

periodic L^∞ functions with respect to normalized Chebyshev polynomials also holds for Jacobi polynomials in a weighted space. Roch shows that fractality is a property of an approximation method which makes certain limiting processes uniform. Moreover, he shows that every approximation sequence possesses a fractal subsequence. Maz'ya and Shaposhnikova investigate properties of maximal Banach algebra between Bessel potential spaces.

The book is a true memorial to Siegfried Prössdorf in that it mirrors all the areas in which he worked and is a tribute to him from those who knew and worked and admired him.

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The Intelligent Genome – On the Origin of the Human Mind by Mutation and Selection. Adolf Heschl. (Translated from German). 2002. 362 pp. Price: US\$ 49.95/Euro. 39.95.

Let me start this review with a summary of what in my opinion are the most serious drawbacks of this book. It is poorly written and poorly translated, so poorly as to make the book unnecessarily difficult to read. The absence of a strong editorial hand is apparent on each page; each argument comes laden with the thickest prose and the most Germanic constructions, each clause festooned with sub-clauses. Here is a typical sentence, quoted verbatim:

‘Since if we hear again and again that the species *Homo sapiens* still carries in itself some important biologically determined residues of its physical and even behavioural constitution which should be taken into consideration, but at the same time excluding specifically human characters such as thinking, consciousness, language, morality, in short the capability for cultural tradition, from biological evolution, then we must ask ourselves whether it is not so much a scientific

boundary which is touched here, but rather an ideological taboo.’

I mention these somewhat obvious flaws because they are obvious, and also because they manage to make some of the more thought-provoking arguments in the book needlessly obscure and obtuse. I have other criticisms to make of the book, but this will not be on matters of style and presentation.

What this book is about, is a proposition: Life is cognition. Or as Heschl puts it, $L = C$, this equation being the central thesis of a paper written by the author in the *Journal of Theoretical Biology* over ten years ago. This is not a rehash of the Cartesian point of view (‘Je pense, donc je suis’) put forth three centuries ago, which must surely be among the earliest and the most widely known philosophical points of view concerning the relationship between awareness and existence. Heschl is an evolutionary epistemologist (which subject he defines as ‘the ambitious attempt to provide a biological explanation for complex cognitive capacities in human beings’, and which he recognizes ‘is yet far from being accepted by the scientific community as a new and serious discipline’; in short, he is interested in the evolution of human intelligence), a polymath who combines research in biology with philosophy, ethology and cognitive science.

The genome – the human genome to be specific – is a widely discussed entity these days. The availability of the complete genomic sequence and its extensive analysis have created new fields of study and have given fresh impetus to old, deep questions. The apt metaphor is the order of the day: the DNA is the blueprint of life (‘ex DNA omnia’), genes can be selfish, there is ‘junk’ DNA. And now, there is the intelligent genome.

Genomic sequence information is, by and large, static. That is to say, DNA sequences contain a roster of genes and other features that we have learned to recognize (such as promoters, repetitive elements, transposons, telomeric regions, etc.), with no indication as to how and when genes may be expressed, how the different entities interact among themselves, or how life (however difficult that is to define) sustains. There is another order of magnitude of difficulty in asking about the connection between the genome and behaviour.

Heschl’s book treads on matters arising from this last sort of questions:

the subtitle of this book is *On the Origin of the Human Mind by Mutation and Selection*. What determines human intelligence and human behaviour – nature or nurture? Does natural selection apply to the evolution of cognition itself?

The traditional viewpoint in discussing the evolution of human intelligence, articulated for instance in *The Theory of Evolution*, by Maynard-Smith, is as follows. Intelligence in primates evolved as an adaptation to living socially and in coping with the complex demands of maintaining harmony and hierarchy in such a situation. The use of intelligence in other tasks (doing theoretical physics, say) was a spin-off. But even within the traditional viewpoint, the realization was there that humans are unique in that we can manipulate selection to an unnatural extent. Not just to create different dog, cat, or pigeon breeds, but also to manipulate the DNA at a cellular level as is now becoming increasingly possible, in order to practice freedom of genetic choice and control.

A contrast has been made by several people, Popper, Dawkins and Gould (Steven J.) among them, between human evolution and human cultural evolution. Do these march to the beats of different drums? There is no serious divergence of views on the question of human evolution which falls well within the Darwinian framework, but on the matter of cultural evolution, opinions can and do differ. Gould goes so far as to say that cultural evolution is Lamarckian, and therefore moves much faster, while the more moderate Popperian argument is that human cognition (and its ancillary features such as reason and logic) makes it possible for us to subvert natural selection (the paraphrasing is mine). And to Dawkins, what sets man apart from all other species ‘can be summed up in one word: “culture”.’

Heschl sets out to question this, whether different rules need apply to the evolution of human intelligence. He proposes a critical examination of ‘life’ which leads him to the conclusion that life equals cognition. He starts by defining living as having the following features.

(a) A demarcation between the system and the surrounding (say by a cell wall or a membrane or skin): a natural definition of the self and the other.

(b) Metabolism of substances from the environment for the maintenance of the internal equilibrium, namely homeostasis.

(c) An ability to reproduce and to pass on genetic material to offspring.

(d) A possibility to evolve through random changes of the genetic material.

Cognition, he states, 'when examined closely, corresponds exactly to that quality which did not come into the world *until and as a direct result* of the emergence of living systems' (the emphasis is mine). Stated so, the proposition $L = C$ is seemingly tautological.

Meandering through some fifteen-odd chapters, Heschl takes the reader on a series of discursive excursions, through Darwin and Dawkins, Kuhn, Piaget, Popper, Chomsky, (Jared) Diamond, and quotes extensively from the molecular biology literature to make his point, which in elaboration, is this. Everything is there in the DNA, not just the genetic information that controls metabolism, but also the genetic information that decides intelligence. 'The total information', he says, 'about how an organism can meet the challenges of the environment can only be found in the system itself and that the environment in this respect can contribute not a lot, not half, but nothing whatsoever'.

Some may find these arguments in turn simplistic, circuitous and needlessly anthropomorphized (should there be such a word!). I have no doubt that any serious philosopher with any knowledge of modern molecular biology will recognize that the mind-body problem meets a new challenge when faced with the reality of DNA and the transmission of genetic information from generation to generation. However, none will seriously quibble with the idea of genetic determinism, that the basic information is there in the genes. The problem is that we do not always know what precise (usually environmental) factors trigger what actions. Even at the genetic level, this can be a problem. There are numerous examples of genes that get switched on by physical (heat shock) or chemical stress, for instance.

Enough has been said and something has been learned about the profound implications of small changes in the DNA: the intraspecies difference in genomic information is negligible, yet the intraspecies variation in any particular

trait is enormous. The interspecies differences, again, can be rather small, but these have no bearing on interspecies similarity in any particular feature, including intelligence and cognition. At the DNA level, God is very much in the details: single nucleotide differences can spell the differences between health and disease, and there are numerous examples of this. There is, to the best of what one can see, no guiding hand, no overarching principle that has directed the course of biological evolution – much of it is entirely chance, however unpalatable it may be to accept.

But does that give enough support to Heschl's argument that the environment can provide no feedback to the DNA? The world around us does guide evolution in a particular manner, though. Selection works so as to amplify genes from those individuals in a species (in terms of number of descendants) that cope best with their surroundings. So is there something about the physical world that we inhabit that, so to speak, teaches us through selection? Namely, is there something about the planet earth that has conferred an evolutionary advantage on our type of intelligence? I cannot imagine any serious disagreement on this point of view, but the absence of a control experiment in this and in most other cases where the long process of evolution is responsible, makes it impossible to give a definitive answer.

And in the end, this is the most serious comment on *The Intelligent Genome*. There are no definitive answers but several provocative arguments, not all (any?) of which are truly substantiated, either through the apposite biological experimental example, or through a deep philosophical underpinning. There are straw men everywhere, and many windmills at which the author has tilted. It does not suffice to say that any book on a matter so important has to be so tentative and so speculative, but I suspect that this is ultimately the only defence that is on offer.

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Chemical and Biological Warfare – A Comprehensive Survey for the Concerned Citizen. Eric Croddy. An imprint of Springer-Verlag, Copernicus Books, 37 East 7th Street, NY 10003, USA. 2002. 306 pp. Price: US\$ 27.50.

After the all-too-well-known terrorist attack in the US on 11 September 2001, there have also been a spate of biological attacks with anthrax spores. This perhaps promoted Eric Croddy to write a new book. The author has extensive experience on the disarmament aspects of chemical and biological warfare. The book is meant to explain to the common citizen – what bugs and gases are, how they can be used to kill people and the way they cause death. There had been obviously innate fear that chemical and biological weapons (CBW) are the most gruesome, effective and abominable. It is the purpose of the book to give a correct picture about these weapons and clear the myths that surround the terms.

Each war always bring in an element of surprise. Chemical warfare was one such surprise encountered in World War I, though the decisive victory did not go to the Germans at the end. Biological warfare had never been used openly in any war, though clandestine use cannot be ruled out. Though in the context of modern time war, nuclear threat is much more feared than chemical and biological weapons, as long as these weapons are possessed by belligerent or rogue nations, the chances of their use cannot be ruled out. Moreover, because of less complexity of production and dispersion of these agents, CBWs have passed onto terrorists' hands and therefore the common man must be aware of the consequences of such attacks.

This book is divided into three major parts. Part I describes 'Gas, bugs and common sense' in which the method of proliferation by States and terrorist organizations is brought out. Intelligent guess by the nations that have CBW capabilities and the threat perception of CBWs are also given in detail.

Part II describes chemical weapons in detail. The chemicals that qualify to be chemical weapons, history of chemical warfare and the Chemical Weapon Convention (CWC), from its inception to the present status, are described.

Part III gives a detailed account of biological weapons. The treatment is