STATED MEETING, HELD APRIL 6, 1908.

INFANTILE PARALYSIS TREATED BY TENDON TRANSPLANTATION AND NERVE ANASTOMOSIS.

Dr. Astley P. C. Ashhurst presented several patients from the Orthopædic Hospital, from the services of Dr. G. G. Davis and Dr. R. H. Harte, to whom he was indebted for permission to operate and to report the operations.

Case I.—*Paralytic Varus; Transplantation of Tibialis Anticus into the base of the fifth metatarsal bone.*

Alfred C. came to Dr. Harte's clinic, April 20, 1905, when 11 years of age. In December, 1901, when 7 years old, he had had a disease in which both legs and arms were paralyzed, and which confined him to bed for five months. The boy was unable to walk alone for a year afterwards. His family physician has informed Dr. Ashhurst that the diagnosis of cerebrospinal meningitis was confirmed by the board of health. When seen at the Orthopædic Hospital the chief complaint was that the left ankle turned very easily, and that the boy was constantly falling; there was quite a noticeable limp. The peroneal muscles were paralyzed, and there was a mild degree of varus, the foot turning easily until the sole was parallel with inner surface of the tibia. He had been wearing a brace for several years. A new brace was ordered which held the foot in perfect position. The patient wore this brace for nearly two years longer; and it was then decided, as no further improvement had occurred, to resort to operation. As a preliminary the foot was stretched manually, and put up in plaster in an over corrected (valgus) position, on February 18, 1907. On April 4, 1907, Dr. Ashhurst transplanted the tendon of the tibialis anticus to the base of the fifth metatarsal bone. The cast was changed at the end of three weeks, and a new one applied for five weeks longer. At this time, eight weeks after the operation, the transplanted tendon was firmly attached at its new insertion, and by its contraction flexed the foot into a very slight valgus position. A shoe was ordered, with its sole raised on the outer side, so as to maintain over-correction for some time longer. Two months later it was noted that all the

motions of the foot were normal, the transplanted tibialis anticus everting and flexing the foot well, while the power of inversion was retained by the tibialis posticus. The boy now walks without any limp, never falls from turning of the ankle, and except for the scars of operation, it is difficult to tell which was the paralyzed foot.

Case 2.—*Paralytic Valgus, ankle-drop, and knee-drop. Transplantation of peroneus brevis to the base of the first metatarsal bone; and transplantation of the gracilis and semi-tendinosus to the upper border of the patella.*

Frank W., entered the service of Dr. G. G. Davis, February 26, 1907, when 11½ years of age. He had had infantile palsy at the age of 10 months, and had been under the care of Dr. T. G. Morton, who ordered a brace and had the patient treated with electricity. Later at the University Hospital, an operation (arthrodesis?) was done on the ankle, and a brace was ordered. When the patient came to the Orthopædic Hospital he could hardly walk at all without his brace, having to put his hand on his left knee at every step to keep it from collapsing like the blade of a pocket knife into the handle, as there was absolutely no power of holding the knee extended. Besides the paralysis of the quadriceps extensor femoris, the following muscles of the foot were paralyzed: tibialis anticus, extensor longus hallucis, extensor longus digitorum, tibialis posticus, and flexor longus hallucis; the calf muscles were weak, but contracted feebly. The only muscles which contracted well were the peronei, and the flexor longus digitorum. On April 17, 1907, Dr. Ashhurst transplanted the peroneus brevis to the base of the first metatarsal bone, to replace as far as possible the paralyzed tibialis anticus; at the same time the gracilis and the semitendinosus were transplanted into the upper margin of the patella. The plaster cast was removed eight weeks later, and, after the patient's old brace had been fitted, another cast was applied while alterations were being made in the brace. It was found possible to dispense with the apparatus above the knee, as the transplanted hamstring muscles effectually prevented the collapse of the knee in walking, although voluntary extension is not yet possible. He never falls down now, and the transplanted peroneus muscle can slightly invert the foot and correct the extreme valgus deformity present before the operation. The boy, however, still wears the old

brace to keep his foot in good position, and it seems probable that arthrodesis will have to be resorted to before the brace can be entirely discarded. There is also paralysis of the erector spinæ group of muscles, and the limp, due partly to the shortening of the whole lower extremity, is aggravated by the extreme lordosis.*

CASE 3.—*Paralytic calcaneus, with varus and foot-drop. Transplantation of the anterior tibial nerve into the musculocutaneous; and of the peroneus longus muscle into the insertion of the tendo Achillis.*

Fred J. S.. entered Dr. Davis's service February 26, 1907, when 7 years of age. He had had infantile palsy at the age of 2 years, affecting both legs. The left leg largely recovered its functions, only a slight cavus deformity remaining. The right foot showed moderate calcaneus, with varus and foot-drop. The peroneal muscles contracted well, but there was paralysis of the following muscles: tibialis anticus, extensor longus hallucis, extensor longus digitorum, flexor longus digitorum, flexor longus hallucis, and the muscles of the calf. The condition of the tibialis posticus was doubtful, but it was certainly very weak. The only voluntary motion possible was a very feeble extension (plantar flexion) and abduction of the foot by contraction of the peroneal group. There was no power of raising the heel, and if there had not also been foot-drop, the boy would doubtless have walked on his heel with his toes in the air, as in pure paralytic calcaneus. As the entire distribution of the anterior tibial nerve, embracing the tibialis anticus, the extensor longus hallucis, and the extensor longus digitorum, was paralyzed, while the entire distribution of the musculocutaneous nerve was intact, the case seemed a suitable one in which to attempt to divert some of the nerve impulses from the latter into the anterior tibial nerve. It was determined at the same time to transplant the peroneus longus into the calcaneum, so as to overcome as much as possible the calcaneus, which was the most disabling deformity. On June 1, 1907, Dr. Ashhurst isolated the musculocutaneous nerve by dissecting through the peroneus longus muscle, just below the head of the fibula. After finding the musculocutaneous nerve on the surface of the fibula, the anterior

* On June 3, 1908, Dr. Ashhurst did arthrodesis of the ankle-joint and of the subastragalar joint in this patient.

tibial nerve was easily located just to its mesial side, before it had perforated the septum between the peroneus longus and the extensor longus digitorum. Two sutures of very fine silk, threaded in ophthalmic needles, were then passed through the sheath of the anterior tibial nerve, one on either side, and after this had been done, the nerve was divided with a tenotome above this point, just below its recurrent articular branch. Then a longitudinal slit was made with a tenotome in the musculocutaneous nerve, and by means of the sutures previously placed in the musculocutaneous nerve the latter was drawn into the slit in the anterior tibial nerve, and sutured to the sheath of the anterior tibial nerve. Two other sutures were placed above and below the first two, through the sheaths only, to act as guys, and relieve any possible tension on those first placed. The deep fascia was closed with interrupted silk sutures, and the skin with chromic gut sutures. Then the peroneus longus tendon was divided at the base of the fifth metatarsal bone, and transplanted into the periosteum at the insertion of the tendo Achillis. The time of the operation was 40 minutes. A plaster cast was applied, extending to the middle of the thigh. After six weeks a new cast, extending only to below the knee, was applied, and worn for several weeks longer. At no time was there any evidence of injury to the musculocutaneous nerve, into which the paralyzed nerve had been transplanted. Since August, 1907, the patient has been wearing his old brace. There has been absolutely no result from the nerve anastomosis, the muscles supplied by the anterior tibial nerve having no more power than before the operation. The transplanted peroneus longus muscle has restored a slight degree of power of raising the heel, and has at all events prevented a recurrence of the calcaneus deformity. Subastragalar arthrodesis will probably be required later, as the foot is still rather flail-like.

CASE 4.—*Paralytic valgus; transplantation of peroneus longus and brevis into base of first metatarsal bone.*

This case was reported at the last meeting of the Academy by Dr. G. G. Davis, in connection with his operation of transplantation of the tensor fasciæ femoris for outward rotation of the lower extremity from infantile palsy. The operations were done October 22, 1907. The transplanted peroneal muscles act well, and overcome almost entirely the previous valgus. An

ordinary shoe is worn, and the slight limp is due chiefly to the shortness of the paralyzed leg.

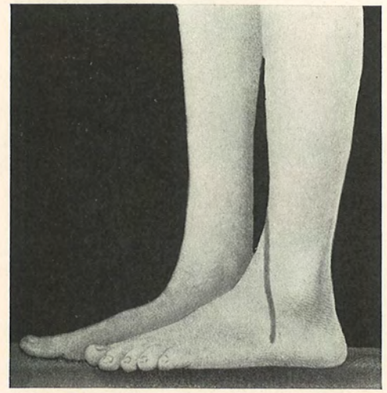
CASE 5.—*Paralytic valgus; transplantation of peroneus brevis and extensor longus hallucis into base of first metatarsal bone.*

Pasquelino R., aged 7 years, had infantile palsy when four years old, and had never received any treatment for the resulting deformity. He entered Dr. Harte's service at the Orthopædic Hospital October, 1907, with marked valgus of the right foot. The tibialis anticus was paralyzed, but the extensor longus hallucis and extensor longus digitorum contracted well, and the peroneal muscles also appeared to be normal. The boy walked on the inner surface of his foot, with a very marked limp. On December 10, 1907, Dr. Ashhurst transplanted the peroneus brevis into the base of the first metatarsal bone, and as it did not appear to be as strong when seen at operation as it had been thought to be before, the tendon of the extensor longus hallucis was divided on the dorsum of the foot, and after suturing its distal end to the neighboring tendon of the extensor longus digitorum, its proximal end was also sutured into the base of the first metatarsal bone, at the point of insertion of the tibialis anticus, thus supplementing the paralyzed tibialis anticus by both the peroneus brevis and the extensor longus hallucis. The plaster cast was removed two months later. The transplanted muscles now contract satisfactorily, and while there is no over-correction, the valgus deformity has been overcome, and the arch of the foot restored. The patient wears a shoe with its sole raised on the inner side, and is able to walk very well without any kind of apparatus, and with a scarcely noticeable limp.

CASE 6.—*Paralytic valgus; transplantation of peroneus longus into base of first metatarsal bone, and transplantation of distal end of tibialis anticus into extensor communis digitorum.*

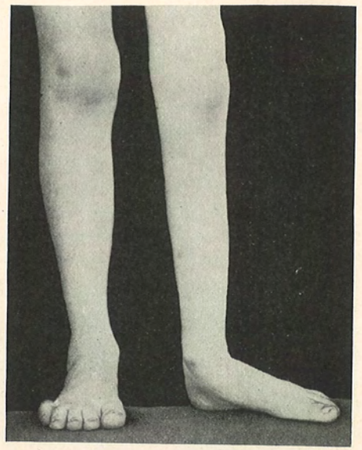
William M., entered Dr. Harte's service at the Orthopædic Hospital, May 4, 1905, at the age of 7 years. He had had infantile palsy at the age of 2 years, which had left him with valgus and slight ankle-drop of the right foot. The tibialis anticus, tibialis posticus, and extensor longus hallucis were paralyzed; the extensor longus digitorum contracted well, and the peroneal muscles appeared to be normal. A brace was ordered, but the patient did not return to the Orthopædic Hospital for nearly two years, when it was found that an operation

FIG. 1.



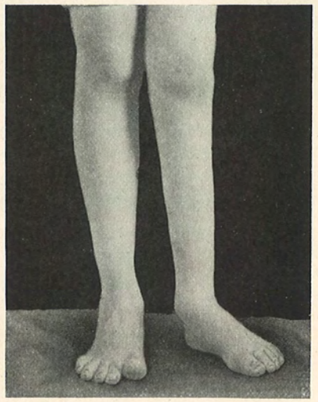
Case I. Position of transplanted tibialis anticus outlined on the skin.

FIG. 2.



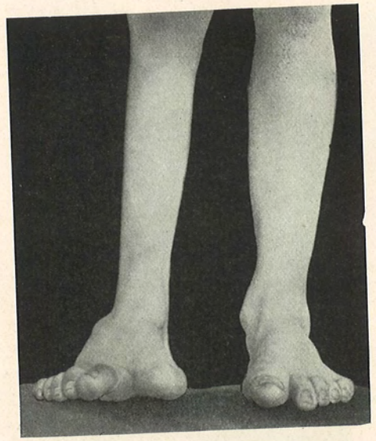
Case II. Paralytic valgus before operation.

FIG. 3.



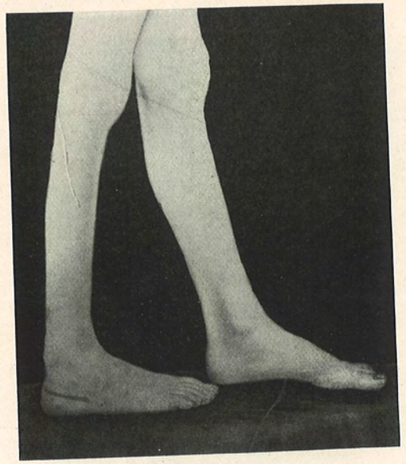
Case II. Paralytic valgus after operation.

FIG. 4.



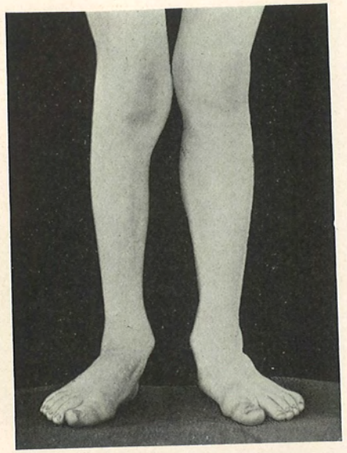
Case III. Paralytic calcaneus with varus and foot-drop. Before operation.

FIG. 5.



Case III. After operation. The incisions for the nerve-anastomosis and for the tendon transplantation have been outlined on the skin.

FIG. 6

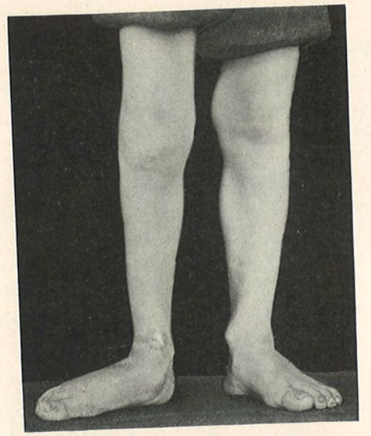


Case V. Paralytic valgus. Before operation.

FIG 7.

Case V. After operation.

FIG. 8



Case VI. Paralytic valgus. Before operation.

FIG. 9.

Case VI. Paralytic valgus. After operation

of some kind (apparently shortening of the tibialis anticus) had been done by a homœopathic doctor. The boy was now wearing a brace, and his foot was if possible in a more deformed condition than at his first visit. Without the brace there was marked toe-drop, and he walked on the inner side of his foot, his sole turning outwards. He was admitted to the ward of the Orthopædic Hospital in October, 1907, and his foot was forcibly stretched under an anæsthetic on October 24, November 7, and November 30. The deformity having now been entirely overcome, Dr. Ashhurst operated December 31, 1907. The peroneus longus was transplanted into the base of the first metatarsal bone, and as it did not appear to be very strong, and as the extensor longus hallucis was entirely paralyzed, the tendon of the tibialis anticus was divided above the annular ligament, and its distal end was sutured under tension to the tendon of the extensor longus digitorum, which was normal, thus pulling the foot into the varus position. The plaster cast was removed two months later, and the result was found to be more satisfactory than had been anticipated: by flexion of the ankle through the extensor longus digitorum the distal end of the tibialis anticus is also pulled upon, so that the foot is no longer everted, but can be somewhat inverted also. The patient wears a shoe with its sole raised on the inner side, to maintain the over-corrected position.

Dr. John H. Jopson discussed the result in the second case shown by Dr. Ashhurst, in which he transplanted the gracilis and semitendinosus into the upper border of the patella. The patient is greatly improved, there being additional strength given to the knee. But the lack of power of voluntary extension would seem to support the views of Lange, who advises that in transplanting the ham-string tendons the entire group be transplanted rather than a couple of muscles, as in this way there is a much greater chance of achieving early alteration of function of the muscle from a flexor to an extensor.

Dr. G. G. Davis referred to the question raised by Dr. Jopson as to the utility of transplanting certain parts of a group of muscles. Dr. Davis said that in practically all of the cases, even where there was a transplantation of but a single muscle, the result was satisfactory; that he has had cases in which the transplantation of the semitendinosus has been sufficient, and

although it might not give the power of extension which would be derived from the transplantation of the entire group of flexor muscles, it was nevertheless sufficient to steady the knee, rendering it possible to dispense with the use of any apparatus. The main object of the operation is to give sufficient power of extension to prevent the knee from suddenly flexing as the patient walks and he believes that this result can be obtained in some cases by the transplantation of a single muscle.

Dr. John H. Jopson said that he had not meant to criticise the operation which had been done in the case discussed, as the result was an excellent one, but thought the case referred to was a good example of the contention raised by Lange. When tendon transplantation was first brought forward it was claimed that one could alter at will the function of the muscle as easily as we could change its insertion. This claim has been found somewhat exaggerated, and as a result there had been for a time a revulsion of feeling in regard to the operation.

Dr. William L. Rodman said that three weeks ago he had anastomosed the musculospiral for wrist-drop, doing practically the same operation as Dr. Ashhurst, bringing the distal end of the nerve over to the median, by transfixing the brachialis anticus muscle and anastomosing it with the median and musculocutaneous. At the present time there seems already return of sensation in the skin over the hand and fingers.

Dr. Ashhurst, in closing, said, in reply to inquiry, that he did not know how long one should expect to wait for a nerve to regenerate; ten months had elapsed in the present case. He said that he had seen statements that even one or two years should be allowed to elapse before hope of a good result should be abandoned; and said that if in that length of time his patient should be fortunate enough to obtain return of power, he would take pleasure in showing the boy again.

TWENTY-FIVE HUNDRED CASES OF GAS-ETHER ANÆSTHESIA WITHOUT COMPLICATION.

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The recent inroads of surgery into the domain of medicine have not only largely increased the number of operations, but have introduced so many extensive proceedings requiring prolonged anæsthesia that the problem of the administration of anæsthetics has been raised from a comparatively trivial to an important position. The surgeon fully realizes that to a large degree his success depends upon his anæsthetist, that many a skilfully performed operation has been rendered useless by clumsily administered ether and that many a convalescence has been unduly prolonged by over-anæsthetizations. Still the progress of this art has not been commensurate with surgery's advance. We still see, too often, patients profoundly shocked and deeply cyanosed in the hands of inexperienced men—perhaps in those of an obliging practitioner, entirely incompetent to take this important duty upon his shoulders. To a certain extent the text-books are responsible for over-etherization. It is usual to find the statement that surgical anæsthesia requires the absence of all reflexes. This is obviously erroneous teaching and leads to gross over-use of the drug.

A glance at the records and statistics of spinal anæsthesia suffices to show that at this stage it has not approached the usefulness of general narcosis. The mortality is variously estimated at from $^1/_{10}$ to ½ per cent. Failure to produce anæsthesia occurs in 4 per cent. of cases according to Bier, 14 per cent. according to Moynihan, 10 per cent. according to Doderlein, etc. The after-effects are likewise more severe, 10 per cent. suffering from severe persistent headache; many

have paralysis; nausea and vomiting is not infrequent. Rigidity of the muscles of the neck has been observed many times as well as untold more unusual complications.

An attempt to collect statistics as to postoperative complications and mortality from ether anæsthesia, showed a lamentable absence of records, both in the literature and hospital reports. In three of our leading hospitals no statistics whatever could be collected—in a fourth a list of 1800 cases was traced, with 18 cases of pneumonia, thirteen of which were fatal, giving a percentage of 1 per cent. of pneumonia and of .7 per cent. mortality. This is unusually high; which fact can be partly explained by the type of cases brought to this institution. As in many others, anæsthetization in *this* hospital is the duty of the junior resident, who is usually inexperienced. It is therefore a more or less fair example of statistics of etherization and its mortality in the hands of unskilled men, especially as these records do not show deaths from any of the other complications of ether anæsthesia, such as renal failure, acute cardiac dilatation, apoplexy and shock.

The present series of twenty-five hundred cases without serious complications and absolutely without pneumonia or bronchitis forms therefore a marked contrast.

A word as to what should constitute a complete surgical anæsthesia. It is that degree of sensory and motor depression required to enable the surgeon to complete his operation unhampered by movement or rigidity of the patient's muscles, and not one whit more. From this definition it obviously follows that the degree of anæsthesia varies with each operation and each individual, which fact the competent anæsthetist keeps constantly in mind. The signs and symptoms of sufficient narcosis vary likewise.

In a general way it may be said that complete surgical anæsthesia is indicated by a pupil reacting sluggishly to light, a regular noiseless breathing, a good color, muscular relaxation and absence of cutaneous reflexes. The best guide is the pupil, but unfortunately in from 85 to 90 per cent. of cases it is not reliable during the whole time of narcosis. We find

irregularity, inequality, absolute fixation of one or both pupils, etc., etc., in the above percentage of cases. This sign failing the respiration furnishes the best gauge. Close observation of the rhythm, the depth and the sound of breathing will almost invariably indicate the return of reflexes. The irritating vapor causes reflex contractions and consequently a more noisy, more hurried or more spasmodic breathing. Often the alteration is ushered in by one deep inspiration.

It is rarely necessary to carry the anæsthesia beyond a point where slight reflex inhibition of respiration is occasioned by administration of fresh ether.

To keep the patient on the borderland between consciousness and unconsciousness requires the absolute concentration of the anæsthetist. The subject's degree of narcosis varies from minute to minute. It is impossible to watch the details of the operation, or do anything but observe the changes in the patient's condition. It is much easier for the etherizer to carry the anæsthesia into the deep third stage with absolutely fixed dilated pupil, shallow respiration, cyanosis and increasing pulse rate. He then may follow the operation for minutes at a time or otherwise amuse himself, but he does so at the expense of the individual temporarily in his care. Ether is an irritant depressing poison, and each drop needlessly administered increases the danger to the patient's life, and decreases his power of resistance, so sorely needed in his period of convalescence.

In my hands the best results have been obtained by the use of nitrous oxide as a preliminary, followed by the gauze drop method. This has the following undisputed advantages: Nitrous oxide is by all means the safest anæsthetic we have, a series of 300,000 cases without a single death having been recently reported. It is not irritating and therefore greatly enhances the patient's comfort. All the choking, gagging and struggling so often seen where ether alone is used is eliminated. It greatly reduces the length of time required to produce surgical anæsthesia, the average being from seven to eight minutes, and likewise greatly reduces the amount of

ether required. This is especially true, as it is a well-known fact that it often requires as much, or more ether to anæsthetize a patient as it does to keep him under its influence for a considerable length of time. Its disadvantages are: nitrous oxide requires a more or less bulky apparatus, it is expensive, and in about 50 per cent. of cases, principally males and children, leads to an increased secretion from the respiratory mucous membrane. This last disadvantage would be an objection indeed had we no way to prevent, or at least to limit it. The most efficient preventative is the administration of a hypodermic injection of a full dose of morphine and atropine twenty minutes before the anæsthesia is commenced. This has many uses. The morphine quiets the patient, and to some extent depresses the nervous system so as to limit the amount of ether required. The atropine controls mucus secretion. Preliminary sprays of adrenalin and cocaine solution are also of some use. A thorough spraying of the mucous membrane of the nose and throat furthermore eliminates the rare danger of reflex cardiac inhibition occasionally observed as the result of the first administration of ether. If mucus is secreted in excess, notwithstanding these preliminary precautions, great care is necessary. Under no circumstances should such a patient be deeply anæsthetized—never to the point where inhaled mucus ceases to cause a reflex cough. The common practice of swabbing out the mouth and throat by gauze or other sponges is worse than useless; mucus reappears in less than two minutes and the friction of the sponges increases the flow. Raising the patient's shoulders allowing the head to extend fully while placed on its side allowing the mucus to flow into the cavity of the cheek thence leak out at the angle of the mouth, is the best treatment for this condition. Occasionally repeated sprayings and another dose of atropine helps to control the ceaseless flow.

As to the administration of ether itself the open method, and the most open one, namely, gauze, was invariably used. Pads about four by five inches and about eight layers in thickness form the most convenient method of administering the

drug. The concentration of the vapor may be regulated by the number of layers of gauze employed. Sixteen is about the average number, children requiring less, women less than men, the latter frequently calling for twenty-four layers. If great concentration is required the ether may be dropped upon the under gauze and then covered by an overlaying pad, which will practically exclude the air. More ether is required by the gauze than by any other method, the average amount for men being seven to eight ounces for the first hour, five or six for women. After this time the amount is greatly reduced, especially if a morphine preliminary has been employed, it not being an unusual occurrence to have thirty minutes elapse without the necessity for more vapor. Average amounts of ether required per hour are of no value statistically inasmuch as they vary so greatly with the individual.

If the anæsthetist observes the precautions cited above he will be enabled to carry on his narcosis without endangering the patient's life from over-etherization, which may lead to shock, inhalation pneumonia, kidney complications and great physical depression, reducing vital resistance and healing powers during convalescence.

The management of a so-called difficult case often taxes the ingenuity of the most experienced. Every one knows that notwithstanding the greatest care and knowledge it is sometimes impossible to completely relax some individuals. The type occasioning these difficulties is usually the fat, flabby, plethoric, short-necked male, addicted to the use of alcohol, whose mucous membranes are in a constant state of congestion, and whose arteries are sclerotic. This class of patients run great danger from complete ether narcosis. Their resistance is low, hence pneumonia is more likely to follow inhalation of infected mucus, almost always profuse in these cases. Their arteries are brittle, hence subject to apoplectic rupture, caused by the cyanosis so often the result of the early administration of ether. Their kidneys are, as a rule, impaired and therefore likely to suffer from the anæsthetic, best results in these cases were attained from the following precautions:

Twenty minutes before the anæsthesia a very full dose of morphine and atropine is injected hypodermically, the chest is covered by a cotton pneumonia jacket. Immediately before administration of ether, the mouth, nose and throat is thoroughly sprayed with a 2 per cent. eucaine solution. Then a mouth-gag of the Whitehead type is inserted and the preliminary nitrous oxide commenced. When the patient is unconscious, ether is substituted in moderate concentration,—about sixteen layers of gauze moistened with ether being sufficient. At this stage frequently the patient spasmodically and reflexly fixes the jaws defying all attempts to open them, respiration ceases leading to profound cyanosis and the increased blood pressure dependent thereupon, which in turn may cause the rupture of sclerotic vessels. Atropine and morphine will decrease this tendency, but not eliminate it. The presence of the previously inserted mouth-gag saves the situation inasmuch as it is easy to open the jaws, pull the tongue forward, open the larynx and relieve the cyanosis.

If after ten minutes of administration of ether the patient shows no sign of relaxation I change off to chloroform through an Esmarch inhaler, unless contraindicated by the cardiac condition. By observing these precautions it is usually possible to handle these cases in the safest and most satisfactory manner.

A word as to the after-effects of ether anæsthesia: Nausea and vomiting are perhaps the most constant. This annoying, and at times dangerous complication, is greatly reduced by the gas-ether method. In a recent series of one hundred cases anæsthetized by this method by students under my instruction the following results were obtained; persistent vomiting (48 hours) in one case, a gall-bladder operation, the condition being ascribed to a low degree of acute gastric dilatation, 81 per cent. did not vomit at all after regaining consciousness, the remaining 19 per cent. had varying amounts of gastric distress during the first twelve hours, in a few continuing during the first twenty-four hours. The use of oxygen and inhalation of vaporized vinegar have been given

up after a thorough trial. If the patient be not over-anæsthetized oxygen is not needed, because there is no cyanosis, and the patient will regain consciousness within ten minutes after the last suture is placed, often moving and talking at random immediately after completion of the operation. The administration of oxygen did not seem to improve upon the statistics given above. A similar conclusion was reached after the use of vinegar.

Ether burns of the face never occur when the gauze drop method is adhered to. If the ether be spread over a sufficiently large evaporating surface and not allowed to drop in one place it will be found that the under surface of the gauze pad is entirely dry. In no case has an ether burn resulted in this series, nor in any of the cases anæsthetized by students.

The advantages of this method are: Its relative safety, comfort to the patient, the time and ether saved in anæsthetization, freedom from complications, such as bronchitis, pneumonia, annoying nausea and vomiting, shock and reduced vital resistance.

In conclusion I would make a plea for less profound anæsthesia in all cases, for rules preventing the junior resident from giving anæsthesia, unaided, and for the more extensive instruction of this art in our medical schools, in the light of its daily increasing importance.

Dr. John B. Roberts thought the reader had brought out a point not always insisted upon, namely, that very little ether is needed after the patient once becomes etherized. Dr. Roberts said that it would seem from his experience with the Resident Physicians who administer ether for him that they had never been taught the importance of this fact. They get the patient etherized for the surgeon and then continue to pour on as much ether as they did at the start. He thinks Dr. Van Kaathoven has properly emphasized the need of plenty of ether to start with but very little afterwards, and the desirability of having the patient in such condition that he comes out of ether as soon as the operation is over. He is inclined to believe that what is called the "drop method" has been so talked of recently that

many men are claiming to give ether by what they call the "drop method" when they are really pouring more ether on the inhaling apparatus than is done by those who know what is scientific administration of the anæsthetic. After all, it is not the "method" that is to give safety to the patient, but the experience and brains and attention of the administrator.

Dr. G. G. Ross said that there were two things about serious operations which gave him an undue amount of alarm. The first is the junior resident who gives the ether and the other is the unsophisticated female who handles the gauze. He thinks that the danger does not lie so much in the ether as in the man who is giving it. In hospitals where they do not have teaching in connection with the other hospital work and therefore no teacher for that particular art, he thinks it would be wise to have an official anæsthetizer on the senior staff who would be responsible for the instruction of students or residents until they are fully qualified to give ether properly and safely.

Dr. G. G. Davis said that the use of nitrous oxide preceding ether anæsthesia is an old one although it seems to be coming into favor only now in this progressive country; it was commonly used in London over twenty-five years ago, and he thinks a method which has taken so long to establish itself on an acceptable basis argues either that the public is very slow in recognizing the utility of good things or else it is not worthy of recognition. The objections to the method are in the first place, that it requires more experienced anæsthetizers and it gives rise to very considerably more mucus, and the transition from nitrous oxide to ether is liable to be unsatisfactory, especially, Dr. Davis believes, when the so-called "drop method" is used. We hear of eight to sixteen layers of gauze but personally Dr. Davis has never liked gauze, thinking it inferior to a close meshed towel in efficiency. Time and time again he has had the anæsthetizer fail to anæsthetize the patient rapidly, simply on account of the amount of air which is inhaled. He believes in deliberately excluding air when it is desired to rapidly anæsthetize the patient.

As regards the advantages of nitrous oxide, Dr. Davis was not prepared to admit with Dr. Van Kaathoven, that it leaves the patient in better shape than a simple anæsthesia with ether. If ether is used alone and time is taken in its administration, he believes it is the safest anæsthetic agent, and if it is preceded by

the morphia and atropine injections its results would be as good, as far as the after-effects go, as if preceded by nitrous oxide.

Dr. William L. Rodman said that he thought it had long ago been conceded that ether is best preceded by nitrous oxide. He also believes that chloroform can be preceded by nitrous oxide in the majority of instances. He was particularly glad to hear that one hundred students at the University had been allowed to administer the anæsthetic. He does not think it a broad position to say that a paid anæsthetist should be in every hospital; certainly not in teaching hospitals, for if the students are to be sent out without practical experience, how can they be expected to give an anæsthetic. Dr. Rodman thinks that it is perfectly safe for students to give ether under competent instructors inasmuch as the danger signals are thrown out promptly and are easily recognized and met. During the past term every senior student at both the Woman's Medical College and the Medico-Chirurgical College has given an anæsthetic. He thinks that the giving of anæsthetics is one of the most important things to be taught students. Dr. Rodman agrees with Dr. Van Kaathoven that the drop method is the best. Also that if ether is not to be preceded by gas a most valuable adjuvant is talking to the patient, for he has literally seen patients almost talked to sleep. He is impressed with the fact that ether is not as safe an anæsthetic as is generally thought; there is a great deal of pneumonia following it. He does not consider it safer than chloroform. He has given chloroform as often if not more frequently than ether and has never seen a death from it in his own practice, but he has had three deaths from ether. When a patient goes off the table after chloroform one can be easy about him, whereas it is the reverse with ether; they are apt to have suppression of urine, develop pneumonia or bronchitis. For these reasons Dr. Rodman prefers giving chloroform in nephritis rather than ether. He thinks that in hospitals where it is practicable, ether should always be preceded by nitrous oxide, as he believes this will reduce the mortality rate from the administration of ether very materially.

Dr. Charles H. Frazier does not believe surgeons connected with non-teaching hospitals realize how much they are handicapped in educational institutions where a greater part of the routine surgical work is carried on with students as etherizers

and assistants. It is not fair to criticise a junior resident at the hospital because he is not at the time he enters upon his work a skilled anæsthetist. The fault lies with the organization of the clinic and the administrative officers of the hospital. To assign to a junior resident the responsible post of anæsthetizer is a practice worthy only of condemnation and fortunately long since abandoned by many hospitals.

Dr. Oscar H. Allis said that the discussion on this subject had helped him to understand why it was so hard to teach the young men who came to the Presbyterian Hospital the way in which to administer an anæsthetic, as they had administered it two or three times somewhere else and thought they knew it all. It seemed to make no difference to them that Dr. Allis had had thirty-five or forty years of experience. Dr. Allis said that operators often become impatient and hurry the anæsthetizer; for his part he never hurried the anæsthetizer, and always considered his duty as important as was his own as operator. He has sometimes seen the patient almost dead from an overdose of ether, and the anæsthetizer still pouring it on, wholly oblivious to the patient's critical condition. He thinks that anæsthetizers are as a general rule too much interested in the work of the surgeon and not enough interested in their own important duties.

Dr. Allis said that any one who knew anything about ether felt that he knew nothing, as the dangers and responsibilities change with each individual case. He thinks it would be a wise arrangement if each hospital had a well paid expert anæsthetizer.

Dr. John H. Gibbon emphasized one improvement which has been made in general anæsthesia, namely, reduction in the amount of ether which is given. Where gas or ethyl chloride is given first, and especially where these agents have been preceded by morphia and atropine, the patient can be fully anæsthetized in from three to four minutes. The morphia and atropine given twenty minutes or half an hour before the anæsthetic is started reduces the amount of ether necessary during the progress of the operation. By following out this plan the ether given the patient is reduced to the minimum, and the after-complications which result from ether are greatly reduced. Dr. Gibbon wished to know in what number of the 100 cases which Dr. Van Kaathoven stated had been anæsthetized by students,

and in 81 per cent. of which no subsequent nausea or vomiting had occurred, morphia and atropine had been given prior to the anæsthetic.

Dr. Van Kaathoven, in replying to Dr. Gibbon's question as to the number of patients who had morphia and atropine given beforehand in the series of 100 anæsthetized by students, said that he did not think over 20 per cent. received this preliminary treatment, and that in at least fifty private cases there was the same percentage. He does not think the morphia renders the patient more prone to nausea. After the patient becomes conscious from the anæsthetic he often passes off into a comfortable sleep.

With reference to Dr. Allis' remarks, Dr. Van Kaathoven said that he realized the difficulty of impressing the student with the fact that just because he has a bottle in his hand there is no reason why he should always be pouring from it, and that it is only by keeping them to the other extreme that he is able to impress upon them the importance of not anæsthetizing too deeply. One never knows what is going to happen and it is therefore of the utmost importance to pay strict attention to the patient at all times.