LOCAL AND GENERAL ANESTHESIA IN DENTISTRY.

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IN A REVIEW of the proceedings of this society, one is impressed with the fact that papers upon the subject of anesthesia have been presented and discussed at almost every meeting. This leads to the assumption that altho the field of anesthesia has been steadily expanding, we have not, as yet, arrived at the ideal in anesthetics. It demonstrates that the profession as a whole realizes the need for and anxiously awaits further development in this most interesting and essential specialty of medical science.

In the onward march of dental advancement beginning with the barber and blacksmith who extracted teeth as a side line, down thru the years of evolutionary development to the complexities of modern practice, numerous methods for the alleviation of pain have been employed with varying degrees of success. Today we are confronted with a new problem—that of pulp conservation—which demands extensive cutting away of vital teeth for bridge attachments and fillings without devitalization of the dental pulp; and while we hear many arguments to the contrary, I believe it to be a fact that we are facing an era in which most teeth with devitalized pulps are to be critically scrutinized by the medical profession, while the tooth containing a vital pulp will pass without question. That being the case it behooves us to conserve the vitality of

dental pulps more religiously than we have ever done in years gone by. This means that anesthesia will be demanded in operative work upon many teeth that a few years ago would have had the pulps removed prior to preparation for permanent restoration.

Much has been written upon the systemic effect of sensory nerve shock, the evil results of psychic disturbance and their lowering of bodily resistance to infections. No doubt can exist in the mind of anyone who has had the experience of having hypersensitive dentin excavated in his own mouth, that nerve shock is exhausting to say the least. It was with gratification that we read Crile's report of his experimental researches proving histologically that cellular degeneration of vital organs actually occurs in animals under conditions of pain or nervous excitation.

We are not in sympathy with the stoic who invites pain, or endures it unnecessarily in order to demonstrate his physical endurance. He could utilize energy to much better advantage than that of ruthlessly burning it up in combatting painful impressions.

Our profession must realize that anesthesia is not to be looked upon as a convenience to be used only at the request of the patient but is an absolute essential to the health of the individual who places himself under our care. Then too, all arguments to the contrary not-

withstanding, we must admit that the dread of dental operations in the average patient's mind is not one of theory or fancy, but was born in the fact that they have experienced excruciating pain incident to dental manipulations, or have been truthfully informed by someone else who has.

In looking back thru the misty haze of the centuries, we marvel at the early puny attempts to relieve pain incident to disease or surgical procedures—decoctions of mandragora and wine, hemp, essence of hyosciamus, poppy and belladonna, hypnosis, asphyxia, topical applications of ice, etc., down to Wells' historic failure in attempting to clinic publicly with nitrous oxide. Had it not been for the fact that his former pupil Morton, had faith in him altho his anesthetic was rejected by the medical profession and Wells branded as an imposter, anesthesia might have slept in oblivion for many more years. But, with Morton's substitution of ether for nitrous oxide, general anesthesia became a fact in 1846. Little more was heard from nitrous oxide for nineteen years when Colton in 1863 formed an association for the performance of dental operations under its influence in New York. Their results were so successful and satisfactory that its adoption spread rapidly thruout the dental profession and by the year 1870, (fifty years ago) its employment had become universal thruout the civilized world and nitrous oxide became the anesthetic for dentistry.

Thirty years ago the anesthetic properties of cocain were discovered. Ophthalmologists were the first to employ it topically to the conjunctiva obtaining true local anesthesia. One year later (1885) Halstedt successfully used it for mandibular anesthesia, making his injection at the mandibular foramen in the same manner as that employed today. Like many men now, dentists then showed considerable temerity regarding

the block injections and the general use of cocain was restricted to infiltration anesthesia at the site of operation until Braun, Fischer and others again brought to the front the conduction method after the discovery of the comparatively non-toxic novocain by Einhorn in 1905. Ethyl Chloride discovered by Fluorens in 1847 and revived in 1898 as the principal ingredient in Somnoform has had many enthusiasts practicing in high altitudes but never has become popular in Illinois.

Much improvement in apparatus for nitrous oxide administration together with the fact that pure gas is obtainable in steel cylinders, has assured it of a permanent place in the profession. The admixture of oxygen has rendered it safer as to mortality and more comfortable to the patient by preventing nausea. It provides the operator with a prolonged, tranquil, smooth anesthesia free from muscular contractions or rigidity, asphyxia, cyanosis or markedly increased blood pressure, under which he may deliberately work with comfort.

The enthusiasts of a few years ago who so strongly advocated operating under nitrous oxide while the patient was in the first stage of anesthesia the analgesic stage, have dropped their extravagant claims to its universal applicability and now use it in its proper place, as an adjunct to suggestive therapy or hypnosis, in favorable subjects. Thus, the practitioner of today finds himself confronted with an array of pain relieving methods and a positive demand that some of them be employed in daily practice. Here the personal equation enters into the consideration and the same care and skill in anesthetics is required as that required in performing any other dental service. To become expert in gold foil manipulation one must insert gold foil. In order to become proficient in anesthesia one must give anesthetics.

If nitrous oxide be administered by

one skilled in its symptomatology excluding all air for the first twelve to fifteen inhalations, then adding three to four per cent oxygen for a few inhalations gradually increasing the oxygen percentage to keep the dusky color from the patient's face until the mixture is approximately ninety two per cent nitrous oxide and eight per cent oxygen, there will develop a tranquil anesthesia that is absolute; that does not depend upon hypnosis or suggestion for its certainty, that may be maintained for five, ten or fifteen minutes if necessary without serious danger to the patient. The blood pressure is not raised more than twenty to thirty millimeters of mercury and the patient is not likely to suffer from nausea or to recollect anything that has transpired. Such an anesthesia is ideal for the extraction of teeth for children, for uncomplicated extractions in adults, for opening pulp chambers in abscessed teeth, for surgical procedures of short duration such as lancing abscesses, boils, felons, maxillary sinus operations, etc.

Continuous anesthesia for oral operations is somewhat difficult with nitrous oxide because the patient will, sooner or later, begin to take in air thru the mouth. This is most likely to occur in patients having nasal obstruction.

The following may be considered as difficult nitrous oxide patients,—those suffering from goitre, asthma, nasal obstruction, alcoholics, drug addicts and the obese. It is considered inadvisable to administer it to the aged or others carrying a high blood pressure unless urgent indications for general anesthesia are present.

Local anesthesia like general has had its developmental difficulties. The ice pack, later the ether or ethyl chloride spray, produced surface refrigeration; but if carried to the point of anesthesia from freezing produced a marked lowering of the vitality of tissues and in some instances actually resulted in slough. At any rate the most that can be ex-

pected of refrigeration is an incomplete surface anesthesia. Used in sensitive cavities refrigeration is extremely painful in its application and while it will produce a rather satisfactory anesthesia for excavating sensitive dentin it occasionally will cause the death of a pulp so treated.

From the local anesthetic standpoint, cocain has always performed the function of completely obtunding sensibility whenever it is placed in proximity to sensory nerves or their end organs, but because of its marked toxicity and the unexpected idiosyncrasies of patients toward it, its employment has been a source of apprehension to the operator. For this reason many substitutes have been offered, and while they in most instances are found to be less toxic in equal percentages of solutions their anesthetic potency is never so great as cocain. Therefore, they must be used in higher percentage solutions in order to obtain equal anesthetic value. Novocain most nearly approximates the ideals sought for today, after fourteen years of extensive use. It is non-toxic in the required dosage, non-irritating to living tissue, stable enough to withstand sterilization by boiling and is capable of uniting temporarily with nervous tissue in a manner to produce an anesthesia that is satisfactory to both patient and operator. The difficulties encountered in its application are not to be traced to the novocain but to the means of its application. If we could dispose of the hypodermic syringe in its use—novocain's adoption would be universal since most of the soreness, sloughing of tissues, after pain, infections, broken needles lost in tissues, painful injections etc., result directly from the use or rather the misuse of the hypodermic syringe and to the employment of unsatisfactory solutions.

In overcoming some of the disagreeable sequella that have too often followed the administration of local anesthetics in the past, we found it necessary to make certain modifications; first in the solu-

tion, second in the manner of carrying the solution into the tissues.

The fact that novocain and body fluids are both miscible with water makes it logical to employ that universal solvent as the vehicle for carrying the anesthetic agent to the tissue that we wish to influence. Sterile distilled water presents no properties capable of producing injury beyond that of disturbing the osmotic balance between tissue cells and their surrounding fluids; a feature that may readily be overcome. In order to obtain uniform results the use of freshly distilled water is demanded for the reason that deterioration takes place in distilled water upon aging. This is evidenced by the collection of sediment in the bottom of the container after a time, in the form of a flocculent precipitate. Decomposition may be augmented by the action of light, bacterial organisms, or by chemical compounds in the composition of the glass or other container. That anesthetic solutions compounded with distilled water that has become stale are more irritating than those prepared from freshly distilled water has been observed by many operators. Therefore, let us start right in the preparation of our solutions by procuring freshly distilled water; this can be quickly prepared in some one of the small inexpensive stills obtainable from any dental or surgical supply house, distilling the amount required from day to day as it is needed.

Physiologists long ago observed that the bathing of tissues in unmodified distilled water caused a swelling of the individual cells. This is brought about by a disturbed osmotic balance; the tissues containing normally a definite percentage of crystalloid material in the form of salts; principally the chlorides of sodium, potassium and calcium, the aggregate amounting to approximately six tenths of one per cent. The presence of these salts cause the hypotonic distilled water to be imbibed by the tissue

cells resulting in swelling and mechanical injury to the delicate stroma and cytoplasm and may even cause the rupture of the cell wall.

This disturbance within the cells of any tissue injected with a hypotonic anesthetic solution is in itself sufficient to account for much of the smarting, pain, swelling and after soreness so frequently observed following the administration of some widely advertised proprietary preparations. These disagreeable symptoms may be avoided by the addition of the proper amount of salts to the water, rendering the osmotic balance equal to that of the human tissues. The so-called Ringer's solution fills this need satisfactorily, having a formula of

Sodium chloride.0.6 per cent
Calcium chloride. . . .0.04 per cent
Potassium chloride. . .0.02 per cent

For convenience in compounding the ingredients in their respective proportions have been incorporated in tablet form by various pharmaceutical houses rendering the making of the Ringer's solution a very simple matter. All that is necessary is to add a tablet to a measured quantity of freshly distilled water. This solution may be injected hypodermatically without irritation save that resulting from the introduction of the needle, because it does not disturb the osmotic balance of the cells with which it comes in contact and is non-irritating when freshly prepared and sterilized. If soreness should occur after the injection of such a solution it is usually traceable to excessive force used in expelling the contents of the syringe.

Novocain, a white crystalline powder synthetically prepared, is freely soluble in water in all proportions up to equal parts. It is non-irritating, even when the pure crystals are dusted upon abraded surfaces; it is vaso-dilator to a very slight degree, and it is non habit forming—being exempt from the Harrison Narcotic Law requirements. Novocain possesses the property of combining tem-

porarily with nervous tissue in a manner to bring about a suspension of its power of receiving or of transmitting impulses during that period of combination, and of leaving no perceptible tissue change after its effect has been dissipated. It is rated as being seven times less toxic than cocaine while idiosyncrasies are extremely rare. Amounts of three to six ounces of a 1% solution and from one half to one ounce of a 2% solution have often been employed in extensive operations in general surgery, without untoward effects, placing the comparatively small amounts required for dental uses entirely within the limits of absolute safety; no other cocaine substitute is so nontoxic.

A 1% solution of novocain for infiltrative anesthesia in minor surgery such as simple extractions, pulp extirpations etc., and for conductive anesthesia in the upper jaw where the nerve trunks are of small diameter leaves nothing to be desired; but for conductive anesthesia of the heavier mandibular nerve a 2% solution should be used in order that the drug will reach the central fibres of the trunk in sufficient amount and concentration to give a complete anesthesia of the deeper structures including the pulps of the teeth. If a 1% solution be used here an anesthesia of the lip and soft tissues supplied by the outer fibres would ensue but the central fibers being unaffected by the weak solution would retain their function and the result would be a failure to anesthetize the dental pulps.

Following the isolation of the blood pressure raising principle of the suprarenal gland with a study of its physiologic action and the ischemia produced by its topical application due to its vaso-constrictor properties, it was suggested that the combination of adrenal solutions with local anesthetic agents would tend to localize and thus intensify and prolong their effect by preventing their rapid dissipation and absorption into the systemic circulation. Clinical evidence

has conclusively proven this to be true, while it also, for the same reason, was found to possess the additional advantage of preventing toxic symptoms. Thus it has been demonstrated that cocaine may be employed in one-half of one per cent solution when combined with adrenalin with results equal to a two per cent solution without it, in so far as the anesthesia is concerned without so great a danger of toxic symptoms.

The organic product obtained from suprarenal glands of animals offers a rather unstable preparation; but in recent years a synthetic preparation of identical formula has been marketed that has better keeping qualities than the organic product and being obtainable in tablet form is convenient for use.

Suprarenin when introduced into the circulation causes an increase in the force and frequency of the heart's action accompanied by a marked rise in blood pressure due to its direct action upon the musculature rather than to stimulation of the central nervous system. Locally it constricts the smaller blood vessels by direct stimulation of the circular muscle fibres in their walls. Upon injection hypodermically, this vaso-constrictor action is evidenced by an ischemic area surrounding the site of injection for a distance of one to two centimeters within five or ten seconds and lasts from thirty to sixty minutes. After a time the effect wears away and a condition of vasodilatation ensues, lasting for several hours; probably due to exhaustion of the muscular tonics from over stimulation.

Suprarenin, if administered in an overdose produces the quite characteristic and distressing signs and symptoms of precordial pain, air hunger, dizziness, a very full and often intermittent pulse, headache, etc. The symptoms come on suddenly, but are very transient lasting only from three to ten minutes and while they are those of an over-stimulation, they are not followed by the long period of depression that is observed in cocaine

toxemias. In the few cases that I have had, no medicinal treatment was given, the symptoms very quickly subsiding without assistance and the operations performed without further difficulty. These symptoms may often be averted by following the slow injection method. Just as the point of the needle enters, the tissues expel two or three drops of solution and then wait a few seconds to allow the vaso-constrictor action to take place before continuing. The barrier formed by the ischemic ring resulting from the primary injection walls off and prevents systemic intoxication, and incidentally increases the profundity of the anesthesia by retaining the solution in the injected area. The needle may then be advanced and the solution be very slowly expelled that it may be imbibed, not forced, into the tissues.

One other requisite of local anesthetic solutions is that they be rendered sterile. We need not discuss the dangers of tetanus or septic infections resulting from unclean needles or infected solutions. Many antiseptics have been employed, the majority of them being used with the idea of their acting as preservatives for stock solutions. Unfortunately the ideal anesthetic solution cannot be really preserved successfully for more than a few days, and all of the preservative agents employed are open to criticism inasmuch as the anesthetic solutions are less irritating if they are omitted.

A freshly prepared solution may be boiled for a short time thus rendering it sterile without impairing its action in the least and is to be recommended over the chemical preservatives that have been suggested from time to time. The practice of adding cardiac, cerebral or respiratory stimulants followed for so many years is looked upon today as unwarranted and unnecessary and their addition should be discouraged.

To review briefly, our anesthetic solution is now composed as follows: Freshly distilled water as a vehicle, one

to two per cent novocain as the anesthetic agent, sufficient chlorides of sodium, calcium and potassium in the form of a Ringer's tablet to render the solution isotonic with the body fluids, sufficient suprarenin to localize and retain the anesthetic mixture in the locality in which the injection is made, and the solution thus compounded sterilized by boiling.

For simplicity, all of the ingredients have experimentally been included in one tablet but these show indisputable evidence of deterioration after being kept for a few weeks so they are not to be depended upon. However, time has shown that novocain and synthetic suprarenin may be included in the same tablet without deterioration, and Ringer's solution tablets may likewise be kept indefinitely. By the use of these two tablets and freshly distilled water we are enabled to prepare a fresh solution in a few minutes that will cut short the patient's discomfort many hours when compared to the stock solutions too often employed, and the absence of after soreness and pain fully compensate for the extra effort expended.

Body cells in the deep tissues are just as much, if not more subject to catching cold or of having their resistance lowered by cold as our respiratory mucosa, and the chilling of the site of injection by carrying a cold solution into the tissues unaccustomed to temperature changes is undoubtedly productive of damage. This consequent lowering of resistance and retarding of tissue repair may be avoided by the injection of warm solutions. If the anesthetic solution be drawn into the hypodermic syringe soon after boiling and the slow injection proceeded with, it will be found to be just about the body temperature by the time it reaches its destination. This important item has been too often thoughtlessly disregarded in local anesthetic operations.

Then too, we must consider the amount of force needed for injection ever bearing

in mind the small amount of pressure actually required to traumatize and injure living tissue when hydraulically applied. We have all seen instances in which areas of necrosis one centimeter or larger in diameter have occurred. These are seen most frequently in the upper and lower first molar regions and are often traceable directly to hydraulic pressure exerted by the forcing of an anesthetic solution therein with a heavy syringe. We must ever bear in mind that fixed cells unaccustomed to trauma are bathed in lymph, and that serious damage is sure to result unless time be allowed during the injection for the lymph to escape ahead of the anesthetic solution as the latter is forced in to replace it, and in order to avoid mechanical injury only a very light pressure upon the piston is permissible during the injection. If forty to sixty seconds are consumed in emptying the syringe in loose cells and two to three minutes in firm gum tissue those minutes are well spent and are far from being time lost.

Oral mucosa like the skin, constantly harbors infectious bacterial organisms in its superficial layers. These are held in abeyance under normal conditions by the phagocytic properties of the leucocytes, but if they be carried mechanically into the deeper structures inflammatory processes would likely ensue. This carrying of infectious material along the course of the needle has undoubtedly been the cause of considerable after soreness, pain and delayed healing following the administration of local anesthetics and should be considered as one of the avoidable accidents.

Tincture of Iodin U. S. P. 7% applied by means of a tightly rolled pellet of cotton and massaged well into the mucosa at the point selected for the insertion of the needle will not only fix the bacteria in the tissues and disinfect the site, but will render the pain of the initial puncture with the needle almost imperceptible.

With a little practice any operator may so train himself to manipulate the hypodermic syringe that the pain of the insertion may be still further minimized by holding the syringe during its insertion in such a manner that no change in the grasp need be made after the needle is inserted in order to expel its contents. The best method will be found to be the balancing of the syringe with the barrel resting between the second and third fingers of the right hand, placing the first and fourth fingers above the second and third respectively, with the cross bars resting between and the thumb on the piston. Holding the syringe in this manner permits the injection of two or three drops of anesthetic solution just as the needle enters the mucous membrane and allows the injection to proceed while it is advanced thru the tissues thus anesthetizing ahead of the needle as it is carried in.

The site selected for the primary insertion of the needle should when conditions permit, be at the point of reflection of the buccal or labial mucosa from the alveolar process. Mucous membrane at this point because of its protection from irritation, has a much poorer sensory nerve supply than the mucous membrane of the gingiva and by taking advantage of this we may make the needle insertion at that point with a minimum amount of pain. The submucosa here is loosely constructed, with large intercellular lymph spaces, allowing the injection of anesthetic solutions with very little pressure, there being an easy interchange of anesthetic for the lymph surrounding the fixed tissue cells giving true anesthesia without such disastrous complications as tearing or traumatizing of tissue from the exhibition of excessive force because the operator happens to be in a hurry.

One of the most frequent causes of imperfect anesthesia, that is met with today is that the operator after making a satisfactory injection will proceed with

the operation immediately without waiting for the anesthetic agent to act upon the nerve fibres. All of the local anesthetic agents in common use require from five to eight minutes contact with nerve endings or nerve fibres in order to be absorbed and to reach the maximum anesthesia. Therefore, when we allow for diffusion thruout the injection area and sufficient time for the drug to be absorbed and reach the maximum anesthesia possible, ten minutes from the time the injection is started is not too long to wait for a true anesthesia of any of the smaller nerve fibres, and from fifteen to twenty minutes are needed for larger trunks such as the mandibular and possibly the posterior dental and infraorbital nerves.

If anesthesia be obtained immediately following either infiltrative or conductive injections it may safely be assumed that it is a pressure anesthesia from tissue injury produced by using too much force during the injection rather than from any action of the anesthetic agent employed, and would be obtained just as certainly if water had been used instead. This is to be avoided because a condition of lowered resistance is produced from the injury, accompanied by after soreness and edema and is often marked by delayed healing.

Local anesthesia is classified under two distinct divisions, viz. Infiltrative;—the application of a local anesthetic agent to the distribution of sensory nerves thus paralyzing their endings and their power of receiving impressions, while conductive or block anesthesia consists of the injection of a local anesthetic solution into the region surrounding a sensory nerve trunk thus paralyzing its power or transmitting afferent impulses sent up from its area of distribution.

For many procedures the infiltrative type of anesthesia is perfectly satisfactory, for example, the removal or normal or hypertrophied gum from over erupting teeth or from proximal cavities that

it has filled in, or of hypertrophied pulps the injection may be made directly into the tissue to be excised so that the point where the puncture is made is excised with the tissue thereby avoiding after soreness from that cause as would probably occur to a slight degree if the puncture and injection be made around the area. For the removal of superficially seated roots that have little bony process supporting them, the infiltration may be made by injecting to the buccal and lingual surfaces allowing sufficient time for the maximum anesthesia to ensue. For cavity preparation in the lower incisors or the ten upper anterior teeth the infiltration of 1 c.c. of solution over the apices of the roots will usually obtund sensation. For the extraction of lower incisor teeth infiltrative anesthesia suffices and is preferable to conductive since the latter affects the entire side of the face producing the characteristic paresthesias for two or three hours which is somewhat annoying to the patient while recovery is taking place. The maximum anesthesia in the infiltration of superficial areas requires waiting for five to ten minutes after injecting. For extraction of deciduous teeth, the roots superficially seated in controllable children, a small amount of novocain solution infiltrated about the teeth will give perfect anesthesia,—the principal difficulty being to make the needle prick as nearly painless as possible. If abscess conditions exist about deciduous teeth gas oxygen anesthesia should be employed.

Almost everyone who has seriously entered the practice of conduction anesthesia has found that with increasing experience in its use he employs it more and more to the exclusion of the formerly more commonly practiced infiltration. This is accounted for in the comparative painlessness of the needle insertion and the injection, the small amount of solution required for blocking large areas, the absence of after pain or soreness, and the absolute anesthesia obtained.

Patients upon whom it has been used for cavity preparation or surgical precedures are pleased with the results and request its use on subsequent occasions and that encourages one to use it with increasing frequency as time goes on. It is not recommended over, nor will it ever supplant nitrous oxide for the highly nervous, the uncontrollable neurasthenic who dreads the sight of instruments; for the physically exhausted individual who has been in pain for a number of days; for the child with whom it is difficult to reason, nor for extractions in acute abscess conditions. But for the preparation of the sensitive cavity that does not respond favorably to the usual methods of desensitization such as compressed air, dehydration, volitalization of phenol and essential oils, sharp burs and delicate manipulation, for the removal of vital pulps with the possible exception of the lower molars, for root amputations; for extractions; for prolonged and complicated operations such as the removal of unerupted and impacted teeth; for maxillary sinus operations; for the reduction of fractures of the mandible and for the removal of tumors and cysts about the jaws it gives complete anesthesia. The patient can be placed in any position in the dental chair that is most convenient to the operator, there is no aspiration or swallowing of blood or mucus and no nausea, vomiting or prostration after the operation is over. In fact the anesthesia will usually last until the patient reaches home which in itself is highly desirable.

The use of the high pressure syringe for the purpose of pulp removal or excavation of sensitive dentin has been almost wholly discarded since its use often necessitated the drilling of a separate cavity or pit for the purpose of confining the solution. Then the occasional reports of death of the pulp subsequent to its use discouraged most of its strongest advocates.

So we find ourselves today face to face, not with a theory but with proven

facts. First: Anesthesia for dental operations is essentially necessary from the humanitarian standpoint alone. Second: Patients suffer degenerative changes in vital structures when painful operations are performed without anesthesia. Third: Many prospective patients are barred from much needed dental service by fear, because dentistry in the past has been too prone to ignore the pain inflicted upon patients. Fourth: If more painless methods are adopted, patients will be seen more often with the result that the vitality of pulps will be better conserved. Fifth: No dentist can do as thoro and lasting operations upon teeth or their supporting tissues if the patient is suffering pain as he would do if anesthesia were present.

In my opinion conductive anesthesia has many advantages over infiltration in that it affects deeper tissues giving total anesthesia to an entire area while infiltration is a surface affair. The needle insertion is almost painless and the tissue disturbance at the site of injection is practically nil.

I believe that the removal of vital pulps under anesthesia is to be preferred to arsenical pastes in most instances both from the point of minimizing pain and because tissue destruction is then mechanical and is under the control of the operator.

In the employment of any method the success or failure often rests not upon the anesthetist but with the patient. There are patients who come to an office expecting local anesthesia, who will fight attempts toward the induction of a general anesthesia and if enough time and patience are consumed to coerce them into taking a general anesthetic will develop all possible unpleasant complications and go home with a feeling of resentment toward both the anesthetist and anesthetist. That patient should have had local anesthesia.

On the other hand I have seen patients who desired general anesthesia in

conditions where in my opinion conductive would better serve the purpose,—would secure perfect local anesthesia, but patient apparently suffer so marked mental distress that I would finish with general anesthesia. Therefore, it should be borne in mind that the attitude of the patient is worthy of serious consideration in the selection of an anesthetic. Remember that a patient is sometimes a patient not always a "case."

In conclusion your essayist is of the opinion that there is a place in every practice for the gas machine, compressed air, infiltration, conduction and possibly intra-osseous anesthesia, and above all, the operator who knows kindness, firmness of conviction, sympathy and human understanding—who will select anesthetics with care to fit his patient as well as the operation.

DISCUSSION.

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In reviewing the essayist's paper seriatim for the purpose of discussion, I find myself at variance with him when he says that those who were enthusiastic a few years ago about nitrous oxid analgesia have relegated it to the past and are using local anesthesia instead. If that is the rule, I am one of the exceptions, as I still use nitrous oxid analgesia in certain cases and with a great deal of satisfaction to both my patients and myself. I do not use it as freely as I did before conductive anesthesia became popular and I appreciate the value of the latter method to a degree which in the average case makes it my method of choice. However there are cases for whom nitrous oxid analgesia amounts to almost the sine qua non and in such cases I use it unhesitatingly. Hence I would say that in properly selected cases nitrous oxid analgesia must even now be regarded as the method of choice.

I have experienced no difficulty with nitrous oxid in goiter cases except per-

haps that type of goitre causing a dyspnoea hence I believe that barring that type, goitre per se does not offer a particular objection to the exhibition of nitrous oxid. I would, however, add a group of cases to those enumerated by the essayist as difficult in the administration of nitrous oxid, namely children. And I believe a good rule to accept is that in inverse proportion as a child is younger than ten years of age does nitrous oxid become more dangerous as you give it for general anesthesia. In the hands of a skilled operator, appreciating the danger and if limited to short anesthetics no serious results need be feared, but these cases should be given even greater care than those of the average adult.

As to local anesthesia I will confine my remarks to the conductive method since that is for we as dentists the most important and most satisfactory type of local anesthesia known.

Let me preface those remarks however with a general statement and I want to make this statement with all the emphasis at my command and that is that the operator who wishes to practice local anesthesia must know and must observe and practice asepsis. The man who does not have the sense of asepsis, who cannot develop it, who is not willing to insure surgical cleanliness in the performance of this work had better leave local anesthesia alone. He is going to have trouble if he attempts to practice this art and he is likely to decry the method and say it is no good.

Lack of asepsis is often responsible for soreness, sloughing of tissues, after-pain and suppuration. A stale solution may also produce the manifestations of infection just enumerated. The cause of these symptoms lies with the operator not with the method. Lack of care, lack of asepsis, traumatic injuries due to dull needles, stripping up of periosteum, too swift an injection of the agent, lack of isotonia, too great a variation of tempera-

ture, solution made of partially deteriorated substances, stale solutions and those containing antiseptics furnish some of the causes of untoward after effects in the practice of local anesthesia.

The essayist refers in his paper to broken needles. Now, needles are broken because the patient suddenly twitches his head to one side when the needle is in the tissues, but they are also broken because they are too old (rusty) too dull, too thin, too short or because of improper technic as, for instance, trying to go around a corner with a steel needle which is imbedded in the tissues.

The essayist makes the statement that no other cocain substitute is so nontoxic as novocain. I cannot agree with him. We have another drug no more toxic than novocain, synthetically prepared like novocain, yet absolutely different in its construction and that drug is apothesine. It is just as quick in action and quite as potent as novocain. Personally I would just as soon use Apothesine as I would novocain or procain.

As to the strength of solution employed the essayist says that one cannot get anesthesia of the larger nerve trunks by using a solution containing less than two per cent of the anesthetic agent. Personally I have come to use a one per cent solution of either novocain or apothesine for all my work. I do not find the stronger solution necessary. And I use a freshly prepared normal salt solution as a vehicle. Ringer's solution for this purpose is just as good, no better. Both solutions are non irritating to the tissue cells and all we need is a solution of about the same osmotic tension as that of the tissue fluids of the body.

A word with reference to the use of suprarenin or adrenalin in the solution. The essayist prefers suprarenin because he says it is more stable and that adrenalin is not of uniform or standard strength. The statement is frequently made that adrenalin is not of uniform strength while suprarenin is. That is

what is claimed for suprarenin by its manufacturers. As a matter of fact adrenalin is standardized, is of uniform strength and can be absolutely depended upon. The same is true of the solution which is freely used all over this continent by both the medical and dental professions. As to the stability of the two agents, I believe that they are about evenly matched, at least they are alike so far as practical purposes go. For instance adrenalin may be boiled three different times over an open flame for fifteen minutes without loss of activity after the second boiling and but slight loss after the third, while suprarenin shows a slight loss after the second boiling and more after the third. So I think that this preference of suprarenin is another piece of German propaganda. There is, however, this difference, a solution containing suprarenin which becomes pink on boiling should be discarded because of the great toxicity of the partially oxidized suprarenin, while a solution containing adrenalin of similar color may be used with just as much safety as a perfectly clear solution, the only change in this solution being a slight loss of activity of the adrenalin due to such deterioration, but no increase in toxicity.

This brings to mind the question of relative toxicity of the anesthetic agent and the suprarenin or adrenalin. One is apt to think of novocain or apothesine in cases of poisoning and forget all about the real offender. As a matter of fact if toxic symptoms develop they are usually due to the suprarenin or adrenalin and not to the anesthetic at all. To impress on one's mind the toxicity of these latter drugs a comparison of their dose with that of novocain or apothesine is in order. The dose of adrenalin or suprarenin is five tenths of a milligram (0.0005) while the dose of novocain or apothesine varies between three tenths of a gram and eight tenths of a gram (0.3-0.8) or an average of five tenths of a

gram (0.5.) We see at once that the dose of adrenalin or suprarenin is one thousand times less than that of novocain or apothesine. Hence great care is necessary in the use of the former agents. If the solution we use contains adrenalin or suprarenin in a proportion varying from 1:50,000 to 1:100,000 we need not fear trouble from its use.

The most potent solution results when we compound it at the time we wish to use it, taking a sufficient amount of a freshly prepared normal salt or Ringer solution as a vehicle, adding to that the required quantity of novocain or apothesine then adding a sufficient amount of suprarenin or adrenalin to meet the requirements of the case in hand. Boil and inject at body temperature. Here too, I differ with the essayist when he says that the ideal solution is one that can be kept for a few days and can be used after a few days. I do not believe in using stale solutions, I want a fresh solution.

As to the management of the highly nervous and neurasthenics who come for operation which demands a local rather than a general anesthetic, I usually administer a sedative one-half hour before the operation and thus avoid trouble. For this purpose bromural six-tenths of a gram for an adult may be used or validol seven drops in a little water may be employed and the patient becomes composed and calm to a degree which permits the work to proceed in a satisfactory manner.

The essayist gives acute abscess as a contraindication to the use of a local anesthetic and where such an abscess lies in the path of the needle or at the site of injection for conductive anesthesia, I agree with him and use nitrous oxid. In all other cases we have the choice of both methods, which ever appeals to us to be the more expedient.

I would like to have the essayist explain in closing the discussion how he expects that ischemic ring produced at

the point of entrance of the needle to influence the solution which he injects for nerve blocking. The ring produced is very small and located from two to three centimeters away from the point at which the principal injection is made, hence cannot possibly influence the tissues at the latter point.

The author has dealt with the subject of anesthesia more from a general than from a detailed or specific standpoint. There are some points I wish to mention at this time which seem to be of great importance to the beginner and which when observed insure success for all practitioners in the greatest number of cases. They are points which I have evolved in my experience in conductive anesthesia, which are not found in textbooks.

First: Technic of mandibular injection. Needle is inserted according to method advocated by Fischer, which means that when in the mandibular fossa it has entered the soft tissues to a depth of about three quarters of an inch. If at that depth the point of the needle strikes the bone, so that it can be advanced no further in the same direction the injection made at that point will be successful every time. If you do not strike bone (the posterior lip of the mandibular sulcus) inject a few drops and repeat technic of inserting needle. Point of entrance may be too low, direction of needle may be wrong.

In this connection I wish to mention a statement we find in most textbooks which is wrong, namely, that in most cases when you make this injection you will also block the buccinator or buccal nerve. That in some cases you do not get it. In these cases you find sensation in the gums on the buccal aspect of the molars which calls for an additional injection to control that nerve. That is all wrong.

The course of the buccal nerve lies entirely out of reach of the injection under discussion. It is given off from

the anterior division coming from the common trunk of the third division of the fifth nerve and is described as passing obliquely forward between the two heads of the external pterygoid to reach the buccinator muscle. The superior head of the external pterygoid arises from the infratemporal surface of the great wing of the sphenoid, the inferior head from the lingual surface of the lateral pterygoid lamina of the pterygoid process of the sphenoid bone. So as a matter of fact we never reach this nerve when we make our injection and the anatomic facts are that this nerve supplies those gums in only fifteen or twenty per cent of cases and in all those we must inject to block the branches in the cheek.

The blocking of the posterior superior alveolar branches seems another difficult route for the beginner. Here too follow Fischer's directions but when needle is about one centimeter in the tissues, make sure that you are near the posterior surface of the maxilla by making a little pressure forward on the syringe so that you may feel if the point of the needle is near bone, if it is, advance it in the same direction to full depth, if not, inject a few drops and change direction of needle until you feel the bone. Needless to say that for this you need a steel needle 24 gauge and that is the only kind I use anyway. By following the above directions you will have uniform success with this injection.

As to infraorbital injections, I would like to suggest caution in following any definite set of landmarks because they do not hold true. You cannot go in a certain direction from the cuspid tooth because the foramen will not lie in that direction all the time, nor can you find it by using the bicuspid as a guide even when there is a full complement of teeth with perfect alignment because there is such a wide difference in different heads that one cannot rely very much on any definite set of landmarks for this

injection. There is one method however which does spell success and that is the actual locating of the foramen by palpation with the index finger and the guiding of the needle to place by means of that finger. When in situ with the opening of the needle looking backward into the canal, make firm pressure with the finger over foramen while injecting and no massage will be necessary after the injection nor will there be any swelling on the face.

If these remarks will prove of help to any beginner or practitioner I will feel that I have not taken up the time of this society in vain.

Henry L. Whipple, Quincy, Ill.

The essayist has given you a most excellent paper and I wish, first, to congratulate him most sincerely. He has handled the subject with rare judgement and has given us excellent data.

When you trace the trend of thought and, following the essayist "from the time of the barber and the blacksmith, who extracted teeth as a side line" one can hardly refrain from expressing himself in these words: "How long, oh Lord" will we be jumping from this idea to that one, fathered by the radical investigator and the dreamer.

Let us refer to the essayists statement relative to pulp conservation: You may look back to the time when the dental practitioner deemed wisely that a tooth with an exposed pulp should by all means be extracted, and if you please, follow up in your mind the methods of treatment of such cases, to the present time. If you happen to be interested in the investigation of the etiology of systemic ailments, directly traceable to the foci of infection in the oral cavity, will we not debate in our own minds if it isn't possible that in the near future we may come back to the idea once again, that in such cases, immediate extraction, which will not necessitate the curettment of the process, is the wiser, as an ounce of prevention vs. a pound of cure?

You must not get the idea that in this discussion I am digressing, for you will see that it must lead to the proper or indicated method of anesthesia for these cases and I most heartily agree with the essayist, that anesthesia is an absolute essential to the health of the individual who is placed in our care. Whether the patient is to be anesthetized generally or conductively or locally, we must be thoroly aware that there is a certain shock to the nervous system suffered by him which can not be obviated no matter how surely he may KNOW he is not to be hurt, you may therefore well imagine the extent of ADDITIONAL shock to the nervous system when the patient is aware that the operation is to be performed without anesthesia, no matter how stoical he may be.

The essayist does not take you any farther back in the use of nitrous oxide than the time of Wells, in the 1840's, and it may be interesting to know that nitrous oxide was discovered by Priestly in 1772 and the principle use made of it at that time was as a means of entertainment, as are our hypnotic entertainments in the present day. It was known to produce peculiar sensations and mental effects when used or inhaled in the pure state and the enjoyment of the audience in the antics of the subjects made a rare evenings entertainment.

Its use in surgery, was first suggested in 1800 by Sir Humphrey Davy, and Wells in 1840 began its use in his practice and even went so far as to administer it in cases of amputation etc. It was carried on by Morton and Colton and Long and it was during a period of serious controversy between himself and Morton, who had been a student under him, that he died by his own hand in the year 1848.

If the technic given by the essayist is carried out perfectly, I can not see any reason why the patient could not be held in a stage of deep anesthesia, safely, for

hours and in fact I have seen very serious abnominal operations performed in the deep stage of nitrous oxide anesthesia, maintained for a period of three hours and the blood pressure remaining relatively normal and the color remaining a perfect pink.

As the patient progresses from the conscious into the unconscious state, the following changes, which will serve as landmarks to the anesthetist—. The respiration may voluntarily be of any type until consciousness is lost, it then settles down to a rythm in anesthesia, with inspiratory and respiratory phases nearly equal, but slightly faster than normal and uninfluenced by the surgical procedure. Should the respiration become irregular or spasmodic, the stage of anesthesia is too deep and is threatening.

The blood pressure in the early stages, before consciousness is lost and tranquility secured, would be higher as a result of rapid heart action, fear etc, but within a few minutes, however, the pressure returns to normal or lower and is modified thereafter by conditions of the operation.

The essayist touches upon the developmental difficulties undergone in the past with reference to local as well as general anesthesia and speaking particularly of cocaine as an anesthetic, I would say with great earnestness, that he is correct in asserting that "its employment has been a cause of appreciation to the operator."

Personally, I have been very much afraid of the results of the use of cocaine and have not used it for many years, and I can assure you that when you are confronted with unexpected idiosyncracies of your patient towards the toxic effect of this drug, you will need to be well trained in the proper and effective treatment antagonistic to its effect. It might be added, that your own blood pressure at such a time will be very much above normal.

With regard to novocain, I heartily

agree with the essayist in the statement that it is the most nearly approximating the ideal sought today. Its non-toxic, non-irritating properties in proper dosage makes it most acceptable as a medium of anesthesia.

The technic given by the essayist is ideal and it is most necessary that operations be carried on in an aseptic manner and the field must necessarily be in a perfectly aseptic condition. I would therefore emphasize his thought and dwell not only upon the essential aseptic solution and needles but would reiterate his caution, that drying and sterilizing the mucosa with iodin prior to the injection, will not only kill the bacteria but will render the pain of the initial puncture almost nil.

I wish to again thank the essayist for his most profitable paper and I desire to congratulate this society in being its recipient.

Arthur E. Smith, Chicago.

Mr. President and Members of the Society: I wish to congratulate the Chairman of the Program Committee on securing Dr. Puterbaugh to present this interesting subject to us this afternoon. It is exceedingly difficult to discuss Dr. Puterbaugh's paper inasmuch as the points he has covered are concrete. I agree with him in all that he has said with the exception of a few minor points. I do not know of any paper to which I have listened and have been invited to discuss that has interested me so much as the paper Dr. Puterbaugh has presented. He has given us not only concrete facts but a comprehensive view of the whole subject.

The modern trend of the dental profession today is the elimination of pain, and I think those dentists who do not take advantage of the various methods which have been discussed are turning

their patients away from the comforts which they should enjoy from anesthesia, local or general, whenever used. I think a large percentage of the laity realize that it is possible today to perform the most painful dental operations without pain, and that this subject of the elimination of pain in the practice of dentistry is a very peculiar one; it is something that demands a great deal of consideration and study, and one that in the past has been passed by as a side-line more or less, and I think many practitioners have looked upon it as a mere specialty or as an excuse for using a slipshod method. I think the time is coming—in fact, it is here now—when most of us realize that the elimination of pain in the practice of dentistry is a reality. It is not as practiced by the quack in years gone by. We have methods at our disposal today which, if mastered, will give patients the benefit of the relief of pain, and in so doing we certainly can perform better and higher class operations. The dental profession should feel proud of the fact that it has in a great measure been responsible for the advancement which has taken place since the year 1844, when Wells made known to the world surgical anesthesia produced thru the medium of nitrous oxid-oxygen.

To illustrate what Dr. Puterbaugh has said, I will say that in the year 1885 or 1887, anesthesia was produced by injecting a solution in the region of the mandibular fossa, thus producing anesthesia of the inferior dental nerve. I spent a great deal of time in the library recently looking up the history of local anesthesia, and to the best of my knowledge I have found that the first nerve blocking injection is due to Professor Matas of New Orleans. He injected alcohol in the region of the second division of the fifth nerve which crosses the

spheno-maxillary fossa in a woman for tic douloureux in the year 1884. Dr. George W. Crile, of Cleveland, Ohio, injected a weak solution of cocain into the region of the brachial plexus in 1887 before the Ohio State Medical Association. This nerve blocking injection was for the amputation of an arm. So after all, according to the literature and in going thru the records, I have found that Professor Matas, of New Orleans, deserves the credit for making the first nerve blocking injection. When we couple that with the discovery of chloroform, ether and nitrous oxid anesthesia by Americans, it certainly should make us feel very proud of that fact.

Do not use anesthetics in your practice merely as a convenience. It is a great convenience, in that it places the patient and you in a position whereby you can operate much faster, whereby you can render a greater service than if you were inflicting pain upon many patients on whom it is not possible to operate without inflicting pain.

The essayist spoke of the failures which were encountered by Dr. Wells in the administration of gas-oxygen. It is not to be wondered that Dr. Wells failed in his demonstration which he gave in the Massachusetts General Hospital in Boston. The apparatus he used was very crude, it consisting of a large bag to which was connected a large rubber tube generating the gas, with a place being provided for squeezing out the gas. It is no wonder Dr. Wells failed. Today we have a number of American nitrous oxid appliances, and those modern machines cannot be compared with the very crude apparatus that Dr. Wells used.

The fundamental basis of general anesthesia first of all, is the symptomatology as Dr. Puterbaugh brought out. The anesthetist by all means should be

able to detect the pathological heart. He should be able to tell when danger is approaching. He should be able by all means to know the pharmacological action of his gas and oxygen, ether and chloroform, or whatever he may be using, so that the fundamental basis of general anesthesia, you may say, is physical diagnosis and of being thoroly familiar with the drug which you are administering.

I might also bring out the point that in many cases, instead of producing anesthesia, asphyxia is produced, and in this respect I have reference to gas-oxygen. Many of you gentlemen have noticed after the administration of gas-oxygen, the patients have become black in the face. That is not anesthesia by any means. It is asphyxia, and many of the patients whom you hear occasionally of dying in the dental chair, if the truth was known, were subjected to extreme cyanosis. General anesthesia is contraindicated in cases of increased blood pressure changes, in patients suffering from arteriosclerosis, or from some pathological condition of the heart, such as myocarditis or aortic regurgitation, or some of the grave heart affections.

The essayist stated that in order to become experienced, one must administer anesthetics. That is a good point. I have heard many remarks made by dentists here and there, saying do not do this or do not do that, and while many of these men have been handicapped, more or less, they are not wanting in experience. When one makes a statement with reference to the technic or to the solutions that are used, or regarding some of the bigger things, he should be very careful and not rush into print because it may mislead some dentist. He must be sure that he is right, but many such statements that are untrue have crept into the journals, particularly with reference

to solutions, distilled water, and technic, and these things have hurt the advancement of block anesthesia and general anesthesia rather than helped them.

As to the toxicity of the various local anesthetics, I will say a word or two about that. It has been my pleasure to do some research work along this line, and when the report is completed it will be published, but our conclusions are today in favor of procain. At this time, I wish to call attention to the fact that the federal government has changed the word novocain to procain because procain is an American word and novocain is the original German word. When novocain was made in this country it was analyzed by Professor Stieglitz of the University of Chicago and by Dr. Letcher of Cornell University, and the product was found to be identical with the original product, and articles were printed in the *Journal of the American Medical Association* in which it was advised to use the word procain in all the prescriptions containing this drug.

Another word to which I desire to call your attention is that of conductive. Dr. Herman Prinz, of Philadelphia, brought this out something like a year ago in an article in the *Dental Cosmos* in which he criticized the word "conductive". The word conduction is preferred. Personally, I prefer the term block anesthesia or nerve blocking. Conduction is a noun and it should be used instead of the adjective conductive.

I cannot exactly agree with Dr. Puterbaugh in stating that the difficulties encountered are not traced to the procain but to the methods of application. I take it from that that he means the toxicity of the drug. Procain, when injected into a patient in an over-amount will produce toxic symptoms similar to those arising from the toxicity of cocain. The symptoms are similar, but of course a greater amount of procain must be injected, but the mode of application has a great deal to do with it I grant you.

Slow injection, as Dr. Schultz brought out, is an important factor in the elimination of approaching syncope or collapse. I have made it a rule to allow a second of time after each minim. For instance, if I inject two mils of solution, I will take thirty seconds, one second per minim. Even a longer period of time would be advisable or better. The injection of the solution, therefore, is a most important factor. The dentist should not allow his office assistant to make up the solution from tablets that are disintegrated, or show the girl how to do a thing which does not conform to the regulations and principles laid down in bacteriology, such as the use of distilled water that has been stale for several days, or Ringer's solution which is stale and adding tablets which have been poured out on a towel or in the bottom of the hand in the solution. All these things should be avoided, and I can only repeat what Dr. Schultz has said that the rules of asepsis must be practiced at all times. Remember in this work, if you get into trouble, if you have a case of infection following the injection, no doubt your technic is to blame, and if you have a deep-seated infection it is far different from a superficial infection. I have noted this time and again in clinics. I have observed in clinics that a dentist will use every precaution in drying the mucous membrane in the mouth with gauze, painting it with tincture of iodine, but in picking up the hypodermic syringe, I find that the area of insertion of the needle is flooded with saliva, or in carrying the needle in the flame and carrying it to the mouth it may touch the lip of the patient or tongue. Now, what is the use or sense in sterilizing the mucous membrane if you are going to overlook one of the great and essential factors that is, in carrying the needle into the tissue in a sterile condition. If the surface or mucous membrane is flooded with saliva,

the needle will carry in a few million of bacteria into the tissue.

In this work of deep block anesthesia, if you get into trouble by having infection take place, no doubt your technic is faulty. You are to blame for using that kind of technic.

I would urge you to be careful in the preparation of your solution. Be sure that it is sterile. Be sure that your iridio-platinum needle has been passed thru the flame and brought to a red heat before you enter the tissues with it. Personally, I have made it a rule never to take the syringe and carry it to the patient's mouth and mucous membrane until it has been passed thru the flame. If you place the syringe on your cabinet, you should be careful not to touch the needle with the coat sleeve, or allow your assistant to touch it, or allow the needle to come in contact with anything that is not sterile. Remember the rules of asepsis and by all means practice them.

I agree with Dr. Puterbaugh in stating that Ringer's solution is the ideal vehicle. Ringer's solution is considered to be the best, not only by a large number of men who are using a great deal of anesthesia, but it is also considered to be better by physiologists. Ringer's solution is a better stimulant and I can cite to you striking experiences.

Suppose you remove the heart from a frog or a turtle and place it in physiological saline solution at body temperature, that heart will not beat for a long period of time. After the stimulation of the physiological salt solution has worn away and each beat of the heart grows weaker and weaker, if the heart is taken out of the physiological salt solution and placed in a normal Ringer's solution at the same temperature of the body, the heart will pick up in force, the blood pressure will increase and the heart's action will be as great as it was before. If there is not something in Ringer's solution of calcium or potassium that produces this effect I would

like to know. The liquid content of tissue contains a certain amount of potassium, sodium and chlorid. It is reasonable that we should use a vehicle which conforms to physiological laws and function, leaving the cell as early as possible, and we find it in Ringer's solution. I do not say that Ringer's solution is a great stimulant when injected. Inasmuch as we are taught to use isotonic solutions, why not use a vehicle that contains calcium and potassium in addition to sodium chlorid instead of employing sodium chlorid solution alone.

Another important point I wish to mention is the isotonic solution. An isotonic solution is one which conforms to osmotic value, or having the same osmotic pressure is equal to the amount of blood or tissue contained, that is, the liquid contents, in the tissues of the cells.

Another striking experiment which proves the value of using isotonic solutions can be carried out by taking three slides. Try this out some day when you have a little time with your microscope. Take three slides; place a small amount of blood on each slide. To slide 1 add distilled water, place it under the microscope, you will see the erythrocytes enlarged, and you can actually see the cells break under the microscope; that is to say, the mucous membrane which surrounds the erythrocytes will rupture and hemoglobin discharge. This shows what has taken place in the way of osmosis. Take another slide and add isotonic solution, and place a cover slip on and you can see the cells float around in the solution. Take a hypertonic solution, one that contains an extra amount or over-amount of your sodium chlorid, and place that solution in contact with the same amount of blood on the slide, and place that under the microscope and you will find just the opposite thing takes place. The erythrocytes will contract, they will give up the

salt contact because the solution which surrounds the cells is greater in its value and the natural cells give up a certain percentage until the pressure between the two is equalized. That process is known as shriveling up, and several minutes after you can see only a black speck under the microscope.

Just a word or two with reference to adrenalin versus suprarenin. Personally, I would just as soon use adrenalin as far as my own work is concerned. In fact, I would rather use it because adrenalin is an American product made by Americans, and suprarenin is made by our former friend.

I cannot agree with the essayist in saying that suprarenin is more stable, that is, synthetic suprarenin. I have not found it to be so from my experimental work and from the information I have been able to gather from a prominent man who is at the head of one of our experimental medicine departments of a certain pharmaceutical house, in saying that adrenalin can be boiled fifteen minutes without deterioration. So much has been said about throwing the solution away if it is slightly discolored. You have been told that if it is slightly pink in color, you should throw it away. I have had hundreds of dentists say to me, would you use a solution that is slightly discolored? I do not inject a solution which is made from synthetic suprarenin. In the case of adrenalin, I would not hesitate to inject the solution if it was straw colored, and if you will pardon me for saying so, I have injected gallons of that solution and never had as much trouble as I have had from the tablets which contained synthetic suprarenin.

Another point: The tablet or the solution which contains adrenalin will turn amber color or straw color, which is due to oxidation or disintegration of the vaso-constricting agent adrenalin.

Suppose you have the twelve-hundredths of a grain of adrenalin and keep

that tablet on hand for six months or more, it makes no difference. Supposing that you have a tablet in distilled water which renders it straw colored or amber colored, you do not have the twelve hundredth of a grain because a certain percentage of the adrenalin has disintegrated, and the solution need not be discarded until you can see a sediment in the bottom of the receptacle. The idea of saying that synthetic suprarenin is the only agent that should be used and with which you can obtain the finest results is true, nevertheless I do not believe in saying that you cannot secure just as good results with adrenalin. Personally, I have obtained just as good results from the use of adrenalin as I have from suprarenin.

As to the symptoms arising during injection, I make practically all injections with the patient in the semi-supine position, and in so doing we can eliminate a great deal of the approaching syncope or collapse in many of those cases that are susceptible to the suprarenin. We must remember that in injecting suprarenin it is a very powerful drug; it produces vaso-constriction; it increases blood pressure, and when a patient is suffering from an advanced case of arteriosclerosis, we should inject the solution cautiously, and in such cases it would not be amiss to observe the pulse or to use the sphygmomanometer, and observe the blood pressure and pulse thruout the injection. But I say to you gentlemen that a patient has to be in a very bad physical condition not to be able to stand the injection of four or five mils of properly prepared procain, isotonic or adrenalin Ringer's solution.

BLOCK ANESTHESIA, INDICATIONS AND ADVANTAGES.

1. In cases in which the administration of a general anesthetic is usually difficult, as for operations upon the jaws, or plastic operations upon the face, wherein the proper nerve blocking injections are of great advantage.

2. In case no anesthetist is present to administer properly a general anesthetic.

3. In short, operations, for example local anesthesia is indicated over ether or chloroform anesthesia. However, if a general anesthetic be employed, nitrous oxid-oxygen is the general anesthetic of choice. In making this statement with reference to short operations, the reader must not be led to believe that block anesthesia is employed only for short operations, for such is not the case, as anesthesia can be maintained over a period of two or three hours, or even longer, if desired, the duration of the anesthesia being controlled by the vaso-constricting content of the injecting solution.

4. Local anesthesia is indicated in operations in which it is better to have a bloodless or almost bloodless field.

5. Local anesthesia is of great value to control postoperative pain within the operated part. Local anesthesia will block the postoperative pain or, at least lessen it until the return of sensation. Quinine and urea are employed extensively for this purpose by some operators.

6. Block anesthesia is of great advantage in general and oral surgery operations to carry the patient over a number of postoperative painful hours into comfort and without pain.

7. Patients who have been operated upon under block anesthesia can in most instances be discharged immediately, provided, of course, the operation be a minor one.

8. When nerve blocking injections are made by skilled hands, with the proper quantity and percentage of solution injected, they are not associated with any grave danger, as is the case many times if a general anesthetic be employed. This is particularly true of ether and chloroform.

9. The surgical convalescence, general physical conditions of the patient,

and postoperative recovery are not so often disturbed as is the case in many instances following general anesthesia.

10. It is indicated in many cases in which it is possible to completely block all nerve communications to the part to be operated upon and render it completely insensitive.

11. It is indicated in those patients who possess a strong personal objection to the loss of consciousness.

12. In individuals who possess a tumor or growth, whereby a small section can be removed for microscopic examination. It is indicated, and many times the patients will submit to a much earlier operation under local anesthesia than if general anesthesia is employed.

13. The duration of anesthesia may be changed in accordance with the amount of the vaso-constricting agent employed. This is of great advantage for various prolonged oral surgery operations, such as the reduction of a fracture, splinting, antrum cases, tonsillectomy, impacted third molars, etc.

14. The long duration of anesthesia permits the operator to take his time with the operation which gives him the opportunity to utilize all of his skill while operating.

15. It is an advantage to the operator to have an open field during the operation, which is the case in block anesthesia, while with general anesthesia many times the anesthetic mask has to be reapplied, in order to keep the patient anesthetized for oral, throat, and plastic operations on the face. However, the reapplication of the anesthetic mask is not necessary when modern appliances are employed, such as when the insufflation intratracheal tube, or mouth tube is employed.

16. Large or small areas may be anesthetized, depending upon the nerve or nerve branches blocked.

17. Anesthesia is secured of infected or inflamed areas by blocking the

nerve branch in healthy tissue at a distant point from the operative field.

18. *Intraoral nerve blocking injections*, when skillfully made, are without pain because the needle is inserted into the mucous membrane and connective tissue. The extraoral injections can be made without any appreciable pain by making a preliminary injection into the skin with a fine sharp needle.

19. One or two insertions of the needle will block an operative field, depending upon the nature of the operation and the area to be blocked.

20. *Cooperation of the patient*. It is well known that this is of material advantage to the operator because he can operate with ease, and complete the operation with a minimum amount of laceration and without the inspiration of blood and mucous.

21. *Safety*. Nerve blocking, when properly executed, is in most cases safer than any general anesthetic where a deep, prolonged anesthesia is required.

22. *Control*. The operator has a certain amount of control over his anesthesia by injecting the proper amount. He also has control of the specific gravity, the isotonicity of the solution, and the amount of the vaso-constricting agent to prevent too rapid absorption.

23. *Simplicity*. Various nerve blocking injections, both extraoral and intraoral, can be easily made, provided the operator is thoroly familiar with his anatomy and the technic of injections.

24. *Efficiency*. In many cases operations coming under the domain of the oral and dental surgeon can be performed successfully under some form of local anesthesia, provided the injections have been properly made. However, in many cases nitrous oxid-oxygen anesthesia is preferable.

25. *After-Effects*. Patients who have been operated upon under nerve blocking seldom suffer any postoperative effects, such as headaches, nausea, retch-

ing or vomiting. This is of exceptional value in case the patient has been operated upon for fracture of the jaw.

26. *Complications*. No complications follow the operation as a result of block anesthesia injections, such as pneumonia, renal conditions, hence it is most desirable in the aged.

27. *Effects on Immunity*. Ether or chloroform anesthesia greatly reduces the patient's resistance against pyogenic bacteria and pneumococci, which is avoided in local anesthesia.

28. The cost of producing block anesthesia is far less than that of any known general anesthetic.

29. Local anesthesia controls or greatly lessens the hemorrhage in the operative field.

30. If the part has been completely blocked, no traumatic surgical shock is produced.

31. If it is employed in septic cases the action on the human organism and the elimination from the system are far less than from the general anesthetic, such as ether and chloroform.

32. Local anesthesia lessens the possibility of the patient swallowing blood and mucous during an oral operation.

33. The patient can cooperate with the operator and assist with the operation.

34. The tissues can be handled more carefully, thereby lessening the amount of trauma and laceration.

35. Nerve blocking, when combined with general anesthesia plus other factors, blocks all afferent impulses, thus bringing about anoci-association. Nerve blocking is one of the important steps in producing anoci-association.

36. Nerve blocking prevents all reflexes from reaching contiguous parts or painful impulses originating at the site of operation, thereby causing a less after-action.

37. The preoperative preparation of the other patient is not so important for

nerve blocking for oral surgery cases, as is the case for general anesthesia.

38. When a patient has been operated upon successfully under block anesthesia, as a rule, he, or she, as the case may be, will readily submit to future operations because confidence has been gained, and such patients are aware of the fact that they can be operated upon without suffering pain, and yet remain conscious.

39. It elevates dentistry and makes better oral surgeons and dentists, because with pain eliminated a better service will be rendered.

BLOCK ANESTHESIA — CONTRAINDICATIONS AND DISADVANTAGES.

Block anesthesia is contraindicated for certain operations and with certain individuals. These contraindications and disadvantages may be summed up as follows:

1. With young children, unless the confidence of these little patients can be secured.

2. On patients suffering from epilepsy.

3. Upon highly neurotic or nervous individuals whose confidence cannot be obtained.

4. For operation of a part whose nerve supply it is impossible to block without inserting the needle into inflamed or infected tissue. If the needle is inserted thru infected tissue it is liable to inoculate healthy tissue.

5. In case the patient is suffering intense pain caused by some pathologic conditions, local anesthesia should not be employed unless a preliminary sedative is given. In most cases general anesthesia is indicated.

6. Local anesthesia is contraindicated with tissues of low vitality. The additional trauma caused by injecting the solution may still lower the tissue vitality, but, on the other hand, the low vitality of the patient may contraindicate general anesthesia; therefore, after

all, local anesthesia may be the method of choice.

7. With patients suffering from severe heart lesion, such as aortic or mitral regurgitation, myocarditis, with threatened dilatation, or in individuals possessing a broken compensation, or in extreme cases of arteriosclerosis, with increased blood pressure, local anesthesia is contraindicated. In case local anesthesia is employed, the solution should contain a smaller amount of the vasoconstricting agent, epinephrin, than the solution for the healthy individual. In many of these cases block anesthesia, when produced by skilled hands, slowly injecting the proper percentage and quantity of solution, is in many cases safer than a general anesthetic. With these patients local anesthetics should be given with caution.

8. When the patient has a strong personal objection or dislike in remaining conscious during the operation.

9. A patient who is anemic, possessing a lowered vitality and resistance, who is very apprehensive, often suffers mental strain, and yet free from actual pain, may pass into a state of syncope or collapse. Local anesthesia with these individuals should be given with caution.

10. A patient who has suffered considerably with some severe pathologic condition, and may be in a state of general infection, is not the ideal patient by any means for nerve blocking for the performance of a severe or prolonged operation.

11. Operations performed under nerve blocking upon pregnant women should be given the greatest consideration, avoiding all pain and mental excitement, but when this is done they are ideal patients for block anesthesia.

12. If the operator is unable to vouch for the purity of the injecting solution, or the asepsis and thorough cleanliness of the apparatus, or if he is not positive he is familiar with the technic,

local anesthesia is certainly contraindicated.

13. One of the greatest disadvantages of block anesthesia is the psychic effect produced upon the patient. As the patient is conscious he is aware of everything that is going on about the operation and can hear the conversation between the operator and his assistant; therefore, nerve blocking inhibits physical pain but does not eliminate psychic fear and strain which are removed under general anesthesia.

14. Local anesthesia should not be used for the removal of a malignant tumor unless the operator is positive it is restricted to a small circumscribed area. If the operator is doubtful as to its limitations the operation may extend beyond the area anesthetized and into tissue which would be difficult or impossible to further block with a local anesthetic, and after all one may have to resort to a general anesthetic.

15. Local anesthesia should not be used on individuals for operations of such a nature which demand a very large quantity of the solution. The patient should never be subjected to an enormous quantity of solution, especially if his physical condition contraindicates such a procedure. Nitrous oxid-oxygen in such a case should be administered.

16. Injection of the solution may cause circulatory disturbances and faintness, which may be due partly to the patient's apprehension, altho the patient in most cases blames the drug that is injected.

Dr. Puterbaugh (closing): I wish to express my appreciation of the kindly manner in which you have sat out this long seance this afternoon, and thank you for the delicate manner with which this subject has been handled by the men who discussed it.

As to the isotonicity of solutions, that, too, is variable. If Ringer in his extensive experiments and physiologic work says that which would be isotonic for Bill Jones would not be isotonic for John Smith, there must be an individual variation in the isotonicity of the preosmotic balance between the tissues of various individuals and animals. So there is no definite formula, and for that reason we will find considerable variation in the different formula given for the so-called Ringer's solution, and Ringer's idea was that we should use a solution that approximated that of the body fluids. Then you are doing much better than you would do if you did not use something to bring the osmotic balance up in some way in order that the tissues swell.

I did not mean to convey the idea that you cannot use conductive anesthesia in abscessed conditions. I meant this, that we, as dentists, must see more than the tissues we operate upon and the tissues to be anesthetized. We must see the patient, and a patient who comes to you after having been distressed and suffering pain for one or two days with an abscessed tooth is not in a condition to go thru mental torture, let alone physical torture, and for that patient gas oxygen is the ideal anesthetic. The same is true of third molar impactions, where you have partial locking of the jaw; you can give the patient gas oxygen, you can pry the jaws apart painlessly, and you can do your operative work. You must think of the patient as a patient and not of the teeth as a certain case.

Dr. Schultz mentioned in his discussion that I did not make clear my idea of the formation of an ischemic ring or barrier in the insertion of the needle and the injection of the solution. What I meant to say was this, that if on the insertion of the needle to the point where

you wish to leave the anesthetic solution you will inject one or two or three drops, and wait a few seconds until vaso-constriction is produced about the area where you wish to deposit the solution, and then make your injection, you will have constricted down the arterioles and the venules that carry the solution over the body; you have contracted them down until the solution will be isolated or confined to that area, and it not only intensifies but prolongs your anesthesia, and it prevents systemic intoxication either from the novocain or from the adrenalin.

As to the statement made by Dr. Whipple, I will say I have reference to gas oxygen, saying that anesthesia might be maintained for five or ten minutes without serious danger, and my idea in saying this was that the longer we maintain general anesthesia, the more you

increase the mortality. In other words, if you wish to carry gas oxygen in your practice you may administer it for five or ten minutes with practical impunity and you will not be endangering the patient's life. This danger, however, increases in geometrical proportion to the length of time you maintain any general anesthesia.

I sincerely hope that those of you who have been physically able to sit out this discussion will go home with a firm resolution not only to try out local anesthesia but general anesthesia, that you will use anesthetics more than you have done in your practice, and as you use them more and more confidence will come to you, and it will prove a great boon and satisfaction to your work, and you will do a better grade of dentistry than you can possibly do without anesthesia.