AMPUTATIONS WITH SPECIAL REFERENCE TO
PHANTOM LIMB SENSATIONS
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The operation of amputation is one of the oldest in surgery but it still remains of great interest to surgeons on account of changes in technique brought about by the intensive experience of warfare and the development of the modern artificial limb. My lecture cannot be termed scientific in the true sense of the word. It is more in the nature of a record of personal experience in the handling of amputation cases gained during the two World Wars, and as a surgeon in the Glasgow Royal Infirmary and Erskine Hospital.

I would preface my remarks by saying that, despite the claims made by the artificial limb makers and others with regard to the capabilities of the amputation case, any major amputation, even of the lower, and much more so, of the upper limb, produces a serious degree of incapacity. Up to date, no matter how beautifully an artificial hand is made it has little function except as a steadying agent, and the artificial hand is worn almost entirely from a cosmetic point of view. Actual function of the artificial arm is brought about by the fitting of special appliances and tools which are clipped in after the artificial hand has been removed. With such appliances it is certainly true that the amputee can sometimes achieve amazing results. Such results, however, vary very much and depend on the mentality and adaptability of the individual. The same remarks apply to the artificial foot, but it is, of course, much more easy to compensate for the loss of a leg than for the loss of an arm, especially when the knee joint has been preserved.

As you are probably aware many attempts have been made by surgeons to imitate, by plastic methods of surgery, a missing hand, the so-called kineplastic amputations. Thus the lower ends of the radius and ulna have been used to give a "lobster claw" grasping agent and the tendons of the forearm have been used as activating agents for artificial fingers. In this country these operations have gained no popularity and have not proved successful.

Recently attempts have been made in amputations through the upper arm to make a new elbow joint with the idea of improving the function of such cases. This procedure has also proved of little value.

At the present time experiments are being made by the limb makers on a new type of artificial hand combining function with cosmetic appearance, and a new type of artificial leg which is fixed by means of suction in place of the somewhat cumbersome pelvic

A Honyman Gillespie Lecture delivered 10th November 1949.
bands and straps. This development of the "suction fixation" artificial limb originated in 1885 and is again being tried out in these modern times.

As regards the total number of amputation cases at present in this country there are, as yet, no reliable figures, but Mr Kelham of Roehampton Hospital informs me that since the commencement of the National Health Service in July 1948, 19,500 new limbs have been ordered. In the first World War, 41,000 amputation cases were dealt with by the Ministry of Pensions. In the second World War, in which the casualty figures were much smaller owing to the different type of warfare, 21,000 amputation cases have been dealt with and in this figure is included amputation of digits. Mr Kelham estimates that 12,000 of this figure were major amputations and a certain number of cases will still require amputation. In this connection, I may say that I am still removing limbs injured in the 1914-18 War and it is not long ago since I had to amputate a leg in a patient wounded in the South African War. Those late amputations are usually performed for chronic osteomyelitis or nerve lesions.

In the general surgical wards of any large hospital the operation of amputation does not rank high numerically as compared with other operations, not nearly so high now as it was in the pre-Listerian days. In my own wards for the past five years the figures are as follows:

| Year | Total Major Operations | Major Amputations |
|------|------------------------|-------------------|
|      |                        | Arms  | Legs  |
| 1944 |                        | 952   | 1     |
| 1945 |                        | 1272  | 4     |
| 1946 |                        | 1245  | 7     |
| 1947 |                        | 1199  | 6     |
| 1948 |                        | 1138  | 5     |
|      | **Total**              | 5806  | 25    |

Average: 5·5 per year, or 0·4 per cent. of all operations in five years.

During the five years under review the reasons for amputations were as follows:

- (1) Traumatic: **7**
- (2) Gangrene of various types (not due to trauma): **15**
- (3) Others (neoplasm, etc.): **4**

Figures for St Thomas's Hospital for 1913; out of 5483 major operations there were 34 amputations.

In general terms it may be said that the younger the patient is when amputation is performed the easier it is for him to compensate...
for the loss. The converse is also true and there are certain general factors, physical and mental, brought about by amputation which are frequently not realised. As regards those which are purely physical I would mention the tendency to adiposity particularly in leg amputations at a high level, and particularly in double amputations. The remaining leg, owing to undue stress, may be affected by such conditions as flat foot and arthritis of the hip, and I have no doubt that the stress of wearing an artificial leg also predisposes to various types of hernia. I shall refer to the mental condition later on.

Coming to some matters of more detail, I would refer first to the question of amputation levels. Speaking in general terms, amputations through joints are not now looked upon with favour and should be avoided. In the case of the hip and the shoulder such operations are more difficult and attended with a much greater degree of shock than amputations lower down and especially in the case of the hip a complete disarticulation makes the fitting of an artificial limb very difficult indeed owing to the sloping nature of the pelvic bones. Disarticulation through the knee or elbow leaves a bulbous extremity which requires external metal joints on the artificial limb.

If at all possible the knee and the elbow joints should be preserved as this ensures the conservation of as much function as possible and the optimum leg stump is six or seven inches below the knee and the optimum arm stump is at the junction of the middle and lower thirds of the forearm. Even with stumps considerably shorter than those a good prosthesis can be fitted.

In this country where we favour the "side bearing" as opposed to the "end bearing" stump, the operation which bears the name of the famous Edinburgh surgeon, the Symes' amputation, has been largely given up as has also the operation known as the Gritti Stokes. As you are aware in the first of these the weight-bearing area of the heel is preserved and in the second the patella and its coverings are preserved as a buffer between the cut end of the femur and the artificial limb. Both are essentially "end bearing" stumps.

Our experience in this country, as regards the Symes' amputation, is that re-amputation at a higher level has become necessary in many cases owing to pressure complications brought about by the nature of the prosthesis required which is heavy and cumbersome. Were the patient content to use a so-called "elephant boot" he would probably get along perfectly well, but the appearance of this deters him from wearing it. The Gritti Stokes amputation has never been popular, perhaps owing to the difficulty in correct performance.

Both these operations are still popular in America and Canada and are apparently looked upon as operations of choice where possible. Mr Le Mesurier, the Canadian surgeon, whom I met during the last war, was emphatic that in Canada they had had little or no trouble with the Symes' amputations of the 1914-18 War.

The use of a tourniquet in amputating has more in its favour
than the reverse, but there are certain disadvantages. A few moments after a tourniquet has been removed there is an evanescent but very distinct dilatation of all the vessels of the limb, which favours the production of a haematoma in the wound area, just as the use of a tourniquet in knee cartilage operations is sometimes followed by a haemarthrosis. The haematoma may form despite meticulous care in ligation of the small vessels and, apart from the general oozing following the use of the tourniquet, may be caused by bleeding from a nutrient artery. The use of a drainage tube in amputations is therefore a common and safe practice. If a haematoma does form it is better to re-open the flaps at once under an anaesthetic and clear it out otherwise an unsatisfactory stump results.

In many cases of amputation done for senile or other types of gangrene due to endarteritis a tourniquet is quite unnecessary and may indeed cause an arterial thrombosis higher up the limb by fracture of a plaque of atheroma.

As regards the soft tissues, ordinary amputation technique has become much simpler in the last thirty years. We do not now, as the older surgeons used to do, try to cover the ends of the bones by muscle as well as skin, fat and fascia. The actual fashioning of the flaps remains much the same but we are content to produce a stump covered only by skin, fat and sometimes deep fascia. We endeavour, in the case of the leg, to produce a scar which is posterior with the soft tissues freely mobile over the end of the bone. The standard artificial leg aims at a "side bearing" rather than an "end bearing" stump. In the case of the arm a terminal scar is no disadvantage, even if this is adherent to the bone.

In dealing with the bone itself, there is no attempt made to round off the cut end with a rasp or file. We have discovered that nature herself is quite capable of doing this in a very short time. Actually the production of bone sawdust either by the saw or by the rasp, is a disadvantage and tends to produce spurs of bone, and I make a point of protecting the stump from sawdust and of washing it away with saline solution before closing the wound. In my opinion, also with a view to the prevention of possible spur formation it is unwise to strip the periosteum for any distance above the site of bone section. I prefer to cut bone and periosteum practically at the same level leaving stripping to a minimum. Sepsis in the stump also predisposes to the formation of spurs by irritation of the periosteum and in certain cases when re-amputation is necessary it is advisable to give preliminary penicillin. This refers especially to those cases where a so-called guillotine amputation has been performed. The mere presence of a spur does not call for operative interference, many functionally perfect stumps will be found to have greater or lesser degrees of spur formation when examined by X-rays.

In the case of the below-knee stump it is essential to cut the tibia obliquely from before backwards and downwards to prevent pressure
on the skin from the sharp subcutaneous surface of the bone. The fibula should be cut at a higher level than the tibia.

In dealing with the main arteries it became apparent to me during the last war that surgeons did not trust the ordinary catgut ligation and were inclined to use non-absorbable sutures when dealing with large arteries such as the femoral or brachial. It may be that temporary shortage of catgut led to this technique. The wounds appeared to have healed by first intention but sooner or later suppuration and sinuses resulted and I removed many knots of silk or linen thread. I see no reason why catgut should not be used for the larger vessels, but I frequently use a running stitch round the larger vessels which takes in a portion of muscular tissue, and the cut end of the vessel is then embedded and buried in muscle rather like the invagination of an appendix stump. This procedure may be of little value but it gives the operator the sense that the large vessel is better protected and has something to pulsate against.

There are variations of opinion regarding the method of dealing with the cut ends of the larger nerves with the idea of preventing the so-called stump neuroma. No matter which method is adopted a stump neuroma will form because this is the natural response of the nerve to its section. My colleagues in Roehampton advise that simple section of the nerve by a very sharp knife is the method of choice. I myself still prefer crushing the nerve at a point considerably higher than the amputation level and then ligating it like an artery, hoping that the nerve sheath thus closed will act as a limiting membrane and will prevent the formation of a large neuroma.

As I have said, no matter what is done, and various ingenious methods of nerve section have been devised, the neuroma which forms is of no importance unless it becomes, as a proportion do become, a painful neuroma, the treatment of which is a matter of extreme difficulty. Certainly the excision of such swellings and the section of the nerve at a high level is not usually followed by permanent cure, indeed it is common to have a recurrence of neuroma accompanied by more pain than previously. If, however, the neuroma is diffuse and attached to scar tissue or even to the bone, excision may bring about relief. At the present time I have numerous cases sent to me by doctors who advise removal of neuromata. I operate on very few of them preferring to use conservative treatment.

The immediate and remote after-treatment of the amputee calls for special care and successful results depend almost as much on this as the operation itself. From the beginning he should be encouraged to lift the stump himself for any necessary dressings or adjustments. On no account should a pillow be placed under the leg stump otherwise a flexion deformity of hip or knee, or of both, develops which may take weeks or months to correct, and which prevents the wearing of an artificial limb. In the last World War many cases of below-knee amputation arrived in Erskine with the knees flexed to a right angle.
Some of them I was able to correct by repeated plasters gradually undoing the deformity but others were so fixed that re-amputation above the knee had to be performed. This flexion of the knee, if left for any length of time, appears to produce a form of backward dislocation of the joint which cannot be reduced, the articular surface of the tibia actually "climbing up" the posterior aspect of the femur, and this I have demonstrated by specimens removed. The same type of thing occurs in other conditions when the patient has been allowed to assume the position of rest as opposed to the position of function for any length of time. I lay stress on this question of the pillow support because I find so many nurses consider it the correct procedure.

One of the common troubles encountered in the cases of leg amputation is an infection of the hair follicles and sweat glands in the upper part of the thigh due to the friction of the artificial limb. Prevention of this requires meticulous care on the part of the patient both as regards the skin of the stump and the stump socks worn over it. When it does occur minor degrees are best treated by weak ammoniated mercury ointment but other cases may become so chronic, despite all conservative measures, as to require excision of the affected area which leaves a scar which is in an undesirable place and liable to trauma.

The modern artificial limb is an all-metal one made of an aluminium compound (duraluminium), and following on the 1914-18 War all the amputation cases were given the opportunity to change from the wooden to this type of limb. A curious and unexpected result ensued in that it was found that the perspiration of certain individuals, for causes unknown, was capable of corroding the metal and thus producing a rough abrasive surface in a comparatively short time. This happens despite the protective paint applied to the metal in the newer type of limb. In those cases the upper part of the bucket had to be replaced by the older wooden type.

Correct bandaging of the stump is also a matter of great importance. From the first bandaging must be firm and adequate, and even plaster of Paris may be used to produce pressure and prevent flexion. Special stump dressings which fit the stump accurately are an advantage and, following healing, crêpe bandages should be applied to produce a steady pressure which not only prevents œdema but hastens the shrinking of the stump. This bandaging should be made a routine and the bandage changed and tightened twice a day.

The patients are transferred to the Physiotherapy Department as soon as possible and given exercises. These exercises should not be confined to the amputation stump, indeed the care of the limbs which remain and have to take on a double burden is of as much importance as the care of the stump. General exercise is also required. At Erskine the amputation cases used habitually to attend the swimming baths at Renfrew and we have now a swimming bath of our own which I hope to use next summer. They also played a special kind of football.
on the gymnasium floor, when they moved about the floor on their buttocks and used either hands, good leg or amputation stump as a propelling agent. The game was so popular that when I had a lot of cases a league was formed and men who had been discharged used to come back on match days. Classes for the arm cases were established in Glasgow.

I was much impressed by a batch of prisoner of war amputees who arrived at Erskine late on in the war, having been repatriated from Germany. Those men had manufactured limbs for themselves out of all sorts of wood, scrap iron, etc. On arrival in this country they were able to fend for themselves in the most wonderful manner and it struck me forcibly that the more the amputee is made to do for himself at the very beginning has an important bearing on his outlook on life later. Some of the stumps of those returned prisoners were everything that was bad, terminal adherent scars, neuromata, etc., and yet very few of them appeared to have any trouble. I refer to this particular batch of amputees to draw attention to the psychological element which, I am sure, enters into many of the cases.

Perhaps the most interesting and certainly the most puzzling phenomenon connected with amputation cases is the occurrence of the so aptly called phantom limb sensations. They have always intrigued me personally and I have had many arguments with my neurological colleagues regarding their causation and treatment.

It would seem only natural that following an amputation the patient might for some time be conscious of the missing limb and I think that it would be equally natural to assume that such feelings would eventually disappear. Apparently this happens only in a small proportion of the cases for reasons which we cannot explain. It is also the case that the phantom limb sensation may disappear and then recur and become even more distinct as age advances. Despite the wonderful scientific advances of the last twenty years or so, neither the surgeons nor the neurologists have done much to elucidate the curious features which may occur in certain forms of pain sensation and certainly this is so in the case of the phantom limb.

May I quote one case which I think illustrates this point although in a way this case may appear paradoxical in that the pain was present in an apparently normal limb prior to amputation. A man was admitted to my wards in November 1942 with a diagnosis of syringomyelia. When admitted he was suffering from such pain in the left arm that he was having several grains of morphia in the twenty-four hours. The pain was so agonising that he kept apart from his fellow patients in case they should come in contact with the affected arm. He was one of the most, if not the most, tragic cases with which I have had to deal. He had been seen by all the leading neurologists, medical and surgical, and the consensus of opinion was that the pain was of so-called central origin, referred to the arm, and could not be relieved by operation of any sort.
One day he asked me for a private interview. At that interview he told me that he could not stand the pain any longer, and that if nothing was done for him he must end his own life. He also stated that, in his opinion, if I amputated his arm he thought the pain would disappear. He stated that apart from people coming in contact with the arm certain movements of his hand initiated the pain and had a "trigger" effect.

I told him, without shirking any details, the opinions of the various neurologists, and as a further corroboration I offered to send him to see Mr Dott to discuss the whole matter. He saw Mr Dott who again could offer him no hope especially as regards the amputation.

Thereafter he went from bad to worse and his condition became so bad that despite enormous doses of morphia he was never without pain. At this stage I felt that any action was justifiable and I offered to amputate his arm if he would give me his written permission to do so without any definite hope of relief. I also obtained the permission of the Ministry of Pensions to do what was considered to be a useless and mutilating operation. I removed a perfectly good arm with the result that the man was completely cured of his pain and was changed from an actively suicidal patient into a more or less normal individual.

This case, which was inexplicable, was a lesson to me that we have much to learn regarding pain and the same applies to what I have to say regarding the phantom limb sensations.

First let me say, although the great majority of amputees have phantom limb sensations to a greater or a lesser extent, those sensations are not always painful, and if painful they may be so in a somewhat special way. Frequently, for instance, a man who has lost his leg has the sensation that his foot is still present and will describe that his toes appear to him to be in a certain fixed position. He also occasionally has the apparent ability to move his phantom toes away from this position if they feel uncomfortable. The sensation of still possessing a foot is so vivid that it may lead to the patient trying to stand upon it in a moment of aberration and I have several cases of severe hematoma or even fracture of the stump resulting from this. This is, in a way, an argument for the retention of the Symes’ amputation which allows the patient to walk without an artificial limb or crutch.

Other cases of phantom sensation show a tendency to retain the sensation not so much of an absent foot or hand but of the condition which brought about the amputation. Thus an amputee who has had an amputation for such conditions as a tubercular knee or severe leg ulceration may retain the sensation of a painful knee or a painful ulcer. This appears to occur when the condition necessitating amputation has been present for a long time and is not common in the amputation done for gunshot wound, when the amputation has usually been performed shortly after the wounding.

Another curious and rather uncommon phenomenon is the so-called
telescoping sensation sometimes present. In such cases the hand or foot may appear to be not in its normal position but just at the end of the stump itself, or perhaps midway between the end of the stump and its normal position. May I quote a few examples of these forms of sensation from actual cases.

**Examples of Phantom Pain referred to an Old Lesion**

(1) E. M. F. Now aged 31. Amputated through upper third of thigh in 1940 for disease of the knee bones, probably tubercular. Has a phantom foot but main sensation is of pain in the knee. Has also telescoping and feels foot at end of stump.

(2) E. B. Now aged 62. Amputation through upper third of thigh for gunshot wound. Main phantom sensation is now of a bunion on the phantom foot which was there prior to operation and for which he blames Army boots.

(3) T. K. Now aged 41. Amputation of leg below the knee for Thromboangitis Obliterans. Main sensation is pain in the middle two toes of the phantom foot which were first involved in gangrene.

**Examples of Telescoping**

(1) M. L. Now aged 24. Amputation of leg four inches below the knee following a street accident in 1936 at age 11. Now feels foot at the mid-calf level, not just at end of stump.

(2) J. McC. Now aged 50. Amputation of leg above the knee. Amputation for tuberculosis of knee at age 22. States as the years pass the foot appears to “grow up” the leg and is now at the mid-calf level.

(3) J. C. Now aged 50. Amputation of leg below the knee at age 19 for gunshot wound of foot. Now feels the foot attached intimately to the end of the stump.

I thought at one time that this question of telescoping might have something to do with the growth of the patient. In the case of No. 1, M. L., quoted above, the amputation was performed when she was aged 11 and I considered it possible that the phantom limb felt might be that of age 11, and not of age 24. I quoted the other two cases to disprove this plausible theory as growth in both of those cases had ceased before amputation was performed.

It is interesting to note that the patients with phantom limb sensations almost invariably refer to the sensations in the missing hand or foot. No matter how high the amputation, the intervening portion of the limb causes no comment except in the exceptional cases to which I have referred when continuous pain has been present prior to operation. I presume that this is in some way connected with the massive terminal nerve supply of the hand and foot as compared with the rest of the limb.

Many amputees are prone to what they call “the jump” in the amputation stump, meaning that the limb may suddenly give an involuntary jerk. They will tell you that this often occurs when they go to bed at night and it may keep them from sleeping. A more severe
form of involuntary movement may occur and to this the name of "stump chorea" has been given. In such cases movement of the limb may bring about clonic movements which are acutely distressing, and prevent the wearing of an artificial limb. Stump chorea is frequently associated with vivid phantom limb sensations.

In the cases of painful phantom limb sensation many forms of operative treatment have been tried, and it is my experience that few of them have any lasting result. Shortening of the nerves has been tried and given up. Lumbar ganglionectomy does not appear to help and more recently I have seen a few cases where chordotomy has been tried without success.

In a recent article in the *British Medical Journal* of 11th June 1949 Ritchie Russell describes a novel form of treatment for phantom limb sensations which consists of percussion of the neuromata, and he claims that the results of this treatment are very satisfactory. He bases his theory of treatment on three main factors. First, in the normal limb, nerve endings in the skin are rendered insensitive by occupations which involve repeated minor trauma or prolonged firm pressure on the skin. Second, conduction of a mixed nerve is easily interrupted by repeated pressure without the production of any spontaneous pain, and third, that the regenerating nerve fibres in an amputation stump are likely to be no less vulnerable to minor trauma or pressure than are normal nerves and nerve endings. He concludes that the effect of maintaining tender neuromata in a chronically concussed state merits investigation. He treats the patients by first compressing the limb by means of a pneumatic cuff at 200 mm. Hg, for a few minutes and then hammers the neuromata with a wooden mallet. Later the patient performs his own treatment.

I was interested to note that he mentioned the relief often obtained from the pneumatic cuff alone, a method which I have used for many years, and also the recurrence of pre-amputation sensations after or during percussion of the neuromata.

At present certain Ministry of Pensions cases are being sent to Dr Ritchie Russell with a view to testing out his method of treatment and it will be interesting to see the results over a large number of cases.

I have recently experimented in several cases with spinal anaesthesia both as a treatment of the condition and also as a test for a possible chordotomy. In some of the cases pain is relieved for some time and the patients have actually asked for repeat doses. In others, and this is rather interesting and instructive, the spinal anaesthesia does not relieve them of their phantom limb sensations, indicating, I think, that the sensations are central in origin and not capable of cure by localised operations, even such major procedure as chordotomy. Many of the cases are fortunately relieved by rest and general treatment together with psychological encouragement. Others obtain no relief whatever is done and the severe cases, which are fortunately few, tax all our efforts to give them some degree of comfort.
During the last few months, for the purpose of obtaining data as regards phantom limb sensations for this lecture, I have, with the help of two of my assistants, interviewed one hundred cases of amputation. Those were seen, so to speak, at random. That is, we went to the limb-fitting centre and saw the cases as they came up for limb fitting or adjustment. They were not cases sent into hospital for advice and most of them, I am glad to say, were at work. The ages varied from early childhood to extreme age and included leg amputations, arm amputations, and double amputations. The lesions which necessitated amputation included all the usual factors such as gangrene, gunshot wounds, civilian trauma, tuberculosis tumour, etc., so that a varied section of the amputation population was tapped. The actual figures are as follows:

| Reasons for Amputation | Total | Legs | Arms |
|------------------------|-------|------|------|
| 1. "Civilian" accidents | 41 | 26 | 15 |
| 2. Gunshot wounds | 26 | 24 | 2 |
| 3. Gangrene of various sorts | 12 | 12 | ... |
| 4. Bone infections (osteomyelitis, etc.) | 9 | 9 | ... |
| 5. Congenital amputations | 4 | 2 | 2 |
| 6. Trench foot | 2 | 2 | ... |
| 7. Neoplasm | 2 | 2 | ... |
| 8. Tuberculosis | 2 | 2 | ... |
| 9. Others | 2 | 2 | ... |

| | 100 | 81 | 19 |

The above figures include eight double amputations, seven of them being double leg amputations and one amputation of the leg and arm at different times and for different reasons.

In the 100 cases investigated phantom limb sensations varying in degree were present in 74 cases (58 legs and 16 arms). Phantom limb sensations were entirely absent in 26 cases (23 legs and 3 arms). It is noteworthy in this group that two of the arm cases were those of the congenital type which should not really be counted as they were in fact not true amputations but rather cases of maldevelopment with rudimentary fingers which form a small group by themselves. We are therefore left with the fact that all the true arm amputations investigated, except one, showed phantom limb sensations. The group is, of course, comparatively small to come to any definite conclusions, but appears to indicate again the significance of the rich nerve supply of the hand as compared with the foot.

Telescoping was present in 13 cases (4 arms and 9 legs). Phantom sensations accompanied by definite pain were present in 14 cases. The actual measure of the pain complained of is difficult to assess. Many of the patients complained of itch rather than pain and others stated that cramp rather than real pain was the feature of the sensation felt.
In 10 cases the pain complained of was that of the pre-amputation type and definitely referred to the old lesion which necessitated the amputation. All of these were legs.

The ages of the 100 patients interviewed varied from 11 to 70 years, and the dates of the amputations varied from those performed a few months ago to one performed in 1878. Most of the gunshot wound cases were those of the 1914-18 War. I do not propose to bore you further with more detailed statistics.

Since I commenced this brief survey my attention was drawn to a remarkable article on the subject of phantom limb phenomena, termed “Phantom Limbs and Body Shape,” by the late Dr George Riddoch, which was the presidential address of the neurological section of the Royal Society of Medicine, delivered in 1941. This article was published in the journal called Brain in December 1941. To those of you who are interested in the subject I would commend the study of this paper which discusses in detail most of the points I have discussed to-night. Among the very interesting discoveries which I made in this paper was the fact that in certain cases phantom limbs may occur without amputation, the patient having an apparent duplication of a limb. Riddoch also refers to phantom noses, breasts etc., in addition to phantom limbs. In the case of the breast he indicates that owing to the nerve supply it is usually only the nipple which is felt.

In conclusion I would say that it has been my endeavour to give you a short account of certain difficulties encountered in dealing with amputation cases. Some of those do not belong to the operation itself and are only realised by those surgeons who not only perform the amputation but also have the opportunity of seeing the cases for years afterwards. This follow up is not usually carried out in the general hospitals and the cases are dealt with in various limb-fitting centres which, in Scotland, are unconnected with the hospitals.

Certain of the problems encountered and especially the phantom limb sensations have proved impossible of solution by surgery alone and further detailed investigation not only by surgeons but by neurologists, psychiatrists and physiologists.

I am conscious that what I have said has not added much to our knowledge of treatment but I hope that it may stimulate some of you to take a special interest in the amputation case. The general morale of these disabled people, men and women alike, is astounding and the amazing way in which most of them adapt themselves to their disability has always filled me with something more than admiration.

I think that we in Britain can pride ourselves not only on our methods of dealing with the amputee himself, but also on the excellence of our artificial appliances which, under the new laws, are now available to war veterans and civilians alike.

We have in Roehampton Hospital, which is really a combination of hospital and limb-making factory, something which has been an example to the world. Sometime in the future I should like to see a
similar institution established in Scotland. Not only would such a centre give employment to many of our amputees but it would stimulate local interest in their welfare. It would also be a wise insurance against having all our eggs in one basket in times of war.

I wish to express my thanks to my two assistants, Mr Thomson and Mr McSwan, for their help in interviewing patients and to J. G. Hanger & Co. Ltd., and Hugh Steeper Ltd., for supplying me with demonstration artificial limbs and appliances.

REFERENCES

1 Kelham, R. D. L. (1949), Personal Communication.
2 Ritchie Russell, W. (1949), “Painful Amputation Stumps and Phantom Limbs,” Brit. Med. Journ., 1, 1024.
3 Riddoch, George (1941), “Phantom Limbs and Body Shape,” Brain, 64, 197.