

blastogenesis ends at the beginning of gastrulation and, indeed, the indexer agrees with this opinion. I cannot see the intended audience selecting this book on the basis of its title to browse through in a bookshop so, if the publishers want to sell it, I hope that they are publicising it in other ways.

The price of the book is £124, an amount far in excess of its value and I can see no reason why it should be so expensive other than it has a few colour plates (of 3D reconstructions). It seems to me that the March of Dimes would have served the field better had they chosen a cheaper publisher and provided a degree of subsidy to enable foetal pathologists to buy the book. As it stands, I suspect that the book will merely be found in a few rich libraries and in the offices of participants and reviewers. While the original topic of the workshop, human foetal pathology, merited support by the March of Dimes, I feel that this charity has been let down by its editor and publisher.

JONATHAN BARD  
Department of Anatomy,  
University of Edinburgh

*Physician to the Gene Pool.* By JAMES V. NEEL. Wiley, New York & Chichester. 1994. 457 pages. Price £18.95. ISBN 0 471 30844 7.

Human geneticists know Jim Neel very well, and will already have bought his autobiography knowing that it will be a stimulating and provocative read, as it surely is. Other geneticists are advised to study it for the insights it throws on their trade, and many will want to lend it to their friends for the knowledge it gives of how a geneticist thinks and works – and how often have we wanted just such an exposition to save us from embarrassment?

Neel started as a *Drosophila* geneticist working on the effects of environment on gene expression, and this nature-nurture thread runs through the whole book. Typically, the mutation *polymorph* appeared spontaneously in his flystocks, for Neel is one of those people who finds four aces in every hand of cards he picks up: serendipity he calls this, but you have to spot the mutation before you use it and Neel rarely misses his opportunity. One of the charms of the book is following the interplay of chance and the author's preparedness to exploit it. Lucky Jim!

But flies are not all, and Nazi plans for eugenics experiments during World War II, better understood in Europe than in America, turned Neel's interest towards human genetics. While working at Cold Spring Harbor he had seen the Eugenics Record Office established there by Davenport, and a glance at the terrifyingly inaccurate data accumulate for the benefit of American race-cleansers showed that there was a whole world of genetics waiting to be explored.

Neel decided to get a medical qualification to prepare himself to study this subject. As a third year student he identified a case of Cooley's anaemia (Thalassemia) and recognized that haemoglobin mutants were good 'clean' genes to work with. He found a second, Sickle Cell Anaemia, and this became the focus of his studies when he moved to Ann Arbor where he worked out the significance of the polymorphism through relative resistance of the heterozygote to malaria. This is now all standard textbook material, but at the time there were other plausible hypotheses and the need to decide among these sent Neel to Africa to measure gene frequencies in relation to malaria incidence – gene-environment interactions on a population scale – and it also introduced him to primitive societies.

Between the first and last of his haemoglobin studies Neel was called-up to do his military stint as a first lieutenant in General Hospitals, although the war was over by then. There he suggested to a fellow intern that he would be interested in studying the genetic consequences of the Hiroshima and Nagasaki bombs. Surprisingly, for the word got through, he found himself posted to Japan with the remit to advise the National Academy on the delayed effects of the atomic bombs. Four chapters are devoted to the studies which derive from this assignment, and they update the earlier report of Neel and Schull (but a more comprehensive summary of the genetic effects of radiation on man is given in *The Children of Atomic Bomb Survivors*, 1991, National Academy Press, ISBN 0 309 4537 1, which includes that classic paper). The unexpectedly high level of radiation (about 2 Sv) needed to double the mutation frequency, gonadal and somatic, and its implications for the 'normal' mutation rate in man are again textbook topics. What will interest more is how Neel overcame the difficulties of data collection in a foreign, defeated country, and how he (and his associates) coped with the problems and advantages of Japanese social structure, including its high levels of consanguinity. Despite its complexity this part of the story is clearly and amusingly told.

More stories follow. Neel recognized that his studies had given him no insight into the nature and organization of the human gene pool. He decided to establish a base line for exploring this by starting with a simple, primitive community since this might also expose some of the selection-genetic systems under which we have evolved; the maturing gene pool. After a serendipitous hold-up in Venezuela (the Brazilian revolution of 1964) he chose the Yanomama to work with; a tribe of about 15000 forest dwellers in the upper reaches of the Orinoco. This did not simplify the problems of logistics; but it is as well that it was done since such of these peoples as have survived 'civilization' are now dispersed among the entrepreneurs seeking to take over their mineral rights, etc. No-one will again be able to study such a simple, untouched community, the story of whose future will depend on the emergence of a new B. Traven.

We can only outline some of the findings concerning the Yanomama relevant to what follows. Typically of early man, prior to agriculture, the sustainable population is small and organized in villages, so that a child would contact only 1000 or so individuals during its lifetime. The women all marry and are fertile, but a taboo on intercourse for a year *post partum* and the practice of prolonged breast feeding limits population growth to near replacement levels. Polygamy is practised, as usual to the advantage of the headman who contributes most to the gene pool. The mating structure is essentially cousin marriage and since this must have been practised for many generations, current matings are necessarily equivalent to brother–sister. This level of inbreeding gives a heterozygosity index well below western norms. There is also infanticide of abnormal offspring and of excess females increasing the homozygosity of the population. Despite this, because the village is the breeding unit, as commonly reported by anthropologists, there are considerable microdifferentiations within the population, including distinctive chromosomal abnormalities. As Sewell Wright pointed out, evolution can occur rapidly in such sub-populations (demes) which by their diversity also permit rapid adaptation to fluctuating environmental differences. Neel says that the Yanomama population is the best known example of Wright's theory. But concomitance is the one argument which should carry no weight in biology.

The last six chapters of the book have a very different feel: they are didactic and summarize the author's conclusions from the lifetime experience. All his arguments are expounded in detailed chapters and their essence is summarized in the last, which has the same title as the book. It gives no more of a definition of the gene pool than the totality of genes in the entire interbreeding human population. Such a generalized idea is not useful, and it leads to the thesis that we must preserve what has evolved, even though we know that most of these genes were selected 100000's of years ago in entirely different environments from now. So what must we do to preserve the genetic *status quo*?

'The first genetic priority... is to decrease the gene pool to a sustainable size... while preserving its poorly understood diversity.' Since the means are at hand, this demands a world-wide programme of population control: two offspring per family. This population problem was identified when Neel was a boy, and our record in dealing with it demands efforts which are no-where in sight. Indeed, as I write, the Italians have discovered that they have the world's lowest birth-rate (1.26) and their new Government and the Pope have appealed for greater fertility. I don't think this book will make much difference to these political decisions (though we may take some hope from the Chinese). In

short, the first priority is naive in view of the political and religious forces operating against it.

The second genetic priority, the obverse of the first, is 'to optimize the expression of *all* genotypes'. By changing from our high fat/low physical activity/high salt regimes to the Yanomama model, on the assumption that that is where our evolution is at. A member of the most overfed people in the world should now better than make such a proposal. Euphenics on an individual scale must be used, as now, to ameliorate inherited complaints, but even this is not without its problems for it will exacerbate the problems of emerging gerontocracy causing a dangerous population imbalance. So genetic research on thwarting the 'ageing switches' should have a low priority. Unfortunately, hopeful ageing millionaires who support this kind of research think otherwise.

The third priority is increased genetic counselling and pre-natal diagnostic services, 'with the objective of providing the option of abortion' when severe diseases are found in the foetus. One might expect that somatic cell gene therapy would be followed in this context, but Neel allocates it the lowest priority because it would have a minimal impact on the gene pool, would exacerbate the ageing problem, would have unpredictable mutation effects due to the insertion of vectors into essential genes, and since human geneticists would be turned into 'DNA jockeys'. It follows that Neel is opposed to the big science of the Human Genome Project, although this multi-national effort will surely tell him much about the human gene pool he is so concerned about.

Neel is well aware that his three-point programme (and the text goes into great detail by defining a gene, on the analysis of mutation and so forth which should provide good seminar material for undergraduates) will be discussed as impractical (again something for students to discuss). But he believes that we are at a time of decision when judgmental errors on these issues will mean that we shall squander our genetic legacy from the past five million years of evolution. This is a very small harvest from such a rich crop of experiences, mainly because Neel limits himself to following the restricted logic of his own observations and because no-one, *post*-Hitler, is yet prepared to confront the issues of the 'new eugenics' as formulated by Huxley, Muller, Haldane and Osborn (views well summarized by G. E. Allen in *Julian Huxley*, eds. Walters, C. K. & Van Helden, A. (1992), Rice University Press). If we are really at a time of decision the qualities of the gene pool should surely have been discussed. But the first priority is getting the nurture right, as the old *Drosophila* experiments demonstrated.

JAMES H. SANG  
Biological Sciences,  
University of Sussex