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*History*

# Thirty Nobel Prizes: Cavendish Crocodiles

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## INTRODUCTION

On October 25, 1921 Peter Kapitsa[1,2,3] (Table 1) (Fig. 1) wrote to his mother referring to the future Lord Rutherford as a "Crocodile" (Fig. 2)[4,5,6]. Rutherford had advanced from his native New Zealand to Montreal, to Manchester, England, to head the Cavendish Laboratory at Cambridge University, succeeding Sir Joseph John Thomson[4,5,6,7,8,9,10,11] (Fig. 3). Rutherford was third in a series of thirty Nobel Prize winners from the Cavendish Laboratory (Table 1). Lord Rutherford died in 1937 of persistent abdominal ileus[12].

In 1952, as a Cambridge undergraduate reading Honours

**Figure 1.** Peter (Pyotr Leonidovich) Kapitsa, FRS (1894-1984), oil on canvas, 107.9 x 90.5 cm, 1926 by Boris Kostodiev (1878-1927). Gift of Anna Kapitsa, 1935, after their return to the Soviet Union. From the collections of the Fitzwilliam Museum, University of Cambridge, No. 1770, and reproduced with permission. Award of Kapitsa's Nobel Prize in Physics was postponed until 1978 (Table 1). Kapitsa returned to the Cavendish and Cambridge post World War II[2,3].

**TABLE 1. NOBEL PRIZE RECIPIENTS FROM THE CAVENDISH LABORATORY, CAMBRIDGE[1]**

| RECIPIENT | YEAR | PRIZE |
|---|---|---|
| Lord Rayleigh | 1904 | Physics |
| Sir Joseph J. Thomson | 1906 | Physics |
| Lord Rutherford | 1908 | Chemistry |
| Sir Lawrence Bragg | 1915 | Physics |
| Charles Barkla | 1917 | Physics |
| Francis Aston | 1922 | Chemistry |
| Charles Wilson | 1927 | Physics |
| Arthur Compton | 1927 | Physics |
| Sir Owen Richardson | 1928 | Physics |
| Sir James Chadwick | 1935 | Physics |
| Sir George Thomson | 1937 | Physics |
| Sir Edward Appleton | 1947 | Physics |
| Lord Blackett | 1948 | Physics |
| Sir John Cockcroft | 1951 | Physics |
| Ernest Walton | 1951 | Physics |
| Francis Crick | 1962 | Physiology or Medicine |
| James Watson | 1962 | Physiology or Medicine |
| Max Perutz | 1962 | Chemistry |
| Sir John Kendrew | 1962 | Chemistry |
| Dorothy Hodgkin | 1964 | Chemistry |
| Brian Josephson | 1973 | Physics |
| Sir Martin Ryle | 1974 | Physics |
| Antony Hewish | 1974 | Physics |
| Sir Nevill Mott | 1977 | Physics |
| Phillip Anderson | 1977 | Physics |
| Pyotr Kapitsa | 1978 | Physics |
| Allan Cormack | 1979 | Physiology or Medicine |
| Sir Aaron Klug | 1982 | Chemistry |
| Norman Ramsey | 1989 | Physics |
| Didier Queloz | 2019 | Physics |

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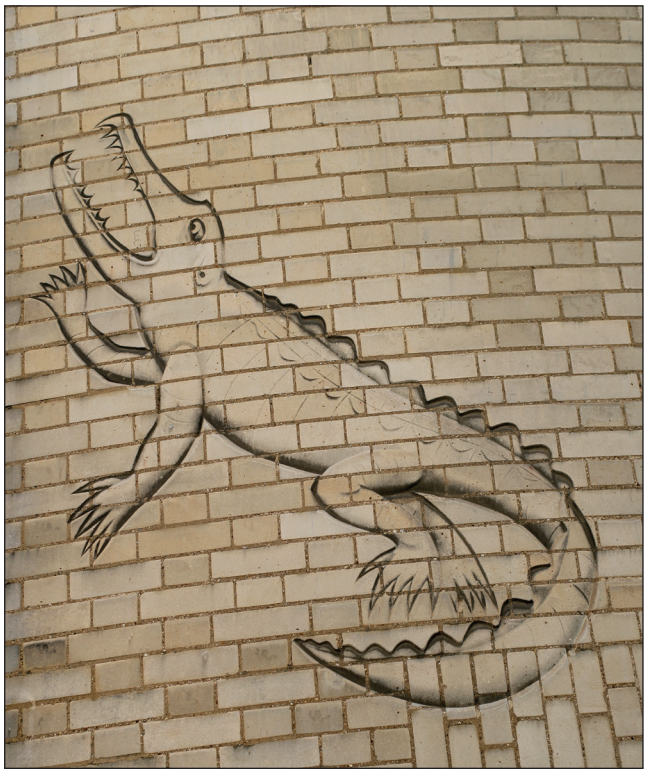

**Figure 2.** Crocodile on the outer wall of the Cavendish's Mond Laboratory, engraved by Eric Gill, 1933, courtesy of the Cavendish Laboratory, Cambridge. In 1933, the Cavendish's extension, the Mond Laboratory, was built for Kapitsa to continue his research into intense magnetic fields. Future Nobel Laureate Kapitsa commissioned the engraving of the crocodile—his nickname for Rutherford[4,5,6].

Natural Science Tripos Part 1, I[1] asked the future Sir Michael Stoker, my tutor, who or what was meant by "Crocodile" in this context[13,14,15,16]. Michael G.P. Stoker replied, "Choose a 'Crocodile' to approach donors and get funding. 'Crocodiles' when working should always test their equipment at different barometric pressures and temperatures. Electrical supply must be constant and gas supply stabile and of demonstrated purity. After acceptance of your first scientific papers, you should apply for new funding. If you were successful, then you were probably a 'Crocodile'."

## SIR MICHAEL G.P. STOKER

Sir Michael Stoker became Professor of Virology, at University of Glasgow. Stoker served as Acting Director and then Director of the Imperial Cancer Research Fund (ICRF) Laboratories, London, for more than a decade[13,14,15,16,17]. My tutor visited Harvard on many occasions and advised on both Virology and treatment of cancer. Stoker arranged for my colleague Prof. Howard H. Hiatt, who headed the Department of Medicine at Harvard's Beth Israel Hospital from 1963 to 1972, to study advances in Oncology at the ICRF Laboratories[18,19]. After returning to Boston, Hiatt was a founding director of the Beth Israel's Cancer Treatment Division, and was appointed Dean of Harvard's School of Public Health[18,20].

1 This and other first-person references are to the first author.

**Figure 3.** Sir Joseph John Thomson (1856-1940), Cavendish Professor (1884-1919), later Master of Trinity College, Cambridge, President of the Royal Society (1915-1920), by Arthur Hacker (1858-1919). Oil on canvas, 90.2 x 68.6 cm. From the collections of the Cavendish Laboratory and reproduced with their permission.

While Master of Clare Hall (1980-1987), Sir Michael Stoker did much to expedite work at the Cavendish. Decades before, Prof. V.E. Cosslett and his Cambridge colleagues, including Stoker himself, had greatly advanced electron microscopy[21,22,23]. This technology enabled progress in Virology and the development of vaccines for infectious diseases.

## HARVARD UNIVERSITY EXPERIENCE

On the second weekend in May 1943, twenty-year-old Lembit Hans Laasberg and his young wife Irene had escaped from Estonia, their country of origin, in a flat-bottomed wooden boat. The Laasbergs had obtained their boat from the Forest Brothers[24]. They rowed through the shallows by night along the Estonian coast to avoid the additional mines and net barriers placed in the Gulf of Finland by Germany and Finland to block Soviet Submarines[25,26]. They eventually made their way to Finland and traveled to Sweden. Laasberg, who had studied Agriculture and Biology at Tartu University for a year, continued his education in Chemistry at Hermods Institute and the University of Lund in Sweden[27,28]. He then relocated to Gothenburg, Sweden, where he received a Chemical Engineering degree[28]. Later he was employed by an oil company. He would sometimes compare the analytic process for petroleum to that of human plasma.

In the late 1950s the Laasbergs emigrated to Canada where Hans continued graduate studies in Immunochemistry and Immunology at McGill University, Montreal, where Lord Rutherford had once been Professor of Physics[8,9]. By the mid-1960s they had emigrated to the United States. In 1967, I recruited Hans Laasberg from Tufts University to Harvard.

As our research program expanded on the Harvard Medical School campus, Laasberg's wide-ranging knowledge and advice was a treasured resource. He ran the Harvard Medical School Blood Gas Laboratory for two decades[29,30,31,32,33,34]. Laasberg corresponded with Cavendish Nobel Laureate Max Perutz[35] (Table 1) about the role of halothane and its interaction with blood[36,37]. Once, in 1969 when I was chairing a Harvard Medical School Meeting, Laasberg whispered to me that I was acting as a "Crocodile". Recalling Stoker's explanation from my Cambridge days, I understood the significance of this appellation (Fig.2).

Laasberg also mentored then Harvard researcher Susan E. Lynch, later physician and First Lady of New Hampshire for her Governor husband's four terms (2005-2013)[38]. Susan Lynch co-authored papers with bacteriologist colleague Dr. Gary C. du Moulin[39,40] (Fig. 4). Dr. Lynch served on the Board of Overseers of Dartmouth University's Geisel School of Medicine, and as paediatrician-First-Lady of New Hampshire promoted public health and nutrition initiatives[41,42]. As we celebrate the centenary of Hans Laasberg's birth in Rakvere, Estonia, the Biotechnology Lecture series he founded at Worcester Polytechnic Institute in Massachusetts continues his legacy[27].

In Harvard's Longwood Medical Area, Prof. John Enders was a great friend and fellow "Crocodile"[43,44]. After winning the Nobel Prize in 1954 with his Harvard colleagues for "Discovery of the ability of poliomyelitis viruses to grow in cultures of various types of tissue"[45], he went on to successful development of a measles vaccine, with the support of government, industry and private philanthropy[44,46]. His legacy continues in the Enders Building at Harvard's Boston Children's Hospital that bears his name.

**Figure 4.** Lembit Hans Laasberg, Ch.E. (1922-2014), left, with Gary C. du Moulin, Ph.D., then Assistant Professor of Microbiology, Harvard Medical School, at Beth Israel Hospital, Boston, 1987.

For two decades, L.H. Laasberg directed the Blood Gas Laboratory, where he mentored young scientists and encouraged support from area politicians and philanthropists with his scientific integrity and personal charm. Dr. du Moulin continues his distinguished career in academic and applied research, and retired as a Full Colonel from the U.S. Army Medical Reserve.

## JOHN WHARRY DUNDEE AT HARVARD

Prior to my arrival at the Beth Israel Hospital on the Harvard Medical School Campus, I had been mentored at the Massachusetts General by Henry Knowles Beecher[47,48,49,50] jointly with John Wharry Dundee[51,52,53] (Fig. 5). Dundee and Beecher were impressive lecturers on Medical Sciences. Both Professors John W. Dundee and Henry K. Beecher were interested in the overuse of thiopental especially in shock. They lectured together in the early 1960s at the Massachusetts General Hospital on thiopentone's misuse after the Japanese attack on Pearl Harbor, Hawaii, in December 1941[54,55,56,57,58,59]. Beecher and Dundee's mentoring of junior faculty included tutorials on selection of the most effective journals in which to publish the results of research.

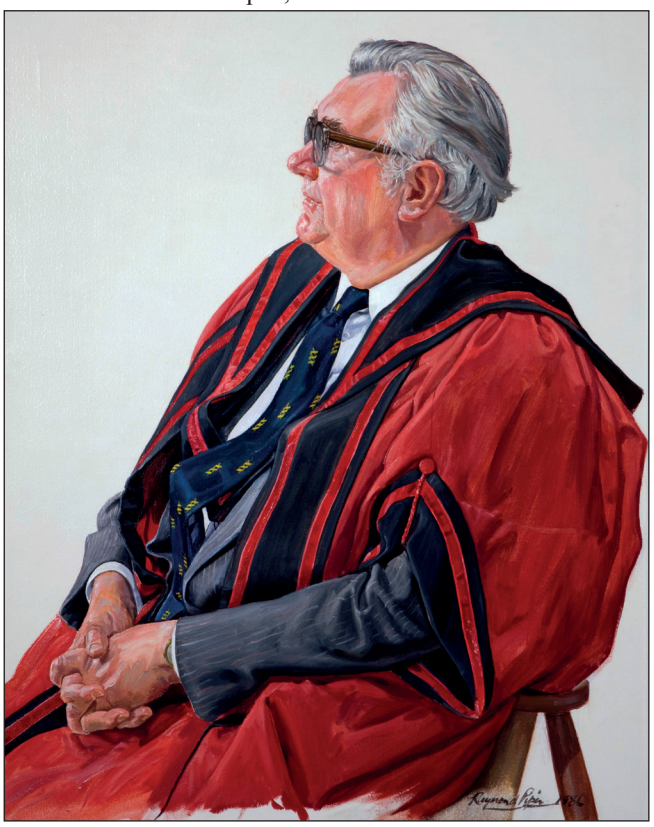

**Figure 5.** John Wharry Dundee, OBE**,** M.D., Ph.D., FFARCS, FFARCSI, FRCP, (1921-1991). Oil on canvas, 1986, 103 cm x 83 cm, by Raymond Piper (1923-2007). From the Portrait Collection of the Naughton Gallery, Queen's University Belfast, no. 174, and reproduced with permission. Photograph provided by Queen's University Belfast.

John Wharry Dundee claimed to have several close relatives living in the Boston area. Dundee was an excellent

church organist who played at Christ Church, Cambridge, Massachusetts, where George Washington had sheltered while Boston was besieged during the American Revolution.

**THE NATURE OF "CROCODILES"**

One explanation of Kapitsa's designation of Lord Rutherford as "the Crocodile" was that he moved in one direction only—ahead-- and never looked back[10]. Tutor Stoker's 1952 explanation to me clarified some aspects of academic leadership that defined a "Crocodile" following the examples of Thomson[7] (Figure 2) and Rutherford[8,9,10,11]

**Figure 6.** Dorothy Crowfoot Hodgkin, OM (1910-1994). Photograph by Walter Stoneman, half-plate glass negative, 29 June 1947. NPG x26009, © National Portrait Gallery, London and reproduced with permission. Nobel Prize Winner Hodgkin's formative contributions to X-ray crystallography revolutionized the manufacture of insulin and led to its wider availability. Quality control and therapeutics in the practice of Anaesthesia benefited from Hodgkin's discovery and implementation of x-ray crystallography.

(Table 1). These included the ability to raise funds whether from industry, private philanthropy, or governmental funds; identification of exceptional scientists and other staff and their effective recruitment and training. Equally important are the interpersonal and managerial skills that promote both team-building and individual professional development. Optimization of grant-writing and in-depth knowledge of the world of academic publishing are key areas.

**A CAVENDISH ALUMNA AND "CROCODILE"**

Dorothy Crowfoot Hodgkin (Fig. 6) (Table 1) was the sole awardee of the 1964 Nobel Prize in Chemistry for "her determinations by X-ray techniques of the structures of important biochemical substances"[60,61]. She attended Somerville College, Oxford 1928-1932, which assisted

**Figure 7.** Dorothy C. Hodgkin, on May 20, 1971, the day of her installation, in Chancellor's robes of the University of Bristol, once worn by her predecessor Sir Winston Churchill. University of Bristol Photograph 1971, no. DM2705/Box6/L157E, reproduced with permission. The oil-on-canvas portrait of the Right Honourable Sir Winston Churchill, KG, OM, CH, MP, Chancellor of the University of Bristol 1929-1965, was painted in 1943 by Frank O. Salisbury (1874-1962), No. PCF 13 in the University of Bristol Portrait Collection.

her with a research fellowship to be held for one year at Cambridge and one year at Oxford. Under the supervision of Professor J.D. Bernal, Cambridge, she was awarded a Ph.D. in 1934, after which she returned to Somerville College, Oxford, with First-Class Honours Degrees from both Oxford and Cambridge[60,62,63].

Professor Crowfoot married historian Thomas Hodgkin in 1937. Her career as Official Fellow and Tutor in Natural Science advanced the teaching of Chemistry for the women's colleges at Oxford, including Somerville[60,62,63]. Her Oxford career advanced as she became University lecturer and demonstrator in 1946, Reader in X-Ray Crystallography in 1956 and Wolfson Research Professor of the Royal Society in 1960[62,63]. As "Dorothy, Mrs. Hodgkin" she received the Order of Merit in 1965[64].

Hodgkin raised funds for advanced X-ray apparatus from

diverse sources such as the Rockefeller and Nuffield Foundations. The Rockefeller Foundation provided her Somerville College Laboratory with funding throughout World War II[62,63]. She and her trainees used x-ray crystallography to map organic molecules of increasing complexity[65,66,67,68], including insulin[69,70,71,72,73,74,75,76,77,78,79], penicillin and other antibiotics[80,81,82,83] and cobalamin, or vitamin B12[84,85,86]. Hodgkin's post-World-War II work on the analysis of the rhombohedral 47z insulin crystal with trainee Marjorie Harding resulted in improvements in the production of pharmaceutical insulin and its wider availability[70,71,72]. There were many notable visitors to her laboratory including the Braggs[11], J.D. Bernal[62,63], Dame Kathleen Lonsdale[62], and Cavendish Nobelist colleague Max Perutz[35] (Table 1).

Dorothy C. Hodgkin was elected Chancellor of Bristol University in 1970, where she actively served until 1988. This post had previously been held from 1929 to 1965 by Sir Winston Churchill (Fig 7), and from 1965 to 1970 by Henry Somerset, the 10th Duke of Beaufort[62,63]. Hodgkin promoted the peaceful uses of atomic energy by becoming president of Pugwash in 1975, at the request of Professor, later Sir Joseph Rotblat, KCMG[11,62,63,87]. Hodgkin's work demonstrates that greater advances in both Physiology and Pharmacology result from their close cooperation and complementary harmonization rather than scientific rivalry[88,89].

## CONCLUSION

"Crocodiles" have contributed greatly to the success and stature of universities across the globe. Queen's University Belfast (QUB) "crocodiles" have included numerous distinguished individuals. For example, President and Chancellor Baron Ashby (1904-1992) recruited noted virologist George W.A. Dick to QUB, advancing the production and safety of polio vaccine[43]. Lady Ashby was also a distinguished scientist. Vice-Chancellor Sir David Lindsay Keir, L.L.D. (1895-1973) chaired the Northern Ireland Council for Orthopaedic Development during World War II [90]. Sir John Henry Biggart (1905-1979), Pathologist and Dean of QUB's Medical Faculty for 27 years, showed extraordinary leadership during World War II and later in assuring close cooperation between postgraduate medical education and the National Health Service[91,92]. Prof. Dame Ingrid V. Allen (1932-2020) was a pioneer in several areas of Neuropathology and established Northern Ireland's Regional Neuropathology Service[44]. All personified the requisite qualities for the highest standards of academic leadership in Science and Medicine. In the Humanities, Nobel Laureate Seamus Heaney contributed much through his poetry to our cultural standard of living on both sides of the Atlantic, and especially at Harvard[93,94]. In the century since Kapitsa's October 1921 letter to his mother[4], the "Crocodiles" of academia, at QUB and beyond, have improved technology, medical care and civilization worldwide.

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