gm. (ʒi.). M. Div. in part. æq. No. vi. Sig.: One powder in a wineglassful of water at bedtime. ℞ Sodii brom., 15 gm. (ʒ ss.); Aq. menth. pip., 45 gm. (ʒ iss.). M. Sig.: One teaspoonful at bedtime in a wineglassful of water; repeat the dose every two hours if necessary.

HYOSCYAMUS.—The preparations of hyoscyamus, in large doses, sometimes induce sleep; but on account of the uncertainty of their action and the disagreeable incidental effects, they are rarely employed to relieve insomnia in adults. They are frequently used to quiet the restlessness incident to the diseases of children, who tolerate larger doses proportionally than adults. Recently the alkaloids obtained from hyoscyamus have been recommended as powerful hypnotics in some forms of insomnia.

Hyoscyamine has been used chiefly in excited conditions of the brain, such as delirium tremens and mania. Generally, doses of one-sixteenth to one-eighth of a grain suffice to induce sleep of several hours' duration; but frequently larger doses are necessary—from one-sixth to one grain. Sleep follows very rapidly after the largest dose, often in fifteen minutes; it becomes very deep, may continue ten or twelve hours, and is sometimes attended by marked prostration.

The incidental effects consist chiefly of hallucinations, delirium, dryness of the mouth and throat, marked acceleration of the pulse and respirations, and great dilatation of the pupils.

Ringer found small doses of hyoscyamine inefficient in delirium tremens; larger doses produced many hours' sleep, but without improving the delirium and general condition of the patients.

Hyoscine Hydrobromate (Scopolamine hydrobromate).—This salt has lately been recommended as a very efficient hypnotic. In doses ranging from gr. 1/120 to gr. 1/60 it promptly induces sleep, which lasts from one to four hours if the medicine is given in the daytime, and from six to ten hours if given at night. Wetherill found that even smaller doses, gr. 1/200, frequently produced prolonged rest in cases of insomnia. It is rarely necessary to repeat the dose, or rapidly to increase it.

The following incidental effects have been observed: slowing of the pulse and respiration, slight elevation of temperature, hoarseness, suffusion of the face, sweating, dilatation of the pupils, relaxation of the muscles, impaired co-ordination, and a sense of fulness in the head and of wretchedness.

Occasionally moderate doses are followed by nausea, vomiting, anorexia, dysuria, syncope, with small, rapid, irregular pulse, and with symptoms of partial paralysis of the pneumogastrics (Wetherill).

Hyoscine has been used in the insomnia of acute delirious mania, of agitated melancholia, neurasthenia, chronic mental disorder, the morphine habit, alcoholism, and in confirmed cases of insomnia from unascertained causes. As a rule, it promptly induced quiet and prolonged sleep.

For internal use the following formula is convenient: ℞ Hyoscin. hydrobr., 0.01 gm. (gr. 1/6); Aq. dest., 80 gm. (ʒ xx.); Syr. aurantii, 20 gm. (ʒ v.). M. S.: One teaspoonful once or twice daily.

CANNABIS INDICA.—Cannabis indica has been used as a substitute for opiates when the latter do not agree with the patient, and in cases of acute and chronic mental derangement. The susceptibility of different individuals to its hypnotic action varies greatly. Fronmüller, who administered it in 1,000 cases, found that it succeeded completely in 530, incompletely in 215, and had little or no effect in 255. In careful experiments Preisendörfer found that doses of one grain and a half of an alcoholic extract sometimes acted well, but in other cases had no effect. Larger doses, in no case exceeding five grains, usually produced more or less deep sleep.

Generally, hypnotic doses of cannabis indica produce decided incidental effects, such as giddiness, headache, hallucinations, delirium, slight redness of the face and conjunctiva, dilatation of the pupils, and brilliancy of the eyes. Very large doses often cause intense headache,

nausea, and vomiting. In the experiments of Preisendörfer marked alterations of the circulation were observed. Two or three hours after the medicine had been given there occurred palpitation of the heart, with general relaxation of the arterial tension and increase of pulse rate from eleven to twenty-two, sometimes even forty, beats per minute. Sleep usually ensued at the time when the changes in the circulation began.

The hypnotic action of cannabis indica seems to be increased by bromide of potassium. As a result of experiments Clousten found that forty-five minims of the tincture of cannabis indica, with forty-five grains of bromide of potassium, were fully equivalent to a drachm of laudanum as a means of allaying maniacal excitement.

HEDONAL, according to recent reports, seems to be a useful hypnotic in light forms of sleeplessness. In appropriate doses it usually induces sleep in about half an hour, though sometimes its action is delayed for one or two hours. The sleep may continue for from two to eight or nine hours, depending upon the size of the dose and the condition of the patient. After some time, several days or weeks, the dose must be somewhat increased to obtain the hypnotic effect. Usually no incidental effects are observed either during or after the sleep—the pulse, the breathing, and the temperature not deviating from the normal. In a few instances, on the day following the sleep, complaint is made of headache and giddiness.

The dose of hedonal is from 2 to 3 gm. (gr. xxx.–xlv.) given as a powder, which may be placed upon the tongue and swallowed with some cold water. It is supposed that 2 gm. act as efficiently as 1 gm. of trional and 2 gm. of chloralamide.

Dormiol has been found to produce sleep in about half an hour, which may continue for from one to ten hours, but on the average continues five hours. No notable depression of the functions of circulation and respiration occurred. Usually the doses given varied from 1 to 4 gm. of a ten-per-cent. solution. It was better to give one large dose than several small doses at intervals. Dormiol is held by some observers to be quick, safe, and sure in action.

Chloretone causes sleep in about half an hour, and this effect may continue for from one to twelve hours, the average being about four and a half hours. After large doses the pulse becomes depressed both in volume and in frequency. The breathing also becomes lessened in depth and volume, and the temperature lowered.

In experiments on warm-blooded animals it was found that chloretone in hypnotic doses diminishes the frequency and volume of the inspirations; depresses the vaso-motor centres and dilates the blood-vessels, thus lowering blood pressure, and also depresses the heart and lowers temperature.

Some recent writers, however, state that they have obtained good results from the employment of this remedy in the persistent insomnia of the aged, and in cardiac disease with renal complication and high arterial tension. In some cases sleep ensued after doses of 1.3 to 1.6 gm., but in most cases it was necessary to repeat this dose once or twice.

Chloralose acts as a hypnotic in smaller doses than chloral, but seems also to be more toxic and less certain. In a child the small dose of 0.2 gm. caused trembling of the hands and arms, and severe dyspnœa. Very grave symptoms have followed 0.3 gm.—coma, oscillatory movements of the head and the arms, and Cheyne-Stokes breathing.

It is given in doses of 0.2 to 0.3 gm. in capsule.

Samuel Nickles.

HYPODERMATIC MEDICATION.

HYPODERMATIC MEDICATION.—The hypodermatic method of administering drugs, now so commonly employed, was first introduced by Dr. Alexander Wood, of Edinburgh, in 1843. It was gradually evolved, by the patient labors of numerous observers, from the endermic or endermatic mode of using certain soluble remedies formerly much in vogue, and, as the term clearly indicates, consists in the injection of solutions of suitable

medicaments under the skin by means of a small syringe specially adapted to this purpose.

To insure success, care should be taken in the choice of the syringe. The essential qualities are, uniformity of calibre of the barrel, a properly fitting piston, and a sharp needle attached to the nozzle by means of a water-tight joint. These instruments are now made of glass, celluloid, hard rubber, and metal.

Since the earlier days in the history of this subject, important improvements have been wrought in the construction of hypodermatic syringes, so that of late years they have been offered in great variety; and manufacturers have displayed much enterprise and ingenuity in bringing them to the present state of completeness. Excellent instruments may now be readily obtained at very moderate cost.

The original syringes, and those of inferior quality still made, consist of a glass barrel with a metal or hard-rubber cap at each end.

This kind of instrument is not to be recommended. It is frail; the mountings, of metal or hard rubber, are liable to be separated from the barrel by very slight force; it is apt to become leaky, and the diameter of the glass tubing is rarely uniform throughout its length; but even in this class of instruments, some superior workmanship is now shown in the best specimens offered by dealers.

A decided improvement upon this make is illustrated by Fig. 2772. The glass barrel is enclosed in a fenestrated, sometimes a double fenestrated, metal sheath, which reveals the contents of the syringe when charged, and renders an otherwise weak instrument sufficiently

FIG. 2772.

strong for ordinary use. It is easily taken apart for cleaning, and to those who prefer the glass barrel it is recommended. Nevertheless, it is open to other objections urged against glass syringes. Unequal diameter of the cylinder and likelihood of leakage are the principal defects.

Neither the celluloid nor the hard-rubber syringes have given entire satisfaction, and the specimens usually found in the market cannot be indorsed as trustworthy or desirable instruments.

The metal syringes are to be preferred to all others on account of their superior strength and durability, the even diameter of the bored cylinders, freedom from leaks, and compactness of construction. The metals used in their manufacture are German silver or brass—plated inside and outside with nickel—pure silver, and gold.

Fig. 2773 illustrates an instrument which meets fully the demands for a first-rate hypodermatic syringe. It
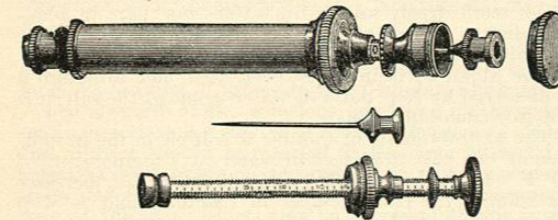

FIG. 2773.

has a nickel-plated German silver barrel, which is not corroded or injuriously affected by any solution which it is proper to inject into the tissues.

The minim scale, in this instrument, is placed upon the semi-cylindrical piston rod, which is made hollow to receive the needle, and is provided with a screw-thread and traverse nut, designated to regulate, when set, the extent of downward movement of the piston. A cap

should be screwed upon the nozzle when the needle is removed. If desired, a drop or two of water may be put in the cap to prevent inconvenient drying of the packing.

These syringes require no case for their protection, but may simply be slipped into a chamois-skin pouch and carried, without injury, in the pocket. More recently the leather-packed piston has been superseded by a solid metal plunger, which is so accurately adjusted to the barrel that no packing is required. Thus the annoyance
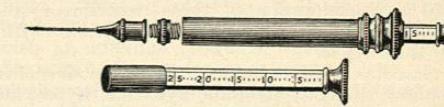

FIG. 2774.

of a dry and consequently an insufficient packing is obviated and a thoroughly aseptic instrument may be insured (see Fig. 2774).

It is prudent to be provided always with an extra needle, which may be enclosed and held by a screw-thread, in a small metal sheath, furnished by instrument-makers for this purpose.

The gold and silver syringes are not superior in practical utility to the instrument above described, and are unnecessarily expensive. The syringes provided for diphtheria antitoxin are similar in construction to the ordinary instrument, but are considerably larger. The packing of the piston is made of rubber and by a simple but ingenious mechanical device may be tightened at will. The syringes used for subarachnoid injections are substantially the same as the antitoxin syringes.

The needles for hypodermatic syringes are usually made of steel, plated with gold or nickel. Some advantages are claimed for gold or platinum needles. The needles are attached to the nozzle of the syringe by a screw or slide joint. The former is the more convenient style. A fine wire should be passed through the needle when it is not in use, to prevent occlusion of the calibre, either by the deposit of crystals from any solution that may have been employed, or by the accumulation of rust. The needles ought to be of small size, with large relative calibre, and it is desirable to have the tips strengthened at the junction with the sockets. The points should be lancet-shaped and free from any groove, depression, or shoulder-like projection.

The use of these instruments requires no special skill, though the dextrous performance of the little operation materially diminishes the discomfort of the procedure to the patient. The skin may be pinched up between the thumb and forefinger of the left hand, while the needle, held perpendicularly to the surface, is thrust rapidly through it. After penetration, the point of the needle should be passed obliquely to the desired depth into the areolar tissue, and the contents of the syringe slowly discharged. The operator, before making the puncture, must be careful to expel all air from the syringe by inverting the instrument, and at the same time depressing the piston sufficiently to cause a drop of the contained solution to appear at the point of the needle. It is scarcely necessary to urge the importance of rinsing out the barrel and of thoroughly cleansing the needle, immediately after using the instrument.

The injection may be made under the skin in almost any portion of the body; but the neighborhood of large vessels and nerves, bony prominences, and specially sensitive or inflamed regions should be avoided. The places ordinarily selected are the arm, near the insertion of the deltoid muscle, and the outer surface of the thigh. The rapidity with which absorption takes place is regulated somewhat by the vascularity of the part into which the injection is made. It is stated by some writers that a prompter effect may be expected from injections into the inner aspect of the limbs, or into the pectoral region, than from similar injections into the outside of the limbs or into the back. If this difference really exists, it must

be so slight that it is scarcely worthy of serious consideration.

The injections may be superficial, into the subcutaneous areolar tissue merely, or they may be deep, into the body of a muscle, or, as has been recommended in some obstinate cases of sciatic neuralgia, a concentrated solution of morphine may be forced into the very substance of the nerve itself. Injections are sometimes made into diseased tissues and into abnormal growths. Intravenous and intraspinous or subarachnoid injections are also practised, but a consideration of these procedures, and of hypodermatic alimentation, is incompatible with the scope of this article.

The remedies most commonly used hypodermatically are morphine, codeine, atropine, hyoscine, hyoscyamine, strychnine, eserine, pilocarpine, caffeine, cocaine, apomorphine, ergotin, quinine, arsenic, mercury, chloral, digitaline, nitroglycerin, alcohol, and ether.

Morphine thus employed has a wide range of usefulness, and, on account of its power to allay pain, is far more frequently given hypodermatically than any other drug. The sulphate is the salt generally used. It makes a solution which is in every respect well adapted to subcutaneous administration. The ordinary dose is from one-sixth to one-fourth of a grain.

Codeine is used to meet the same indications and is sometimes a desirable substitute for morphine. It is not so likely to nauseate or to constipate, though as an anodyne it is not so trustworthy. The usual dose of either the phosphate or the sulphate is from one-half to one grain.

Atropine, in minute doses, is often combined with morphine, as it is capable of correcting, in some instances, the occasional unpleasant after-effects of the opiate when taken alone, besides possessing valuable therapeutic properties of its own. As an antidote to opium in toxic quantity it is superior to any other drug. The dose ranges from gr. $\frac{1}{150}$ to gr. $\frac{1}{60}$. Duboisine has been recommended as an advantageous substitute for atropine in about the same doses.

Hyoscine is a most valuable cerebral and spinal sedative and hypnotic in doses of gr. $\frac{1}{100}$ of the hydrobromate. It may be administered alone or combined with other anodyne and narcotic drugs. In combination with codeine its hypnotic influence in cases of cerebral excitement is most gratifying.

Hyoscyamine is closely allied in its action to atropine, but it has been found peculiarly effective in allaying maniacal excitement. The usual hypodermatic dose is gr. $\frac{1}{60}$. It should be cautiously administered at first. Testimony is not lacking of its value in various forms of motor excitement—as muscular tremor, laryngismus, hiccough, etc.

Strychnine produces more decided, and often more satisfactory, results when injected subcutaneously. A simple aqueous solution of the sulphate answers this purpose well. One grain to the ounce of water makes a convenient solution, which will keep without change for a considerable time. Fifteen drops—representing gr. $\frac{1}{32}$—gradually increased when required,—is a proper initial dose.

Eserine, the active principle of calabar bean, acts more promptly when given hypodermatically than when administered by the stomach. The dose of the sulphate or muriate is from gr. $\frac{1}{100}$ to gr. $\frac{1}{30}$. In effect, it diminishes the reflex excitability of the spinal cord.

Pilocarpine is administered in doses of from one-eighth to one-quarter or one-half of a grain. The nitrate is the salt most commonly employed. It is freely soluble in water, and acts, when used hypodermatically, with great promptness.

Caffeine—the sodio-benzoate—may be exhibited in one-grain doses in conditions of mental and physical depression, for nervous headaches—especially for such as are dependent upon the omission of the accustomed cup of coffee—and in addition to atropine in cases of opium poisoning. It has also been used with some success in the treatment of neuralgia.

The hydrochlorate of cocaine is used hypodermatically mainly for its local anæsthetic effect. Its use is not free from danger. Excessive depression of the circulation sometimes follows its administration. The dose is from one-eighth to one-half of a grain, dissolved in water. The latter quantity has produced alarming symptoms, but is ordinarily safe, especially when preceded by generous alcoholic stimulation. It seems, however, that in smaller doses it reduces the frequency, but increases the force, of the pulse. More or less nausea may be experienced during its action. The extent of its anæsthetic influence is very limited, probably including only the absorbing tissues which may be brought into immediate contact with the solution. It is more than likely that the drug supplied to the trade is of variable strength. Herein lies a danger that should be watched.

Apomorphine is serviceable in conditions requiring a prompt emetic, and when, from unconsciousness or from some other circumstance, deglutition is rendered impracticable. It is conspicuously useful in some cases of narcotic poisoning. In consequence, however, of its depressing influence upon the system it should be used with caution, more especially in cases of profound narcotization, in which the respiratory and cardiac movements are feeble. The usual dose is one-tenth of a grain for adults.

Ergotin is given subcutaneously in doses of from two to five or ten grains, or even in larger quantity in cases of extreme urgency. One drachm of water will dissolve twenty grains of ergotin—which, in fact, is only an aqueous extract of ergot. A more concentrated solution may be made by rubbing up the purified extract with distilled water until one minim represents one grain. It should be carefully filtered to remove all solid particles. One-half grain of carbolic acid added to each ounce of the solution will prevent destructive changes, which, without it, will take place very rapidly. In the absence of the aqueous extract the fluid extract may be used. Ergotin injected under the skin is beyond doubt a most potent remedy in hæmoptysis, hæmatemesis, metrorrhagia, and, indeed, in many forms of hemorrhage beyond the reach of surgical control. It is valuable also in congestions of the brain and spinal cord, in the early stages of meningitis, and in a number of uterine and other disorders. Sclerotinic acid has been prescribed as a substitute but it does not represent ergot.

The sulphate of quinine—the salt of quinine commonly prescribed in this country—requires for its solution seven hundred and forty parts of water, which fact is an insuperable obstacle to its satisfactory hypodermatic administration. It has been proposed to dissolve the disulphate of quinine in water by means of heat and of dilute sulphuric acid—two minims to the grain—so that one drachm of the solution would contain six grains of the quinine. The solution is to be filtered immediately and a few drops of carbolic acid added to insure sterility.

The official bisulphate of quinine, as commonly supplied, while freely soluble in water—one part in ten—contains an excess of acid, and, consequently, like the foregoing, is very irritating to the tissues.

The kinate of quinine has been used, and, although it is dissolved by four parts of water to one of the salt, it is not free from objections.

The hydrobromate of quinine is soluble in the proportion of one part to sixteen of water at a temperature of 59° F. Heat, or the addition of a little alcohol, increases its solubility. It is neutral in reaction, and is well adapted for hypodermatic use.

Of all the preparations of quinine at present known, the muriate of quinine and urea is the most available for subcutaneous injections. It is not official and is but little known in this country, yet it is used with the most satisfactory results in Germany (Hager's "Handbuch der pharmaceutischen Praxis"). This double salt is made by adding three parts of urea to twenty parts of hydrochlorate of quinine dissolved in fifteen parts of muriatic acid of a specific gravity of 1.061. It is soluble in its weight of water at ordinary temperatures. A fifty-per-

cent. solution is used with prompt effect, followed by very slight local irritation and only a transient stinging sensation at the point of insertion.

The most important field for the hypodermatic use of quinine will probably be found in the pernicious types of malarial fevers, where the utmost promptness in securing its full effect is often requisite, and in the more common malarial derangements attended with gastric disturbances, which preclude its use by the mouth. The dose varies greatly according to the indications to be met. It may be stated as from one to twenty grains.

The official solution of the arseniate of potassium is the form in which arsenic is generally exhibited subcutaneously. It produces less local irritation if diluted with an equal quantity of water. The dose is three minims—equivalent to about gr. $\frac{1}{48}$ of arsenious acid. It may be gradually increased to a much greater amount.

Some advantages are claimed for the arseniate of sodium for hypodermatic use. The official solution may be given in the same dose as the preceding preparation.

The hypodermatic method is ordinarily not an available mode of using mercury in private practice, though the visible lesions of syphilis undoubtedly disappear under its use in this manner more rapidly than when it is given by the mouth. Nevertheless, from the force of circumstances, recourse to this means of treatment must be reserved for exceptional cases. The corrosive chloride dissolved in water is the favorite preparation of the drug. The dose, to commence with, may represent gr. $\frac{1}{20}$.

The great and persistent pain which accompanies and follows the hypodermatic administration of chloral seriously militates against its use in this manner. A fifty-per-cent. solution in water is generally employed. A more liberal dilution of a full dose, while it diminishes the local irritation, at the same time inconveniently increases the bulk of the injection. An anodyne effect is said to follow the subcutaneous use of chloral, which is not observed when it is taken by the mouth. In cholera—both epidemic and sporadic—it yields excellent results. Bartholow reports a "very formidable case, in which there seemed but little hope; sixty grains were administered hypodermatically in two hours, with the effect to stop the cramps, restore warmth, and to remove indeed all unfavorable symptoms." The same author says: "There is no means of treating cholera now known so effective as this."

Chloral may be injected in combination with morphine, or morphine and atropine. The combination constitutes a powerful anodyne hypnotic. The dose of chloral is from five to ten grains or more.

Digitaline is administered to meet the indications for which digitalis is used.

Nitroglycerin is a diffusible cardiac stimulant.

Alcoholic stimulants may be given hypodermatically in the form of brandy, whiskey, or diluted alcohol, when an immediate effect is required, and when administration otherwise cannot be accomplished. A syringeful may be injected.

Ether is extolled as a diffusible stimulant in conditions of collapse or of profound physical depression. It may be given in doses of fifteen to thirty minims undiluted.

The strength of the solutions employed for hypodermatic injections is a matter of some consequence. If too free dilution should be resorted to, the mere bulk of the injection is annoying on account of the pain consequent upon distention of the tissues or upon successive punctures of the skin, which may be necessary for its introduction. If, on the other hand, the solution should be too concentrated, it may prove very irritating. Then, again, it should be remembered that a few drops of the solution may remain in the nozzle and in the needle. This residuum will, of course, be of more importance if taken from five than from twenty drops. Two drops, for instance, will represent in the former case nearly one-half of the dose, which might be a serious loss, while in the latter it would be a waste of only one-tenth, and possibly be inappreciable so far as the effect of the drug is concerned.

As most of the remedies used hypodermatically are concentrated poisons, accuracy of dose is very necessary.

Distilled water is not essential in making the solutions; indeed, it is inferior to river, cistern, or well water, either of which will answer every requirement, if only free from visible impurities.

Strong acid and strong alkaline solutions are unfitted for hypodermatic administration. The solutions should be as nearly neutral as possible and free from irritant qualities. "Metallic salts have their irritating properties diminished or removed by being combined with albumen or with an alkaline citrate or tartrate, so as to form double salts" (Brunton).

Solutions of the alkaloids undergo subtle and unknown changes when kept for a considerable time. They develop also a fungous growth—*penicillium*,—a minute organism which multiplies at the expense of the alkaloid, and the solution deteriorates in proportion to the increase of this formation. The evaporation of the menstruum will also influence the strength of the solution. Therefore fresh solutions only should be employed, or, better still, they may be extemporaneously prepared from powders of known quantity, or from hypodermatic tablets, which are now manufactured by a number of responsible parties whose established reputations may be accepted as a guarantee of absolutely reliable products. Simple tablets, composed of a single drug or several combinations of different drugs, may be procured. They are pre-eminently adapted to the convenience of practitioners and possess many advantages over the ready-made solutions.

The use of cherry-laurel and of eucalyptus waters as menstrua for the alkaloids serves to prevent the destructive changes that render the simple aqueous solutions unstable and unreliable. The antiseptic influence of carbolic acid and of salicylic acid has been invoked for the same purpose. One to four grains of either to the ounce will not prove objectionable, and will preserve the solutions for several months. Boric acid is also employed with a like object.

The solution injected should be entirely free from solid particles. To insure this point it is well to warm the mixture before drawing it into the syringe, as heat increases the solvent action of water, and, besides, a moderately warm injection is less disagreeable to the sensations of the patient. This heat may be conveniently applied by holding the spoon containing the solution for a few moments over a gas jet, a lamp flame, or a burning match.

The prominent advantages which accrue from the hypodermatic method of exhibiting drugs consists principally in the prompt effect obtained; the opportunity which it affords to surmount the obstacles of nausea and vomiting so commonly encountered, and to overcome also any voluntary or involuntary resistance on the part of the patient, the consequence of unwillingness or inability to swallow. In many cases, too, from some idiosyncrasy of the individual, a peculiar susceptibility exists to unpleasant after-effects of certain medicinal agents when taken by the mouth. This result may, not infrequently, be moderated or obviated by the subcutaneous injection of the same remedy, and a smaller dose may be depended upon to yield given results; moreover, it is possible that a special therapeutic effect may sometimes be secured. Absorption from the subcutaneous cellular tissue is less likely to be modified by the condition of the organism than absorption from the stomach and intestines. In the alimentary canal the condition of the circulation, the presence or absence of foods, the state of the lining membrane, the nervous supply, etc., influence, regulate, and determine absorption.

With a sharp needle, of not too great size and free from rust, properly managed in a suitable locality, the pain from the operation is, as a rule, insignificant. The danger of provoking inflammation either by the puncture or by the presence of the injected liquid, of the resulting cicatrices, of conveying through the medium of the syringe specific disease, and of injecting air into a vein, are all objections that have been urged against the pro-

cedure; but with the exercise of ordinary skill, prudence, and cleanliness, the risks are so remote and so improbable that they need not be seriously considered in estimating correctly the great, palpable, and immediate advantages pertaining to this accepted and indispensable therapeutic resource. *James B. Baird.*

HYPODERMOCLYSIS.—There are few therapeutic procedures which have sprung into such well-deserved popularity as hypodermoclysis. So frequently is it employed to meet urgent surgical and medical conditions that it is difficult for us to realize that less than ten years ago it was an almost unknown method of treatment. While it had been employed sporadically, so to speak, by a number of continental investigators at various times, and very occasionally by a few American physicians and surgeons, it was not until Hildebrand, of San Francisco, published a paper upon this matter that it received the attention that it deserved. Soon after the appearance of Hildebrand's paper, the writer of this article, having become much interested not only in the employment of hypodermoclysis but in the question of the most suitable fluids for use in conditions in which hypodermoclysis was indicated, carried out a series of clinical experiments which confirmed him in his belief that we had in hypodermoclysis a ready means of supplying the body with fluid and in flushing the kidneys, thereby aiding the excretion of effete materials by these organs, and also aiding in the elimination of them through the skin.

Clinical applications of intravenous injection and hypodermoclysis side by side have, it seems, convinced the profession that for most cases hypodermoclysis is much the more useful method, and that only in very urgent cases with peculiar conditions present is it to be substituted by intravenous transfusion. In the majority of instances in which hemorrhage requires the speedy injection of normal saline fluid, it is found that the employment of hypodermoclysis is equal to the occasion and that absorption from the subcutaneous tissues takes place with sufficient rapidity to supply the blood-vessels with a proper amount of fluid. It is only when the hemorrhage is very profuse and the condition is most urgent that intravenous injection can be employed as a satisfactory measure in its place.

The conditions in which hypodermoclysis can be resorted to most satisfactorily are hemorrhages, as just mentioned; in cases of uræmia not associated with dropsy; in certain cases of pneumonia in which the infectious aspect of the case is most marked, and the action of the kidneys is imperfect; and in all of the acute infectious diseases in which it is impossible for the patient to take enough liquid by the stomach to supply his tissues and eliminating organs with a sufficient quantity of fluid. Hypodermoclysis can also be satisfactorily employed in cases of gastric ulcer, and after abdominal operations, when it is necessary to provide the body with fluid and yet in which it is impossible for fluid to be taken by the ordinary channels. Used in this way in cases of obstinate vomiting, saline infusions will very frequently relieve much suffering, allay thirst, maintain urinary flow, and in every way tend to support the patient through a trying ordeal.

Another very useful employment of saline infusions by the hypodermic method is its use in the treatment of threatened collapse in cholera infantum, in cholera morbus of a severe type, and particularly in Asiatic cholera. In the latter disease its employment has undoubtedly saved life in many instances; the saline infusion taking the place of the fluids which are purged out of the body, and diluting the toxins of the disease which are then more readily eliminated by the kidneys. Still another instance in which hypodermoclysis may be employed with great advantage is in the treatment of severe burns, not only for the purpose of overcoming shock, but, more important, for the relief of the toxæmia which seems to be the true cause of death in many cases of this character.

In regard to the employment of hypodermoclysis in the treatment of surgical shock or that which follows severe injuries, it is important to bear in mind that the condition of the patient is one in which there is a complete relaxation of the vaso-motor system. Or, in other words, he who is suffering from shock is being bled to death into his own blood-vessels. Under these circumstances the administration of fluids, either by hypodermoclysis or even by intravenous injection, is of no value so far as their bulk is concerned, unless in association with them are administered drugs which will overcome the vascular relaxation and tend to restore normal arterial tension. Many physicians ignore the well-known physiological fact that the vascular system is capable, when completely dilated, of holding many times the quantity of blood contained in the body. This fact is emphasized when we remember that at an autopsy we are wont to find practically all the blood in the body in the great veins of the thorax and abdomen. When it is recalled that not only are these great veins capable of holding all the blood which the body contains, but that the capillaries of the skin, the capillaries of the muscles, and the capillary systems of large glands, as the liver, are capable of holding immense quantities of blood when relaxed, it will readily be seen that an enormous quantity of liquid would have to be placed in the patient's body before this liquid could by its presence actually fill the widely dilated blood paths. And even if it were possible to fill the blood-vessels of the body by the profuse administration of normal salt solution, this would be of no advantage to the patient, since, under these circumstances, his heart would not be able to pump so much of a bulk of blood and his tissues would be practically drowned. When, therefore, the use of normal salt solution by hypodermoclysis is followed by good results in the treatment of shock, it is to be clearly understood that these good results accrue not so much by the presence of an additional quantity of fluid in the blood-vessels as upon the stimulant effect which the injection may have directly or reflexly upon arterial tension and cardiac activity, and the therapeutic point is to emphasize that it is wise, under these circumstances, to employ a normal salt solution which is not absolutely indifferent, but one which really possesses some slight stimulant power over the cardio-vascular apparatus.

Another important point to be remembered in the use of hypodermoclysis is that it is not safe to infuse a greater quantity of liquid than one drachm to each pound of body weight in each fifteen minutes; as, if this amount is exceeded, the accumulation of the liquid in the system is so great that the tissues become drowned because the kidneys cannot excrete the liquid fast enough. Hypodermoclysis is also contraindicated in œdema of the lungs due to either cardiac or renal disease, in cases of chronic bronchitis with excessive secretion of mucus and fluid. In stout old persons, and in young children in particular, it must be used with great caution, if at all, and the same remark applies to parenchymatous nephritis, because the tissues are usually dropsical in this affection; and even if they are not, there is a tendency to œdema of the lungs and an imperfect eliminative action of the kidneys so that fluids rapidly accumulate in the tissues. It is hardly necessary to add that in patients having a high arterial tension hypodermoclysis is also contraindicated unless perchance uræmia or puerperal eclampsia is present, under which circumstances arterial tension should be reduced by bleeding or, in the case of puerperal eclampsia, by the administration of full doses of veratrum viride, since by this means arterial pressure is reduced and an active secretion on the part of the skin aids the kidneys in eliminating both fluid and materials from the patient's body.

Physiological experiments made by many investigators, and particularly by Dr. Sydney Ringer, of London, and Dr. Locke, of Harvard University, have proved that a most useful combination is the one which follows, and, at the suggestion of the writer, large manufacturing chemists have put this formula upon the market dissolved in one ounce (31 gm.) of sterile water in such strength that when this quantity of concentrated solution is added to a quart (litre) of pure water, it forms a normal physiological salt solution. The writer has employed this concentrated saline, after diluting it, in a great many cases with the most satisfactory results, and believes that it is the best solution for the purposes named. The formula is as follows:—℞ Calcium chloride, 0.25 gm.; potassium chloride, 0.1 gm.; sodium chloride, 9 gm.; water, 31 gm. This, when added to a quart (litre) of pure water, constitutes what is known as "normal saline solution."

The proper means of introducing normal saline solution under the skin is to employ an ordinary clean glass irrigating apparatus and rubber tube. In the distal end of the rubber tube is inserted, and if necessary tied in, a needle having a calibre about that of the ordinary antitoxin needle. The reservoir is filled with normal saline solution and hung about eighteen inches or two feet above the level at which the needle is inserted. The salt solution should be at about 110° F. in the reservoir, since it cools rapidly in its slow passage through the tube. Or, better still, it may be placed in a warm reservoir at the temperature of 100°, and the rubber tube may be coiled in a basin of water at the same temperature so that the fluid in it is maintained at the temperature of 100° during its flow. The skin where the needle is to be inserted should be thoroughly cleansed before the puncture is made, and the most satisfactory site for the injection is a little above the groin, about half-way between the navel and the anterior superior spine, or, in stout persons and in women, in the submammary region, and sometimes it may be employed on the inner side of the thighs, care being taken to avoid the great vessels. If even moderate antiseptic precautions are maintained abscess practically never results, and the operation is quite painless, although some tenderness may exist in the region of the injection for a few hours after the absorption of the fluid. When it is wise to inject a considerable quantity of liquid into the patient at once, more than one needle and tube may be employed simultaneously. *Hobart Amory Hare.*

HYPOGLOSSAL NERVE.—(Synonyms: Nervus motorius linguæ; Nervus hypoglossus; Par nonum of Willis and the older writers; Par duodecimum; *Nerf hypoglosse* (Fr.); *Zungenfleischnerf* (Ger.).

The twelfth or hypoglossal nerve, whose name is derived from the Greek ὑπο, beneath, and γλῶσσα, the tongue, is the motor nerve of the muscles of the tongue and of those of the hyoid bone, with the exception of the digastric, stylo-hyoid, mylo-hyoid, and the superior constrictor of the pharynx. It also supplies the sterno-thyroid muscle. According to the old nomenclature it was termed the *ninth* nerve.

For the anatomy of the hypoglossal nerve consult the article on *Cranial Nerves.*

PHYSIOLOGY.—The hypoglossal nerve is the motor nerve for the muscles of the tongue, the sterno-thyroid muscle, and all those attached to the hyoid bone, with the exception of those mentioned above. Through its connection with the upper cervical ganglion of the sympathetic, vaso-motor fibres for the muscles of the tongue pass into it. From the ganglionic plexus of the vagus and its lesser lingual branch are derived its fibres of muscular sensation. Whether any such come from the cervical nerves or through the anastomosis with the lingual is still doubtful, though Lewin says: "Recurrent fibres run from the lingualis to the hypoglossus, and these in part ascend as far as the anterior condyloid foramen, in part descend in the ramus descendens." As a rule, no influence reaches the tongue through the ansa hypoglossi, and, on the other hand, little effect is produced on the muscles supplied by the ramus descendens (the sterno-thyroid, omo-hyoid, and sterno-hyoid) by irritation of the roots of the hypoglossus.

PATHOLOGY.—Injury or disease of the hypoglossal nerve or its nucleus produces either spasm or paralysis of the muscles which it supplies.

(a) *Spasm of the Muscles Supplied by the Hypoglossal Nerve; Lingual Spasm.*—This is rarely idiopathic and is very infrequent as an independent affection. On the other hand, it occurs not uncommonly in certain affections of the brain, and more rarely in some of those of the spinal cord. In all forms of general convulsions, in eclampsia, epilepsy, chorea, and hysteria, we meet with it frequently, and it is often seen in company with spasms of the muscles supplied by the motor branch of the fifth nerve, and by the facial and spinal accessory nerves. At times it accompanies facial neuralgia, or is coincident with stuttering. It is not rare in bilateral athetosis, and it occurs in trismus. It may also be dependent on a definite pathological condition of the brain or its membranes, and is found in meningitis and in certain forms of cerebral and bulbar paralysis. It sometimes occurs in certain diseases of the spinal cord, as progressive muscular atrophy, in which the disease probably extends upward and involves the hypoglossal nucleus.

In many of these cases we may suppose some injury of the nucleus, or, possibly, of the nerve itself, but we must not forget that lingual spasm may in all probability be produced by lesion of the cortical motor centre of the tongue at the base of the ascending frontal convolution, or possibly of some of the fibres which connect this with the hypoglossal nucleus. The spasm is also at times apparently due to peripheral or reflex causes, as in some cases in which it occurs with tic douloureux or in company with the spasms of neighboring muscles. In one case it was apparently caused by caries of the teeth, which had produced an ulceration of the gums.

The spasms vary in character in different cases. They may be either tonic or clonic. They may consist in mere protrusion of the tongue. Sometimes the tongue is thrust violently forward against the teeth, or it may be protruded and rapidly retracted, as in Berger's case, in which this occurred as often as fifty or sixty times a minute. Sometimes the tongue seems to be simply rolled round in the mouth. Again, the movements may be very varied and irregular. These spasms may also affect the sterno-thyroid, sterno-hyoid, and thyro-hyoid muscles. There is usually no pain or swelling, but the spasm may be preceded by a sensation of numbness in the tongue, or discomfort and oppression about the throat above the larynx. The tongue sometimes feels too big for the mouth. The spasms are for the most part independent of the acts of speaking, masticating, and swallowing, neither affecting them, unless when at their height, nor being affected by them. In certain cases, however, the spasms are induced or greatly aggravated by such acts.

The tonic spasms likewise may either occur independently, or they may be induced by voluntary efforts to move the tongue. Those of the latter class have been divided into articulatory and masticatory spasms, according as they were produced more especially by attempts to move the tongue in speech or in eating. These articulatory spasms are known as articulatory hypoglossal cramp or aphthongia (aphthongie, Fleury), from the Greek, *a* privative, and φθογγος, the voice. In some cases the tongue is glued to the hard palate whenever the patient attempts to speak; in others (masticatory cramp) the food is ejected from the mouth by the involuntary action of the tongue during mastication. In Ganghofner's case, in which there was spasmodic contraction of the tongue in ordinary speech, singing, rapid speech, and the declamation of previously known pieces were more easily accomplished.

The *prognosis* of independent lingual spasm is generally good, though the disease may be obstinate and persistent.

Treatment. There is no symptomatic treatment, as such, for lingual spasm except the application of electricity. The constant current may be applied directly to the tongue or to the hypoglossal nerve in the neck. The faradic may also be used in the same manner. These are the most useful means of direct treatment. When the spasm occurs as a symptom, or in the course of some other disease, the primary disease is, of course, to be