held by the index finger, while the right hand draws the knot tightly. The clamp is now removed and the tying completed. With catgut, three loops should be used. Though incomplete removal may be the cause of severe hemorrhage, I can not agree with Dr. Welty, that it is the sole cause. In both severe hemorrhages reported by me, the tonsils were removed completely, with capsule intact, leaving a clean, smooth fossa. As to the removal of each tonsil separately, as suggested by Dr. Mayer, this may be advisable when a great deal of blood is lost from one side. When bleeding from the one is completely controlled by the ligature, however, before the other is excised, I can see no need of twice incapacitating the patient. I always remove both at one sitting.

There are two minor causes, which have appealed to me: One is foul breath when nothing but decomposing tonsillar secretion can be found to account for it. Another is pain referred to the ear, but in reality due to secretion pent up in the supratonsillar fossa. Tonsillectomy promptly relieves both conditions.

TRIFACIAL NEURALGIA *

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One has only to glance over the literature covering the subject of trifacial neuralgia to realize the state of mind in which the medical profession has been in regard to the pathology and treatment of that most painful affection. It is well known that the more uncertainty there is as to the etiology and pathology of a disease the more varied is the treatment and the less uniform are the results. Rarely do we see anything approaching specific treatment of a disease unless the inciting cause and the resulting reaction are known.

The suffering occasioned by trifacial neuralgia has been such as to have excited for years the interest of physicians in the endeavor to find some means of permanent relief. The treatment of the disease has varied according as the ideas of the cause and pathology have varied, and it does not seem probable that the treatment will ever be uniform until a definite knowledge of such pathology is established. It is not the purpose of this paper to present any new information on the subject as the result of original research, but rather to endeavor, if possible, to arrive at some definite conclusions on the nature of trifacial neuralgia from an examination of the already existing literature on the subject.

For a long time it has been known that certain constitutional states of the body can produce a neuralgia of the trigeminal nerve. This is occasionally seen in such diseases as diabetes mellitus, malaria, syphilis, exhaustion, chronic nephritis, rheumatism, gout, lead poisoning, *et cetera*. As long ago as 1891 Dana¹ called attention to the fact that patients suffering from trifacial neuralgia very frequently have associated with that condition one of general arteriosclerosis. This led him to believe that arteriosclerosis was the chief cause of neuralgia. This view has been supported at times by others, notably by Putnam,² who published in 1891 ten cases in which he found an endarteritis and a general fibrosis; and by Horsley,³ who had already advanced the same idea in 1887. Later, in 1897, the same surgeon, in discussing the pathology of trigeminal neuralgia, stated that he had not found any more degenerative

changes than could be accounted for by the age, condition and habits of the patients.

Cushing⁴ admits that arteriosclerosis is a persistent condition, but asserts that it follows the neuralgia and is a result of the pain. In support of this view, he cites a case in which, before operation, the blood pressure averaged 190 mm., rising to 200 mm. during the paroxysms. Since operation the average pressure has been 140 mm. The condition of heightened blood pressure is brought about, he thinks, by constantly recurring afferent impulses, which, like hard work, lead to changes in the vessels. Undoubtedly the condition of arteriosclerosis can produce trifacial neuralgia, and in these cases the use of the vasodilators to the proper degree will relieve the pain. It is easily conceivable, also, that the constantly recurring paroxysms of pain can aggravate an already existing arteriosclerosis, so that after operation an improvement will be seen in the blood pressure.

Tumors of the base of the brain, of the skull and of the Gasserian ganglion itself, may cause a neuralgia of the fifth nerve, as can also irritative conditions about the nose and mouth. Porcher,⁵ in 1903, reported six cases in which the neuralgia was due to localized inflammation in the nose, antrum of Highmore or teeth. In two of the six cases, the Gasserian ganglion had already been removed by well-known surgeons, with a recurrence of the pain. Both patients were cured by proper drainage of the antrum of Highmore.

In 1905, Snow⁶ reported 20 cases in which the neuralgia was due to intranasal pressure or a collection of pus within some of the accessory sinuses. He said he had seen "many cases of the acute form of *tic douloureux* accompany a cold with sinus accumulation and pass away with abatement of the inflammation or proper drainage of the nose." Somers,⁷ in a paper in 1906, mentions the nose as a frequent and often unrecognized cause, and states that hypertrophy of the turbinates, especially the middle, not infrequently produces both supra-orbital and infra-orbital neuralgia. He also calls attention to inflammation of the frontal, ethmoidal, sphenoidal sinuses and of the antrum of Highmore, as causes of trifacial neuralgia.

In the mouth, impacted third molars, carious teeth, pulp nodules found in the pulp chamber, and decayed roots entering the antrum of Highmore and producing antrum disease, frequently bring about a neuralgia of the fifth nerve. It is also well known that mere exposure to cold or damp weather is sufficient to start up attacks in some patients.

The type of lesion induced by the foregoing causes, which are irritative in character, is probably either a degenerative one or a peripheral neuritis which may be ascending in character, and may secondarily involve the Gasserian ganglion. But the number of cases of *tic douloureux* coming under this division is small and there remains by far the greater majority in which no constitutional or local irritative cause can be found. This gives some grounds for thinking there may be two types of neuralgia; one in which the lesion consists primarily of a neuritis of the peripheral branches which may be ascending in character, and another in which the primary lesion appears in the Gasserian ganglion.

* Read in the Section on Stomatology of the American Medical Association, at the Sixtieth Annual Session, at Atlantic City, June, 1909.

1. Dana: *Med. News*, New York, 1891, lviii.

2. Putnam: *Boston Med. and Surg. Jour.*, August, 1891.

3. Horsley: *Tr. Odont. Society*, Lond. 1887.

4. Cushing: *Johns Hopkins Hosp. Bull.*, 1907, xviii.

5. Porcher: *Tr. Am. Laryngol. Assn.*, 1903.

6. Snow: *Tic Douloureux and Other Neuralgias from Intranasal and Accessory Sinus Pressures*, New York *Med. Jour.*, 1905, lxxxi.

7. Somers, Lewis S.: *Nasal Disease and Neuralgia*, *THE JOURNAL A. M. A.*, 1906, xlvii, 741.

The first group might be said to include the minor neuralgias in which the pain is not so intense, or the attacks so paroxysmal. The second group includes the major neuralgias in which the lesion is primarily central. These neuralgias are characterized by their paroxysms which tend to recur more frequently and to become progressively worse and by the associated facial tic.

Is there a definite pathology to be found in these cases of major neuralgia?

Rose⁸ found a thickening of the interstitial connective tissues of the ganglion, and an irregularity in the form of the ganglionic cells. On this basis he regards the disease as a chronic inflammation resulting in contraction and compression of the nerve cells. Horsley,⁹ in 1897, said he had not found more degenerative changes in ganglia than could be accounted for by the age, condition and habits of the patients. Krause,¹⁰ in 1896, found degeneration of the ganglionic cells and nerve fibers, but no sclerosis or endarteritis.

In 1898 Spiller¹¹ gives the following as a result of the examination of seven ganglia removed by Keen:

The medullary substance of the nerve fibers within the ganglion and its branches is much swollen, atrophied or entirely gone, depending on the intensity of the disease. The axis cylinders similarly are markedly degenerated or entirely destroyed. The vessels are very distinctly sclerotic, in some the lumen being entirely obliterated. There is also an increase in the connective tissue of the ganglion.

Two years later Barker,¹² in reporting the condition of two ganglia after removal, said that there were scarcely any normal-appearing cells; some of the nuclei were swollen and concentric bodies were present.

Schwab,¹³ in 1903, reported the microscopic findings in four ganglia, two of which were removed before any peripheral operation had been done. The condition found in these four ganglia was the same as was found in two others reported the year preceding. He said:

In all the ganglia a certain number of distinctly abnormal cells have been found. The number is too large to be accounted for by the accidental effect of faulty technic or through any hardening or staining processes. The cell changes have been found mostly in the peripheral portions of the ganglia, and in those cells which are characterized by staining deeply, by elongated outline and by their small volume, as compared to the cells which lie in the deeper portions of the ganglia. The changes found in the cells vary all the way from a slight degree of chromolysis to profound changes of total cell disintegration and nuclear migration. In three of the six ganglia perinuclear pigmentation was present in large numbers of the cells. In one of the ganglia a sclerosis of the periganglionic tissue with excessive connective tissue formation around and between the cells was found, which was so pronounced that its pathologic significance is unquestioned. In some of the ganglia neuritic changes were found in the peripheral branches, but only in those cases in which a peripheral operation had previously been done.

Later on Schwab, from twenty cases, concludes that there is a neuritis ascending from the terminal branches; that there is an interstitial inflammation of the ganglion, and that there is a central neuralgia affecting the roots at their entrance into the pons.

In 1904 Spiller¹⁴ stated that, of 159 ganglia examined, all presented evidences of degeneration. Davis¹⁵ also reported, in 1904, a ganglion examined by him, which showed advanced degeneration. Gordon,¹⁶ two years later, in eight ganglia, "found the blood cells more or less thickened, depending on the age of the patient. The nerve bundles situated in the vicinity of the altered blood vessels always showed distinct degeneration. The duration of the disease has no special bearing on the degree of involvement of the nerves." He concludes as follows:

The occurrence of degeneration of peripheral nerves is frequent, if not constant in neuralgia. This nerve degeneration is probably a primary one which, as a neuritis, assumes an ascending condition, and secondarily involves the Gasserian ganglia; the blood vessels undoubtedly play a certain rôle in the causation of a degenerative state of the peripheral nerves. It is difficult to draw a sharp distinction between neuritis and neuralgia, as accumulated facts tend to show an anatomic basis for the latter affection.

Cases are on record in which the ganglion removed by operation has showed nothing abnormal on microscopic examination. Caminiti¹⁷ points out that at times cellular changes are present in the ganglion when tic douloureux has not even existed.

Dana has suggested, I believe, that the pain occurring in women in early years may be in the nature of migraine; but that after a number of years the pain becomes chronic and more definitely located in the divisions. In the beginning, he says, it may be a disorder of the sensory neuron, neither in the ganglion or in the peripheral branches, but later certain degenerative changes may develop in the branches. The pain occurring after 40 years of age is due to a definite lesion either in the ganglion or in the branches.

The type of lesion in trifacial neuralgia when present has been either a degenerative one, an inflammatory one, as interstitial neuritis, or a neoplasm. As I understand, Spiller, who perhaps has made as careful a study of the subject as any one living, and whose experience has been extensive, has not yet examined a ganglion which has not showed evidences of abnormality. And yet, in a personal communication to me, he said that he was not ready to state that there was a definite pathologic condition to be found in every case of trigeminal neuralgia. Possibly the consensus of opinion may be summed up in his words:

I should be unwilling to say that pathologic changes will be found in every case because we must believe that in some instances sufficient time has not been given for severe alteration to develop before the ganglion was removed.

And still, if the lesion is in the ganglion, why will division of the second and third branches of the fifth nerve, as they come off the ganglion within the skull, cure, for the time being at least, the neuralgia occurring in those divisions? In certain cases of recurrence in which Abbe operated a second time, it has been found that the pain has returned with regeneration of the nerve trunks. It was this fact which led him, in 1903, to adopt the method of interposing rubber tissue between the cut ends of the nerves to prevent reunion. If the lesion is in the ganglion, why should division of the peripheral branches give relief? Have not the better

8. Rose: Practitioner, London, 1899, lxii.

9. Horsley: Clin. Jour., 1897.

10. Krause: Berl. klin. Wchnschr., 1906, xlii; Die Neuralgie des Trigemini, Leipzig, 1896.

11. Keen and Spiller: Am. Jour. Med. Sc., 1898, cxvi.

12. Barker, Lewellys F.: Microscopic Examination of Several Gasserian Ganglia, THE JOURNAL A. M. A., 1900, xxxiv, 1093.

13. Schwab: Jour. Nerv. and Mental Dis., 1903, xxx.

14. Frazier, Charles H., and Spiller, William G.: Physiologic Extirpation of the Ganglion of Gasser, THE JOURNAL A. M. A., 1904, xliii, 943.

15. Davis: Univ. Penn. Med. Bull., 1904, xvii.

16. Gordon: Is Neuralgia a Functional Disease? Tr. Coll. Phys.

17. Caminiti: Arch. f. klin. chir., lxxvii, 4. Philadelphia, 1906, xxviii.

end-results obtained in complete removal of the Gasserian ganglion been due to the impossibility of regeneration of the nerve fibers? Spiller¹⁴ says:

Very few ganglia have been entirely removed without relief of pain; indeed, I know of only two cases, and I am skeptical concerning these.

It seems also that we have a great deal to learn about the chemical changes in nerve cells during discharges of nerve impulses. "It seems possible that long after primary irritation has ceased, an abnormal chemical state may remain and excite the pain."¹⁵

We may divide the treatment of trifacial neuralgia into medical and surgical. In determining which to advise, it is necessary, if possible, to find the cause of the disease. Also the duration and frequency and severity of the attacks must be considered. It has been estimated that nearly 20 per cent. of the cases of trifacial neuralgia are amenable to treatment other than surgical. In view of this fact, it seems advisable first to recommend medical treatment to be given only for a short length of time unless improvement in the symptoms is seen. It is needless to say that in those cases recurring after some peripheral operation, medical treatment is contraindicated.

In the treatment of neuralgia of the fifth nerve by medical means, we should first remove, as far as possible, all predisposing causes, such as anemia, malaria, lead-poisoning, syphilis, etc., giving each condition its appropriate treatment. Occasionally, this alone will be sufficient to correct the neuralgia. If the patient is arteriosclerotic, the vasodilators pushed to the degree of producing a sufficient softening of the pulse may control the pain. In the migrainous type of neuralgia, according to Dana, surgical treatment should never be advised, as the lesion is probably located in the central nervous system. One has only to glance over the long list of drugs recommended for use in trifacial neuralgia to realize the uncertainty attending the use of any one. I shall speak of only one, namely, strychnin, as it seems to be the most reliable. It should be given in large ascending doses once daily subcutaneously. If a favorable response occurs, after the pain has disappeared, the drug should be gradually withdrawn.

In 1903 Zimmern¹⁹ published an article giving the results obtained in eighteen cases treated by galvanism. He applies the constant galvanic current of an intensity of eight to fifteen milliamperes over the affected nerve endings for an hour or more at a time, after having first placed a large flat electrode over the nape of the neck, and a half mask of heavy tin-foil moulded to shape the face. In this way, as the current is distributed, no burning occurs. Of the eighteen cases of severe type treated in this way, Zimmern was successful in every case. The value of this treatment has been subscribed to in this country by Zabriskie and others.

In view of the fact that certain cases have been reported in which the neuralgia has been ascribed to nasal and buccal conditions and has been relieved by the correction of those abnormal conditions, a thorough examination of those cavities should be made. One should not be in a hurry, however, to ascribe the neuralgia to the teeth, for many patients have been martyrs to the cause in the past and have sacrificed all their teeth on one or the other side, without relief to their pain. But, as we do know that a carious tooth, antrum disease, accessory sinus disease or hypertrophied turbinates occasionally

produce neuralgia, those conditions, if found to exist, should be corrected in the hope that by so doing we may reach the cause of the trouble.

Experience has shown that by the above means a certain number of cases of neuralgia of the fifth nerve will be arrested, either permanently or for longer or shorter intervals. Medical treatment, however, should be given only a fair trial. If the attacks are very frequent, severe and uncontrollable, one should advise an operation.

The injection treatment of trifacial neuralgia has been practiced with more or less success since Billroth and Neuber first began to use osmic acid in 1884. Many cures were reported as a result of this treatment. In 1900 Schlösser began to use 80 per cent. alcohol instead of the osmic acid. As yet he has not made, I believe, a complete report, but from time to time statements have been made by him and by other surgeons, showing that much is to be expected from the alcohol injections. The object of the treatment is to reach the second and third divisions just at their exits from the foramen rotundum and foramen ovale, respectively. It is not necessary to inject the alcohol directly into the nerve sheaths, but only into the vicinity of the nerve trunks. The operation is not a difficult one to do, and as yet no bad after-effects have been noticed. As a result of the injections, a degenerative reaction is set up in the nerve, the effects of which are only transitory. Anesthesia of one-half of the anterior part of the head from the vertex to the chin is produced, as well as some incomplete paralysis of the masticatory muscles, which usually passes away in a few hours, but which may, according to Ostwalt,²⁰ last two or three months. The nerve recovers its normal condition, but "the pathologic irritability causing neuralgia disappears for a long time."²¹ Ostwalt²⁰ reported, in 1906, sixty cases of trifacial neuralgia treated by injections of 80 per cent. alcohol; one-third of the patients had recurrences within five months of the time of the first injection. The relapse, as a rule, however, was much less severe and was promptly relieved by other injections. In 1907, Schlösser, at the Medical Congress at Wiesbaden, reported 209 cases in which relief from pain lasted on an average about one year from the time of the injections. Kiliani has reached his hundred-and-eightieth case and states that "his failures are exceedingly few." Patrick²² published sixteen cases with one failure from supposed inability to reach the nerve. Of the sixteen patients, four have had occasional recurrence of pain, but they refused further treatment.

A permanent cure following a single injection is not, as a rule, to be expected. Recurrences may take place at any time from five months to one year. But Schlösser says that repeated injections delay the recurrences more and more, so that an almost absolute immunity from pain may ultimately be promised these people. It would seem as if the method has been given a thorough enough trial to mark it as a very successful palliative method of treatment.

The history of the operative treatment of trifacial neuralgia has been one of failure, until the intracranial operation was advised and performed in 1890. Since then the results of operation have been steadily growing better. The peripheral operations were a failure in

20. Ostwalt: *Lancet*, London, 1906, i.

21. Hecht, D'Orsay: *The Methods and Technic of the Deep Alcohol Injections for Trifacial Neuralgia*, *THE JOURNAL A. M. A.*, 1907, xlix.

22. Patrick, Hugh T.: *The Treatment of Trifacial Neuralgia by Means of Deep Injections of Alcohol*, *THE JOURNAL A. M. A.*, 1907, xlix, 1567.

18. Zabriskie: *Postgraduate*, 1905, xx.

19. Zimmern: *Arch. de neurol.*, xv, No. 87.

most cases, because of regeneration of the nerve fibers. Still, in those cases in which a peripheral operation is indicated, good results may follow if measures are taken, such as plugging the foramina with silver screws or plugs, to prevent reunion of the ends of the divided and avulsed nerves. Peripheral operations on the third division, for one reason or another, are usually followed by better results than operations on the other two divisions. Frazier²³ says that, if pain is restricted to the distribution of the inferior dental branch of the third division or to the infraorbital branch of the second division, there is no question but that a peripheral operation is the one of choice, because the risk is less from this operation; a certain percentage of patients will recover, and a larger number are given relief, at least for some time. One should always, however, resect a considerable portion of the nerve, or remove as much as possible by avulsion and plug the foramen.

When recurrence follows one or more peripheral operations, or when the distribution of the pain becomes more widespread and is no longer limited to one, but is referred to two or all the branches of the ganglion, the period in which the peripheral operation is indicated has passed.

There are many variations in the procedure of surgeons in performing the intracranial operation. Some surgeons, as Abbe,²⁴ prefer to divide the branches, resect a small portion as they leave the anterior aspect of the ganglion, and then interpose rubber tissue between the cut ends to prevent reunion. Other operators, as Cushing,⁴ Krause, Lexner,²⁵ favor total extirpation of the ganglion; while others, as Frazier and Kocher, prefer division or avulsion of the posterior sensory root of the ganglion. Cushing, I understand, has also lately begun to perform this operation in preference to total extirpation.

The failure of the intracranial operation from recurrence of pain has been due to reunion of the divided anterior branches when the Abbe operation was performed, or to incomplete removal of the ganglion when complete extirpation was attempted. To overcome these possibilities, Spiller, in 1898, suggested that the sensory root be divided. The success of this operation lies in the fact that unmyelinated nerves do not become regenerated after division; and, as the nerve fibers comprising the sensory root of the ganglion are not myelinated, regeneration after division does not take place. This has been proved experimentally by Spiller and confirmed by Ballance and Stewart²⁶ and Van Gehuchten.²⁷

The difficulties of the intracranial operation do not lie in the exposure of the ganglion, but in the attempt to free it from its bed and in the fact of its close proximity to the wall of the cavernous sinus and the sixth nerve. For these reasons, it is asserted that division of the sensory root is the easiest method to carry out and will result in a still further decrease in the mortality.

For a long time intracranial operations were held in disfavor, because of the attendant high death rate. Tiffany's²⁸ estimated mortality, in 1896, of 22 to 23 per cent. for many years was the basis of the argument that the intracranial operation should be advised only in case of last resort. At that time the operation was in the

developmental stage and as a consequence the risks were greater than they are at present. Hartley and Frazier place the mortality now at about 3 per cent. in competent hands. Cushing has had 2 deaths in 49 cases, while in the last 25 cases he has had no deaths. Abbe, in his last 25 cases, reports no deaths.

At present, when done by experienced men, the intracranial operation for trifacial neuralgia is not attended by more danger than is the average abdominal operation.

SUMMARY

Facial neuralgia may be classed as minor and major neuralgia. Minor neuralgias are due to peripheral causes, as carious teeth, disease of the antrum of Highmore, or nasal sinuses, by hypertrophied turbinates, nasal spurs, etc. The major neuralgias are probably due to a central lesion in the Gasserian ganglion, although, in these cases, the causes at times may have been peripheral.

The pathology of trifacial neuralgia is still indefinite. Although the investigation along that line has been very extensive, there still seems to be no definite lesion which can be demonstrated in every Gasserian ganglion removed. At least, some of the ganglia examined have given negative results, as reported by the pathologist. The lesion when present may be of a degenerative type, interstitial neuritis or a neoplasm (Frazier). Arteriosclerosis of the blood vessels is a common condition seen. In the peripheral nerves, there may be an ascending neuritis, which may secondarily affect the ganglion.

The treatment of trifacial neuralgia may be arranged under three divisions:

1. *Medical Stage*.—Medical treatment, often effective in the minor neuralgias due to constitutional conditions; includes also local treatment of nose and mouth; should not be persisted in too long without results.

2. *Peripheral Operation Stage*.—Peripheral operation, as neurectomy or avulsion, often effective in those cases in which one branch of a division or one division alone is affected. This stage includes treatment by injections of 80 per cent. alcohol in the region of the painful nerve, the results of which treatment have been very satisfactory. Cases for peripheral operation or treatment by injections should be carefully selected, and even in those cases there will be a certain percentage of recurrences.

3. *Stage of Intracranial Operation*.—Intracranial operations indicated in all types of major neuralgia where more than one division is affected and where medical treatment and peripheral operations have been tried and have failed. The operation advocated by Spiller, consisting of division of the sensory root of the Gasserian ganglion, seems to be the most rational one.

Note—In addition to the authorities previously cited, the following may be found of interest:

- Armour: Practitioner, London, 1904, lxxii.
Bristow: Brooklyn Med. Jour., 1905, xix.
Corney: Tr. Am. Laryngol. Assn., 1903.
Gabriel: Brit. Jour. Dent. Sc., 1905, xlviii.
Kilian: Med. Rec., New York, January, 1908.
Lathrop: Neuralgia of the Superior Maxillary Nerve, Boston Med. and Surg. Jour., July, 1907.
Levy and Boudouin: Presse méd., April, 1906.
Mayo: Surg., Gyn. and Obst., 1906, cxi.
Moschcowitz: Med. Rec., New York, 1906, lxx; 1907, lxxi.
Murphy, John B.: Osmic Acid Injections for Relief of Trifacial Neuralgias, THE JOURNAL A. M. A., 1904, xliii, 947.
Rickets: Virginia Med. Semi-Month., April, 1906.
Sherman, H. M.: Intracranial Neurectomy for Trigeminal Neuralgia, THE JOURNAL A. M. A., 1904, xliii, 941.
Spiller and Frazier: Philadelphia Med. Jour., October, 1902.
Van Lennep: Hahnemannian Monthly, August, 1903.
Wiatt: Trifacial Neuralgia, St. Louis Clinique, 1907, xx.
259 Benefit Street.

23. Frazier: Am. Jour. Med. Sc., 1903, cxxvi.

24. Abbe: Ann. Surg., January, 1903.

25. Lexner and Turk: Arch. f. klin. Chir., 1902, lxx.

26. Ballance and Stewart: The Healing of Nerves, Macmillan Co.

27. Van Gehuchten: Univ. Penn. Med. Bull., 1904, xvii.

28. Tiffany: Ann. Surg., 1896, xxiv.

ABSTRACT OF DISCUSSION

DR. EUGENE S. TALBOT, Chicago: I have had very little experience in the general treatment of trifacial neuralgia. Perhaps some of the most obscure cases are those in relation to irritations about the jaws and teeth. The most difficult cases I have been called on to treat are those in which there has been interstitial gingivitis for a number of years, with absorption of the alveolar process and in which the nerve fibers running into the apices of the roots have become exposed. In some cases it is very easy to diagnose these conditions, especially when the teeth are loose; on the other hand, there are obscure cases in which only one side of the alveolar process has been absorbed and the tooth still remains tight. The pulps are alive in these teeth, and it is only after exclusion of other conditions that we are able to locate the pain. In these cases the only thing to do is to destroy the pulps of the teeth. Other cases which are common and difficult to diagnose are those in which secondary dentine has developed in the dental pulp, or pulp stones. While all of us understand the pathology of the dental pulp, to a certain extent, yet from my experience in the study of this organ, I believe no one has a full idea of its pathology. It is a singular thing that within the last few years we have noted that certain conditions of the system such as autointoxication, blood poisoning, no matter whether due to drugs or systemic conditions, affect this organ, and it is one of the first structures to become involved in autointoxication. The pulp is an end-organ situated within the tooth. There are only one or two blood vessels and nerves entering the root of the tooth, where they multiply and divide and become a large mass, as compared with the entering nerves and arteries. This mass is enclosed in a crypt or cell. Toxins circulating in the blood, no matter what they may be, enter. The moment the pulp becomes engorged with blood there is stasis. Indicanuria, acidosis or any form of blood poisoning, causes this organ to become so involved that many of the diseases due to irritations are developed and deposits of secondary dentine, the formation of calcification islands, and the pressure on the nerve fibers in the pulp cause facial neuralgia. These are important pathologic conditions to the stomatologist. The average general practitioner would never locate the cause of the facial neuralgia in these structures. In cases of facial neuralgia, the stomatologist and the general practitioner should consult in order to locate the cause of the pain. The treatment outlined in this paper has become one of the fixed methods. I would like to hear more in regard to it.

DR. M. L. RHEIN, New York: As an observer I have carefully noted for some years what has been done in these cases, and from my own observations I have reached the conclusion that the general surgeon is prone to underestimate the number of cases of major facial neuralgia which develop from peripheral causes, which most originally have been minor neuralgias. This is the portion of the essay which is of especial interest to our Section. It is my belief from observation that the percentage of these cases that are ascending, as he puts it, is very much larger than is generally credited, and there is good reason for the fact that the general surgeon does not appreciate the number of cases that start in this manner. In the first place it is very rarely that he has the opportunity to come across these cases in the initial condition when it is purely of peripheral origin. But every stomatologist of any experience has had so many cases of this kind that have eventually terminated in the major form, that I feel we can all substantiate this point.

The question that is of peculiar interest to us is the prevention of major neuralgias by radically treating them in the condition that they present to the stomatologist when they are of peripheral origin. As I understand, Dr. Talbot was discussing the effect of the pathologic condition of the pulp of the teeth in these cases. It is in this very respect that I have been looking for the real etiologic factor of the peripheral origin of these cases for a number of years. Dr. Vida Latham has been very helpful to me for a number of years in mounting pathologic specimens of pulps of this nature which I have sent to her, and the microscopic examination of these pulps has borne out this fact. The peculiar relationship that the pulp has to the teeth when it is subject to unnatural irrita-

tion, is one that is bound to result in more or less of a pathologic condition at various periods of stress due to this irritating action, and it is my conviction that a great many dental operations are primarily at fault for this irritating and painful effect on the pulps of the teeth. In my experience the patients have been benefited to a great degree by absolutely eradicating the neuralgia when the case has been seen early enough before the disease has extended sufficiently into the nerve fiber itself, by the thorough removal of the pathologic pulp. In this respect I believe that when the offending tooth has been distinctly located, there has often been failure to produce the desired results.

It is absolutely essential in these cases that the pulp tissue should be removed to the very end of the root canal. In a majority of these cases crystallization of the pulp tissues has started and progressed to some extent, and this makes the removal of such pulp tissue in the multi-rooted teeth, where it generally exists, a very difficult matter, and instrumentation alone is never successful in satisfactorily accomplishing these results. When an operator discovers that he has located the real origin of this trouble in such a tooth, and is unable to remove every particle of the contents of those canals, there is only one recourse left, and that is to remove the tooth. In my experience the number of such teeth removed is very small, and only occurs when the irregularity of the roots is very great. The *x*-ray is of great help to the stomatologist, not only in giving him aid in diagnosing the offending pulp, but in informing him when he has satisfactorily reached the end of such roots. I could recite a number of cases that have passed into my hands after such pulp removal has been attempted and not successfully completed, in which, on completion by removing the contents from each of these canals, the result has been satisfactory. When the case once departs from this condition and reaches the unfortunate state described by the essayist as the major form, no method yet devised can be absolutely depended on.

I have paid special attention to the statistics regarding injection of alcohol, and I have found that my patient is relieved sometimes for a year, and even for two years; but recurrence of the major neuralgia finally ensues in a large number of cases treated in this way. I believe this to be due to the fact that the injection of the alcohol does nothing more than paralyze the nerve tissue involved at this period, and that when this action has been finally thrown off, as it generally is in time, the old condition recurs so far as major operations are concerned, therefore I am in hearty accord with what I judge is the technic of the essayist. I believe that when it is incumbent to have an operation of this kind, only the most radical offers any permanent results.

DR. J. E. POWER, Providence, R. I.: This error of faulty diagnosis is not confined entirely to the members of the dental profession. It is true that numbers of teeth are extracted for neuralgias which are not of dental origin; but this same error exists in the ranks of the neurologist, the surgeon, and the physician. By the very direction of their interests they are likely to see things from their viewpoint alone. I believe that the surgical procedure for the treatment of neuralgia should be the last thing on the program of treatment, and that while the dentist is bound in the interest of justice to refer his patient to the neurologist, the neurologist and physician have an equal responsibility, and they also are bound to refer such a patient to the dentist. While there are numbers of cases in which all the teeth have been extracted from a patient for relief of neuralgia with negative results, major operations are performed when proper examination and treatment of the teeth would reveal the cause and perhaps cure the disease. I believe that there is a very small percentage of those cases, which have become chronic, that can be traced directly to a dental origin, but the number is sufficient for us to give proper consideration to dental pains as a probable etiologic factor in neuralgia. Possibly Dr. Hussey will tell us whether or not there is any danger of tumor formation at the ends of the nerves when rubber has been interposed, and the relative danger of its presence. Since he has a wide experience in the medicinal treatment of neuralgia I shall be glad to have him relate his experience with aconitin.

The following is a brief history of a case which came under my treatment about four years ago. A patient, about 35 years old, suffered with neuralgia during varying periods, for five or six years. During these periods relief could be secured only by the administration of drugs. Examination showed a normal oral cavity. The lower third molar had been with difficulty extracted some three or four years previous. I performed an exploratory operation in the region of the extracted tooth which consisted of cutting through the tissues, chiseling through the bone, and establishing a communication with the inferior dental canal. Everything seemed normal, so I dressed the case, and in due time discharged the patient. Three years have now elapsed and there has been no recurrence of pain since two days after the operation. I do not know just what happened to cure the pain. We all know that in a process of repair of bone a callus is formed. I believe that in the extraction of the third molar referred to, the dentist had injured the bone. During the process of repair which followed a callus probably formed on the inner surface of that canal, which was just large enough to produce pressure on the inferior dental nerve. This of course is theoretical reasoning, but that the patient is cured is indeed fact.

Another case which will show the relative importance of dentistry to all other branches of medicine is the following, which had been diagnosed as trifacial neuralgia by several physicians, including a noted neurologist. The patient was prepared for an operation which would remove the second branch of the fifth nerve. The incision was made just below the orbit. When the bone was broken through pus flowed steadily from the antrum. The antrum drained and the patient was discharged cured. Is it not reasonable to believe that if the patient had been referred to a dentist or to a nose and throat specialist, the modern dentist or specialist would have examined the antrum by transillumination or other methods and even in the absence of any subjective symptoms would have made a positive diagnosis, thereby increasing the happiness of the patient.

DR. M. L. RHEIN, New York: My experience with the application of cold and heat and electricity in these cases is not very satisfactory; in the majority of cases they do not give the exact diagnostic results we desire. I have had success in reaching the tooth involved by a careful radiograph of each individual tooth in turn so as to not get one large radiograph of one side of the jaw but simply a non-distorted shadow picture of each particular tooth and its surroundings. It is generally at the point where the pulp with its circulation enters the root canal that the evidence of this inflammatory action becomes evident, and a careful study of most of these radiographs will show the effect of the inflammatory action on the alveolar structure in this neighborhood.

I do not mean to confine the dental irritation entirely to pulp effects. There are all kinds of dental disturbances that will act as peripheral etiologic factors in these cases, but nothing is so prone to do so as the condition in the case described by Dr. Powers. The number of cases due to the roots of the teeth impinging on the inferior dental canal itself has come to the observation of almost every one of us, and this is also true of the effect of leaving portions of the roots of the teeth in the jaw after such teeth have been extracted. It has been my misfortune in a way to find myself at loggerheads with a number of men in my own locality, who are specialists in the extraction of teeth, for the simple reason that it has been the dogmatic practice of the majority of these specialists in extraction, that when they fracture the roots of the teeth (and there is no blame to be attached to them for that), and find that there is no purulent condition surrounding the roots of the teeth they calmly advise the patient that they need give no further consideration to this portion of the tooth left in the alveolus, and I have found it impossible at times to get such a specialist to remove such pieces. There is no factor more prone to produce peripheral irritation than a piece of root left, especially in the neighborhood of the inferior maxillary sinus.

DR. U. C. WENDELL, Milwaukee, Wis.: Not as a neurologist or pathologist, but as a general practitioner, I am much amused at the remarks made here about the general prac-

titioner. In diagnosing these conditions, especially inflammation of the bone, cold and hot water may be used, and also the *x*-rays, but the response may be due to an inflammatory condition, or it may be absolutely reflex. The idiosyncrasy of the patient ought also to be taken into consideration. Diagnosis of a remote disease of this kind is very difficult, even the most skilful physicians and surgeons have made the greatest mistakes in conjunction with the dentist. I have known of teeth being extracted indiscriminately without any relief of the condition. I recall an instance of a small root being left in the alveolar process. The tooth had been extracted years ago. This patient was under my care for two or three years, also under the care of a physician. He came in about six months ago and said this tooth was troubling him and it would have to be removed. I told him I did not believe there was any tooth trouble, that it was a reflex from some other source. The tooth was removed. Eventually I used the exploring needle and found the remains of a small root. I removed this also, but the man came back inside of several months with the same trouble; no doubt of reflex origin. He died of endocarditis.

The reflex action of the stomach and intestines is remarkable. I recall a patient in whom, when these stomach and intestinal conditions would come on, a swelling on the left side of his tongue would appear. This is outside of the discussion, but only goes to show how misleading cases may be.

DR. E. A. BOGUE, New York: During the past thirty years I have extracted or caused to be extracted only five good firm teeth. At present I have a case which has been going on for two years. The patient has been to nine different physicians, and no one has been able to discover the cause of his neuralgia. One man thought he found it in the inflammation of the Eustachian tube. He treated him and the pain subsided and stayed away for three weeks; then it returned. No one has since been able to stop that pain for more than three consecutive days. I do not think any one stopped it; it stopped itself. Thirty years ago in New York the practice of examination of each tooth separately was advocated and Dr. Bronson read a paper at that time advocating the isolation and careful examination of each tooth. I have myself subjected my teeth to examination by six or eight different men. One hurt me so much I did not get over it for two days. Not one of them, according to my idea, made a proper examination.

A surgeon, one of the professors of the Post-Graduate Medical College, brought a woman to my office with a swelling in the roof of the mouth. I suspected some trouble with the permanent molar on the right side. She said, "Impossible, I have just come from Dr. So-and-So a week ago, and he said my teeth are in perfect order." I found on the right side two cavities between every two teeth. Dr. Rhein intimates that we do not get the results we are after along diagnostic lines. It seems to me that we should outline among us here a careful examination of such a nature that it may be possible to those who can not afford radiographs of each case. That is not applicable to people at large. We have not time to put in that way, and the patient can not afford it; the great bulk of sufferers can not have it. A specialist and (so-called) oral surgeon described at Albany one time a case of pulp nodules, as he called it, which he had been able to diagnose causing facial neuralgia. He agreed with the patient that he would cure him for \$1,600, and after an examination he found a big hole and put some arsenic in, and got his \$800 to begin with. After the arsenic had been there twelve or fourteen days the slough was removed and he got his other \$800. The facial neuralgia was cured.

I will confess my own utter inability to conceive any cause for the facial neuralgia which exists in the case which I mentioned. Transillumination has been tried. Every single tooth in the mouth has been either isolated by a rubber dam or cotton or both. There are a number of vacant canals. The patient's mouth has not been radiographed. I made the suggestion to him, but it has not been done to my knowledge. The pain is referable from time to time to the Eustachian tube on the right side. I feel certain there is no pulp exposure anywhere, no calcic abscess anywhere. I have not drilled into the roots.

I am glad Dr. Rhein has concluded that it is not wise to leave any pieces of pulp in the canal, and I hope he will agree that they are not easily removed in their entirety. I have seen several canals so small that it could not be removed at all.

DR. M. L. RHEIN, New York: I felt in the discussion of this subject we should not enter into the question of dental technic, but I do feel that so long as this is going into print I want emphatically to contradict the final statement of Dr. Bogue that it is impossible to remove the pulp contents of fine dental canals, and of the impossibility of removing pulp contents unless arsenic is used. I can demonstrate by means of radiographs of such cases the possibility of the stomatologist getting to the end of the finest canal, and I also want to protest emphatically at this time against the use of arsenic in treating these patients at all. I take an entirely opposite view from Dr. Bogue in this respect, because the very action of arsenic, its irritating effect on the tissues involved, is of such a nature that it is not an unusual etiologic factor in producing peripheral neuralgias.

DR. F. V. HUSSEY, Providence, R. I.: I agree with Dr. Talbot in ascribing a great deal of importance to intestinal conditions. I believe thoroughly that the toxic state of the body resulting from a disordered intestinal condition has a great deal to do in many instances with so-called cases of facial neuralgia. The question of dividing neuralgias into minor and major types is simply theoretical for case of discussion. We can not draw a sharp dividing line. I am of the opinion that the majority of these cases are of peripheral origin. The mere fact that we can not lay a finger on the peripheral cause does not necessarily mean that no cause is there. We know the body is constantly receiving peripheral stimuli, whether we are awake or asleep, and the fact that we are not always conscious of them does not necessarily exclude them.

Another thing which makes me think the pathologic findings which have been recorded in ganglia have been due to peripheral causes are that these findings are always very much more pronounced after preliminary peripheral operations; and in studying pathologic ganglia we should draw a distinction between ganglia which have been removed before peripheral operation and those removed after peripheral operation.

One point I wish to bring out is that medical treatment should not be indulged in too long without satisfactory results. The mere fact that a patient comes into your office and you prescribe for the pain and for the time being stop the neuralgia, does not necessarily mean that you are doing right by allowing that patient to drift along until he comes back. I think that if after three or four months of medical treatment a patient shows no signs of improvement he should be turned over to some one who can institute more radical means.

Thorough examination of the mouth, nose, eyes, ears, etc., should be made in all obscure cases. If we can eliminate disease of these structures we are so much better off.

While I believe that a cure can be promised much more definitely as a result of intracranial operation, we can not always do it. Other methods bring good results, and although they may be only temporary in the majority of instances, we can promise relief for a short time anyway.

The percentage of relief with alcoholic injection has been higher than with any other so-called palliative treatment. The mere fact that these cases recur five months, on an average, after the first injection, is no argument against the use of that method. It has been the experience of men using this method that recurrences after repeated injections become farther and farther apart.

Dr. Schlösser, who has had more experience than any one else, has taken the ground that by repeated injections you can offer a patient definite cure. It seems to me that the fact that the pain does recur is no argument against the injection treatment. I think Dr. Powers' theory in the case he recites, of a callus resulting from some injury to the jaw when the tooth was extracted, is a good one. We do know that certain exostoses will produce neuralgia, and there are cases on record in which removal has cured the trouble.

A STUDY OF MALNUTRITION IN THE SCHOOL CHILD *

[EDITOR'S NOTE: The article with the above title, by Dr. E. Mather Sill, New York, appeared in THE JOURNAL, June 19, before the discussion thereon had been submitted to the speakers for correction. The discussion was therefore omitted at that time and is now presented below.]

ABSTRACT OF DISCUSSION

DR. E. S. TALBOT, Chicago: This paper covers so much ground that it is difficult to discuss the entire matter. There are some points, however, of unusual interest to stomatologists. We all know that adenoids occur at an early age; this is also true of deformities of the turbinates and other bones of the face, nose and jaws. If the child be poorly nourished during the period of development—from the first to the twelfth year—it stands to reason that these tissues will cease to develop and will not improve later in life; that is to say, they become arrested or excessively developed and remain so. Since the brain presides over the development of the tissues of the body, when the brain is not properly nourished the poorly nourished nervous system affects the blood supply, produces arrest of development of the face, nose and jaws, and malnutrition of the teeth. I have called the attention of the profession for the last four years to the fact that the teeth are involved in malnutrition. In the eruptive fevers and other constitutional diseases the teeth do not develop strength as they would in health. I think the essayist has brought out these conditions in a general way very well. We all know that the slum children of European cities, as well as of New York, are the most poorly nourished, have the greatest deformities of the face, nose, and jaws, with adenoids, hypertrophies, etc. It is in our province as physicians and dentists to aid these children toward being properly nourished and cared for, more especially during the early developmental years, and I am sure much could be done toward alleviating, or rather preventing, deformities of the jaws and teeth, which in turn would in a large measure improve their mental qualities.

DR. W. C. WENDEL, Milwaukee: In our city we have been endeavoring to ascertain whether the children in the poor wards in the school districts are more subject to dental caries than the children in the better wards. We find very little difference between these poorer children, who have probably never consulted a dentist, and those in the better districts. We investigated some of the other school districts, where they are not exactly the poorest, but the medium class, although in these districts some attention is paid to the teeth, yet we find practically the same conditions, viz., dental neglect. Carious teeth among these children is not even so great as it is among our "better class." Tuberculous patients often have extremely fine teeth. In other cases, in which the parents are apparently healthy, we find exceedingly carious teeth in the children. Investigations have not been carried on extensively enough in this direction to be of much value, but I am of the impression that there is something deeper seated in the civilization of our people than local causes. At the same time we can not deny that malnutrition has a great deal to do with the building up of the osseous structures.

DR. E. A. BOGUE, New York: Dr. Sill did not go far enough back in his discussion. We must go back to infancy to trace the history of most of these carious teeth in children. Dr. Cronin, as you all know, has done considerable work in the matter of examination of school children. He is even now arranging for a system of school-houses, desks and seats, and a dietary and general treatment for all children under the care of the teachers. He takes the ground that we are not sufficiently paternal in this matter. That, having taken charge of the children during the hours of so-called education, we should care for them morally as well as physically. He points out that if physical defects can be corrected, either by diet or anything else, that it will cost less to correct them than to

* Read in the Section on Stomatology of the American Medical Association, at the Sixtieth Annual Session, at Atlantic City, June, 1909.