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- Where Genes Fail -- Dietary Interventions for Alzheimer's and Parkinson's?
- Chief Scientist Bob May Lambastes Human Genetics Panel
- The Human Genome Map, the Death of Genetic Determinism and Beyond
- Public Subsidy of Failed Corporate Science

ISIS Report -- June 9, 2001

Dr. Mae-Wan Ho was invited to the Green Research Forum in the European Parliament to debate Framework VI, the European Union's Research Funding Programme 2002-2006. She argues that the massive divestment of public research funding into health genomics is aimed at bailing out an industry already in trouble over GM crops, and in danger of being driven to bankruptcy by the human genome. The real disaster, however, will fall on public health. It prevents scientists and civil society from addressing the real causes of ill health, which are overwhelmingly social and environmental, and will end up victimising those most in need of care and treatment. Here is the complete text of her contribution to the Biotechnologies Panel.

The Human Genome - A Big White Elephant

Green Research Forum, European Parliament, Brussels, June 6, 2001

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The human genome may go down in history as the biggest white elephant for humanity. It cost a lot and is useless, it does not work, and is so expensive to maintain and grows so big so fast that it will bankrupt the industry as well as entire nations [1]. The only clear message in the 'book of life' is "there is no one home, life is not to be found here". Craig Venter, whose company Celera raced the publicly funded sequencing consortium to the finishing line, said as much, "We simply do not have enough genes for this idea of biological determinism to be right. The wonderful diversity of the human species is not hard-wired in our genetic code. Our environments are critical." [2].

I was researcher and lecturer in genetics throughout the mid-1970s to the early 1980s when new discoveries on the fluid genome made headlines every week, overturning the most deeply held convictions of classical genetics. Craig Venter may have just discovered that genetic determinism cannot deliver the goods, after sequencing the human genome. But many of us knew that genetic determinism had died with the revelations of the fluid genome, if not before [3].

The scientific establishment has remained firmly wedded to genetic determinism, if only because it is indispensable for business. It is also fuelling the resurgence of eugenics and genetic discrimination, and making even the most unethical uses seem compelling, such as the creation of human embryos to supply cells and tissues for transplant in so-called 'therapeutic' human cloning [4].

I started my career in human biochemical genetics, studying genuine genetic diseases that could be attributed to mutations in single genes. These account for no more than 2% of all human ailments. But diagnosing and curing rare single gene defects simply "did not fit the business model". So, 'genetic defects' and 'gene therapy' expanded in recent years to include the far more common and potentially highly profitable diseases such as cancer, heart disease, AIDS, Alzheimer's and Parkinson's. Francis Collins, head of the public human genome consortium, runs a laboratory in the US National Institutes of Health. He is now engaged in a "huge and very complicated" search for genes for adult-onset diabetes [5]. Adult-onset diabetes, like asthma and cancer has reached epidemic proportions over the years, increasing from 4.9% in 1990 to 6.5% in 1998, in both sexes, across all ages, ethnic groups, education levels, and in nearly all states in the United States [6]. That should have alerted all rational scientists to look for environmental causes instead of genes.

James Watson and other proponents of the human genome project perpetrated the ultimate genetic determinist myth that the human genome sequence contains the 'blueprint for making a human being'. The public has paid out billions of dollars in the United States and hundreds of millions of pounds in the United Kingdom. Now, dozens of genome sequences later, the sequencers haven't a clue of how to make the smallest bacterium or the simplest worm, let alone a human being. The human genome may consist of up to 98.9% 'junk DNA' with no known function. Geneticists are baffled. "The genome isn't a code, and we can't read it." [7]

Public investment was needed to keep the human genome in the public domain, we were told. But that had not prevented any human gene from being patented. On the contrary, scientists funded by the public have been busy patenting genes and starting up private companies, with little or no return to the public coffers [8]. Genes and cell lines stolen from indigenous peoples are patented, and governments are selling DNA databases of entire nations to private companies. These patents and proprietary databases not only violate basic human rights and dignity, they are seriously distorting healthcare and stifling scientific research and innovation [9]. They should be firmly rejected by the scientific community.

Now, the elephant attendants are saying the human genome needs more money before it can deliver the goods. The UK Government is obligingly giving away £2.5 billion over the next four years to 'health genomics', to identify all the genes that predispose the UK population to disease [10]. The elephant is growing big fast.

Such massive divestments of public funds are designed to bail out the biotech industry already in trouble over GM crops, and now showing every sign of being driven bankrupt by the human genome [11]. But the real disaster will fall on public health. It is narrowing the options for healthcare and foreclosing other promising approaches. Health genomics is a major diversion and obstruction, and is preventing us from addressing the overwhelming environmental and social causes of ill-health. It will also victimise those most in need of care and treatment. I call it "a scientific and financial black hole" [12], a colossal waste of scientific imagination and financial resources.

In many respects, health genomics epitomises the failures of reductionist medicine, which have reached crisis proportions. Drug and antibiotic resistant infectious diseases have come back with a vengeance within the past 25 years. Infectious diseases are responsible for one-quarter of the 53.9 million deaths in the world, second to cardiovascular disease [13]. For poor countries and children under five, however, infectious diseases top the list, accounting respectively for 45% and 63% of deaths. Among the factors blamed are the overuse and abuse of antibiotics, destruction of the environment, poverty, malnutrition and increase in air travel, all of which serves to remind us that disease cannot be understood in reductionist terms. One likely contributing factor that has yet to be named by the scientific establishment is the rise of commercial genetic engineering within the same period [14]. Genetic engineering, in agriculture as in medicine, uses the same tools and makes the same kinds of artificial constructs, all of which enhance horizontal gene transfer and recombination, precisely the processes that create new pathogens and spread drug and antibiotic resistance genes.

The other big killers are cardiovascular disease, which tops the list at 31%, and cancer at 13%, after infectious diseases. Both cardiovascular disease and cancer are predominantly illnesses of rich industrialised nations. Cancers are linked to ionising radiation [15] and to the hundreds of actual and potential carcinogens among the industrial and agricultural chemicals polluting our air, water and soil [16].

The incidence of cancer is known to increase with industrialisation and pesticide use. Women in non-industrial Asian countries have a much lower incidence of breast cancer compared to women living in the industrialised west. However, when Asian women emigrate to Europe and the United States, their incidence of cancer jumps to that of the white European women within a single generation. Similarly, when DDT and other pesticides were phased out in Israel, breast cancer mortality in pre-menopausal women dropped by 30%. Environmental influences clearly swamp out even large genetic differences [17].

Health genomics research will do nothing to identify or remove the causes of cancer. Instead, it will identify all the genes that ‘predispose’ the victims to cancers, to enable corporations that have made lots of money polluting the environment with carcinogens to make lots more money selling diagnostic tests and ‘miracle cures’. Patients are bankable assets, and terminal cancer patients all the more so.

The disease statistics are bad enough. But the cures may be far worse. Successive studies have documented a rising epidemic of iatrogenic diseases, ie, diseases caused by medical treatments, interventions and drugs. Doctors are now the third leading cause of death in the US [18], responsible for some 250 000 every year, among which are 106 000 due to non-error

negative effects of drugs. The problem is not confined to the US, it is endemic in all industrialised countries that adhere to the same reductionist model of health and disease: Canada, Australia, New Zealand and Britain. We can already see the tip of the iceberg in the new classes of iatrogenic diseases that 'health genomics' will bring. Clinical trials of 'gene therapy' have killed six and caused more than 650 adverse events [19]. The 'miracle cure' for Parkinson's turned into an irredeemable nightmare because the cells from foetuses transplanted into five patients' brains grew uncontrollably [20]. And watch out for viral pandemics if xenotransplantation is to go ahead [21].

A sweeping paradigm change is long overdue. The human genome, like the genome of any other organism, is fluid and dynamic. Genes function organically, in entangled networks that respond from moment to moment to the changing context of the whole organism in its ecosystem. They are not mechanical elements operating in fixed circuit boards. Let me give a few recent examples of how genes, genomes and organisms respond organically to their environment, demanding a radical rethink of the conventional approach.

Many bacteria are now found to change reversibly from a benign, non-proliferative phase to a pathogenic, proliferative phase, depending on ecological conditions [22]. Some scientists are now rethinking the failed conventional model of killing pathogens with new, ever more deadly antibiotics as bacteria become resistant to the old ones [23]. They are designing drugs that physiologically tame the bacteria, rather than kill them. A logical extension of that approach is to find how ecological balance could be achieved, so bacteria do not become virulent.

The dominant reductionist model of cancer says cancer is caused by mutations in specific cancer genes and cancer-suppressing genes. There is growing evidence that those gene mutations are neither necessary nor sufficient for cancer to develop. Every cancer has a different genetic signature. In fact, every cancerous growth in an individual differs in genetic signature. The cancerous state is a physiological response of the cell to its environment, which is ultimately the whole organism in its ecological context. Cancer is associated with gross genetic instability that gives rise to large genomic abnormalities [24]. Cancer cures based on single molecular interventions offered by health genomics will therefore be largely irrelevant and ineffective. The emphasis must be prevention rather than cure. The phenomenon of spontaneous cancer remission should also be much more thoroughly investigated. Remissions can occur after various experiences that affect the whole body, such as fever, a change of diet or change of life-style.

There have been a large number of observations suggesting that genes in bacteria and other organisms can mutate in response to environmental challenges, so as to enable them to survive [25]. There is evidence that defective genes in human beings can also regain function by mutation. Cells in the body of individuals born with defective genes have been found to revert spontaneously to functional states [26]. Thus, rather than persist in futile and dangerous attempts at 'gene therapy', substantial effort ought to be redirected towards elucidating the physiological and environmental conditions that can encourage the body to mend its own defective genes [27].

We have had decades, if not centuries, of reductionist, mechanistic science that has given us a surfeit of knowledge of the parts, not all of which has been put to good, sustainable use.

Now is the time to complement this knowledge of the parts with investigations aimed at knowledge of the organic whole [28] that can truly bring health and well being to the community. In particular, I propose that we target at least part of our research budget to the following areas which are currently either grossly under-funded, or not funded at all.

1. Ecology and Energy Use in Sustainable Systems

- To investigate the precise role of complexity and biodiversity
- To elucidate energy-relationships, energy use, renewable energies
- To identify biophysical indicators of ecosystem health
- To develop non-invasive, non-destructive technologies for monitoring and regulating environmental quality

2. Science of the Organism and Holistic Health

- To articulate a concept of an organic whole as the basis of health
- To identify biophysical and dynamical indicators of health
- To develop non-invasive, non-destructive technologies for monitoring health and for quality control of food and other agricultural produce
- To develop effective therapeutic methods based on minimum intervention.

3. Working Science Partnerships

- To enable scientists to work directly with local communities
- To revitalise and protect traditional agricultural and healthcare systems from biopiracy and globalisation
- To develop appropriate sciences and technologies

4. Science and Technology Monitor

- To monitor new developments for social/ecological accountability and safety
- To promote critical public understanding
- To promote science-public dialogue and public participation

Key words: human genome, health genomics, eugenics, genetic discrimination, antibiotic resistance, infectious diseases, iatrogenic diseases, cancer

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4. See "The unnecessary evil of 'therapeutic' human cloning" Mae-Wan Ho and Joe Cummins. *ISIS News* 7/8 Feb. 2001. Also, Third World Resurgence 127-128, 43-45

5. See an excellent essay, "A Map to Nowhere, The genome isn't a code and we can't read it", by Tom Bethell, *The American Spectator*, April 2001.

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7. The following description given by Tom Bethell (ref. 5) is the best that I have come across anywhere for describing the flexibility and fluidity of gene function:

   > Imagine that an intelligence service were to discover some unintelligible messages being sent by a spy. At first the intelligence agents naturally assume they are looking at a code. They assume the task of decoding will be straightforward. But on closer analysis it turns out that the message means one thing if the signal has been received and acted upon, another thing if it has been received and not acted upon, another thing if the receiving apparatus is not switched on, and so on. Rather than just a code the message is a bit like a set of rules for a rather complex interactive game. There are feedback loops, and circuits within circuits, and a lot of things happening inside the cell but outside the genome...

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25. See Ho, 1998, 1999 (ref. 3), Chapter on "The fluid and adaptable genome".

26. In heterozygous individuals, ie, those with two different copies of the gene, one of which is defective, recombination occurs during cell division, when the two copies exchange parts, and the defective copy gets mended. In other instances, the functional copy corrects the defective copy by substituting for it directly. But even in homozygous patients, ie, those individuals with two identical, defective copies of the gene, both copies have been found to mutate spontaneously to regain function. See Waisfisz, Q., Morgan, N.V., Savino, M., et al (1999). Spontaneous functional correction of homozygous Fanconi anaemia alleles reveals novel mechanistic basis for reverse mosaicism. *Nature Genetics* 22, 379-83.

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