chloride channels of intracellular organelles. The possible involvement of CFTR in pH regulation in intracellular organelles is far from proven. Clearly, given the apparent abnormalities in CF mucin sulphation, fucosylation and sialation, this would be an attractive hypothesis. However, the chapter is far too complex and its relevance uncertain.

Part III of the book addresses clinical aspects of CF. In a book that is so scientifically based, a simple chapter on the medical and social consequences of living with cystic fibrosis would have been a good opening for the clinical section. Instead an attempt is made to cover every aspect of the disease and put it in its historical perspective. This is unsatisfactory, as it inevitably means that topics meriting separate reviews are covered in a couple of paragraphs. The beginner will find it difficult to separate historical beliefs from up-to-date medial practice.

There follows an excellent chapter on pseudomonas infection in CF. The evidence that the host response is as important as characteristics of the invading organism in the pathology of chronic pseudomonas infection is reviewed. Further, the possibilities of intervention to prevent colonization becoming chronic infection and to restrict the damage of chronic infection are outlined.

Neonatal screening for CF has long been controversial, as it has been difficult to fulfil the principle upon which screening programmes are justified, namely that early detection results in a better outcome. Nevertheless, enthusiastic practitioners have convinced local areas to establish screening programmes, and the methods, problems and results are reviewed. It was thought that finding the CF gene would make screening procedures easier, but the multiplicity of mutations has meant that there is no simple screening test. This chapter could usefully have been extended to consider the related topic of population screening for CF carrier testing.

The scientific progress of the past five years has brought great excitement to clinicians and patients. The challenge of translating laboratory advances to progress in clinical care is carefully documented in a chapter on 'New Directions in Treatment'. Careful clinical research will be required to substantiate the long-term benefits of new treatment.

In conclusion, this book is a useful addition to the CF literature, which will undoubtedly improve as the series progresses. The text would benefit from an introductory chapter that explains the contents of each section and its relevance to CF disease. However, even with this addition it is likely that few readers will be able to read and understand all of the book.

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Archibald Garrod and the Individuality of Man. By ALEXANDER G. BEARN. Oxford University Press. 1993. 227 pages. Price £35.00. ISBN 0 19 262145 9.

In his 1958 Nobel Lecture, George Beadle made the comment, 'In this long, roundabout way, first in *Drosophila* and then in *Neurospora*, we had rediscovered what Garrod had so clearly seen so many years before'. Later Beadle was to write, 'Regardless of when it was first written down on paper, or in what form, I myself am convinced that the one gene–one enzyme concept was the product of gradual evolution beginning with Garrod'. Following this tribute, many geneticists including myself have believed that Garrod was the first scientist to have caught a glimpse of what genes actually do, and that it is right and proper that he should be known as the father of biochemical genetics.

The truth is probably less certain. In this meticulously researched and beautifully written biography, A. G. Bearn, who is a distinguished clinical geneticist in his own right, traces the life and times of Garrod and attempts to tease out from the ideas of genetics, biochemistry and medicine that prevailed at the turn of the century just what it was that made Garrodian concepts so unique and insightful.

Archibald Garrod, son of a distinguished rheumatologist, was born in 1857 into the prosperous and self-confident middle class of Victorian England. The family home was in Harley Street and the atmosphere one of striving intellectuality. At the age of ten, young Archibald penned his first booklet on classical architecture. Like many young men of the time his interest in science was stimulated by natural history (his enthusiasm was butterflies), and he went up to Oxford to read Natural Sciences. Despite a First in chemistry, family tradition claimed the young scholar and Garrod returned to London and a career in medicine at Bart's. In the 35 years between gaining his medical degree and his appointment as Regius Professor of Medicine at Oxford (1920), he held a variety of clinical posts at Bart's and co-appointments at the Royal Hospital for Sick Children, Great Ormond Street. He had to wait until he was 55 before becoming a consultant, by which time he was already an FRS.

Although a practising clinician for most of his career, Garrod's first love remained chemistry. His fascination with urinary pigments, pursued in collaboration with Frederick Gowland Hopkins, led him inevitably to 'black urine disease' or alkaptonuria. It was already known that the black pigment was homogentisic acid; Garrod's contribution was to suggest that alkaptonuria was the result of a chemical aberration in the tissues, present at birth, or as he was later to call it, an inborn error of metabolism. He was quick to grasp the concept of biochemical individuality, but his dogged pursuit of this theme (later

adding albinism and cystinuria as examples) seems to have fallen on unreceptive ears.

In his study of alkaptonuria Garrod had noticed an increase in consanguinity amongst the parents of affected cases. This fact was picked up by the botanist Bateson, one of the early advocates of the recently rediscovered Mendelian principles, who pointed out that 'the mating of first cousins gives exactly the conditions most likely to enable a rare and usually recessive character to show itself'. A rapid exchange of correspondence between the physician and botanist followed, and in a *Lancet* paper in 1902 Garrod stated that Mendel's law of heredity offered the best possible explanation for a condition such as alkaptonuria.

In the first decade of the twentieth century a furious debate raged between the Mendelians and the biometricians. Garrod took no part. He continued to study his 'metabolic sports' and the detailed chemistry of the urinary pigments. Once he had satisfied himself that consanguinity was involved in inborn errors of metabolism, he seemed to have had little further interest in the genetic mechanisms that might be responsible. In 1914 the German biochemist, Oscar Gross, reported that an enzyme capable of oxidizing homogentisic acid was deficient in patients with alkaptonuria. The vital connection between gene and enzyme was tantalizingly near. But not until Beadle's paper in *Chemical Reviews* in 1945 was it explicitly stated.

It is easy with hindsight to see what others missed. Perhaps the intellectual climate in 1914, with the Great War looming, was not right for making theoretical deductions. By the end of the war, Garrod had lost two of his three sons, while the third died in the flu epidemic of 1919. As befitted an English gentleman of the time, his grief was private and he talked little to friends about his loss. But is hardly surprising that at 62 years of age some of the fire went out of his work. One can only speculate on how the development of genetics might have changed had Garrod been able to deduce from the evidence before him in 1914 that the function of genes was to make proteins.

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Preimplantation Diagnosis of Genetic Diseases: A New Technique in Assisted Reproduction. Edited by Y. VERLINSKY and A. M. KULIEV. Wiley–Liss. 1993. 144 pages. Price $59.95. ISBN 0 471 58824 5.

'Genetically disadvantaged' is the new political correctspeak for couples where both partners are heterozygous for the same rare recessive mutant gene. If such couples wish to have unaffected children they must resort to prenatal diagnosis and the 1 in 4 possibility of a termination of pregnancy. For some, though in actual practice a total minority, abortion is morally unacceptable, and their options are to forgo reproduction or to take a chance. In theory the development of methods of preimplantation diagnosis overcomes this problem by permitting selection of unaffected gametes prior to fertilization or unaffected pre-embryos before implantation. These two techniques, of which the latter is the better established, have been collectively termed preimplantation diagnosis.

The most serious drawback to making genetic diagnoses on gametes or pre-embryos is that the high failure rate of the subsequent fertilization and implantation processes usually renders the findings void. In fact the 'take home baby' rate of in vitro fertilization centres, from which the success rates must be derived, is usually below 15%. This means that a preimplantation diagnosis may have to be repeated up to 10 times before the couple achieve their goal of an unaffected child. Couples need to be absolutely sure that termination of pregnancy is outside their moral framework and equally determined that they want to have a child before they go through this long-drawn-out and emotionally draining experience.

Many of us suspect that preimplantation diagnosis will never become a mainstream part of antenatal care. None the less, it attracts a great deal of attention in both the lay and medical presses. The professional publications, like this one, all suffer from the same disadvantages in that they are written by aficionados for aficionados, and give completely unbalanced accounts of the reality of the subject. Lavish chapters on the technical minutiae of making cytogenetic or molecular genetic tests on single cells are usually followed by an apologetic few paragraphs on the fact that the whole science is undermined by the failure rates of artificial implantation. This book is no exception; furthermore it is compiled by the staff of the Reproductive Genetics Institute and Illinois Masonic Medical Center, which I understand to be a private organization selling preimplantation diagnosis. Perhaps it should be labelled 'advertisement'.

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Handbook of Quantitative Forest Genetics. Edited by L. FINS, S. T. FRIEDMAN and J. V. BROTSHOL. Kluwer Academic Publishers. 1992. 398 pages. Hardback £54.00. ISBN 0 792 31568 5.

This book is Volume 39 in the excellent 'Forestry Sciences' series published by Kluwer Academic. It has brought together 10 of north America's most respected quantitative tree breeders to present a chapter each on different aspects of quantitative tree breeding. The book grew out of a meeting of the Western Forest Genetics Association (WFGA) back in 1987, when it