A Critical Note on Joseph Rotblat and the 15 MeV 750 mA Linear Accelerator at St. Bartholomew’s Medical College

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Abstract

Joseph Rotblat was appointed to a Chair of Physics as applied to Medicine at St. Bartholomew’s Medical College with the intention of pursuing research. A 15 MeV high current electron linear accelerator was installed in the Medical College dedicated to research. This machine was not a success. Joseph Rotblat’s Archive is now available at Churchill Archives Centre, Cambridge. This Archive contains a detailed account of the problems associated with this machine and these are discussed and conclusions outlined.

Introduction and Background

Joseph Rotblat was one of the leading medical physicists of his generation. He pioneered the use of radio-isotopes in diagnosis,¹,² did fundamental work in the biological effects of radiation,³,⁴ and the use of accelerators in research and treatment.⁵ He was appointed to the Chair of Physics as applied to Medicine at St. Bartholomew’s Medical College, University of London, taking up his post in 1950.

This appointment followed from his work in nuclear physics in Poland and at Liverpool University, working with James Chadwick on Uranium fission properties that demonstrated that the Bomb was feasible. He joined the Manhattan Project but walked out within a year, which aroused considerable suspicion.⁶,⁷ His appointment at St. Bartholomew’s was not without

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controversy, but he was intent on pursuing research using the Mullard 15 MeV 500 W linear accelerator, capable of delivering an electron beam or intense gamma-rays. This machine was initially installed in the Medical College, but then transferred to the hospital for use in radiotherapy. The decision was made in 1960 to order a machine for the Medical College dedicated to research.

A full assessment of the performance of this machine can now be made from papers contained in ‘The Papers of Joseph Rotblat’, Churchill Archives Centre, Churchill College Cambridge.

The 15 MeV linear accelerator

An order was placed with Vickers in May 1961, and delivered to site in July 1963 and assembled by December of that year. The specification called for a 5 micro-second pulse at 100 pulses per second. Vickers carried out trials during 1964 and obtained a pulse length of 1.7 micro-seconds at full power. A new wave guide was fitted in 1965 and Vickers claimed a beam of electrons at an energy of 14.6 MeV and a current of 750 mA. St. Bartholomew’s staff measured the energy to be 11.8 MeV. In October 1965 it was agreed that an independent measurement should be sought and Bart’s agreed to take the machine if it performed within 10% of the specification.

Independent assessors from the Rutherford Laboratory were appointed and carried out energy measurements in June 1966, after a new klystron was fitted. The energy was measured at 13.5 MeV at a current of 750 mA which was just within the agreed acceptance limits.

The machine was subject to frequent breakdowns and not fit for day to day running and research. Bart’s wanted a complete independent assessment of the machine but Vickers refused. In 1967 the S.R.C were brought in for a final arbitration and the Rutherford Laboratory recommended acceptance of the machine in March 1968. However, some months later the klystron burnt out and a replacement was purchased with an S.R.C grant. Various attempts were made to run the machine from July 1968 to March 1969 which failed due, largely, to arcing in the waveguides. In March 1969 the klystron burnt out again after

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10 The Papers of Joseph Rotblat, Churchill Archives Centre, RTBT, C.156.
only 485 hours of operation. A new klystron was eventually purchased from hospital funds but funding ceased in September 1976. Some student based research work was undertaken,\textsuperscript{11} but the machine was not a success.

**Conclusions**

The Vickers 15 MeV linear accelerator installed in St. Bartholomew’s Medical College in 1963 was plagued with problems from the outset. Independent assessors were appointed to review the machine, but Bart’s agreed, it can be argued, an acceptance criterion that was not stringent enough. When Bart’s wanted additional outside, independent, opinion as to the performance of the machine, Vickers were not pressed hard enough to agree to this. At one point, Thompson-Varian did not honour the guarantee covering the performance of the klystron and hospital funds were used to purchase a replacement. The manufacturer claimed that the klystron was running at too high a current and therefore out of specification. There is no evidence in the Archive of these claims being challenged. Project management was simply not careful and tight enough. Norman Kember, who succeeded Rotblat as Head of The Academic Department in St. Bartholomew’s Medical College (and later appointed Professor) said in relation to this machine and Joseph Rotblat, that ‘great men are allowed to make great mistakes’,\textsuperscript{12} and only one research paper was produced.

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\textsuperscript{12} N. Kember, ‘Personal reminiscences from St Bartholomew’s’, in P.Rowlands, V. Attwood (eds.), *War and peace: the life and work of Sir Joseph Rotblat* (Liverpool, University of Liverpool Press, 2006), pp. 164-66 [at 165].