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AS WE WERE...

Early medical engineering

The COVID-19 pandemic alerted the NHS to the need for more intensive care beds and many more ventilators. Engineering firms, together with ICU specialists, rapidly designed and made intermittent positive pressure respiration (IPPR) machines. In the 21st century medical engineering is commonplace and accepted.

A first important example of such expertise applied in medicine was the 'iron lung' developed by P Drinker and LA Shaw in Boston in 1928;¹ one of these was used for a child with respiratory failure due to polio. Drinker patented his machine, but JH Emerson built a similar one. Drinker sued Emerson, but a New York judge declared Drinker's patent invalid. During the 1937 polio epidemic in Adelaide, South Australia, ET Both (pronounced 'both'), an Australian inventor/engineer there, designed and

built a much cheaper wooden version that could be made quickly – a substitute for the expensive metal US-made machines. Both came to London in 1938 and displayed his cabinet respirator.

Lord Nuffield heard about this respirator and, after consulting with his friend Professor Mackintosh, turned over part of his Morris Motors factory in Cowley, Oxford in January 1939 to the manufacture of Both cabinet respirators, inevitably called 'iron lungs',

though made of blockboard. There was opposition to this from members of the medical 'establishment', the most serious objection being the need for many specially trained nurses. Nuffield, however, went ahead, and 1,700 were made and distributed to hospitals in the UK before production stopped at the onset of the Second World War.²

The sporadic occurrence of polio doesn't resemble the pandemic, but some will recall the acute public anxiety about

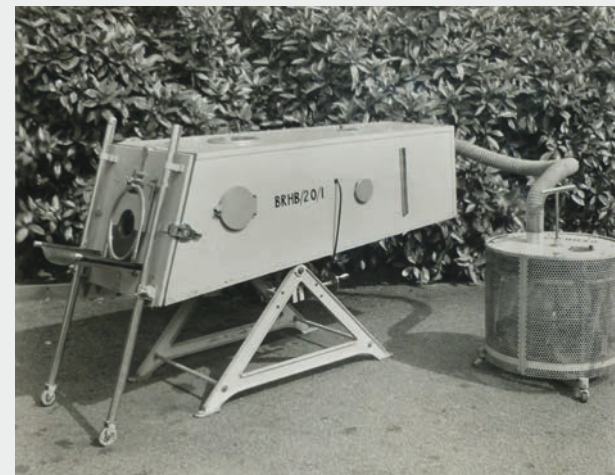


Image: Both Mechanical respirator/Nuffield 'Iron Lung' before modification

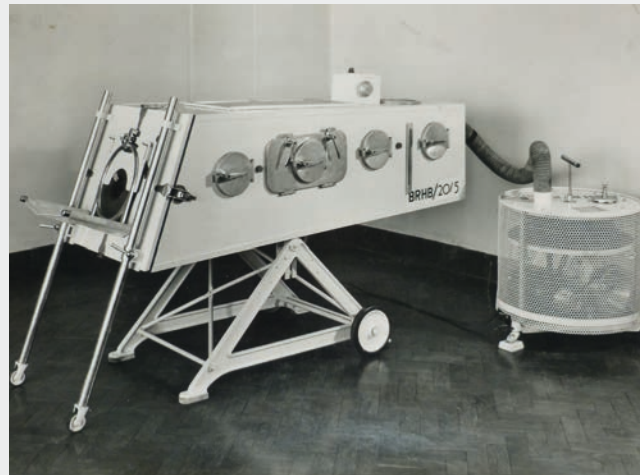


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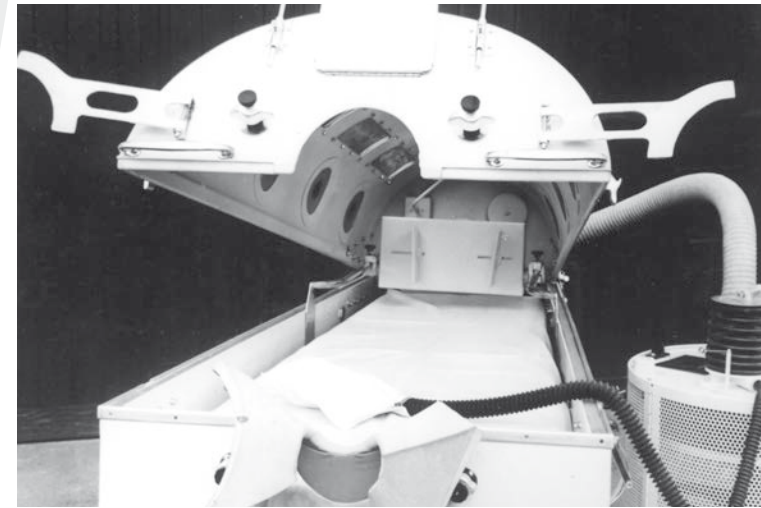


Image: The Coventry 'Alligator'

polio in the post-war years. There were some 700 iron lungs in UK hospitals, but many were in poor condition after damage and deterioration during the war. The Both respirators were 13 years old, 'patient unfriendly' and not easy to operate – they had been designed in a hurry. Access to the patient was poor: only two 'portholes' near the head, so it was difficult to nurse patients within the cabinets, which were heavy and difficult to move, having only two wheels. The pump unit had poor respiratory operating speeds, was noisy and hard to operate manually if there was a (not uncommon) electricity failure. There was no alarm if the pump failed or the cabinet leaked. The NHS Birmingham Regional Hospital Board (BRHB) had 48 Both-Nuffield iron lungs and two Drinkers. In April 1952 the Senior Administrative Officer of BRHB, worried about the quality and quantity of equipment available for the local polio epidemics then occurring, convened a subcommittee.

Modifications were essential. Enter another engineer – Captain GT Smith-Clarke (formerly Chief Engineer of Alvis cars) was co-opted to the subcommittee because of his engineering

expertise; he was also Chairman of the Coventry Hospitals Group. Members of the Health Ministry Breathing Machines Committee thought it was impossible or would take too long to carry out worthwhile modifications. Nonetheless, the five respirators in Coventry were selected for preliminary work. In May 1952, Smith-Clarke, with the hospital physicist, dismantled a Both machine in a disused hospital air-raid shelter. Smith-Clarke prepared the necessary drawings for the parts required and they were made. The hospital engineering department improved the pumps. It is a measure of their dedication to the task that modifications to the first machine were completed by August 1952. In late 1953, during a severe polio outbreak in Coventry, all five machines were put to the test both clinically and mechanically. Two were in continuous use for many months. There were no failures, and the Ministry of Health ordered all Both cabinet respirators to be modified.

Cape Engineering, started by Turner and Webley (formerly of Alvis), won the contract to manufacture the modifications. By the late autumn of

1953 Smith-Clarke had designed a 'new Coventry-type iron lung' that was made by Cape and became known as the 'Alligator'.³ Some 150 Alligators were manufactured between 1954 and 1967, about one-third of which were sold outside the UK. Cape produced adaptations of the iron lung that had been requested by Dr Kelleher of the Western Hospital, Fulham. One version was rotatable for postural drainage.⁴ The Lane Fox Respiratory Unit was set up at St Thomas' Hospital, and Dr Geoffrey Spencer also requested modifications for patients living in their iron lungs. Apart from the iron lungs, Cape Engineering made the foot-operated suction pump devised by Smith-Clarke and a pump for the cuirass used to aid the breathing of patients when out of the iron lung.

After the Copenhagen epidemic in 1952, it was realised that IPPR was a better alternative. In 1955, Smith-Clarke designed an IPPR ventilator; Cape began manufacturing it, and many were sold. The Cape-Waine anaesthetic machine was proposed by Dr TE Waine,⁵ a consultant at the Coventry hospitals, who suggested combining the IPPR with an anaesthetic machine. Cape went on to develop the semi-electronic Cape 2000.

References

- 1 Drinker & McKhann, 1929 JAMA 92 1658.
- 2 Smith RE. April 1953 Lancet i 674.
- 3 Galpine JF. April 1954 Lancet i 707.
- 4 Kelleher WH. November 1961 Lancet ii 1113.
- 5 Waine TE & Fox DER, 1962 BJA 34 410.

Adapted from Dr Padfield's forthcoming book – **Coventry, Alvis and the Iron Lung**. A biography of Captain GT Smith-Clarke (1884-1960)