

demand. Is this entirely the consumer's fault?

Yours faithfully,

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## Forensic Science

SIR,—Dr Curry in his article on "Recent Developments in Forensic Science" (*Nature*, 235, 369; 1971) errs on the side of extreme conservatism when he

asserts that the existing techniques of blood grouping and enzyme measurement can occasionally give a discriminatory power of 1 in 1,000. This laboratory uses routinely in case-work three serological systems (ABO; MN; Rh) and up to six enzyme systems (AK; ADA; PGM; 6PGD; G6PD; PCE) plus haptoglobin and haemoglobin. Discrimination of 1 in 1,000 is commonly obtained but from time to time values as high as 1 in  $10^6$  have arisen.

Dr Curry has apparently overlooked the advantages of atomic absorption spectrometry which are being exploited in several forensic laboratories. Considerable developments are also being

made in scanning electron microscopy particularly in conjunction with electron probe X-ray microanalysis. Such equipment has been in use in the MP Laboratory for nearly a year and has been very useful in the elemental analysis of fragments of paint, glass and metals even when the cross section of the sample analysed is as small as  $10\ \mu\text{m}$ .

Yours faithfully,

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# Obituary

## Sir Frederick C. Bawden



SIR FREDERICK CHARLES BAWDEN, FRS, Director of Rothamsted Experimental Station and Treasurer of the Royal Society, died on February 8 at the age of 63.

Frederick Bawden was a scholar of Emmanuel College, Cambridge, and he graduated with first-class honours in botany. Rather than enrol for a PhD—a degree he never did acquire—Bawden instead obtained a diploma in plant pathology at the Cambridge School of Agriculture. His first appointment in 1930 was as research assistant to the formidable Redcliffe N. Salaman. Salaman, the son of a wealthy Jewish family and a medical man, was originally engaged in medical research at the London Hospital, but he contracted tuberculosis at the age of 30 and was advised to lead an outdoor existence. Living quite near Cambridge at Barley, Salaman became interested in the scien-

tific genetics and breeding of the potato, on which he became a leading authority, and subsequently he developed an interest in the virus diseases of potatoes. As a consequence he persuaded the Ministry of Agriculture in 1927 to establish and finance the Potato Virus Research Station (later to become the ARC Virus Research Unit), which was situated on the edge of Cambridge University Farm, and at the time consisted only of a few glasshouses and a potato shed. There Bawden was to meet Salaman's other colleagues, who included Kenneth Smith, the station's entomologist, and to receive a thorough grounding in virus diagnosis and transmission by grafting, sap inoculation and insect transfer. The work of a research assistant consisted very largely of routine work of this type and of recording the results, often photographically, under the most primitive conditions. The darkroom was built onto the potato shed and was hot in summer and freezing in winter. There Bawden was to make his only contribution to scientific photography. Taking advantage of the infrared reflexion band of chlorophyll, he managed to get good photographs of necrotic virus symptoms on plant leaves using infrared plates<sup>1</sup>.

Subsequently he became interested in the diagnosis of virus diseases using the immunological methods that had just been developed. This resulted in a fruitful collaboration with E. T. C. Spooner of Cambridge University Pathology Laboratory. Intrigued as to the nature of the viral antigens present in diseased plants, Bawden also became a close collaborator with a young biochemist, N. W. Pirie, who was Demonstrator in Sir Frederick Gowland Hopkins's famous biochemistry laboratory. Bawden and Pirie, who complemented each other in their knowledge and

abilities, soon found that the antigen of Kenneth Smith's potato "X" virus had many of the properties characteristic of proteins<sup>2</sup>.

At about this time W. M. Stanley at the Rockefeller Institute, Princeton, published his famous paper on the nature of the tobacco mosaic virus, making the claim that the virus was a crystalline globulin<sup>3</sup>. Repeating this work Bawden and Pirie, in collaboration with J. D. Bernal and I. Fankuchen, showed that the tobacco mosaic virus was a long thin nucleoprotein rod at least  $1000\ \text{\AA}$  long, having a regular structural repeat along its length every  $3 \times 22\ \text{\AA}$  and containing about 5 per cent of ribonucleic acid<sup>4</sup>. The "crystals" of Stanley were found to be liquid crystals. This one paper more or less established modern biochemical virology as well as forming one of the foundations of molecular biology. It was followed by a monumental paper in the *Proceedings of the Royal Society*, which contained so much new information that even now it is well worth consulting<sup>5</sup>. In particular they noted at this time that the nucleic acid of the virus was a much larger molecule than was expected on the basis of the chemical evidence available.

The presence of nucleic acid in the virus was a matter of some controversy for some time, but Bawden and Pirie went on to purify potato "X" virus, cucumber viruses 3 and 4 and Kenneth Smith's tomato bushy stunt virus, all of which were found to contain ribonucleic acid. The cucumber viruses proved unexpectedly to resemble tobacco mosaic virus both physically and chemically though they had no known host in common with the latter. This was the first instance in which virus relationships were finally recognized on the basis of chemical and

physical properties, a procedure which has wide application nowadays. Tomato busby stunt proved to be very different from the others, forming beautiful rhombic dodecahedral crystals, and having "spherical" particles which had a considerably higher proportion of ribonucleic acid. This virus has been the subject of much further study, particularly by X-ray crystallography. Subsequently several unstable viruses were also purified.

At this time much of the interest in these new discoveries centred around the fact that viruses were evidently quite simple in their structure and, though obviously able to multiply and so cause disease, were also capable of forming crystalline arrays of one kind or another. This raised philosophical questions as to the nature of life itself, questions that were only resolved after the recognition of the biological functions of the nucleic acids.

In 1936 Bawden left Cambridge to become Virus Physiologist at Rothamsted Experimental Station in Harpenden, a position subsequently held by Pirie and which caused them both some amusement, because at that time viruses had no evident physiology. The Director of Rothamsted was Sir John Russell, who took a great interest in Bawden's work and promoted him to Head of the Plant Pathology Department in 1940. Elected to the Royal Society in 1949, he shortly afterwards became Deputy Director and finally, in 1959, Director of Rothamsted, the oldest and most famous agricultural research establishment in the world—a position which he held until his death.

Although he was plunged into administration at a fairly early age, Bawden kept up with his own work on viruses, which he later said "was for long my livelihood and has recently been my hobby"<sup>6</sup>. His group at Rothamsted, which was very successful and productive, included among many others A. Kleczowski, B. Kassanis and Marion Watson. His list of original scientific publications is enormous. Apart from the work already mentioned he was active in the study of the infection process of viruses, the behaviour of vectors, the effects of radiation on viruses and many other aspects of virology. His first textbook, *Plant Viruses and Virus Diseases*, was published in 1939 and was so different in its approach to its subject matter that one reviewer felt obliged to remark, "This forms the theme of his book, which might with advantage have been entitled *Recent Research on the Nature of Plant Viruses*. Thus it differs, particularly in outlook but also in treatment, from the recent textbooks of virus diseases, which are primarily concerned with the economic host plants: this one especially considers the infective agents"<sup>7</sup>.

Always an entertaining speaker, he spoke with a soft accent betraying his native county of which he was justly proud. At an international meeting at which speakers had been praising the quality of their countries' agricultural products, after commenting on the quality of British seed potatoes, he disclaimed any association with Scotland and Ireland and added as a characteristic aside, "I come from Devon, where they grow the best cider in the world, the best cream in the world and the best men in the world." So popular were his lectures that on the occasion of his Loewenhoek Lecture at Burlington House in 1959, not only was all sitting and standing room filled but many would-be listeners failed altogether to get admission to the Royal Society's lecture room.

He was President of the Association of Applied Biologists in 1965 and of the Society for General Microbiology from 1959–61, of the Institute of Biology, the British Insecticide and Fungicide Council (1966–68) and the British Crop Protection Council. At the First International Plant Pathology Congress in London, of which he was also President, he was given the Elvin C. Stockman Award of the University of Minnesota. He was the recipient of many other awards and honorary degrees, which were given not only because of his scientific distinction, but also for the vast amount of work which he carried out all over the world investigating serious local plant disease problems. He was also a member of the Natural Environment Research Council.

He was knighted in 1967 and became a Vice-President and Treasurer of the Royal Society in 1968.

The last few weeks of his life were devoted to a large extent in attempting to expose what he felt were the inadequacies of the arguments put forward by Lord Rothschild in his contribution to the Government Green Paper on Research and Development, a task which he undertook with characteristic forthrightness and humour<sup>8</sup>. He will be greatly missed by very many of us.

<sup>1</sup> *Nature*, **132**, 168 (1933).

<sup>2</sup> *Brit. J. Exp. Path.*, **17**, 64 (1936).

<sup>3</sup> *Science*, **81**, 644 (1935).

<sup>4</sup> *Nature*, **138**, 1051 (1936).

<sup>5</sup> *Proc. Roy. Soc., B*, **123**, 274 (1937).

<sup>6</sup> *Ann. Appl. Biol.*, **58**, 1 (1966).

<sup>7</sup> *Nature*, **145**, 122 (1940).

<sup>8</sup> *Nature*, **235**, 7 (1972).

chair of social and preventive medicine at Middlesex Hospital Medical School, University of London; Dr B. E. Ryman, Royal Free Hospital School of Medicine, has been appointed to the chair of biochemistry at Charing Cross Hospital Medical School, and Professor H. K. Weinbren, University of Nottingham, has been appointed to the chair of histopathology, Royal Postgraduate Medical School. The following titles have been conferred within the University of London: professor of anthropology of Africa and the Near East, on Dr A. Cohen in respect of his post at the School of Oriental and African Studies; professor of philosophy of science, on Dr H. R. Post in respect of his post at Chelsea College; professor of applied pharmacology, on Dr R. G. Spector in respect of his post at Guy's Hospital Medical School; professor of virology, on Dr H. Stern in respect of his post at St George's Hospital Medical School; professor of the history and applications of mathematics, on Dr G. J. Whitrow in respect of his post at Imperial College.

## International Meetings

March 28–29, **The Education of Human Ecologists**, Huddersfield (Dr P. F. Rogers, Biology Section, The Polytechnic, Queensgate, Huddersfield HD1 3DH).

April 5–7, **High Energy Collisions**, Oxford (Dr G. Manning, Rutherford Laboratory, Chilton, Didcot, Berkshire).

April 6, **Introduction to Statistics for all Chemists**, London (Assistant Secretary, Society of Chemical Industry, 14 Belgrave Square, London SW1).

April 11–13, **Inter-disciplinary Investigations of the Brain**, Oxford (Dr J. P. Nicholson, Physics Department, Westminster Hospital, Page Street Wing, London SW1).

April 13–14, **Biochemical Aspects of Industrial Pollution**, Cardiff (The Biochemical Society, 7 Warwick Court, Holborn, London WC1).

April 17–20, **Seed Ecology**, Nottingham (W. Heydecker, University of Nottingham, School of Agriculture, Sutton Bonington, Loughborough LE12 5RD, Leicestershire).

## Erratum

IN the title of the article by R. N. Thompson on page 106 of this issue, the word andesite should be in inverted commas. This correction should also be made in the first subtitle and on page 107, lines 1, 10, 14, 17 and 20 of column 1; page 108, line 4 of column 1 and lines 6 and 38 of column 2; page 109, lines 4, 18, 32 and 34 of column 1 and lines 7, 21 and 32 of column 2; page 110, lines 4, 13 and 15 of column 1.

## Announcements

### University News

Dr D. L. Miller, Central Public Health Laboratory, has been appointed to the