Should we fear the future?

Suresh I.S. Rattan

Our Posthuman Nature: Consequences of the Biotechnology Revolution

by Francis Fukuyama

Profile Books, London, UK

256 pages, \$28.40

ISBN 1 86197 297 0

Redesigning Humans: Choosing Our Children's Genes

by Gregory Stock

Profile Books, London, UK

277 pages, \$28.40

ISBN 1 86197 242 3

On receiving the above two books for review, I began with Fukuyama's much publicised Doomsday rhetoric. There was not a single moment of boredom during

the next few days of reading—a period which, however, was punctuated by several fits of irritation, anger and provocation. One phrase that reverberated around my brain during this studious journey was the 'fear of the future'. I checked several websites on psychology, but could not find this phobia mentioned anywhere. By the time I had finished reading Fukuyama's oracle, I felt as though I had been locked up in the company of eternally depressed people for whom any straw to clutch at—however irrational, mystic or conservative—was a saviour. But I quickly broke out of this spell when I started reading Gregory Stock's much more realistic, rational and sensible exploration of exactly the same issues as those at the root of Fukuyama's fears.

It cannot be a mere coincidence that Profile Books simultaneously published two books dealing with the same subject but whose treatment of which and whose messages are so different. But whatever the publisher's socio-economic-political reasons for doing so, an opportunity does appear to have been missed—rather than encouraging the authors to debate these issues page-by-page, we have instead these two seemingly independent but highly intertwined books in which, strangely enough, both authors largely ignore each other's well-known and previously published works, except for a lone citation of Stock and Campbell in Fukuyama's bibliography.

The central dilemma of both books is: now that we are capable of altering the basic *Homo sapiens* genetic blueprint, will we still remain human? Does the potential of introducing major, inheritable alterations at the level of intelligence, memory, mood and lifespan, which are qualitatively different from the prevention or treatment of genetic diseases, make us super-human (Stock) or post-human (Fukuyama)? Should we legislate against or regulate such possibilities temporarily or forever? Of course, these questions immediately raise others regarding what is human, and what is meant by human nature, human dignity and human rights? Do we really need to consider ourselves superior to any other life form, and does

that consideration then give us special rights, privileges and responsibilities?

Fukuyama would like us to believe that there is something sacrosanct and divine about being human, and he virtually declares human DNA as holy and as something qualitatively different from the DNA of other organisms. If Fukuyama is so concerned about preserving the purity, originality, authenticity and holiness of the human genome, he should be aware that any additions, deletions, substitutions or rearrangements of its sequence for the purposes of prevention, treatment or even so-called improvement are not going to defile it. This is because there is no single idealised human genome, since there already exists at least three million (0.1%) differences between any two individuals, except in the case of monozygotic twins. Gregory Stock, on the other hand, takes the scientific and positivist stance, demolishes the 'man in the image of God' myth and reminds us that it is in the very 'nature'—if there is such a thing—of human beings to break any constraints imposed upon us. In comparison with any other life form, the position of human beings today—for better or worse, but mostly for better—is mainly due to our ability to challenge our limitations. Using Stock's terminology, we are already relatively advanced functional cyborgs (fyborgs), who have developed numerous epigenetic and non-genetic means of transcendence, including biomedical technology. Future redesigning of human beings and other animals and plants is only a logical extension of this.

Of course, there are several important issues to be resolved as regards what can and cannot be done technologically, biologically and ethically. Genetic manipulation to prevent the onset of certain diseases is one thing, but trying to 'improve' upon something such as intelligence, state of mind and lifespan is a matter of ever-changing socio-cultural priorities. In addition, constraints imposed by the interacting factors genes, milieu and chance practically determine the feasibility and outcome of any manipulation. Both Fukuyama and Stock present their fears, concerns, visions and

arguments about these. Whereas one would like to advocate layer upon layer of rules and regulations, the other prefers further education and open debate about all these issues so that a collective decision can be made. Stock's 'Appendix 2' with eight hypothetical scenarios of genetic manipulation is a starting point to test one's own feelings and thoughts about these issues and to initiate discussion around them. Fukuyama gives us no such opportunity. He just tells us what should be done.

In my opinion, read Fukuyama's Doomsday warnings, but be aware of his trappings; and read Stock's concerns in order to re-think your own opinions. Creating fear only benefits those few who have some other personal and political agenda to follow. And by the way, my Greek friends tell me that if I want to coin the term for the fear of the future, it could be 'mellontophobia', which, like most other phobias, is not a desirable state of mind. Fukuyama frightens, Stock stimulates!

Suresh I.S. Rattan is at the Danish Centre for Molecular Gerontology at the University of Aarhus, Denmark.
E-mail: rattan@imsb.au.dk

DOI: 10.1093/embo-reports/kvf209

Lucky experiment

Andrzej Stasiak

Meselson, Stahl, and the Replication of DNA

by Frederic Lawrence Holmes

Yale University Press, New Haven, CT, USA

510 pages, €55.00

ISBN 0 30 008540 0

The 1957 Meselson–Stahl experiment is known to be so logical and so perfect that little effort is required to recall its design and its outcome. But is it worth reading another 500 pages about it, when it is already described in every biology textbook? I believe so. Frederic Lawrence Holmes, Professor of History of Medicine at Yale University, spent more than 10 years researching and writing this book, and the end result is not only highly enjoyable but also holds quite a surprise. Matthew Meselson and Frank Stahl shared their memories with Holmes and allowed him access to their laboratory journals and other documents of the period; additional illuminations are provided by interviews with other prominent scientists of the time, such as Jim Watson and John Cairns.

Every biologist is familiar with the elegant demonstration of the semi-conservative mechanism of DNA replication. To produce labelled DNA of high buoyant density, bacteria were grown for several generations in a medium containing N^{15} compounds as a nitrogen source. Upon transfer to the 'light' medium containing N^{14} , Meselson and Stahl observed that the first round of DNA replication produced molecules with an intermediate density corresponding to that predicted for those composed of one heavy and one light strand. The second round produced a 1:1 mixture of light and intermediate density

DNA molecules. DNA molecules with one of these three buoyant densities could be separated and formed clearly defined bands in a caesium chloride density gradient. This very clean, clear-cut result supported the then much-debated proposal made in 1953 by Watson and Crick, which stated that, during replication, the two strands of DNA separate and each serves as a template for the newly synthesised complementary strands. In fact, the Meselson–Stahl experiment made its prominent entry into the history of science since it is considered to be the first experimental proof of the Watson and Crick DNA model.

For me, the book has two culminating points, although I am not sure that the author intended the second. The first highlight of the book comes after the very slow, somewhat random progress of the Meselson and Stahl joint project, suddenly everything starts working correctly and, following a series of analytical ultracentrifuge runs, Meselson develops a film showing three well-defined DNA bands. The second highlight, which was much more thrilling for me, was the realisation that the experiment only worked due to a fortuitous artefact.

Now that we know much more about the replication of bacterial chromosomes, we may ask whether the experimental design of Meselson and Stahl should have produced the result that they obtained. We know that bacterial chromosomes, replicate continuously during logarithmic growth and also that a new round of replication starts even before the previous one is completed. Meselson and Stahl did not synchronise the bacteria they worked with; therefore, when the culture was transferred from the heavy to the light medium, the chromosomes of each cell were replicated to a different extent. Consequently, when the first sample was analysed after 0.3 of a generation time of growth in the light medium, molecules that had just finished replication should have diminished their buoyant density to a similar extent as those that had simply advanced in their replication cycle, since both these categories should have incorporated similar proportions of bases containing N^{14} . Instead, Meselson and Stahl observed that ~30% of the DNA molecules 'jumped' to the clearly defined intermediate density level, while the remaining 70% stayed at an unchanged high density level. At subsequent time