Country Hospital Museum

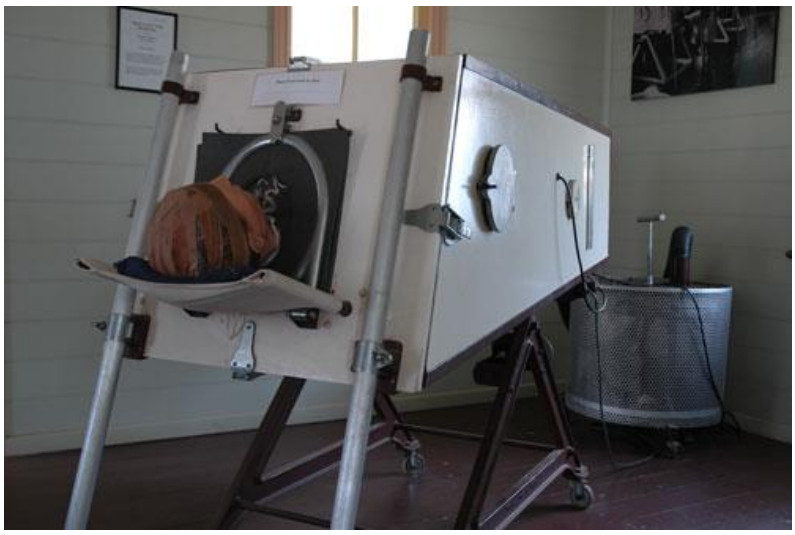
The Both Respirator or 'Iron Lung'

Among the many terrible diseases that have been largely eliminated from wealthy developed nations such as Australia is poliomyelitis (polio), a highly infectious disease caused by a virus which invades the nervous system and can cause total paralysis within a number of hours. One in 200 infections lead to irreversible paralysis usually in the legs and among those paralysed, 5% to 10% die when their breathing muscles become immobilized. [1]

The earliest epidemic of poliomyelitis in Australia was recorded in 1895 and the last in 1961 before the Salk vaccine and the Sabine oral vaccine were widely delivered. Major epidemics occurred in 1937-38, 1947-48 and 1951-52. [2]

Patients with certain forms of poliomyelitis are unable to breathe unaided and must be given artificial respiration. The 1937-38 epidemic was particularly severe and the 'iron lung' formed a vital part of the treatment regime available. The basic mode of operation is to encase the patient's body other than the head in a sealed chamber, called the 'tank'. A pump is then used to artificially raise and lower the pressure in the tank so that the patient's chest expands and contracts inhaling and exhaling air through the mouth and nose as in normal breathing. A successful 'iron lung' had been developed in the United States in 1929 by Dr Philip Drinker and Dr Charles McKhann. [3] The problems with the so-called Drinker respirators were that they were expensive and, being made of 'iron', very heavy and unwieldy. While there were Drinker respirators in Australia, there was a need for a larger number of more practical and less expensive machines. A number of Australian inventors went to work and the most successful Australian model was the Both respirator developed and manufactured in Adelaide using blockboard (a material in which wooden strips about 25mm wide are glued together between veneers of timber). This lowered both costs and weight and made the respirator quite portable compared to the steel-based respirators. However, despite the fact that they were made of timber materials, the name 'Iron Lung' continued to be used. The respirators were also fitted with wheels to make them more mobile.

The photograph shows the Both Respirator located in the ACHHA's display at the Country Hospital Museum at the Rockhampton Heritage Village.



The image clearly shows both the 'tank' enclosing the patient and the bellows machinery at the bottom right of the photograph. The hose connecting the two is also visible. A flexible rubber seal surrounds the patient's neck.

The 'Both' respirator took its name from its developer, a young Adelaide man Edward Thomas Both who set up a laboratory to develop scientific and medical apparatus at Adelaide University in the early 1930's. He and his wife and younger brother subsequently set up a company which became known as Both Equipment Limited.

The device for creating the air pressure variation in the chamber is a large electrically driven cylindrical bellows on its own wheeled stand. As the bellows expand, air is drawn out of the tank enclosure, lowering the pressure and causing the patient's chest to expand, inhaling air through the nose and mouth. When the pressure is allowed to increase again to atmospheric pressure the patient is forced to breathe out. The Iron Lung in our collection was in working order until recently. Unfortunately, the interconnecting hose from the pump has split and we need to seek a replacement.

This type of respirator is described as a "negative pressure respirator" because the function of the pump is to reduce the pressure in the tank to below the atmospheric pressure rather than pumping in air to increase the pressure above atmospheric pressure.

In many hospitals, iron lungs were located on verandas because of the noise created by the pump.

Although the Both Respirator was relatively inexpensive and could be made fairly quickly, there was still an issue with ensuring widespread availability during the polio epidemics. Here Lord Nuffield (Sir William Morris) who started his career with a bicycle shop in Oxford, England enters the story. In 1913 he made his first motor car, the Morris, and by the 1930's had become an important philanthropist. He was impressed by the simplicity of the Both machine and decided to manufacture and give away units to any hospital in the British Empire which requested one. There is some uncertainty about the number of units manufactured in the Morris Cowley works. Lord Nuffield apparently set an initial target of 5000 machines. However, the war intervened and the number of units distributed is more likely to have been around 1800. A very detailed review of the role of the Both respirators in the past by Ronald V. Trubuhovich reports that an article published in The Lancet in 1947 stated that 750 machines had been distributed in the UK, 347 in Canada, 198 in Australia, 183 in India and Burma, 46 in South Africa, 40 in Eire, 33 in New Zealand, 14 in Newfoundland, 10 to British Hospitals abroad, and 134 elsewhere in the British Empire, a total of 1755. [4]

Because the respirator was subsequently manufactured in many locations including some hospital workshops, they are not all identical. The Nuffield model was further developed over time and baby incubators and emergency respirators for transfer by plane were developed. The Both factory in Adelaide was eventually sold to Drug Houses of Australia (DHA) which retained all of the workers.

The ACHHA's respirator was one of those provided by the Nuffield Foundation. Our records and a plaque on the machine indicate that the Hospital Board agreed at its December 1938 meeting to accept the machine and pay the transport costs. The Morning Bulletin report stated: [5]

> *"Yesterday the Rockhampton Hospitals Board received a telegram from the Director General of Health and Medical Services (Sir Raphael Cilento) stating that Lord Nuffield was prepared to offer a free Respirator ("Iron Lung") for the treatment of paralysis at the Hospital."*

Other photographs in the ACHHA collection at the Heritage Village show iron lungs in use in a hospital ward. The display also outlines the procedures and difficulties associated with nursing patients dependent on an iron lung to keep them alive.

One notable event relating to this respirator resulted from a severe cyclone which hit Rockhampton on 02 March 1949 with winds of up to 100 mph (160 km/hr). A sixteen year-old girl was relying on the respirator when power was disrupted during the evening. A call went out for volunteers to operate the respirator manually during the blackout. A sufficient number of men made themselves available and despite the difficulty of the task, the outcome was successful with manual operation until power was

restored the next day. [6] The T-handle used to operate the pump manually can be seen protruding from the top of the pump unit in the above photograph.

One of the advantages of living in earlier times is that the hospital had wood-fired stoves so the nurses could keep up a supply of tea and toast to the men doing the pumping in shifts for 12 hours before power was restored. [7] We are grateful to one of the nurses on duty that night, Mildred-Brittain-Baker, for writing the story of that night for our ACHHA Collection.

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1. World Health Organisation Media Centre, Poliomyelitis, Fact Sheet No. 114 October 2015 http://www.who.int/mediacentre/factsheets/fs114/en/ , accessed 15 March 2016.

2. Megan Hicks, *The 'iron lung' in Australia*, The HaMMer, No. 24, March 2003, pp. 3-9. [Megan was Curator of Health and Medicine at the Powerhouse Museum, Sydney. HaMMer was published by the Health and Medicines Special Interest Group of Museums Australia. The Group is no longer active.]

3. University of Virginia, Iron Lung: 1929 Drinker Respirator in 'Historical Collections at the Claude Moore Health Sciences Library', http://historical.hsl.virginia.edu/ironlung/ironlung/pg4.cfm.html accessed 15 March 2016.

4 Trubuhovich, Ronald V., *Notable Australian contributions to the management of ventilatory failure of acute poliomyelitis,* Critical Care and Resuscitation, Vol. 8, No., 4, December 2006, pp. 383 -393, http://www.cicm.org.au/Resources/Publications/Journal/ accessed 15 March 2016.

5. Information from the Australian Country Hospital Heritage Association Inc Archives.

6. 1949 'ROCKHAMPTON BATTERED BY 100M.P.H. CYCLONE.', *Morning Bulletin* (Rockhampton, Qld. : 1878 - 1954), 4 March, p. 1, accessed 15 March, 2016, http://nla.gov.au/nla.news-article56896260

7. Brittain-Baker, Mildred, *Cyclone Drama with the Iron Lung*, 1983 – ACHHA Collection