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The Human Genome Map, the Death of Genetic Determinism and Beyond

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The complete human genome map was announced just before Valentine's day [1]. But it was an anticlimax for the proponents, despite much effort to keep up the hype. The scientists declared themselves 'surprised'. The "book of life" turns out to have as few as 30 000 genes. Craig Venter, whose company Celera raced the publicly funded sequencing consortium to the finishing line, was the only one to read the implications correctly. The number of genes is far less than needed to support the extravagant claims throughout the past decade that individual genes not only determine how our bodies are constructed, what diseases we suffer from, but also our patterns of behaviour, our intellectual ability, sexual preference and criminality.

Facts of Life: [2]

- The human genome has about 30 000 genes, twice as many as a fruitfly and 10 000 more than the simple roundworm.
- There are only 300 unique genes in the human (genome), which are not in the mouse.

- Forty percent of the genes are previously unknown.
- 113 genes have been transferred into the human genome from bacteria.
- There is no genetic basis for race, humans all over the world share 99.9% of their DNA.
- The ‘complete’ sequence is still riddled with gaps.
- The fugu fish has the most concise genome, it has no ‘junk’ DNA.
- More than 95% of the human genome is ‘junk’ DNA.
- The coding regions for proteins occupy only 1.1% of the human genome.
- About 50% of the human genome are proviral sequences and transposable elements, many with reverse transcriptase.
- One of the most common transposable element, *Alu*, tends to cluster where there are genes.
- Chromosomes vary widely in the number of genes they contain.
- Most mutations occur in males.
- There are 250 000 proteins made by the 30 000 genes.
- The dog is 85% identical to a human in terms of genetic sequence and many of the 380 inherited diseases in dogs are similar to those in humans.
- There are more than four million genetic differences between humans found so far.
- 1 778 genes have been identified with diseases so far, from asthma to Alzheimer’s.

"We simply do not have enough genes for this idea of biological determinism to be right," said Venter, The wonderful diversity of the human species is not hard-wired in our genetic code. Our environments are critical." Many of us have been saying the same decades before the idea for the human genome project had ever been conceived of.

John Sulston, Head of the Sanger Centre in Cambridge in the public consortium, attempts to save face by appealing to ‘executive’ genes that do very sophisticated ‘management’ work. "What we are doing is to increase the variety and subtlety of genes that control other genes." [2] But that only leads us into the infinite regress of having to postulate genes that control genes that control yet other genes. What Sulston should have added, at the end of his sentence, is the phrase "that respond to the environment". Genetic determinism is dead, and has been dead at least for close to twenty years [3].

Worse yet, "Mapping the genome could be route to disaster", headlines another paper [4]. Excitement in the drug industry could be short-lived, according to a report compiled by investment companies Lehman Brothers and McKinsey. The human genome project could be too big for the biotech and pharmaceutical companies to handle, and could bankrupt the industry. The "information overload" will cost much more than previously thought. The report draws on interviews with experts throughout the industry, and concludes, "Perhaps the most surprising and compelling discovery is that, in fact, genomics threatens to increase not only the associated research and development costs, but also the average cost per new drug."

I have referred to human genomics as "a scientific and financial black hole that swallows up all public and private resources without any return either to investors or to improving the health of nations" [5]. Now that the bubble has burst, it is time to take stock and seriously rethink healthcare.

The project to sequence the entire human genome has cost the public $3 billion in the US and hundreds of millions of pounds in the UK. Now, scientists are telling us this is just the end of the beginning, and much more money is needed before the goods can be delivered in terms of miracle cancer cures, eradication of disease, genetic enhancement, gene therapy, personalised medicine and a prescription of lifestyle based on our genetic makeup. Indeed, the UK Government is investing at least £2.5 billion over the next five years to ‘human genomics’ in a misguided attempt to identify all the genes that predispose the UK population to disease [6]. That, at a time when our National Health is in financial crisis and research and development of other aspects of healthcare has been sorely neglected.

But even if the goods can be delivered against all odds, they will be beyond the means of the average taxpayer because private companies are aggressively staking out their claims on our genome. The pace of gene patenting has accelerated to a frenzy. Applications for patents in the US have gone from an annual 150 000 in the late 1980s to 275 000 today. In October last year, there were patent applications on 126 672 human gene sequences. By Feb. 2001, there are 175 624, a 38% jump [7]. The US has granted patents for millions of SNPs (single nucleotide polymorphisms) and gene fragments for which functions are unknown before it tightened the patent laws in December 1999. The human genome is already covered with dozens of times more patents than there are genes, because multiple patents are being granted over the same stretch of DNA. Such patents are seriously distorting healthcare and stifling scientific research and innovation [8].

Among the human genes and cell lines patented and sold by corporations are those stolen from indigenous peoples under the pretext of providing medical care, and even coercion is used. DNA databases of entire populations such as those of Iceland and Tonga have been sold to private companies. The Swedish Government is in negotiation with another company for the ‘ethical’ takeover of its population database, and the UK Government is planning to establish one of its own.

Some 740 patented gene tests are already in the market, and hundreds more in the pipelines. For cases where such tests can help to diagnose and treat patients, exorbitant licence fees have prevented them from being used. On the other hand, healthy people testing positive are denied employment and health insurance. Insurance companies in the UK can now require individuals to reveal the results of genetic tests. At the same time, prenatal and

pre-implantation diagnoses are eliminating human foetuses and embryos carrying genes said to pre-dispose them to cancer as adults.

Governments are diverting large amounts of tax money into human genomics research which benefit the corporations. This is the real disaster for public health. For it has narrowed the options for healthcare and foreclosed other promising approaches. It is also a major distraction from the real causes of ill-health, which are overwhelmingly environmental and social, which will end up marginalizing and victimising those most in need of care and treatment.

Long before we were told there aren't enough genes to support the genetic determinist view, many scientists have concluded that there are no simplistic explanations for diseases in terms of single genes, because the action of each gene is modified and affected by many other genes. The connection between genes and disease becomes all the more tenuous when it comes to conditions such as cancer, heart disease, diabetes, schizophrenia, intelligence, alcohol abuse and criminal behaviour, where environmental and social factors increasingly predominate.

There are hundreds of variants in each of the 30 000 genes in the genome. Craig Venter's Celera has identified over 4 million single nucleotide polymorphisms, or SNPs -- variants of genes that differ by a single base. Each person is genetically unique, except for identical twins at the beginning of development, before they can accumulate genetic mutations independently. It is impossible, in principle, to give the prognosis for any disease for an individual, let alone predict his or her lifestyle based on the person's genetic makeup [5].

More than a decade of somatic 'gene therapy' has met with no success. On the contrary, there have been deaths and numerous adverse events, the causes of which remain largely unknown. Many hazards are already evident from existing scientific findings. These include immune reactions to GM constructs and creation of new viruses due to recombination between artificial gene therapy vectors and dormant viruses in the genome.

Nevertheless, arch genetic determinists and other prominent scientists as well as 'bioethicists' are advocating human germline gene therapy and human cloning. They see the creation of a gene-rich class of human beings to be inevitable due to the free reign of the global marketplace. The rich will pay to genetically enhance their offspring, in the same way that they will pay for expensive private education. Consequently, there will be a genetic underclass -- children of the poor -- that will eventually become a separate, inferior species. Social inequity can thereby be translated into genetic inequity and *vice versa*. Fortunately, this genetic determinist fantasy will never come to pass. Unfortunately, it is fuelling the resurgence of eugenics and genetic discrimination, giving rein to the worst prejudices of our society.

The cloning of Dolly the sheep first raised the possibility that the same procedure could be used to create a human being. This met with universal opposition from citizens and governments all over the world. However, human cloning came back on the agenda as companies and their scientists pushed for approval of 'therapeutic' human cloning, the creation of human embryos for the purpose of providing cells and tissues for transplant. In January 2001, the UK became the first Government in the world to pass a law that makes this

legal, even though the available scientific evidence indicates that such human cloning is totally unnecessary and immoral [9]. 'Human' clones have even been created, by transferring the genetic material of a human cell into the egg of the cow and the pig. Apart from the moral objections, such interspecific hybrids are well-known to result in gross abnormalities. Against this background, the international trafficking of human organs is already rife, and eggs and embryos will be added to the list. At least fifty women are needed to provide enough 'empty' eggs to clone a single human embryo. Advertisements for egg donors have appeared on the internet.

Another development is xenotransplantation, the creation of 'humanised' pigs by genetic engineering to supply spare organs and cells for transplant into human beings. This is so clearly a case of bad science and big business putting the world at risk from pandemics of viruses that cross from pig to human beings that it should be banned immediately [10].

All the developments in and around human genomics stem from the mechanistic paradigm that still dominates western science and the global society at large. Mary Shelley´s brilliant novel, *Frankenstein*, was not just a parable of the arrogant scientist playing God, it is also about mechanistic science out of control today, in pursuit of corporate profit.

The irony is that contemporary western science across the disciplines is rediscovering how nature is organic, dynamic and interconnected. There are no linear causal chains linking genes and the characteristics of organisms, let alone the human condition. The discredited paradigm is perpetrated by a scientific establishment consciously or unconsciously serving the corporate agenda, and making even the most unethical applications seem compelling.

It is high time scientists across the world free themselves from the corporate agenda, to work in partnership with the organic uprising from the grassroots, to recover and revitalize the holistic perspectives of traditional knowledge systems, to secure food and health for all.

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