

## Solvitur Ambulando

A brief history of the production and use of artificial limbs

*Willem J. Mulder*

### Introduction

"I've done it! Have just come in from a 10-mile walk! The best I've done yet. Time 2 hrs 40 mins – not racing time, I am afraid, but I hope to improve on it. My Hanger is doing very good service. I can never be too grateful to Hangers for the skill and patient care with which they fitted me, and also for the sympathy and kindness shown to me. The loss of a limb can never be exactly a joke, and it makes a wonderful difference when your fitters realise that their work has a human as well as a technical aspect."

So far a citation of an enthusiastic miss G. G. Vaughan from Lincoln, England. She is talking obviously about her artificial leg that was produced and fitted by the Firm J. E. Hanger & Co Ltd in Roehampton, London in 1936.

Recently I rediscovered the proceedings of a symposium that was held in 1936 in St Mary's Hospital London about the development and production of artificial legs. The firm, J. E. Hanger & Co Ltd, which was specialised in this kind of equipment, had initiated the symposium and made it their business to promote their efforts as much as possible. The company employed some 400 employees at the time and occupied an enormous plant. Especially after World War I, there was an obvious demand for such appliances. The much more aggressive and dangerous traffic and better possibilities to conquer invasive diseases which involved arms and legs, had its effects as well. The firm claimed to have produced more than 100.000 artificial limbs.

In these proceedings some of the more than more 40.000 recent clients spoke about the success, help and relief provided by these artificial legs. Amongst them the formerly cited miss Vaughan.

The Hanger Company was not only just producing artificial legs and other appliances. There was also an extensive department of new developments in the

field, because of this they also owned several patents that had to be protected. In addition they bought patents from others and used them. By accident I found a report concerning a lawsuit from the Australian Government between a firm Desoutter Bros Ltd (an instrument makers company) and our J. E. Hanger & Co Artificial Limb Makers Ltd, about a tax problem.

It is clear that Hanger & Co played an important role in the world of the disabled; they had branches and representatives all over England as well as agents in and even outside Europe.

## Museum Collections

Strangely enough hardly any of these objects can be found in the better-known museums of medical history. The reason why we do not find them in our exhibits and displays or even in collections seems obvious, but is in fact difficult to explain. One reason could be the love – hate relation between the patient and his or her prosthesis, particularly patients such as war-victims, victims of traffic accidents or invasive diseases. On the other hand relatively little is written about the history of the development of artificial limbs.

Of course, the pictures, diorama's, displays and even reports on the actual amputation of limbs are numerous and well known, but the follow – up, fitting a "new" leg, seems to be less popular.

In fact in most medical museums little attention is paid neither to the development nor to the actual display of prostheses and in particular of artificial limbs. Nevertheless, in the course of time many of these objects must have been produced and used. There must have been hundreds of thousands of victims in the middle and later ages that used and even were dependent of such appliances.

In the Utrecht University Museum, where I used to work, only two examples are to be found in the repository and they have never been exhibited. Museum Boerhaave, the Dutch National Museum of the History of Science and Medicine, has another two examples that I know of and they were never on display either. Outside the Netherlands there may be some examples, for instance in the London Science Museum.

The Museum Catalogue of the *Deutsches Orthopädisches Geschichts- und Forschungsmuseum* in Frankfurt also mentions (together with) a replica of the Paré model of a prosthesis, to which we will come back later, and one model after a design of N. Pirogoff (1810–1881). This was made in 1920.

A source of more information and pictorials are the extensive catalogues that were published by large companies, selling medical instruments and appliances. Well known is the catalogue of the *Universal Verzeichnis der Verfertiger chirurgischer Instrumente und Bandagen, orthopädischer Apparate*, etc., that was published in the 1870ties.

In another catalogue, published by a firm in medical instruments and appliances Laméris in Utrecht in the nineteen thirties, several types and models of

prostheses are offered. Special attention is given to the cosmetic aspects of the artificial leg. Almost all used to be camouflaged with clothes, this in contradiction with the present time as we can see "unrevealed" prosthesis. Obviously formerly the idea was that a prosthesis of a natural looking design would be more acceptable to the patient.

The scientific and specialized literature of course is another source of information. Numerous cases have been published including first with illustrations and later photos. Famous are the drawings by Bourguery and Jacob in their Atlas of Human Anatomy and Surgery that was published in 1853. Special attention is given here to the relation of the amputation stump and the possibility to make a proper fitting.

Medical photography became more important later. Prof. H. J. Laméris (1872–1948) at the Academic Hospital of Utrecht described a congenital malformation of the legs of a young boy in the early 20th century.

### **Early history**

The ancient Egyptians seem to be the first to have used artificial limbs after amputation of one of the extremities. From early history we all know the traditional wooden stick, used by (preferably) a poor and suffering patient. The first more serious and documented attempt to make a functional prosthesis was introduced by Ambroise Paré (1509–1590). Paré developed an artificial limb out of tin, which was fitted and fastened with leather bands. Whether his patients were happy with such an appliance, is hard to say. Anyhow, there have been several craftsmen after Paré who developed various models with varying success. Many used wood as basic material but these prostheses often appeared much too heavy. It is almost impossible to wear a massive wooden leg because of its weight. Orthopaedic experts believe that two kilograms are about the maximum for a "whole" leg. That may be the reason why in earlier days the "foot" was often left out as that may have saved a lot of weight!

The famous Edinburgh surgeon Benjamin Bell (1749–1806), who seems to have carried out relatively many amputations, introduced a new model that was made and developed by the "artist craftsman" Mr Cavin Wilson. This leg was made of hardened leather and was supplied with two "shamoy" cushions. With these cushions, that were connected laterally on both sides of the upper knee with the main lower part of the prostheses, using iron splints and some leather straps, the leg was stabilized.

"A piece of soft shamoy leather which fixes by a buckle and strap round the condyles at the knee. In legs of this kind, the person's weight rests upon the condyles and patella, the stump itself hanging quite free within the leg. This band or strap serves in the most effectual manner to prevent pain and excoriation, which otherwise would probably ensue from the friction of the leg against the knee," reported an enthusiastic Bell.

Gradually more attention was paid to the technical possibilities. The borders of movements had to be fixed, but at the same time easier functioning was demanded for. Important in this respect is the development of artificial joints.

### **Modern history**

We find a more modern, but still primitive description of two artificial legs in the splendid contribution of the Gothenburg meeting, presented by Atli Thor Olason which most of us will remember. A craftsman must have produced them in the early 20th century.

Nowadays a more sophisticated artificial leg is on display in the *Mütter* Museum in Philadelphia. This example was donated by the former owner who used it only once during the marriage service of his daughter. It seems that the design was developed according to his more cosmetic than practical wishes.

In this review we will not discuss the latest very sophisticated and electronically steered mechanical appliances. The German firm Otto Bock, orthopaedic techniques, made an enormous contribution using microprocessors and highly sophisticated materials and techniques. However, it would be interesting to study the progress in patient acceptance of these devices that unveil every detail of the design, technical and practical approach.

### **Materials**

In general, the earliest prostheses were made of wood, tin and leather, in that order. All these materials were introduced in order to reduce the total weight of the artificial limb. The technical limitations such as artificial joints, splints and supports, were also important, but these solutions and extras often added to the total weight. In the 20th century, as we saw before, more lightweight materials became available such as aluminium and later certain plastics. These materials not only meant a reduction in weight but were also more practical and provided better cosmetic possibilities. In former times it was much more difficult to find a good balance between the fitting, practical use and handling.

### **Conclusions**

The aim of this review is a better insight in the development and production of artificial limbs. It is surprising that so many ingenious and sophisticated techniques can provide so much relief and add to the quality of life. It is not clear why so little has been preserved of so many of these appliances and why so little is on display. A more active search for these objects may provide us with more details of these extremely interesting and useful appliances, which have been of such help to so many people over the ages.

## References

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