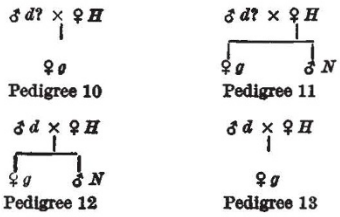

black or another dark colour, and in these cases that kind of confusion was not mentioned. In Pedigrees 12 and 13 all relatives were given adequate tests. The four cases all strongly support the view that the daughter was a heterozygote for deuteranopia and the green anomalous condition together, and that the latter was dominant. The possibility that one of the untested fathers was a protanope must be borne in mind, and it would carry with it the implication that the green anomalous condition was still dominant.

In four published pedigrees the underlying principle is the same[28]. All these pedigrees will be found to include a group of relationships such that a green anomalous woman must have been a heterozygote for green anomaly and deuteranopia together, thus again indicating that the green anomalous condition was dominant; and in one of these pedigrees the two conditions segregate independently in the two sons, one of whom is a deuteranope and the other green anomalous.

Four other cases quoted by Bell are also very interesting. One due to Göthlin[29] shows two sons as protanopes, while the father and maternal uncle are both deuteranopes. Here it would not be an unlikely hypothesis that the mother was a protanope heterozygote, inheriting that condition from her father, for her two sons, who must follow the mother, are both protanopes. Another case, also due to Göthlin[30], shows two sons as deuteranopes, two as protanopes and the daughter as normal, while both parents were said to have been normal. A case due to Jeffries[31] shows one son a protanope and the other a deuteranope, while no information is given about the parents. In these two pedigrees the mother might possibly have been a heterozygote for protanopia and deuteranopia together, and, since she was believed to be normal in the one case while no information was given about her in the other, the possibility arises that this particular heterozygote does not differ much from the normal condition, though it is more likely that the defect was not revealed by the tests used. A fourth case, due to Hess[32], shows father and daughter as deuteranopes, though it is not known for what condition the mother was a heterozygote. It is clear that added information in this case would have been most valuable, as in so many others.

Heterozygotes

If it is true that there are five defective allelomorphs for red-green colour vision, then the possible number of genotypes in women will be twenty-one. Of these, one will be the normal homozygote, five defective homozygotes, five normal heterozygotes and ten will be defective heterozygotes. The probable frequencies of these genotypes may be calculated from the observed frequencies of the corresponding defects in men[27], and some would be very rare indeed. It has been shown that the majority of the normal heterozygotes have a small red-green defect[19]. Fuller study of these and of the other combinations would be most valuable.

Conclusion

The hypothesis that there are six multiple allelomorphs for red-green colour vision and its defects in man is supported by the following evidence: (*a*) At least four and probably five different types of red-green sex-linked defect are statistically distinct, namely, deuteranopia, protanopia, green anomaly, red anomaly with and red anomaly without the darkened red of the protanope. (*b*) Many pedigrees indicate that these are inherited true to type, or not at all. (*c*) Many pedigrees show that these types segregate independently. (*d*) Eight pedigrees show that the green anomalous condition is dominant to that of the deuteranope, while all the defective forms are recessive to normal red-green colour vision.

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[15] Bell, *op. cit.*, Plate XXXVI, pedigree 513, and Plate XXXVIII, pedigree 565.
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[21] Bell, *op. cit.*, Plate XLI, pedigree 593.
[22] Bell, *op. cit.*, Plate XLI, pedigrees 596 and 599.
[23] Bell, *op. cit.*, Plate XLI, pedigrees 598 and 601.
[24] Bell, *op. cit.*, Plate XLI, pedigree 600.
[25] Bell, *op. cit.*, Plate XXXVI, pedigree 512, and Plate XXXVII, pedigree 527, and Plate XXXVIII, pedigree 563.
[26] Bell, *op. cit.*, Plate XXXVIII, pedigree 551.
[27] Pickford, R. W., *Nature*, **160**, 335 (1947).
[28] Bell, *op. cit.*, Plate XLI, pedigrees 594, 598, 600 and 601.
[29] Bell, *op. cit.*, Plate XXXVI, pedigree 512.
[30] Bell, *op. cit.*, Plate XXXVII, pedigree 527.
[31] Bell, *op. cit.*, Plate XXXVIII, pedigree 563.
[32] Bell, *op. cit.*, Plate XXXVIII, pedigree 565.

OBITUARIES

Prof. Alan F. C. Pollard

FEW people in the world of science and engineering have had such a strong sense of order and direction as Alan Faraday Campbell Pollard, who died suddenly at the age of seventy years at Thames Ditton on August 15. He was essentially a crusader, and his sense of mission was such that he spared no amount of trouble and effort to further the objects in which he so optimistically believed. He will perhaps be best remembered both for his efforts to reform methods of instrument design on a sound scientific basis, and not less for his untiring advocacy of comprehensive schemes for indexing scientific literature and, in fact, all serious knowledge. He was fortunate that in these things he seemed, comparatively late in life, to find his true *métier*, when the very varied experiences of his earlier days had given him a foundation on which to build.

The son of Lieut.-Colonel B. H. Pollard, of the Indian Staff Corps, he thought at first of an Army career, but later studied medicine at St. Bartholomew's Hospital and King's College, London. Circumstances making it impossible for him to complete his medical training, he turned to engineering, which he studied at University College and (as an apprentice) at Siemens Bros. However, during his period at University College, he acted for some time as demonstrator and assistant to Prof. Karl Pearson, a contact which powerfully affected his thought and methods.

In 1911 Pollard joined the staff of Nobels Explosives, Ltd., and established a special physical laboratory at Croydon for this firm. He was presently given the post of chief physicist and superintendent of the firm's testing station, but on the outbreak of war in 1914 he was gazetted a second lieutenant in the Royal Scots Fusiliers (having previously held a commission in the militia forces). In 1918 he was appointed sub-director of the Instrument Section in the Ministry of Munitions (Aircraft Production) and was gazetted captain in the R.A.F. However, the exigencies of war had led to the formation of a Technical Optics Department at the Imperial College, under the directorship of the late Prof. F. J. Cheshire, and Pollard was appointed to the chair of instrument design, which he held until he reached the age of sixty-five. Even then he seemed to have lost little of his health and vigour, and until his death he was director and consultant to Messrs. Daniel Varney, Ltd. He was awarded the degree of D.Sc. (Engineering) in 1943. He was made a professor emeritus of the Imperial College and held numerous honorary posts of public importance.

Being extremely inventive and versatile, Pollard developed many instruments and appliances, including a new nephelometer, appliances for artificial limbs, reflector lights, an interchangeable nosepiece for microscope objectives, and many other things. He felt very strongly that instrument makers in Great Britain were dominated by ideals more appropriate to heavy engineering production than to scientific instruments, and he turned to the kinematical theories of Clerk Maxwell as a satisfactory basis for reform. His views were expounded especially in his Cantor Lectures to the Royal Society of Arts in 1922, and in a book on "The Kinematical Design of Couplings in Instrument Mechanisms", published in 1929 by Adam Hilger, Ltd. He tried to show that instrument design is essentially a special subject and demands a discipline all its own. Although his chair at the Imperial College has not so far been filled, it may be claimed that his influence can be felt in such steps as the beginning of the new Department of Instrument Technology at the Northampton Polytechnic, London, and in numerous examples of modern instruments in which kinematical principles are employed.

Pollard had essentially a tidy mind, and he loved card-indexes and files. His personal possessions were well catalogued; he did not keep his gospel merely for others. This trait was sometimes the source of quips by others with more haphazard methods—'slovenly' was his most severe word of scorn, and there was unholy joy when on one occasion he was human enough to lose a library book. The Universal Decimal Classification made an instant appeal to him, and he not only became an enthusiastic advocate, but also contributed very materially to its development in the field of optics. He became the first president of the British Society for International Bibliography in 1927, and took a leading part in the conferences of the International Federation for Documentation held on the Continent. A noteworthy address was on "A Proposed Plan for the Mobilization of the Bibliographical References to the contents of the World's Non-fiction Literature", in which there is a plan for National Bureaux of Information which might, working under an International Information Council, make (and keep up to date) complete U.D.C. indexes of human knowledge; for a student of a special subject might then obtain all the useful references to papers or books in his field simply by citing the appropriate classification numbers. He beheld with dismay human knowledge growing not only out of control but also out of reach. Like H. G. Wells, he believed in wisdom as contained in books, and wanted badly to make it accessible. He will be missed in an age in which such optimism is more rare, but at least he has helped us to grasp the magnitude of the problems involved.

Pollard had a wide circle of friends both in Great Britain and abroad, and was always willing to give time and attention to those who asked his help or advice. In 1915 he married Gabrielle, daughter of Mr. Frederick Urwick, and he leaves also a son and a daughter.

L. C. MARTIN

Mr. G. J. Arrow

WE regret to record the death on October 5, after a brief illness, of Gilbert John Arrow, late deputy keeper in the Department of Entomology in the British Museum (Natural History). Born on December 20, 1873, the son of John Garner Arrow, of Streatham, Arrow was trained for the profession of architecture, but in 1896 entered the more congenial service of the British Museum (Natural History) at South Kensington. Here he was assigned to the study of beetles and early specialized on the Lamellicornia, upon which group he soon made himself an authority. His greatest work was the four volumes on the Lamellicorn Coleoptera of the Fauna of India series. He also contributed numerous papers, more than a hundred in all, to the *Transactions of the Royal Entomological Society of London*, the *Annals and Magazine of Natural History*, and other scientific journals.

Mr. Arrow retired under the age limit in 1938, but continued voluntarily his work at the Museum until within a few weeks of his death. This work was of untold value to the Museum, especially during the war years and the trying times that followed, and was recognized by the Trustees of the Museum by the bestowal upon him recently of the special distinction of 'honorary associate' of the British Museum. His imperturbability was immense; he would continue calmly at work during air-raid warnings, and even when found under a shower of glass when a flying bomb fell almost outside his window, his main concern was that he could not find his spectacles.

He was a great lover of music, and did much to encourage musical talent among the junior members of the Museum staff until increasing deafness made this no longer possible. He was also an expert photographer and would frequently use his own photographs in illustration of his papers.

He married in 1912 Miss Rachel Katharine Davis, who survives him, and to whom we would tender our sincere sympathy in her bereavement.

K. G. BLAIR