Progress of Cases 1, 2, and 3.

1. *Eli Tovey*: Hand much deformed, and at present useless. The left tympanic membrane was ruptured, and he is still deaf on that side. He had no symptoms of nervous depression.
2. *Evan Jones*: Fractured leg. No nervous symptoms.
3. *Wm. Cleavy*: No definite injury, but complained of weakness after any slight exertion. Marked tremor of hands. Well-marked nystagmus also set in immediately after accident, although he had had no trouble from his eyes before. Is only able to do light work still.

It is interesting to note that, of these five cases, 1 and 2 had marked physical injuries, but no nervous symptoms, while the others had marked nervous symptoms but trivial injuries.

AFTER-RESULTS OF THE EXPLOSION.

All the cases who suffered from after-damp recovered very quickly, with one exception: J. McCarthy, of the first rescue party, was unable to work for six weeks. He suffered from great nervous depression, inability to perform any physical exertion, and loss of appetite. He showed marked weakness of grip, with tremor of hands.

A. Thomas, who was in charge of a pump underground on the night of the explosion, and who escaped through Gilfach, is also at present unable to work. He suffered from great nervousness, loss of appetite, sleeplessness, and weakness. The other men were all able to resume work when the pit started.

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TRIGEMINAL NEURALGIA AND ITS TREATMENT BY ALCOHOL INJECTION.

BY

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OWING to the frequency of dental caries, or other causes connected with the teeth, neuralgic pain in the area of distribution of the fifth cranial or trigeminal nerve is one of the commonest disorders calling for treatment. Excluding dental neuralgia due to caries, erupting or impacted teeth, periostitis, etc., errors of refraction and other ocular and nasal troubles, antral and other sinus disease, there yet remain a number of cases of intractable neuralgia affecting one or more of the divisions of the fifth nerve, whose cause is either irremovable or else cannot be discovered. Prominent amongst these are the cases of true tic douloureux, often spoken of as trigeminal neuralgia. It has been a matter of general agreement that true tic douloureux, once acquired, persists indefinitely until either death or removal of the Gasserian ganglion has brought relief. Cases of so-called cure following cataphoresis or other electric treatments, or the use of various drugs, have probably been either not instances of the disease at all, or else the relief was transient, and recurrence of the pain soon takes place. The only treatment besides extirpation of the Gasserian ganglion that gave any real relief was resection of the nerve trunks, and this often failed, as in the cases of neuralgia of the second division. When the pain affected the upper jaw as well as the skin of the nose, lip and cheek, unless the superior maxillary nerve was resected intracranially no improvement resulted, as peripheral resection of the infraorbital nerve alone would not influence the pain in the upper jaw, owing to the dental nerves being given off from the trunk of the nerve some distance behind the point of resection at the infraorbital foramen. Pain referred to the lower jaw alone, or to the supraorbital nerve, was often relieved for one or two years by division of the inferior dental nerve at the angle of the lower jaw, or of the supraorbital nerve at the notch respectively. In neuralgia of the third division, however, if the pain was referred to the tongue and auriculo-temporal nerves in addition to the lower jaw, peripheral resection became more difficult. The real reason, however, of the failure of the treatment by peripheral resection of the nerves, was the impossibility of repeating the operations when the pain recurred, due to regeneration of the nerve, which invariably occurred in from one to two or three years. Thus, extirpation of the

Gasserian ganglion was the only real remedy, and that had the advantage of producing a permanent cure, some cases having now been free from pain for more than fifteen years since that operation. It is, however, an operation of considerable severity, and many patients have refused to undergo it, and preferred to submit to the pain, rather than undertake the risk, which the latest statistics show to be about 7 per cent., even in skilled hands.

In 1903, Schlösser,⁴ a Munich ophthalmologist, published his method of injection of strong alcohol into the main branches of the fifth nerve at their points of exit from the skull at the deep foramina. The action of the alcohol instantly paralyses the nerve, destroying the nerve fibres at the point of injection, if the needle has properly punctured the nerve sheath. The immediate result is anaesthesia to all forms of sensation on the skin and mucous membrane supplied by the nerve below the point of injection, and, if the third division of the nerve is injected at the foramen ovale, there will also be motor paralysis of the masseter, pterygoids, and temporal muscle. Experimental work by Finkelnburg¹ has shown that degeneration of the nerve fibres of the ordinary type follows injection of a nerve trunk with strong alcohol, so that this method practically amounts to a chemical resection of the nerve. The advantage of this method over resection by the ordinary method of incision is that the needle leaves practically no scar, and it is possible to repeat the operation indefinitely, whenever pain returns after regeneration of the nerve. Schlösser² states that alcohol injection is less successful in those cases in which resection of the nerves has previously been done. This has not been my experience in three cases in which the inferior dental, infraorbital and lingual nerves had been divided. In each case the relief of pain after injection was complete.

During the last twenty months, between October, 1908, and May, 1910, I have treated with alcohol injections 50 cases of neuralgia of one or more branches of the trigeminal nerve. In this period I have had sent to me 38 cases of true tic douloureux, 23 in private practice and 15 in hospital. Of these 38 cases I have treated 33 with injections of strong alcohol into the affected nerve trunks at their foramina of exit from the skull. Two of my cases have been unsuccessful, owing to my failing to hit off the nerve, and the pain remained uninfluenced. One case died suddenly of angina whilst awaiting the injection treatment to be begun; two refused all suggestion of any form of operative treatment, and one is considering the question. Another, a woman with bilateral spasmodic neuralgia of the second and third divisions, which has continued off and on for over thirty years, ever since she was 17 years old, improved somewhat under butyl chloral hydrate, and injection treatment was consequently postponed. The remaining 31 cases were all completely relieved of the pain in the affected nerve, as the result of the injections, for periods varying from two months to eleven months and more. Nine of my cases have had recurrences of the pain after intervals of complete freedom varying from two to nine months. Five of these cases have been re-injected, causing much deeper anaesthesia than before, and their next interval of relief will almost certainly be much longer. The short interval of two months' freedom occurred in case 35, a woman with tic of the right third division mostly, with some reflected pain in the upper jaw, of six years' duration. Injection of the foramen ovale on March 5th, 1910, must have been perineuritic, not into the nerve, as no anaesthesia at all was produced, but her pain was instantly relieved, and did not recur until May 13th, and then in the lower jaw only. On May 14th I again injected the foramen ovale, producing complete anaesthesia of the inferior dental and lingual nerves, though only slight anaesthesia of the auriculo-temporal, and no paresis at all of the motor branch. She has been perfectly free from pain since. Three cases injected in June, 1909, are still quite free from pain, over eleven months, and the remaining 19 cases, which were injected between the end of August, 1909, and May 14th, 1910, have so far had no recurrence.

Another common type of trigeminal pain, though quite distinct from tic douloureux, and yet equally curable by alcohol injection, is supraorbital neuralgia, or brow ache. Of these I have injected eight cases with alcohol at the supraorbital notch, with the best possible results, the pain disappearing generally at once, as though by magic,

though in two cases it did not disappear finally until four or five hours after the injection. Of late years these cases of supraorbital neuralgia have been fairly common as sequelae of influenza. The pain is agonizing while it lasts, and is very periodic, usually starting about 10.30 a.m., and lasting without intermission until about 5 p.m., returning every day, perhaps for weeks. The periodicity of the pain is suggestive in its resemblance to the supra-orbital neuralgia or brow ache due to malaria. I have not come across any such malarial neuralgia, but I think it would probably yield to injection with alcohol of the supraorbital nerve at the notch, in the same way that the post-influenzal type does.

I have also used this method for injecting the superior maxillary nerve in two cases of chronic antral disease with periostitis, for the inferior maxillary nerve in three cases of inoperable carcinoma of the tongue and base of skull, in two cases of chronic neuritis of the ophthalmic division of the fifth nerve, two cases of neuralgia of the auriculo-temporal area of a migrainous type, and one case of sclerosis in the medulla involving the spinal root of the fifth nerve, causing neuralgic spasms in the analgesic facial area.

Indications.

As the result of this experience, it appears clear to me that the alcohol injection method is indicated under the following conditions in any persistent neuralgia:

1. When the site of irritation or injury to the nerve is more or less peripheral, so that the nerve can be injected on the central side of the lesion. No benefit results from alcohol injection of a nerve below the point of irritation. This method is therefore contraindicated in tabetic and in post-herpetic neuralgia.

2. When paralysis of the affected nerve will not cause extensive muscular palsy. Thus injection into the sciatic nerve, or into either of the nerve trunks of the upper extremity, is contraindicated.

I need not repeat the description of Schlösser's method of working with a very stout needle like a cannula, with a blunt stilet or trocar projecting beyond its point, as I do not consider it is the best method. I have followed Sicard⁶ in using finer needles, without any projecting stilet, and I entirely agree with him that the use of a blunt stilet, in order to avoid vascular injury, is unnecessary. I, however, use drawn steel needles, not of platinum, as Sicard recommends. For the foramen rotundum and foramen ovale I use hollow steel needles, 2½ in. or 64 mm. in length, made for me by Messrs. Maw and Son, in two sizes, with an outside diameter of 0.8 and 1.2 mm., the points being short and bevelled at an angle of about twenty degrees. Of late I have been using the finer needle in preference to the stouter size, as it causes less pain, though it is rather more difficult to work with. The handle or butt ends are round, with a milled grip, and bored accurately to fit a Record syringe. I have the milling incised with a file in line with the bevelling of the point, so that when the needle has been inserted I can direct the orifice of the needle towards the foramen by rotating the needle until the file mark is directed towards the foramen. With ordinary care there is no danger of breaking off the point, and I consider a platinum needle unnecessary. Although a blunt stilet projecting beyond the point is inadvisable, in my opinion, a stilet to fit the bore of the needle as far as the commencement of the bevelled point is necessary, to prevent the interior of the needle becoming filled with blood clot whilst working it down to the deep foramen. For this purpose I use the ordinary brass wire supplied with such needles, bending the end projecting from the handle at a right angle, so as not to interfere with the fingers when working.

As soon as the nerve is found at the foramen I withdraw the wire, and attach the syringe, ready filled with 90 per cent. alcohol, to the needle, and commence to inject slowly two or three drops. If the needle is correctly placed in the nerve, or even touching the outside of the sheath, a sharp burning pain will instantly be felt over the area of the distribution of the nerve, lasting about fifteen seconds, and gradually dying away. As soon as all the pain has disappeared, three or four more drops of the alcohol are injected, causing a repetition of the same burning pain, but lasting probably a few seconds less. Thus, a few drops at a time, from 1 c.cm. to 1.5 c.cm. is injected, the pain produced

with each succeeding push of the syringe being less and less. The syringe is then detached, and the needle steadily withdrawn, a sterile sponge being then firmly pressed over the site of the puncture for three or four minutes, until the oozing of the few drops of blood that always escape has ceased. A small collodion dressing, the size of a threepenny bit, is then applied, and left on for four days.

I invariably boil my needles, wire stilet, and syringe in weak soda solution immediately before use, as strict asepsis must be observed. The skin over the site of the puncture is previously sterilized with ether soap, followed by a solution of lysol, 1 in 3 of spirit. This is wiped off with spirit after a few seconds, as, if left longer, the skin is apt afterwards to become sore, and later will peel.

The method of directing the needle towards the deep foramina I described² fully in February, 1909, and I have little or nothing to add on that point. The question of whether general anaesthesia should be used or not is, in my opinion, one which must be considered for each patient. In five of my patients at least, four women, and in one man, it was quite impossible to attempt the injection without general anaesthesia, owing to their want of self-control. I certainly prefer to make the injections without general anaesthesia, as there is then available a valuable guide to the nerve in the sensations of the patient, who will at once complain of pain in the region of the distribution of the nerve as soon as the needle touches it. Then, as soon as a drop of the alcohol is injected into the nerve, the characteristic burning pain is felt over the same area. With general anaesthesia this indication is absent, and the needle must be guided in the right direction, first, by an intimate practical acquaintance with the correct line and depth, which can only be acquired by experience on the articulated skull and on the dead body. This study of the anatomy of the parts concerned enables the operator to picture before him the foramen and its bony landmarks, so that he is able to recognize what bony parts his needle is touching, and guide it accordingly. In my first paper³ on this subject I described a method which I then thought combined the advantages of general anaesthesia without losing the indication of the patient's evidence of pain when the needle touched the nerve. The patient was allowed to come round partially from the anaesthetic, after the point of the needle had been worked to the probable neighbourhood of the foramen. Then, pushing on the needle into the nerve was accompanied by a spasm of the patient's face as though feeling pain, though afterwards there would be no memory of what had occurred. I have found this method successful on two different occasions, but I am now convinced from further experience that it is fallacious, and that the same spasmodic reaction of the features may occur when the needle misses the nerve, and neither anaesthesia nor relief from the pain follow the operation.

A description of one typical case of neuralgic tic of the third division will suffice. Usually the pain develops gradually, stabs of pain in the cheek or jaw suggesting toothache, so that visits to the dentist, and perhaps total removal of the teeth from the affected jaw, are the earliest remedies sought. The following is an instance of absolutely sudden onset of the pain, which I have met with in four cases, all women:

CASE XIX.

Miss S., aged 50, while at lunch nine years ago, felt a sudden crash on the right side of her jaw, as though she had broken her jaw or a tooth. This was not very painful, but at every meal afterwards she noticed sudden pains, like flashes of lightning, in the right upper jaw. Any movement of the jaw, or talking, would also bring on the pains, for the first year or two during the first few minutes of the meal only, the pains disappearing as suddenly as they came. She described the pains as being "like fireworks playing along the sides of the cheek and then exploding in pain." Her attacks at first used to last for five or six weeks, and then might disappear for months, once for nearly a whole year. In 1908 she had an attack lasting from June to August, and then no more pain until March, 1909, when it started gradually, and then became severe, and lasted until I saw her at the end of August. The pain goes into the tongue, and runs along the lower jaw and into all the lower teeth up to the middle line, but not into the lip, though movements of the lips may start the pain. In the right upper jaw the pain runs only as far as the first bicuspid. The pain also runs up on to the side of the head in front of the ear, and also into the right ear and tragus, and the pinna often feels raw, and she sometimes cannot lie on the right side because of the pain.

Pressure on the lower lip, especially over the mental foramen, and sometimes over the malar bone, will start the pain, and at other times these spots are quite insensitive. No salivation. With the spasms of pain the angle of the mouth may be drawn to the right and the tongue curled up. Resisting the spasm makes the pain worse.

She had never suffered from toothache in her life, and her teeth were pronounced quite sound when the neuralgia commenced. Three years ago she was advised to have the Gasserian ganglion removed, but she refused. On September 4th, 1909, under chloroform, I injected the right foramen ovale successfully, producing complete anaesthesia of the right inferior maxillary nerve, as described in Fig. 2. There was no loss of taste, but the muscles of mastication on the right side were paralysed, and the jaw deviated to the right on being opened. At first the right side of the tongue and lower jaw felt wooden, and she had to eat on the left side, because she lost the food if it got on to the right side. The pain disappeared entirely from the date of the injection, and, although the anaesthesia has gradually diminished, there has been no further return of pain hitherto.

If general anaesthesia is used, chloroform or ether should be employed, not nitrous oxide or gas and oxygen, as the muscular spasm induced in the masseter and pterygoids by the latter interferes very seriously with the proper guiding of the needle. Consequently, whenever possible, I prefer to make the injections without any general anaesthetic, using only ethyl chloride spray for numbing the pain of puncture of the skin. I have tried anaesthetizing the track of the needle with eucaine and with stovaine, but have not found that it appreciably reduced the pain. After all, as several of my patients have told me, the pain

Fig. 1.—Chart of the cutaneous anaesthesia to all forms of sensation, in Cases v, xxvii, xxxiv, and xxxvi, resulting from injection of the supraorbital notch and foramen rotundum. The chart is diagrammatic for Cases v and xxxvi, in which the left side was affected. In addition to the area of skin shown, the anaesthesia was also complete on the inside of the nostril and septum, on the whole of the upper gum, inside of cheek above the line of the teeth, and on the hard palate as far back as its junction with the soft palate. In some cases of injection of the supraorbital notch the triangle of skin bounded by the notch, the middle line of the forehead, and the hair line escapes anaesthesia, owing to alcohol not diffusing to the supratrochlear branch.

of the injection is not so severe as a spasm of the neuralgic pain from which they are constantly suffering, and I have found that patients with good self-control bear it perfectly well, especially the educated class met with in private practice. The most difficult subjects are old women of the almshouse and hospital type.

Results.

Of the 33 cases of tic douloureux that I have treated by alcohol injection, 31 were completely relieved of all pain as the result; 9 of these received the successful injection under chloroform, although in 7 (6 women and 1 man) I had previously attempted to make the injection, using only the ethyl chloride spray. In all these 9 cases deep anaesthesia of the nerve distribution resulted, proving that the nerves had been properly hit by the injection. In 7 of these 9 patients I injected the foramen ovale, in 5 the foramen rotundum, and in 1 case the supraorbital nerve in addition to both the other divisions. In one of the 9 I have injected both the second and third divisions on each side twice under chloroform during the last twenty months. In 22 other cases, using ethyl chloride spray only, I have successfully injected the second division in 11 cases, the third division in 9 cases, and the supraorbital nerve in 8. Two of the cases had all three divisions involved, and in three others the neuralgia affected the first and second divisions together. In 4 of the cases, 1 of the second division and 3 of the third division, the injection must have been perineuritic and not into the nerve trunk, as neither of the four developed any

anaesthesia, although the pain disappeared completely. Case 35, as already related, relapsed after a little over two months, the pain reappearing in the lower jaw, when I again injected the foramen ovale, this time producing deep anaesthesia of the inferior dental and lingual nerves. In the remaining 18 cases anaesthesia of varying depth has been produced, as a rule the anaesthesia being deeper when the injection has been made into the foramen ovale than when the second division has been treated. The statement has been made by an American writer that the second division is never really anaesthetized by injecting to the foramen rotundum; this certainly is not true, for, of a total of 17 cases in which I have attempted to inject the superior maxillary nerve at the foramen rotundum, in 9 I succeeded in producing deep anaesthesia of the skin of the cheek and side of nose, inside of nostril, septum, upper lip, gum and hard palate, so that both tactile sensation and sensation to pin-prick were abolished over this area. In no case have I ever produced any anaesthesia over the area of skin above and outside the outer canthus of the eye, which is assigned in the anatomy books to the temporal branch of the superior maxillary. The limit of the anaesthesia I have obtained has always been sharply limited by the outer canthus (see Fig. 1). The temporo-malar branch is said to arise far back from the trunk in the sphenomaxillary fossa, as soon as the nerve leaves the foramen rotundum, and that is possibly the reason why it always escapes. In 4 other cases in which I have injected the second division,

Fig. 2.—Chart of the cutaneous anaesthesia to all forms of sensation, in Cases vi, xi, xiii, xv, xix, xxi, and xxiii, resulting from injection with alcohol of the foramen ovale. Cases vi, xi, xix, xxi, and xxiii were injected under chloroform. The chart is diagrammatic for Case xi, in which the left side was affected. In addition to the area of skin shown, the whole of the lower gum to the middle line, the half of the tongue, and the inside of the lower part of the cheek were anaesthetic.

only partial anaesthesia was produced, pin-pricks appearing blunt, but tactile sensation being preserved, although the neuralgic pain was abolished in each. In two others injection of the infraorbital nerve produced complete anaesthesia of the cheek, and relief from all pain for four and a half months, but further injection to the foramen rotundum produced no anaesthesia of the gum and palate, and could not, therefore, have pierced the trunk of the superior maxillary. In another case, in which the pain was limited to the right second division, I attempted injection of the foramen rotundum on three occasions, at intervals of three or four days, without producing any anaesthesia at all, yet the third injection was followed by complete cessation of the pain which had scarcely left him for many months, and which had been present off and on for thirty years. In all these 16 cases the pain was completely abolished, although in 4 the analgesia produced was only partial, and in 1 there was no analgesia at all produced. In 1 case only of the 17 did I fail to relieve the pain, three injections failing to hit off the nerve, the pain, which was never very severe, remaining unaltered. In this case, slight diplopia in certain positions of the head was produced, and also some diminution in the acuity of the colour sense, indicating that the alcohol had been injected too far upwards and inwards towards the sphenoidal fissure and optic foramen. In another of the successful cases, transient slight diplopia for a week was produced, and also slight dilatation of the pupil, which persisted after the disappearance of the diplopia.

Very rarely will injection of the supraorbital notch require an anaesthetic. I have injected this nerve in eighteen patients altogether, seven of whom were cases of tic douloureux, and in only one was an anaesthetic necessary.

This treatment of injection of the nerve trunks with strong alcohol is, I am absolutely convinced, a sure cure for the pain in tic douloureux; not a permanent cure as with excision of the Gasserian ganglion, but giving complete relief from the pain for periods varying from two to five months, when the injection has been only perineuritic, and has produced no anaesthesia, to twelve or eighteen months, or even longer, in the more successful cases in which the injection has properly punctured the nerve at the deep foramen, producing complete anaesthesia of the anatomical distribution of the nerve. When the pain returns, as it is likely to do ultimately, the same process can be repeated, giving generally a longer period of immunity from pain than on the first occasion, and so on apparently indefinitely. With the needles I use, no scar is produced which can be detected after the lapse of ten days to a fortnight, even though as many as three injections may have been given at about the same spot within a few days. With proper precautions and strict attention to asepsis, there is absolutely no risk to life, and the only troubles I have met with were in three patients, two of whom had slight transient diplopia, one partial diminution of the colour sense on the one side, and in one case a certain degree of Eustachian deafness. Slight haematoma may occasionally develop after an injection, especially after injection of the foramen ovale, or of the infraorbital foramen, causing a bruised appearance lasting for a few days. Swelling of the cheek or eyelid always follows a superficial injection of the infraorbital foramen or supraorbital notch, closing the eye in the latter case for a day or two, the swelling not entirely disappearing for four or five days. Injection of the foramen rotundum is said to cause sometimes considerable swelling of the lower eyelid and chemosis of the conjunctiva, but I have not met with this in my own practice.

Dangers to be Guarded Against.

1. In injecting to the foramen rotundum, never inject at a greater depth than 5 cm. for an average-sized skull, or, a better guide, be careful not to sink the needle more than 7 mm. past the anterior edge of the external pterygoid plate. This precaution will prevent the optic nerve being injured. If the injection be made too horizontally, it will pass beneath the superior maxillary nerve and reach the sphenopalatine foramen, and will be felt in the nose. If directed too high, the sphenoidal fissure may be reached and the branches of the third nerve may be damaged, causing diplopia and dilatation of the pupil.

2. In making the injection for the foramen ovale, for the third division of the fifth nerve, if the needle is directed too low and too deeply, more than 4½ cm., the pharynx wall or the Eustachian tube may be punctured; if too far back, the middle meningeal artery may be injured, and it is conceivable that if directed much too far back by a person with no experience, even the internal carotid artery or jugular vein might be injured.

As an instance of the boldness sometimes met with in the use of new treatments, I have known a doctor give a patient suffering from tic douloureux of the third division a hypodermic injection of alcohol deeply behind the angle of the lower jaw, because, as he said, "all the nerves ran there"! It is essential that any one wishing to use this method must first practise with a long needle upon a complete articulated skull, and then on the dead body in the post-mortem room, not once only, but many times.

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The American and Colonial Clubs, composed of Rhodes scholars at Oxford, have passed resolutions strongly approving the aims and objects of the Association for the International Interchange of Students. The first touring party is leaving Liverpool on June 21st for Canada and the United States.

ON CIRCULAR OR END-TO-END SUTURING OF ARTERIES:

BEING A MODIFICATION OF AN ALREADY
PUBLISHED METHOD.

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THE following description of a method of end-to-end suture of arteries is an evolution of the method set forth in the book on blood-vessel surgery recently published for the author¹ by the Oxford Medical Press.

Further experience, partly in human surgery, partly in the course of research work in which blood-vessel surgery forms part of the procedure, has led to a greater perfection of the method. One or two instruments for the purpose must first be described.*

1. The "frame" (Fig. 1) takes the place of a very simple appliance termed a "measure" in the original

Fig. 1.—The "frame." Half size.

publication of the method. In a steel frame slides a flat plate of steel engraved on one side with two scales, the upper one being 1½ cm., graduated in millimetres, the lower being the same length graduated in 1½ mm. Any number read off on the larger scale is equal to one and a half times the same number on the smaller scale. The use for this will appear hereafter. At one end of the instrument is a handle, and at each end of the fenestrated portion is riveted a small spring clip,

Fig. 2.—The needle. Actual size.

under each side of which can be fixed and held a suture.

2. A curved needle in a handle (Fig. 2). The eye is not far from the point; the needle is removable from the handle, and, if damaged, or if it becomes unthreaded during the operation, it can readily be replaced by a new one, or by one previously threaded.

3. Clamps required for the temporary control of the blood stream may readily be made by covering both blades of a small spring clamp with rubber tubing; the tubing should be reflected over itself at the heel end of one blade, and the point of the other, making those parts of the blades double covered (Fig. 3). The middle portion of

Fig. 3.—The clamp for temporary control of the blood stream.
Actual size.

the blades is used to clamp the vessel; the extra layer of rubber at the ends serves to prevent injurious pressure on its wall. These clamps are better if the blades outside the rubber are thinly covered with gauze, which prevents the divided vessel from retracting through the blades. (The gauze on the blades is not shown in the drawing.)

The suture material used is silk, for a vessel as large as the human femoral artery, No. 0000; for one the size of the radial about half that thickness. In addition, some fine chromicized catgut, No. 1 or No. 2, according to the size of the vessel, is required. The silk is used from the reel, and it is essential to thread the needle from the convexity of its curve towards the concavity. The catgut should for convenience be in straight lengths, that is,

* These two instruments have been made for me by Mr. C. F. Palmer, 6, Upper Tulse Hill, London.