite side of the face—in second division. Intracranial Neurectomy of second division performed seven years after the first operation—again recurrent Hæmorrhage.

This case was one of unusual difficulty and interest.

The patient, Samuel R., a Hebrew butcher, aged 49, bled so freely after the first operation that the suspicion of hæmophilia arose. However he recovered and went to South Africa. A year later he developed pain in the opposite side of the face which became paroxysmal in the area of the second division, always starting in the right upper lip. The pain radiated towards the lower lip, &c., in very bad attacks; it affected most of that side of the face.

His teeth were all perfect on that side. At the end of seven years he returned from South Africa in order to get relief, and I was compelled to operate again. It seemed to be essential that the motor root of the fifth nerve should be spared, as that on the opposite side had already been sacrificed. Two courses were open, the first to divide the sensory root alone within the dura mater: apart from the uncertainty attending this step it would leave his eye insensitive which I was anxious to avoid. The alternative course was to resect the second division in which the neuralgia centred, and I decided on this. All the steps of the operation were carried out for exposure of the right Gasserian ganglion, the middle meningeal artery was tied and divided between two ligatures, the superior maxillary division was isolated from

the ganglion to the foramen rotundum and cut completely away. The foramen itself was plugged with a piece of bone. Care was taken to secure every bleeding point, and drainage provided for.

He did not come round well from the operation and on the second day his temperature had risen to 101° , his pulse was full and quick, he was unconscious, and there was evidently a collection of blood beneath the temporal flap. In my absence my colleague Mr. Hugh Lett operated for me, after turning down the flap a large collection of blood was evacuated, it had apparently come from various points in the flap itself. A larger drain was inserted, and as on the previous occasion the man made a surprising recovery. That he was not a true hæmophilic was shown by the cessation of the bleeding. I saw him a month later before his return to South Africa, he was completely free from pain and in excellent health.

In the event of the neuralgia returning, the only course open seems to be division of the sensory root within the dura mater. I may emphasize the fact that the cure of his epileptiform neuralgia on the side first operated on had been complete during the seven years that had elapsed.

CASE 4.—*Epileptiform Neuralgia at an unusually early age, almost limited to area of third division. Failure of Alcohol Injection. Cure by removal of Gasserian Ganglion.*

James F., a clerk, began to suffer with neuralgia in the left fifth nerve at the age of 20. The onset was sudden and severe, and for the next six years he never had a meal without bringing on an attack. Ultimately the pain became constant in the centre of the cheek, radiating over the whole lower lip and up towards the temple (as shown in the diagram) during each attack, which might be brought on either by attempting to masticate food or by touching the side of the face, or by exposure to cold, &c. He could not bear to wash his teeth, he became unable to work, and thought "he should go mad with the pain." Many teeth—some decayed—were removed without any relief.

I tried alcohol injection (twenty minims) into the region of the nerve just below the foramen ovale, but this made him worse. Ten days later, on March 13, 1913, I removed the

Gasserian ganglion in the usual way, leaving the ophthalmic division intact. With the exception of temporary and slight frontal pain, he made an excellent recovery, and left the hospital cured ten days after operation. Sections of the removed ganglion showed neither fibrosis nor other abnormality.

Anæsthesia was complete in the area of the face supplied by second and third divisions of the fifth nerve—including the side of the tongue.



FIG. 37.

The anæsthesia is most complete over the cheek and lower jaw. Sensation perfect in ophthalmic area, A, B, and masseteric, F.

CASE 5.—Epileptiform Neuralgia of second division. Injection of Alcohol into region of Foramen Rotundum by Orbital Route. Partial Anæsthesia and temporary improvement. Return of Neuralgia after a few months; subsequent Excision of Gasserian Ganglion.

The patient, Mary Anne C., at the age of 54, became liable to neuralgia in the left fifth nerve, its onset had an unusual and interesting cause. According to her account she

had a severe attack of influenza, followed by temporary insanity, and it was as she recovered her mental equilibrium that she first noticed pricking pain in the upper lip. This spread to the cheek, but was always strictly one-sided. The removal of all her teeth had, as usual in these cases, no good effect whatever, but the loss of them rendered her more liable to dyspepsia. The attacks never became really frequent during the next eleven years, and sometimes as much as a month would elapse between the acute attacks.

When I saw her in June, 1912, the neuralgia was mainly confined to the cheek, inside and out, but there had been implication of the tongue and radiations elsewhere. Looking at her advanced age (66) and the comparatively mild degree of the neuralgia, it was an excellent case to test the effect of alcohol injection. I therefore, under partial anæsthesia, injected through the floor of the orbit (following the spheno-maxillary fissure back to the foramen rotundum) the second division of the fifth nerve. That it was reached was proved by partial anæsthesia in the cheek and burning pain in the upper lip. The loss of sensation was recovered from in a few days.

The attacks did not quite disappear and soon became worse than ever. After bearing them a few months she returned to have the Gasserian ganglion removed.

The operation was performed in the usual manner ; trouble was caused by bleeding from the plexus of veins at the foramen ovale. The ophthalmic division was successfully spared, the whole of the ganglion below it being removed. The patient made an excellent recovery, leaving the hospital within three weeks. She was then free from pain, and retained sensation in the eye and forehead. It may truly be said that she had less trouble and discomfort from the major operation than from the alcohol injection of the nerve, in addition to the fact that the operation cured her.

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Sex and Age.—Patients varied in age from 20 years to 79, few being younger than middle life; males were very slightly in excess.

Operation.—Two-thirds subjected to the Hartley-Krause operation, *nearly one-fourth* to that of Rose, the remainder to other methods. There were forty-seven operators, twenty-five of them operating once each.

Results.—Twenty-four deaths, causes of death as follows: Shock, 8; sepsis, 8; brain trauma, 3; brain abscess (from trauma?), 1; apoplexy, 1; cause uncertain, 3 cases.

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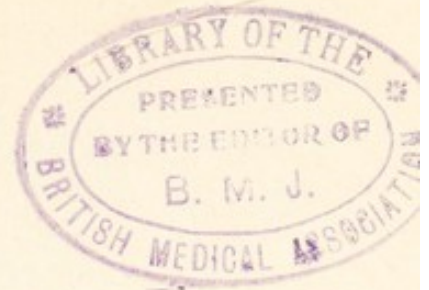
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