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PORTRAIT OF AN ISV FELLOW

Ray Spier–In Memoriam

Ray Spier

***Editor's Note*: Ray Spier made tremendous contributions to the publication and dissemination of high-quality science. He founded *Vaccine* in 1983 as the world's first indexed international journal for this field, which led to the posting of comprehensive vaccine data and information in one major journal for the first time. Ray's journal blazed the trail for the founding in 2005 of *Human Vaccines*, now *Human Vaccines & Immunotherapeutics*. He founded another journal and two societies, notably the *International Society for Vaccines* in 1996 as an international group that continues to disseminate vaccine data and information through conferences and other venues. In addition, his warmth, charm and attention to ethical issues contributed to his ambassadorial roles. These unique accomplishments placed Ray at the forefront of the vaccines field, and he leaves behind a rich and highly productive legacy for vaccines in the world. His family and friends should feel very proud of his accomplishments and his humanity.**

I took a degree course in Biochemistry because I wanted to know more about what life is, how it works, its origin and evolution and to convince myself and others that we do not need to give too much, if any, credence to notions of spirits, gods and other insubstantial fantasies. To be fully educated/trained in Biochemistry I engaged in a research project which looked at the biochemical mechanisms that controlled the development of the chloroplasts of an alga (Scenedesmus) and a protozoan (Euglena). So, issues in the general area of 'control' became a central theme about which I hung the various endeavours that constituted the rest of my career.

As a bench scientist engaged in the discovery of the nature of systems and the mechanisms that drove them I realised that I was getting into a problem area because at the time I made my next decision (1964) the current state of knowledge of the controllers of cellular activities – the biochemistry of the nucleic acid molecules – was hardly developed to the point where we could point to base sequences and the control of their expression. I also regarded myself as uneducated insofar as I could make a practical contribution to the wellbeing of the world and its people. So, I jumped at the opportunity to take a novel course in Biochemical Engineering – an adaptor that could make me into a useful contributor to human progress.

While engaged in my Doctoral research I gave a talk to my Oxford colleagues on the "World Food Problem". The provision of nutritious protein was the key to the enhancement of the nutritional status of those in the Developing World. This provided me with the direction I would take following my engineering adaptor course. Having applied for an unadvertised position at a Glues and Chemicals company that was developing processes to make nutritious proteinaceous materials from plant sources (peanuts, corn germs, coconut meats, cottonseeds, Lucerne grass) I spent the next 3 years in the R&D department putting together processes that would generate nutritious foods for the Developing World's peoples.

Having disagreed with my Managing Director on our plans to make protein from cotton seeds (there already existed processes that made such materials for animal feeds in the USA with which our process was not competitive – in my opinion) and having satisfied myself that my on-and-off girlfriend for the last 9 years was not going to become my wife, I looked around for another position focussing on what was going on in the United States.

My canvas of US companies seeking to develop processes to make foods for the Developing World resulted in a job offer as a Senior Process Engineer at a company located in the Mid-West that sought to make single-cell-proteins from Yeast and Bacteria that could thrive on the carbon substrate, Ethanol (at reactor concentrations of parts per million). After about a year I could see that this was not going to work (the product, while nutritious had the consistency of sand) and perhaps more influentially I learned that the government of India gave a higher priority to the purchase of 40 fighter planes than processes that would provide food for their people. I was free to choose a new goal.

As an experienced Biochemical Engineer, I offered myself for employment to the Pharmaceutical companies on the East Coast of America. I was offered a job optimising the productivity of a microbial fermentation that produced vitamin B_{12}. Three months later I was summoned by Dr Maurice Hilleman to report to the Vaccine R&D area of the company and given the job of designing and operating processes for the mass production of vaccines by unit-process technologies where an increase in production is brought about by an increase in the size of the vaccine generating equipment rather than an increase in the number of individual units making vaccines.

Thus, began the second era of my career.

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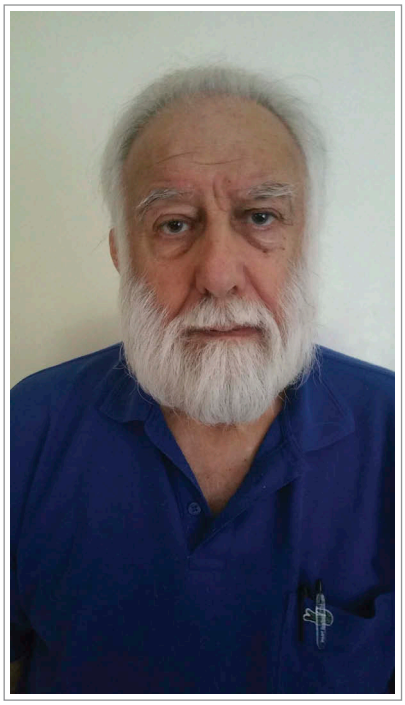

About Ray Spier. Having been educated at Christ Church, Oxford and University College, London in Biochemistry (First Class Honours), Chemical Microbiology and Biochemical Engineering he then spent 7 years as a Senior Process Engineer in industry. The last 3 years in America were spent with Merck Sharpe and Dohme where he was introduced to animal cell biotechnology and the production of viruses for use in veterinary and human vaccines. On returning to the UK he worked for 10 years at the Animal Virus Research Institute, Pirbright, scaling-up bioreactors for virus vaccine production processes and maximizing the biological productivity of the BHK cell lines for Foot-and-Mouth Disease virus generation. He then moved to the University of Surrey as Professor and was Head of Microbiology (7 years) and in 1997 he was appointed to the first chair in the UK in 'Science and Engineering Ethics'. His publication record includes over 200 research papers and reviews along with over 20 edited books and an encyclopedia on animal and plant cell culture technology. In 2002 his book 'Ethics Tools and the Engineer' was published by CRC Press. He founded the journal *Vaccine* in 1983 of which he was the Editor in Chief for 28 years, and in 1994 he founded the journal *Science and Engineering Ethics* of which he was Co-Editor in Chief. Having founded the European Society for Animal Cell Technology in 1975 and the International Society for Vaccines in 1996 (President: 2007–11: Fellow 2013), he was elected to be President of the European Association for Higher Education in Biotechnology in 2000. In his retirement from formal employment he edited the journal Science and Engineering Ethics and progressed his ideas for an improved appreciation of the nature of "Science". Dr. Spier passed away in April 2018.

Our focus now was titanium plate propagators which we succeeded in scaling up for the processes of making human and chicken vaccines. This concurred with my marriage and my becoming a father of two sons for whom I and my wife thought that an education in England (which in 1973 had just joined in with Europe) would be the way to go. At this time also, a British Government R&D Laboratory was advertising for a Biochemical (Microbiological) Engineer to make vaccines using both the stirred tank reactor technology as well as a technology that provided a solid substrate for the growth of the animal cells from which vaccine cells and viruses could be obtained.

From this position I initiated the publication of the journal "Vaccine" of which I was the Editor for the next 28 years and, with colleagues, the establishment of the European Society for Animal Cell Technology (1975). My work at the institute and my contributions to Animal Cell Technology both at the technical and societal levels are summarised in the Appendix. I was also active in European Biotechnology. My wife and I added a daughter to our family in 1974.

After 10 years at the institute I was appointed Professor of Microbiology and Head of the Microbiology Department of the University of Surrey. While in this position I tried to give a sense of direction to my academics which emphasised the prophylactic approach to human health care. I also started the International Society for Vaccines which after a couple of failed iterations finally took off when Shan Lu joined me in bringing this society into being.

The university decided to merge Microbiology with Biochemistry and seek a head of the new department from outside the university. Having been partially displaced I was attracted to the up and coming area of Science and Technology Ethics – where Ethics is a control system based on the use of words. And clearly, Ethics has much to do with the world of vaccines and vaccination. So, to this end I initiated another journal "Science and Engineering Ethics" and invited a Co-Editor (Stephanie Bird) to join me in setting up this publication. That was 24 years ago. I presently (2018) spend much of my time editing the papers of this journal and in the preparation of a monograph on the Nature of Science.

I also built a train set for the grandchildren in the last 3 years.

Appendix

Achievements of Ray Spier 1938–2018

(1) At age 17 in 1957 he won a Manchester City Scholarship and a State Scholarship
(2) He was also awarded the first Smith Exhibition for Biochemistry offered by Christ Church, Oxford
(3) 1961 Awarded an Oxford **First Class degree in Biochemistry** with supplementary Pharmacology
(4) 1964 Doctor of Philosophy of the University of Oxford; dissertation on chloroplast development in Scenedesmus and Euglena
(5) 1965 Diploma in Biochemical Engineering from University College, London.
(6) 7 years in industry (British Glues and Chemicals [3] Nestle [1] Merck Sharpe and Dohme [3])
(7) 10 Years in a Government Research Lab (Animal Virus Research Institute, Pirbright) 1973–1983.
(8) Professor of Microbiology and Head of Microbiology (about 100 people) at the University of Surrey (1983-1997) Professor of Science and Engineering Ethics at the University of Surrey (1997-2002)
(9) Emeritus Professor of the University of Surrey in Science and Engineering Ethics; 2002
(10) Active in the European Federation for Biotechnology:
(11) Secretary of the Animal and Plant Cell Culture Working Party of the European Federation of Biotechnology (1982-1985)
(12) Chairman of the Animal and Plant Cell Culture Technology Working Party of the European Federation of Biotechnology (1990 -1996)
(13) Acting Chairman of the European Federation of Cell and Virus Collections. Co-founder of the Microbiological Resource Data Bank (MIRDAB), Elsevier (1984-1985)
(14) President of the European Association for Higher Education in Biotechnology (2000-2004)
(15) **Founder** and First Chairman of the European Society for Animal Cell Technology in 1975

(16) **Founder** and Editor in Chief of the journal "Vaccine" for 28 years from 1983–2011
(17) Co-Editor in Chief of the journal Enzyme and Microbial Technology for 14 years (1986-2000)
(18) **Founding** Editor of the journal Cytotechnolgy in 1987
(19) **Founder** in 1994 and present Co-Editor in Chief of the journal Science and Engineering Ethics
(20) **Founder** of the International Society for Vaccines starting in 1992 but not really getting going until 2007
(21) Grants awarded with colleagues:
  a. £3,140,000
  b. Successful supervisions/Co-Supervisions of 14 Ph.D students
(22) **Fellowships**:
  a. Institute of Chemical Engineers
  b. Chartered Engineer
  c. Institute of Biology
  d. Chartered Biologist
  e. Royal Society for Arts and Manufactures
  f. Royal Society of Medicine
  g. World Technology Institute
  h. International Society for Vaccines,
(23) **Publications**:-
  a. Co-Authored one book on Monoclonal Antibodies
  b. Sole Author of "Ethics, Tools and the Engineer" 2002
  c. Edited works
    (i) Animal Cell Biotechnology 6 volumes with Bryan Griffiths (1985-1994)
    (ii) The Encyclopaedia for Cell Culture Technology with Bryan Griffiths and Alan Scragg. 2 Volumes, 2000
  d. Associate Editor – Encyclopaediae
    (i) Encyclopedia of Science, technology and ethics. Ed in Chief; Carl Mitcham. 4 vols, 2005
    (ii) Encyclopedia of Industrial Biotechnology: Bioprocess, Bioseparation and Cell Technology (EIB), (7 vols) Editor; M.C. Flickinger 2006
  e. Proceedings
    (i) Proceedings (12 of) of the meetings of the European Society for Animal Cell Technology (1976-1994)
    (ii) Science and Technology Ethics, 2002
    (iii) Vaccines for Sexually Transmitted Disease with A. Mehous 1989
  f. Other publications (single and/or co-authored)
    (i) 80 Research Papers
      (1) Standardisation of animal (Baby Hamster Kidney) cell growth conditions for reliable experimentation
        a. Serum test with aliquoted cells
        b. Mini cultures (18 culture rig)
        c. Simplified system for FMD (Foot and Mouth Disease) Vaccine production for Developing Countries
          (i) Implemented in Sri Lanka
          (ii) Implemented in Indonesia
  g. Scale-up to 100 litre culture volume for cell growth and virus production
    a. Suspension cells
    b. Cells grown on a bed of 3mm diameter glass beads
    c. Cells grown on micro-carriers (Sephadex based)
    d. Cells grown on expanded matrices
  h. Examination of the oxygenation of animal cell cultures
    a. Use of glass sinters to make small bubbles
    b. Theoretical aspects of animal cell culture oxygenation
  i. Examined the factors that affect the growth of FMD virus in BHK cells
    a. Cloned cell lines
    b. Culture specific factors
    c. Relationship with the cell cycle (Secondary Metabolite parallels)
  j. Digital computer control of continuous self-optimising culture of BHK suspension cells (1975)
    a. Multiple Independent Loop Digital Controller (MILODIC)
      (i) 52 Reviews
      (ii) 23 Reports
      (iii) 25 Articles
      (iv) 84 Comments/Articles/Editorials/Letters
      (v) 1 Memorandum
    b. 7 Patents
      (i) Production of Mumps, Measles vaccines in rotating plate culture vessels of 1–10 litre culture volume
      (ii) Designed scaled up rotating plate culture vessels to 70 Litres.