

[Volume 64](#), [Issue 3](#), Pages 253-256 (March 2005)

Henning Ruben

Henning Ruben, athlete, professional dancer, magician and thought reader, dentist, doctor, anaesthesiologist, clinician, inventor, bon viveur and raconteur died in his native Copenhagen on 4 December 2004. He had celebrated his 90th birthday that year.

For the majority he will be remembered as an inventor—of the first constant-rate syringe pump, of the portable foot suction device, the Ruben non re-breathing valve, the self-inflating resuscitator bag and one of the first resuscitation manikins. But there was more, much more, to this remarkable man.

Henning Ruben was born in 1914 in Copenhagen into an orthodox Jewish family. At the age of 19 he began his studies to be a dentist at the Royal Dental College in Copenhagen, but he had many other talents.

As a professional dancer and dance teacher (the tango was reputedly his specialty) he toured the halls of Denmark with a well-known singer to amplify his allowance as a student .

He was an accomplished athlete, representing his country at fencing and was a member of the Danish team that won a bronze medal at the World Championships in Monte Carlo in 1939.

Henning was also a brilliant illusionist and thought reader who was elected a member of the exclusive Danish “Magisk Circel”. This talent was to stand him in good stead later in the crucial years after the second World War.

Ruben qualified in dentistry in 1938 and started a general dental practice in Copenhagen.

He wanted to study medicine as well and enrolled in the University of Copenhagen Medical School. In 1943, however, when Denmark was occupied by the Nazi regime, his partisan activities required him to leave the country very urgently one night in a fishing boat bound for neutral Sweden. As a refugee in Sweden for nearly 2 years, he continued to work as a dentist, and a magician and thought reader in some of the bigger restaurants.

Returning home to Denmark at the end of the war, he graduated in medicine the next year, 1946, and decided to become an anaesthesiologist. Anaesthesia was then an under-developed specialty in Denmark. He wished to study in Sweden but travel and foreign money exchange were very difficult. His talents as a magician came to his rescue when he was able to visit Sweden as an invited guest of the Swedish Society of Illusionists at one of their special performances at a packed Stockholm Concert Hall. During this visit he introduced himself to the anaesthetic leaders at Sabbatsberg Hospital and St Ericks Hospital. As a result he was appointed to the celebrated Serafimerlasarattet the next year, 1948, and was now able also to visit leading centres of anaesthesia in the United Kingdom, including Oxford and Liverpool.

In 1949 he returned to Copenhagen to an appointment as an anaesthetist at the Gentofte Hospital and the Finsen Institute. He began a programme of research and invention that was to continue throughout his professional life as Professor and which was to have an enduring effect on the practice of anaesthesia and resuscitation. Hungry to broaden his experience even further, he negotiated a secondment for six months in 1951 to the Department of Anesthesiology at the University of Iowa to work with the renowned Lucien

Morris. A fortuitous meeting with James Elam in Iowa established their common interest in resuscitation and was the start of an international collaboration that was to last until both men retired.

Back in Copenhagen, Ruben's inventive nature began to flourish. It started with a constant-rate, mechanical syringe pump, propelled by an electric motor and controlled by an alarm clock mechanism. A major venture was into the field of non-rebreathing valves and this was to make him a household name in anaesthesia and resuscitation. Impressed with the Stephen-Slater valve, he tried to copy it from a drawing.

Henning said "I misinterpreted the drawing so, by chance, I introduced changes in the design which resulted in my very first anaesthesia valve". The valve and its subsequent modifications were described in Scandinavian medical journals between 1950 and 1954. At this time Ruben met up with a talented meticulous engineer, Dr. Holger Hesse who owned and directed a company called Testa-Laboratorium, which specialised in making precision haematological laboratory equipment.

The two men immediately found a professional and personal rapport that was to endure for the rest of their lives. The early valves were delicate precision affairs made with rubies and springs from watch balances to support the moving shaft. Later these materials were substituted by more robust silicone membranes and a plastic casing designed by engineers at Testa Laboratorium and marketed as the Ambu "E" valve. Over a million were made and Ruben's name became synonymous with the non re-breathing valve. One confused anaesthesiologist once even addressed him as Dr. Valve!

In response to a contemporary need in Denmark and other countries for the practice of domiciliary anaesthesia for simple ear, nose and throat operations, Ruben designed a lightweight, simple, portable, foot suction apparatus in 1956. It was soon appreciated that this equipment had a very widespread application and it became virtually standard equipment on transfer trollies and ambulances world wide. Variations of this device are still in popular use today. The portable suction unit was also a collaborative effort between Ruben and the Testa Company who now marketed Rubens products under the name of Ambu.

A chance occurrence led to the invention of a device that has probably saved more lives than anything else in anaesthesia, and emergency and prehospital medicine.

The Danish truck drivers bringing gasoline to the service stations went on strike. As a result, the trucks bringing oxygen to the hospital were forced to a standstill by lack of gasoline. When the strike was finally called off, almost no oxygen was left in several hospitals. This inspired Ruben to construct the self-inflating bag resuscitator to allow artificial ventilation without compressed gases. Asking a bicycle mechanic to weld the ends of four bicycle spokes together, he manipulated them with the aid of a piece of string into an anaesthesia bag to form an oval frame which kept the bag expanded. When manual compression of the bag was interrupted, re-expansion made the bag self-filling. The tail of the bag was fitted with an air inlet valve and the patient end was fitted with a Ruben valve. Holger Hesse at Testa was impressed and improved the design exchanging the bicycle spokes for lining the bag with foam rubber, thereby leaving the centre of the bag free.

It is a compliment to Ruben that the "Ambu Bag" that he invented has become a generic term, regardless of the manufacturer, in much the same way as a "Hoover" has become synonymous with a vacuum cleaner. In 1964 Ruben's Ambu resuscitator was declared to be

“one of the most significant advances of the last 25 years” by the American Medical Association. How right they were.

Ruben had maintained his association with James Elam, who now had moved from Iowa to Buffalo, New York where he was Professor and Chairman at the Roswell Park Memorial Institute. In 1958 Ruben joined James Elam at the Institute as a research associate. James Elam and Safar had shown recently that expired air ventilation was more effective than the old manual methods proposed by Silvester, Schafer and Holger Nielsen. James Elam and Henning Ruben, together with Arne Ruben (no relation) from Karlskrona in Sweden, were able to demonstrate that head tilt was the essential element in establishing a clear airway. This was reported in landmark papers in the Lancet in 1959 (a splendid one page article!) and in JAMA in 1960 with other American collaborators in a more extensive paper. Ruben later went on to prove the point using X ray studies. Ruben believed that the mouth-to-nose route was superior to the mouth-to-mouth method with less risk of gastric inflation and the mouth-to-nose route was widely practiced in Denmark and central Europe for decades.

Henning Ruben had an early interest in training aids.

He wrote “In 1957 I constructed the first manikin to make it possible to train people in the proper use of the resuscitator. Apart from imitating facial anatomy, I incorporated an airway mechanism which allowed lung inflation only when forward movement of the jaw and backward tilt of the head was accomplished. I tested it with the local Red Cross Chapter in my own community, Søllerød Rode Kors. One of its members, a painter, who was good in modelling, helped me to make its plaster head. In making the airway mechanism I was helped by the bicycle mechanic who had helped me with my valves, as well as by the watch maker. Half a year later, hearing about experiments on expired air resuscitation, I also started using the manikin to teach mouth-to-mouth respiration. I began demonstrating and using it whenever I got a chance; for example in October 1958 at the meeting of the Swedish Anaesthesiology Association as well as at an international NATO meeting in Copenhagen. In November when I began an appointment in Buffalo in the United States, at the Roswell Park Memorial Institute I took the manikin with me. James Elam, the Director of the Anaesthesiology Department, was convinced of its essential teaching value, so we went together to a number of places in the United States to demonstrate it, including the Walter Reed Hospital in Washington”. The manikin was modified the next year to protect against cross infection and in 1960 had further mechanisms added for the training of closed chest compressions.

This remarkable man continued to attempt to satisfy his almost insatiable appetite for research and invention into his 1970s with new anaesthetic circuitry and valves.

Always a popular and entertaining speaker he was much in demand as a guest lecturer all over the world. He published prolifically. His papers were always succinct and simply explained and of the highest quality.

Henning Ruben was Chairman of the Danish Society of Anaesthesiologists from 1963 to 1965 and received their Honorary Award for his contributions to anaesthesiology. He delivered the prestigious Husfeldt lecture in 1977. He received many Honours including election to the Fellowships of the Faculty of Anaesthetists of the Royal College of Surgeons in Ireland and the Faculty of Anaesthetists of the Royal College of Surgeons of England. In addition he was been made an Honorary Member of the Danish Association of Anaesthesiology in 1990, the European Resuscitation Council in 1994, the European Society of Intensive Care Medicine 1997, and a Knight of the Order of Danneborg in 1973.

Henning Ruben will be remembered as one of the great inventors. For those of us who have the privilege of knowing him, he was also a good friend, a brilliant raconteur, a man of exquisite manners and modesty, a generous and charming host, and above all, always a joy to be with.

He is survived by his charming wife, Vera, four children and seven grandchildren. Like them, we will miss him.