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Book Reviews

DNA Technology and Forensic Science, Banbury Report 32. Edited by JACK BALLANTYNE, GEORGE SENSABAUGH and JAN WITKOWSKI. New York: Cold Spring Harbor Laboratory. 1989. 368 pages. $95.00. ISBN 0 87969 232 4.

My main complaint about this book is the hard cover and the high price. The contents are of much wider interest than will be served by shutting it away in the few scientific libraries which can afford it, and it is to be regretted that the Corporate Sponsors (of whom a large number are listed) did not make enough money available for the book to be published more cheaply in paperback, given a more appealing title and some extra advertising, and aimed at all those who ought to study it. Extra sales might perhaps have covered the extra cost, though I know that publishers are pessimistic by nature and nurture.

The 45 contributors concentrate on the American experience (41 of them work in the United States), and one wonders whether there is any open discussion in other countries of the social and legal problems involved in forensic application of DNA fingerprinting, or whether these are kept under the carpet. That there are such problems and that they need public review is amply demonstrated by this book, in which the opinions of sociologists, independent legal experts and independently minded human geneticists such as Arno Motulski are set against those of FBI and police scientists and District Attorney staff whose function is to use science to get convictions (though with more concern for correct judgements than in the past, one must hope).

A particularly welcome aspect of this book is that virtually every paper is followed by discussion and argument, which in total takes up about 30% of the text and brings out many interesting points which the speaker omitted. The more direct forensic problems discussed concern methods of DNA analysis, training of forensic scientists in use of the new techniques, and establishing systems for collecting and processing the material so as to avoid the many sources of error. In the United States, as soon as the value of DNA fingerprinting was appreciated, many police forces wanted to have their own testing laboratory to deal with their local material, and asked for extra funds to pay for the staff and facilities needed. Nine papers under the general heading 'Transfer of DNA Technology to the Forensic Laboratory' cover these problems in detail, including experience at several County crime laboratories, and an analysis of over 300 forensic cases handled by Cellmark Diagnostics, using single-locus minisatellite DNA probes. This last article illustrates a number of cases with DNA-banding patterns which demonstrate the power of the method. These patterns show clearly identity between semen or blood stains from the victim or her attire and DNA from one of the suspects in several rape and murder cases.

Two other sections discuss Advanced DNA Techniques (five papers already a little dated) and Establishment, Maintenance and Regulation of Databases (three papers, which do not raise the very important questions of what forms of DNA and whose DNA should be stored and who should have access to it).

Section 2: Basic Issues, Legal and Scientific (six papers) discusses in detail the reaction of the American legal system to attempts to introduce the new DNA techniques in particular court cases. Peter J. Neufeld points out that 'The truly perplexing problem of when to admit or exclude new or novel scientific evidence is compounded by the scientific illiteracy of lawyers and judges, which ill equips them to argue or decide the admissibility of evidence proffered through expert witnesses... Regrettably... once a new technique is developed, it is put into immediate use in crime laboratories and no further nonforensic research is conducted.'

The most notorious example of this was the diphenylamine 'paraphin' test for gunshot residue on a suspect's hand, first admitted as scientific evidence in Pennsylvania in 1936. This set a precedent for other state courts, leading to innumerable convictions and death sentences over the next 25 years, until an independent study showed that evaporated urine, tobacco, tobacco ash, fertilizer, various pharmaceuticals, and coloured fingernail polish could all give positive test results on anyone's hand. One is forced to ask whether our (or American) forensic scientists are now trained to take a more critical attitude to the validity of their tests, which have also included the polygraph (lie-detector) test, voiceprints and hypnotism. The polygraph test has now been banned for use in the U.S. business world (85–90% of all polygraph testing) because of its obvious inaccuracy and has been rejected as inadmissible evidence in criminal trials, but according to John W. Hicks of the

FBI laboratory division it is very reliable for getting a confession from a criminal suspect using a straightforward question such as 'Did you take the money?' or 'Did you shoot so-and-so?' Neufeld remarks that in the 1960s and 1970s the primary developers of voiceprint analysis, using sound spectography, 'literally barnstormed the courts'. Criticism of the technique by other types of speech scientist led eventually to a study by the National Academy of Sciences in 1978, which concluded that the technique was acceptable only 'under certain circumstances'!

Section 1, on Legal and Social Issues, contains five important papers of very general interest: Arno Motulsky on Societal Problems in using DNA Technology, Dorothy Nelkin on The Social Meaning of Biological Tests, Alan F. Westin and Philip Reilly, both on Privacy Issues, and Joseph L. Peterson, who describes the uses and effects of forensic science evidence on the adjudication of criminal cases up to 1986. All these, and the lively discussions of each, I recommend to the reader. A general question which arises here and in other discussion sections is that of the future use of DNA databases and DNA analysis. The dramatic success of Alec Jeffreys' first foray into forensic science in England led to calls for DNA to be collected from all new-born babies for future use, and more specifically for DNA samples from all persons charged with a crime to be preserved. It is not clear whether complete DNA samples of suspects are being stored by the FBI or the private companies in the United States which undertake forensic tests for police forces, but it is certainly claimed that merely to keep the banding patterns using current probes will make it impossible to apply the improved methods in the pipeline to compare new and old unsolved crimes.

Should we all deposit our DNA in the emerging mega-databanks, so that in a few years or decades mega-insurance companies and employers will be able to determine our survival value (first-, second- or third-class life) and job suitability by reference to the giant database which HUGO (the Human Genome Organisation) is aiming at? It should be noted that the 1990 edition of *Genetic Maps* lists 550 human disorders for which the mutation has been mapped to a particular site, and this is only a beginning. Should we not be considering who is to get our DNA, in what form, and what they should be allowed to do with it – and, much more difficult – how to prevent it getting into the wrong hands? This will be a very serious question for our descendants.

As a final note, let me draw your attention to *Nature* (1989) issues of 11 May, page 89 and 8 June, page 408, and (1990) 9 August reporting on new arguments about the forensic use of DNA fingerprinting in the USA and its smoother passage in the UK.

ERIC REEVE
Institute of Animal Genetics, University of Edinburgh

Population Biology of Genes and Molecules. Edited by NAOYUKI TAKAHATA and JAMES F. CROW. Published by Baifukan Co. Ltd, 3-12, Kudan Minami 4-chome, Chiyoda-Ku, Tokyo, 102, Japan. 1990. 370 pages. Price 9270 yen (about $61). ISBN 4 563 03890 3.

In November 1988 an international symposium on the 'Population Biology of Genes and Proteins' was held in Tokyo, Japan, where the International Prize for Biology was awarded to Motoo Kimura, founder of the 'neutral' theory of molecular evolution and mathematical geneticist par excellence. This volume serves as both proceedings for the symposium and a commemoration of the award. The book has 21 well-written chapters divided into seven sections, with the subjects covered ranging from cultural transmission to the molecular evolution of pigment genes. The list of authors, though heavily biased towards home-grown (Japanese) talent, is impressive.

The first section contains a summary of the neutral theory by the award winner himself and a historical perspective by Walter Provine. Provine argues that the 'neutral' theory was a radical departure from previous theories of drift, requiring as it did a decoupling of phenotypic and molecular evolution. However it is this very feature which may marginalise the theory. For although it can explain a wealth of data it cannot answer the central evolutionary question: 'why is the biological world so phenotypically diverse?'. This is a problem which Kimura tackles at the end of his chapter by proposing that environment change can convert a previously neutral allele into one under selection.

The second section is entitled 'DNA polymorphism' and contains excellent chapters by Weir on mapping the cystic fibrosis gene, and Langley on polymorphism in *Drosophila*. Of particular interest in the latter article is the observation of low polymorphism in regions of the genome with low recombination, hitch-hiking of neutral polymorphism by advantageous alleles being a possible cause. It is this sort of observation which threatens to greatly complicate the neutral debate by decoupling neutral polymorphism and substitution. The third chapter in this session (Satta *et al.*) is rather sparse on data but suggests interestingly that sequencing DNA may be more cost-effective than using restriction enzymes when looking for mtDNA polymorphism.

The other great evolutionary theory of random genetic drift is Wright's shifting balance theory. In section 3 Crow shows that the phase traditionally thought of as a weak link in the scheme, phase 3, can work with reasonable parameter combinations. It seems unlikely that Wright's theory will ever be directly proved or disproved, rather the critical parameters will be measured and inferences made as to whether the shifting balance theory occurs in nature. One of the most important variables is the