THE DYSTOPIA OF OUR TIMES: GENETIC TECHNOLOGY AND OTHER AFFLICTIONS

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HEALTH IS THE MOST basic measure of human well-being. As such, it is the first constituent condition of any conceivable utopia. Socialists have always understood the basic truth about health which epidemiology, medical economics, sociology and biostatistics arrived at only in the last twenty years, namely that the most important determinants of health are not medical (doctors and hospitals, though these are important, especially in urban cultures) but social: economic adequacy and security, adequate shelter and nutrition, healthy living and working environments and strong families and communities. It is the combination of these factors that best predicts whether any individual will choose a healthy 'life-style', and have the means whereby to pursue it. Every individual is located in a larger social ecology of health which affects those at the top as well as the bottom. The evidence unambiguously shows that above a certain level of per capita GDP what is crucial for the health of a population is not more income per head but the degree of equality in the distribution of income and wealth.[1] Cuba's high performance on health measure in comparison with the United States is one graphic example of this. So is the fact, identified in 1998 by the World Health Organization, that due to increases in 'poverty, unemployment, homelessness, excessive drinking, and smoking' and health reforms that are too reliant on 'market forces' – i.e., neo-liberalism – Europe's overall health is deteriorating for the first time in fifty years.[2] From this perspective, income equalization – and all the measures needed to bring it about, including full employment, education and social supports to women (the main paid and unpaid health providers in all societies) – is the public health metapolicy par excellence.

The economic determinants of health are old news to many socialists. But there is far less awareness about the damage that has been done by capitalist industry to the biosphere that sustains us, and, by extension, to our own health; and even less clarity about the solutions socialists should propose to arrest and reverse this damage. Today, on top of the toxic pollution caused by the old manufacturing, petrochemical and nuclear technologies, the computer and genetics technological revolutions are fuelling new waves of industrialization, with a whole new set of risks and hazards. Far from bringing about a utopia of leisure and well-being, as promised by their proponents, the technologies of production deployed in the last fifty years of industrialization have qualitatively breached the biosphere in which we humans live, and put us all at enormous risk.

Yesterday's production technologies are leaving behind harmful physical facts such as radioactivity, persistent organic pollutants and greenhouse gases that, even more than national debts to the World Bank and IMF, hang like a dead weight on the utopian possibilities of the future. Now, when we intervene into the mechanisms of life itself, as we have begun to do with industrial biotechnologies, the potential to disrupt ecosystems grows to even greater levels, and becomes self-perpetuating. Already, thanks to the technologies of the late industrial age, the planet is witnessing a holocaust of natural extinctions. While species were dying at the rate of about one per decade in the early stages of industrialization, today they are dying at the rate of three per hour.[3] But the extent to which bio-diversity – literally the web of life – is suffering is only officially 'discovered' when crises prompt governments to investigate. To take just one recent example, it is becoming increasingly clear that phytoplankton – the basis of the ocean food chain – seed cloud formations, and hence are also involved in maintaining protection for the planet from ultraviolet rays and in mitigating global warming by absorbing carbon dioxide. These functions have been drawn to the public's attention by scientists because we have noticed huge die-offs of phytoplankton all over the world, and, among the remaining populations, the ascendance of a phytoplankton species that absorbs carbon dioxide poorly.[4] Enormous amounts of toxic pollution, industrial fishing techniques (such as drag nets) and global warming have disrupted vast tracts of ocean ecosystems. Directly and indirectly, the technological processes implicated in the extinction of plant and animal species are sickening and killing human beings as well.

This essay will concentrate on discussing, in turn, three areas of health – the emergence of new diseases, the harms of persistent organic pollutants, and the threats of biotechnology and genetic engineering – that are linked to ecology and technology. The health crises that will be entailed by the developments I trace in these areas will indelibly mark the first decades of the next century, and are already sounding harsh dystopic warnings around the world. I shall go on to argue that these developments must challenge socialists to find the political means of effecting new forms for international co-ordination and co-operation to recover control over the mobility and concentration of capital and the production technologies it employs; and of directing economic development

according to the health criteria of human and environmental well-being at the community and sectoral levels where industrial production takes place.

New Diseases

Because of their faith in the heroic powers of science, from the 1950s to the 1980s most people in the middle-class industrial North had a pretty complacent attitude toward disease, and a fundamentally laissez-faire attitude to medical and pharmacological science and industries. Drugs had appeared to vanquish the hideous plagues of the past. Tuberculosis and polio were defeated. In the South, malaria, dysentery, sleeping sickness and other ailments and fevers continued to plague millions, but in the North it was assumed that these too would eventually improve with modernization (industry plus doctors). Disconcertingly, though, cancer, heart disease, diabetes, lung diseases, allergies, neurological diseases and auto-immune disorders grew year by year. At first they were called the 'diseases of affluence'. By the 1980s and 1990s, they were being explained in increasingly genetic terms, as billions were poured into genetic science and human biotechnologies.

In the South, however, particularly in regions which failed to thrive in the post-colonial era, major disease disasters were unfolding as whole ecosystems and cultures were uprooted and degraded by the forces and technologies of neo-colonial resource extraction and processing. Thanks to the disruption and mixing of ecosystems that has resulted from these technologies, in addition to the disease-inducing effects of pauperization, populations in the South had to face new biological diseases, as well as battle old ones.[5] Displaced organisms, once living in relative harmony with their hosts in an environment in which they had co-evolved with other organisms, became virulent disease agents in their new environments.[6] Yellow fever, for example, can exist in a given area in Africa for decades without afflicting humans, because the mosquito that carries it feeds exclusively on jungle monkeys and marmosets. But take away the forest environment and the marmosets, and the mosquito can change its feeding habits overnight and start a human epidemic. This is what happened in Nigeria and Kenya in 1987, 1988, 1990 and 1993.[7]

The HIV virus that causes AIDS is also a traveller that began life in a different host and ecological niche. In February 1999 scientists definitively identified the human immunodeficiency virus as a descendent of a simian virus that lives in harmony with its chimpanzee host in Africa – a host now on the list of highly endangered species. Researchers speculate that at some point, perhaps in the 1960s, people of tribes that hunted the chimp contracted the virus through bites or ingestion, and passed it on to other humans. The displaced virus mutated (reassorted genes), turned virulent, and, through the human vector, spread outward across the globe.[8] HIV is a relatively slow killer. Much faster killers are also on the rise in the North, and are also part of the ecosystem disruption and mixing story. It is well known that the highly infectious and deadly Ebola virus, a haemorraghic fever, was brought from a Philippine rain forest to Reston,

Virginia, not far from Washington, DC, by green monkeys slated for medical experimentation; its outbreak was contained only with enormous effort, cost and risk.[9] And Ebola is only one of many super-lethal haemorraghic fevers: Hanta, Marburg and Lhasa viruses are also on the rise, as Laurie Garrett has shown in cataloguing and analysing the spread of the numerous viruses, bacteria, and parasites that have already attained, or are capable of attaining, mass lethality globally; Ebola is only one of many super-lethal haemorraghic fevers she discusses.[10]

Old killer bacteria such as tuberculosis and bubonic plague are back as well. Western medicine relied on antibiotics to bring many of the bacterial killers of the past under control in the post-Second World War period. This also amounted to a programme of selective breeding for stronger, more competitive bacterial micro-organisms, more resistant to our drugs. Streptococcus now brings necrotizing fasciitis (the 'flesh eating disease') as well as strep throat, and legionnaire's disease lurks in poorly ventilated ducts of office buildings, schools and hospitals. Virulent, resistant tuberculosis bacilli now thumb their cilia at sophisticated drugs in prisons, in poor neighbourhoods, on first nations reservations in North America, and throughout Africa, Russia and Asia, wherever poverty, overcrowding, and poor nutrition create ideal conditions for transmission.[11] Bubonic plague is on the horizon again with a large growth in the world population of rats due to massive urbanization and global warming. There are now antibiotic-resistant strains of plague in existence.[12] Less spectacularly, millions suffer from chronic resistant bacterial infections.

With global warming new territories are opened up for new micro-organisms – whether viral, bacterial, fungal or protozoan. In 1997, a woman in Toronto contracted malaria from a mosquito bite she received in her back yard.[13] She had not been out of Canada for ten years, and malaria is officially unknown in Canada. Nevertheless, increased international trade likely brought a malaria-bearing tiger mosquito from Asia, which survived in Canada and then infected her. As temperatures rise with global warming, we and our environments in the North become a more congenial home to new hosts and parasites alike. As well, in the wake of climate-linked natural disasters that compromise our sanitation, warmth and nutrition – for example the central North American ice storm of 1998 or Hurricane Mitch – we become tempting targets for microbes looking for a weak host. In fact, global warming is a health catastrophe, and must be understood as such.[14]

Behind the new virulence of many diseases, new and old, lie unregulated industrial technologies. New variant Creutzfeld-Jacob disease (nvCJD), for example, is on the rise in the North, and appears to be the result of humans indirectly ingesting the brains of animals with pathological prions in them. (Prions have no DNA, survive in autoclaves of 800 degrees, and, embedded in living tissue, have no known treatment; they cause a disintegration of the brain, and death.)[15] By feeding ground-up offal contaminated with sheep spongiform encephalopathy (scrapie) to beef cattle – that is, by turning cattle into carnivores

(and in some cases, cannibals) in an effort to grow them faster – farmers passed on the sheep spongiform encephalopathy to cows, and, hypothetically, to the pigs, sheep and even chickens who were also given such feed, as well as to some of the humans who ate their meat. The kind of feed used by British farmers has been used throughout the agri-industrialized world. nvCJD can have a very long incubation period, so we do not know yet whether or not there will be a world-wide epidemic. But the possibility exists, and was noted with concern by medical experts meeting under the aegis of the World Health Organization in Geneva in February, 1998.[16]

Pollution's Threats to Human Well-being

In addition to these threats to health from infectious diseases, the North has already begun to register the long-term consequences of petrochemical-based industrialization – the effects on human health of persistent organic pollutants (POPs). 'From 1940 to 1982, production of synthetic chemicals increased roughly 350 times, and billions of pounds of man-made chemicals poured into the environment … In 1994, one hundred thousand synthetic chemicals were on the market, and a thousand new chemicals were being introduced per year.'[17] We are speaking here of industrial chemicals such as polychlorinated biphenyls (PCBs) and hexachlorobenzene, by-products such as dioxins and furans, heavy metals such as cadmium, mercury and lead, and a host of pesticides such as aldrin, chlordane, DDT and endrin, among others. The nuclear industry has brought us electricity, but also radioactivity. Heavy industry and petrochemical production have delivered the miracles of plastics and temporary pest control, but also persistent organic pollutants and heavy metals. These toxic substances are now present in our air, water, soil, food, household products and work environments.[18]

POPs are heavily present in all areas of past or present industrialization around the Earth, and dispersed by weather and bioaccumulation throughout the biosphere. Bald eagles on the Florida coast are affected by continental plumes of wind bringing poisons from the industrial heartland, and by the high concentrations of POPs they ingest when they eat fish which live in pesticide-laced waters. POPs migrate: from pacifiers to babies, as Canadians recently learned from a Greenpeace-initiated 'toxic toys' campaign, and from the centre of the planet to the poles, there to grow in ever larger concentrations in the tissues of fish, birds, and mammals that humans consume as food: the concentrations of toxic substances in Innuit women's breast milk are even higher than those of many women in the Great Lakes (which are famous for the very heavy chemical burden they carry on the North American continent).[19] Even after some of the worst culprits identified early on (e.g. DDT) have been removed from the market, and considerable environmental clean-ups have been achieved, organic pollutants from pesticides, plastics and other chemical-dependent industries have persisted in the environment, and today they are seriously eroding fertility, intelligence, and health. While almost all

existing public health standards set for the levels of such pollutants have been based on concern with cancer, it has been convincingly demonstrated that the gravest damage done by persistent organic pollutants is related not to this disease, though this is also important, but to the disruption of the endocrine system, and the key functions that depend upon it – above all, in the fragile developmental progression of the foetus and new-born child.[20]

Some chemicals – especially, but not only, those from pesticides – act as pseudo-estrogens, overloading and distorting women's estrogen levels and introducing estrogen-like substances into men's bodies. These chemicals affect the development of the reproductive tract in foetuses. Other chemicals act as androgen blockers, and also bear on sexual development, especially in males. The estrogen and androgen disrupters are creating sterile, hermaphroditic and deformed animals, with impaired parenting behaviour.[21] In humans, they are lowering sperm count in men – down by 2.1 per cent a year for the last twenty-five years in Europe, and 1.5 per cent in North America, and still falling.[22] At this rate, they will produce a crisis in human reproduction in these regions within the next decade. As well, the neurological damage created by POPs thyroid disruption has been directly linked to serious learning, stress and attention disorders among children.[23] The scientific evidence of the harmful effects of these chemicals has finally begun to receive official attention: in 1998 the United Nations organized a conference in Montréal to devise a treaty to ban the twelve worst offenders ('the dirty dozen').

Endocrine disruption is a profoundly environmental and technological health problem – a problem knowing no borders and affecting everyone, the ultimate result of the petrochemical age. There is no way to address this problem without making fundamental changes in industrial and agricultural processes and technologies – in their development and their adoption – and undertaking large public health campaigns and environmental cleanups to address them. But while many communities attempt to seek such initiatives, neo-liberal provincial, state, and national governments loosen their vigilance on corporate polluters. Popular initiatives are often too little, too late relative to the toxicity and carnage capacity of capitalist- and state-directed industrial enterprises. In fact, instead of funding scientists to rapidly explore the full extent and meaning of POPs pollution, and propose solutions, funds flow to the destructive industries that are creating the problems. And this includes, more and more, investments in agricultural, animal, and human biotechnologies that apply environmentally unconscious industrial methods to the realm of life itself.

Reproductive and Genetic Engineering

The biotechnology sector comprises, on the one hand, thousands of small start-up 'brains trusts' with names like Amgen, Organogenesis, Genzyme, and Calgene, and on the other, a group of transnationals, such as Du Pont, Novartis, Upjohn, Monsanto, Eli Lilly, Rohm and Haas, and Dow Chemical. In the US alone, 1,300 biotech companies do nearly $3 billion business annually, and

provide work for more than 100,000 employees.[24] But the TNCs control huge sectors of the agrochemical (81 per cent), life science (37 per cent), pharmaceutical (47 per cent), veterinary pharmaceutical (43 per cent) and food and beverage sectors.[25] These new 'life industries' are based on the proposition that they can develop biomachines – custom-designed, genetically engineered organisms – to solve challenges as diverse as ocean oil spillage and cold sensitivity in vegetables. Funded by governments, universities, and above all, corporations, scientists have been developing genetically modified viruses, bacteria, fungi, plants, and laboratory and agricultural animals in agricultural, medical, and military research. Many of these organisms are transgenic – that is, they are new creations involving the insertion of genes from one species (for example, a flounder, a firefly, a human) into another species (for example, a tomato, a tobacco plant, a pig), in order to enhance a particular quality (for example, cold resistance, genetic marking for patenting purposes, transgenic organs for human transplantation).

The risks involved are extraordinary on all counts, for in these biotechnologies we are creating new forms of non-evolved life, capable of self-replication once released to propagate in our ecosystem. Because of the many dangers of such biotechnologies, environmentalists, progressive agriculturists, consumers and public health advocates have all participated in extended campaigns to refuse government approval for many of the initiatives of the biotech sector in agriculture: the patenting of life forms, the pirating of genes, the transgeneticization of species, the creation of sterile seeds ('terminator genes'), and the genetic modification of foods.

US-based Monsanto Corporation is one major player in these technologies globally that has recently become embattled in several places. Polls in North America and Europe show that substantial majorities of their populations do not wish to eat or buy genetically-modified foods. This reaction, embodied in consumer and citizen mobilizations, constitutes a major threat to agricultural biotechnologies. In addition, in December 1998, the Canadian government rejected Monsanto's bovine growth hormone for approval in Canada. This rejection was a rare victory in the struggle to control the proliferation of biotechnologies in Canada, the result of a protracted battle waged by concerned NGOs from many different sectors, and the outright revolt of a group of federal Health Protection Branch scientists at being told to suppress their negative findings with respect to bovine health. In January 1999, the British government imposed a fine on Monsanto for allowing its genetically-engineered plants to spread beyond the experimental area and contaminate general agricultural land. The British and Canadian setbacks for Monsanto notwithstanding, agricultural biotechnology is far ahead of its opponents. In 1996 'more than three-quarters of Alabama's cotton crop was genetically engineered to kill insects. In 1997, farmers planted genetically-engineered soya on more than 8 million acres, and genetically-engineered corn on more than 3.5 million acres in the United States'.[26] We already live in an environment with extensive genetic pollution.[27] We cannot predict

the effects on present and future ecosystems of every release. But our experience with other great industrial technologies, and with biotechnology to date, makes it virtually certain that there will be enormous problems and costs caused by agricultural biotechnology. Meanwhile, efforts by NGOs to ensure that countries have the power to resist such technologies are being fiercely resisted on the international level by the US government and the TNCs, who frame all such objections as new obstacles to free trade and the flow of capital.

The prospect of *fabricating human beings,* made possible by combining reproductive with genetic technologies, promises even greater financial returns. Funded by the transnationals and governments, scientists are hard at work on a variety of technologies that will make up the package necessary to manufacture human beings and their parts. The multi-government funded Genome Project is yielding insights into human genetic make-up on a weekly basis, and industrialists are looking for ways to apply this knowledge profitably. Craig Venter, the scientist who runs The Institute for Genomic Research (TIGR) in Rockville Maryland, has said he will sequence the whole genome in three years with the aid of private capital and a computer to be completed late in 1999 that he claims will surpass in power even that of the US Defense Department's computer built to simulate nuclear war.[28]

Information being gleaned from such macro research is being sold to enable the creation of micro procedures for many purposes, actual and experimental. Not all are equally problematic. Genetically-engineered drugs are already being used to treat cancer, heart disease, AIDS, diabetes, kidney and vascular disease, and new techniques for somatic gene therapy are being developed. (The leading pioneer in this field, William French Anderson, is on the board of Craig Venter's TIGR.) Leaving a host of problems in the patenting and marketing of human genetic technologies aside, somatic gene therapy has the potential to do the maximum good with the minimum of harm. Its effects are in theory not heritable, so do not saddle the future with the consequences of today's intervention.[29] Somatic therapy does no necessary physical harm to the 'donor' of therapeutic material, and benefits the recipient. Hence there may indeed be some value to a number of such forms of therapy. Motorola is developing technologies to produce chips on a single sliver of silicon that will integrate electronic and biological functions and render human DNA as bar codes. This technology and others which have been developed as a result of the genome project enable totalitarian controls and accelerate the creation of a eugenic society based on severe genetic discrimination.[30]

Such possibilities are posed even more acutely by the many planned applications of genetics to human germ line gene intervention – an intervention that will affect the sex cells of an embryo, and will be hereditary. Many technologies are being developed that will lead to or rely on human embryos as raw material. One crucial ability sought in human biotechnology is stem-cell propagation. Known as 'totipotent' cells, stem cells are produced in the early stages of embryo formation, and differentiate into the 210 different cell types required

to construct human bodies. As such, they constitute unparalleled 'raw material' for human bio-fabrication, the ultimate bio-commodity gold-mine.[31] In late 1998, two teams of university and corporate-funded US scientists, working with 'surplus' embryos from in vitro fertilization clinics, announced that they had succeeded in propagating human embryo stem cells. Then a third team followed with the news that it had fused a human cell nucleus with an enucleated cow's egg, producing a transgenic human-cow tissue with many of the properties of stem cells. Another major technology – creating an artificial uterus – took a major leap forward thanks to Japanese scientist, Yoshinori Kuwabara, who sustained and birthed a goat foetus from an artificial uterus in 1997.[32] Cloning is yet another potential gold-mine technology, also embryo-dependent. First achieved with Dolly the sheep in 1997, its 'perfection' is moving rapidly along in animals and it is now being proposed by leading researchers and clinicians in human reproductive technologies as an alternative to human in vitro fertilization.[33]

All technologies have a price, and the price we will have to pay for the bioindustrialization of human life will be extremely high. This price includes the patenting of human stem cell lines, the creation and commodification of human embryos, foetuses, organs, and tissues, and gestational capacities, the growth of a market for these among the indigent,[34] the severing of genetic from sexual, gestational, and social parenthood, genetic discrimination and eugenic mentality, immense physical suffering for animals and humans, and potential catastrophes from mutational 'errors' that will inevitably occur as a result of crossing evolutionary species barriers.[35]

Some of the health risks of the new human biotechnologies are known, and they have been documented by physicians, scientists, and epidemiologists who specialize in risk assessment. Disease transmission via animal vectors in xenotransplanation is just one of these. Laurie Garrett reported that the baboons used in the first of the 1992–93 Pittsburgh baboon transplant experiments were infected with 'SIV (the simian AIDS virus), CMV (the simian cytomegalovirus), EBV (the simian type of Epstein-Barr virus), and simian agent 8 (the baboon form of b [herpes cancer-causing] virus)'. Had the two patients survived the multiple infections they developed after transplantation, which they did not, they could have acted as vectors for all these simian viruses into the human population. The transplants were undertaken even though it was well known among transplant surgeons that patients usually die of secondary infections (from the transplanted tissue), not of organ rejection.[36] Yet pigs and primates are being developed for the harvesting of organs and tissues by corporations, scientists and clinicians, with the full support of governments and states.

As well, we cannot neglect the potentially devastating hazards now extant in biological labs, both commercial and military. Although the Soviet Union signed the international treaty banning biological warfare, it proceeded to establish a major industry that pursued just this end. Anthrax was a favourite disease for experimentation, and was grown by the ton in the laboratories of a state firm

called MOD. In Sverdlovsk (now Ekaterinaburg) in 1977, an anthrax outbreak killed many people – estimates of 1,500 to 2,000 – when pathogens leaked from the plant.[37] It is feared that 'rogue states' and Mafia and terrorist organizations have access to these installations and will use their contents to advance their interests. Iraq has admitted to the UN that it produced 3,100 US gallons of one toxic germ, enough to kill the world's population several times over. The United States itself has a large Department of Defense programme and licensed the export of large quantities of toxic agents to Iraq during the Iraq–Iran war. In late 1998, the London *Sunday Times* reporters wrote that Israel was working on an 'ethno-bomb' – 'a biological weapon that would harm Arabs but not Jews'. Odious and bizarre as this seems – recalling the eugenics of Dr Mengele himself – 'the research mirrors biological studies conducted by South African scientists during the apartheid era and revealed in testimony before the truth and reconciliation commission'.[38] Lethal pathogens, developed as biocommodities by the pharmaceutical and medical industries, can be bought with no special qualifications on the open market. According to one newspaper report, there are '450 commercial germ collectors worldwide. More than 50 trade in anthrax; 34 sell the botulinum bacteria; 18 sell the plague'.[39] The development of these genetically-engineered lethal micro-organisms, which can never be fully safeguarded against release, is driven directly by profits, politics and states.

The most dangerous of the risks of existing directions in genetics are, however, literally unimaginable. This is because transgenic organisms have what are known as 'emergent properties' – properties that are new, unique, and unknowable consequences of recombining DNA. The health, environmental, and socio-political dangers of emergent properties are absent from the vast majority of mass media discourse on biotechnology, as they are from the corporate practice of genetic science. The green science paradigm – of diverse interdependent co-evolution – is entirely absent from corporate bio-commodification.

At present human reproductive and genetic technologies are rudimentary, risk-laden, and expensive. They are not yet credible answers to the problems of infertility, disability and disease that they purport to solve. Progressive health activists and officials can still argue that their costs and risks far outweigh their benefits; that instead of technologizing and geneticizing illness, public health policy should address the social and environmental determinants of health and fertility.[40] If we do not address these determinants, however, we may well bring these technologies rapidly into the main stream.[41] It is not difficult to foresee a day when fertility will decline to the point where many women and men will look to artificially-assisted reproduction, with its dangerous drugs and disability-prone multiple births, as the 'better way'; when the teratogenic properties of environmental toxins will motivate parents to submit their embryos to genetic screening and engineering, and masses of women to undergo *in vitro* fertilization, a day when the rich will clone headless genetic copies of themselves for tissue replacement, augmented by a trade in body parts, foetal tissue and embryonic cells provided by the poor.[42] Then the dystopic dynamics illustrated in

Margaret Atwood's *A Handmaid's Tale* will combine with those described by Aldous Huxley's *Brave New World* and William Gibson's cyberfuture *Neuromancer*.

The Political Vacuum

The claims made for the therapeutic effects of genetic medicine are miraculous. Some of the claims for somatic gene therapy may be valid, and may indeed offer medical breakthroughs with benefits that clearly outweigh detriments. The positive effects of germ line intervention, on the other hand, are both unproved and highly dubious, especially when measured against their health, environmental, social and human rights risks. Moreover – and this is a key issue for socialists – less than ten per cent of disability at birth is genetically linked. Social and environmental determinants are responsible for the rest – over ninety per cent. Yet genetic science is attracting huge proportions of public and private dollars while the science and practice of preventive medicine and public health initiatives – which could address a much larger proportion of such disability – go begging.

The abundant ethical, evolutionary, health, environmental, animal rights and human rights objections to reproductive and genetic engineering have brought about a general call for moratoria on many of the key directions in biotechnology, and for a public process for the evaluation of their trade-offs. This call is being ignored by corporations and governments alike. As a result, corporations are being allowed to make crucial species decisions for humanity. With respect to human biotechnology, despite many government-sponsored commissions in many industrial countries, and some effort at legislation and regulation by a few (e.g., the UK, France and Germany), there have been no coherent national and international policy or structures to deal with an industry whose division of labour is fully internationalized.

As writers such Richard Sclove and Daniel Coleman point out, until very recently political theory foresaw no need to complement the market mechanism for making technological choices with any type of political oversight.[43] The historical lack of well-established and appropriate institutions for such oversight, and the recent curtailment of public funding for scientific research and technological evaluation in the neo-liberal era, has left production technologies to be driven entirely by profit and political imperatives (careerism, nationalism, war). To deal with the resulting health crises we now need to develop instruments of governance and new models of economic development capable of ensuring that production technologies in heavy industry, resource extraction, infrastructure construction, energy production, agriculture, biotechnology, and communications are greened in ways that enhance, not worsen, the other social determinants of health.

This will be a tremendous challenge because while the short-term drive for profits has been central in creating an environmentally unconscious growth of production industries, nation states also have a huge investment in them. In

most countries the state has been heavily involved in developing vast economies of destructive industrial technologies, either in partnership with capital or on its own. The United Nations has estimated that 'in the early 1990s the state subsidized environmentally damaging industrial activities – energy, water, roads, agriculture – worldwide to the tune of at least $710 billion every year'.[44] Many governments have actively pursued the development of major harmful industries as key strategies for national economic development, with no thought to their impacts on health. Tire plants, pesticide factories, nuclear power stations, hydro dams – all have been subsidized by governments, as have been both 'start-up' and transnational firms in biotechnology. The contested, long-standing refusal of the Canadian federal government to enact regulatory legislation on biotechnology, for example, can be read in light of the fact that Canada has more biotechnology firms per capita than any other jurisdiction in the world.[45] Government complicity in harmful production technologies has also been increased in the 1980s and 1990s as many governments worked to dismantle the public institutions charged with regulating the environmental impacts of heavy industry, agriculture, and the medical and pharmaceutical industries. This policy was of a piece with the larger attempt to downsize public services, and hence remove 'barriers to capital'. Finally, acting directly in the interests of the owning class, governments have sought to privatize many of the previously state-owned corporations that undertook industrial development in infrastructure and energy production, and the environmental and labour standards to which they held.

Politics for a Healthy Future

If capitalist industrialization has 'depoliticized' technology – placed it in the realm of individual and private initiative, to be supported as an unalloyed good by states – production must now be repoliticized if the problems discussed in this essay are to be solved. Politics which work toward good health must contest the deployment of current technologies and find ways to create and employ alternative, health-enhancing technologies and systems of knowledge in the here and now. Many of these are already in hand. From organic agriculture, to wind and solar power, to sewage filtration plants that produce flowers, vegetables and drinking water as their end products, to new techniques of organic agriculture, to refrigerators that do no harm to the ozone layer, to hydrogen powered automobiles that produce water emissions – *homo fabricans* has already proved capable of developing the technical means of correcting our worst environmental abuses. Indeed, this is one of the brightest parts of the overall picture. The problems lie in the lack of political will and resources to further develop and deploy these technologies, and most governments' continuing support for nuclear, petrochemical and bio-technologies. By the uncritical facilitation of corporate agendas in many countries, the majority of public revenues still flow primarily to industries with the biggest investments in harmful technologies.

A health-driven politics of technological control must therefore include a plan for the reconstitution of a vital public sector in science and technology, through non-corporate-aligned universities and clinical and field researchers linked to producers; and it must propose structures and policies that subject technological decisions to socio-political oversight.[46] It must bring about the reorientation of the majority of public funds for research and programmes that address the environmental and social determinants of health; and support technologies best suited to maximizing these. Many examples exist of people and projects that would be supported by such politics – green scientists, sustainable production technologies, organic agriculture, communities that advance green plans for their industries and utilities, workers who develop conversion projects (from 'brown' to 'green' industries), and an impressive sector of public-interest NGOs in many social justice, health and environmental fields.[47]

But in most countries there are still no political parties that group all these forces together, and present programmes that embody a politics of public health, social egalitarianism, technological democracy, and green economic strategies. Environmentalists in social democratic parties have been trying to 'green' their parties since the late 1960s. But ultimately the commitment of existing social democratic parties to present forms of industrialization means that no such transformation has taken or will take place. Where green parties exist in Europe, they group together important activists, and in some cases field winning candidates in elections, but they – like most NGOs – often stop well short of a systematic critique of capitalism in relation to the environmental crisis. And in most jurisdictions, such parties are absent entirely, or have undeveloped connections to labour and other social movements, and gain little in the way of mass recognition or electoral support. New political parties are needed.

Such parties need to think through what kind of polities a healthy (just and environmentally sustainable) society needs. If we begin with an ecological appreciation of our existence, we need polities whose boundaries and jurisdictions are based primarily on their physical environments – their bio-regions – of which governments need to be the guardians. Equally such polities would politicize technological production issues as issues of health. To evolve such polities, we need new political forms at two levels, as well as reform in existing states. We need much closer international collaboration between states to address the mobility of capital and its international divisions of labour, and the global nature of environmental issues. Hence we need to demand accountability from existing politicians and public institutions in international as well as national arenas, and we need to suggest vehicles and processes for this accountability. We should be demanding measures such as proportional representation, recall, and the equalization of election spending at all electoral levels in order to advance a serious health agenda. And we should be proposing the creation of, and/or the reform of, government bodies charged with technological oversight. But second, we also need much stronger local polities that can wrest economic decisions from national elites, permit the exercise of direct democratic control over the technologies

involved in daily life, and have the capacity to proactively pursue pro-social public and environmental policies at the local level. This means we must aim to build new mechanisms of participatory and direct democracy in industry and in local communities, where technology is constructed and operated.

The implication of this conclusion is that socialists must participate in planning and organizing for sustainable technologies of production in ways that integrate social and environmental goals. If capital is permitted to redesign industrial production on its own – the major oil and automotive corporations have purchased all the major patents on solar and clean-automobile technologies – workers will pay a terrible price. Remote economic elites and bureaucracies make poor decisions for those who carry out their decisions. Only people answerable to the communities and municipalities of which they are members and who live most directly with the consequences of the technologies they employ can make and implement adequate decisions regarding environmental sustainability and production technologies. The importance of direct democracy in communities and in sites of production is a theme developed in thoughtful and useful ways by authors such as Richard Sclove, Daniel Coleman and Wolfgang Sachs.[48] It is not possible to do this theme justice within a few concluding paragraphs. But let me give one glimpse, in the crucial realm of energy production, of the ways in which economic production and political organization could and should work together.

In the production of electric power, bureaucratic elites and capitalists have favoured huge hydro-electric dams, large coal- and oil-burning generating plants and nuclear power. The damaging effects of these technologies are now well known. Local communities (as well as the global biosphere) are better off with, and, if given a choice, are more likely to choose, solar, wind, and small-scale hydro power. They are also much more likely to derive direct economic benefits from the activities needed to construct and maintain such technologies. It thus makes sense to place the political power to organize energy production on the municipal and neighbourhood level, in non-profit (public) enterprises, linked to a regional (provincial, state, national) grid. Each community, or group of communities, determines its energy needs and production goals, according to its bio-regional and human characteristics and needs, and adopts appropriate technologies accordingly. Each community controls its energy production, contributes surplus energy to a larger grid, and draws on the grid as necessary. Each community creates jobs in the production, installation, administration and maintenance of the energy technologies. The role of national or regional government is to help fund the creation of this system, develop and fund transitional strategies to retrain and relocate workers in light of the changes involved, ensure the adoption of compatible criteria throughout the system, maintain, monitor and regulate the energy grid, and promote energy conservation and environmental protection. First nuclear plants, then dirty fossil fuel generation plants are decommissioned and attendant threats to the environment and human health are progressively diminished. And the global economies –

military as well as industrial – for nuclear and climate-changing energy production technologies shrink.[49]

Conclusion

Respected scientists such as evolutionary biologist Paul Ewald have demonstrated in the laboratory that the virulence of an infective agent is directly related to the ease of transmission between, and the multiplicity of, its available hosts.[50] Like Arno Karlen[51] and others, Ewald posits that organisms who live in balance with their hosts in a given ecosystem will become virulent only when the number of hosts available to them radically changes and expands. Limit the vectors for transmission – unsafe sex for AIDS, for example, or faeces in the water for cholera – and the organism will mutate to a condition in which it co-exists with, rather than wipes out, its host. Ewald posits that in Japan, where transmission rates are low due to widespread condom use and high health status, less virulent strains of HIV will evolve. The paradigm-shifting import of this new germ theory for medicine itself is that, in concert, proper social, environmental and medical policies really can prevent disease by limiting its vectors. Ewald's findings provide the basis for optimism about our ability to find strategies that will defuse many of the 'new plagues' I wrote about earlier. But expect major resistance to this view within science and the medical industries, because it potentially shifts social emphasis and dollars away from attempting the near-impossible, but highly profitable, task of managing these diseases medically and pharmacologically, and from genetic research, toward systems of knowledge, services, and forms of social and environmental prevention that are far more effective, if somewhat less commodifiable.[52]

Socialists have well understood the importance of defending the pro-social functions of the nation state, those that can permit us to address the socio-economic vectors of disease. Socialists have also understood the need for international organization and collaboration to deal with the forces of globalization that so strongly shape local jurisdictions. What we must now acknowledge is that to achieve good health for humanity, we must address ecological realities and find the means to exert technological control in our lives today. And this task is dependent on a much greater degree of democratic organization on a local level than now exists in most jurisdictions. Participatory democracy in economic development decisions and in public health is not a panacea for the looming threat to human survival on the planet. But it is an indispensable component of the solution – and probably the only basis upon which will rise the level of national and international co-operation needed to address production technology issues globally. An educated and real democracy seems the only possible general alternative to market forces.

The task of thinking through a practicable alternative paradigm of economic development – one that is truly red and green – is urgent, because humanity must bring the age of nuclear energy, fossil fuels and poisonous synthetics to an end sooner rather than later; the facts admit of no other conclusion. This neces-

sitates the conversion of vast aspects of production from toxic to non-toxic technologies. Some experts estimate that chlorinated synthetic chemicals and the products made from them alone constitute as much as 45 percent of the world's GNP.[53] (This investment lies behind capital's resistance to meaningful government and state action needed to address the enormous health hazards of POPs.) A key task for socialists is to develop awareness of these realities, to help in creating local, regional, sectoral, national, and international social-justice strategies for green economic development, and to help make these central in the preoccupations of the labour movement.[54] This too will be an uphill task, for if appropriate technologies are deployed by communities and industries as they move toward a lower-consumption, lower-resource extraction economy, many of the industries in which unions have grown must change, shrink, and in some cases disappear – nuclear energy, for one. This threatens the unions in their present form, and constitutes a major challenge to the labour leadership: either to defend the institutions and industries, however problematic, in which they have been based, or to provide leadership in moving to better ones. If a clear 'eco-justice' programme for an alternative economy were being advanced by political parties, a programme into which the unions could have input, the second option could become a real one.

While there are many different political views and consciousnesses in the industrialized countries, there are also some commonalities: a profound disillusionment with the structures and institutions of liberal democracy, a profound sense that something is very wrong with the environment and a profound confusion about what to do. Participating in the effort to formulate radical systemic alternatives will pay off in broad support for socialists. Greens are increasingly joining socialists in demanding the reorganization of work and the redistribution of wealth: the cancellation of national debts in the South, the recasting of international trade agreements, international controls on capital, the shortening of the work week, and radical electoral reform.[55] And socialists are increasingly coming to understand the importance of environmentalism, and the politics of science and technology. Both movements meet at the point where human health is threatened. Politicizing health may well be one of the most unifying ways that socialists and greens can collaborate in forging a new political project – one that can take us to a truly 'post-industrial' age.

NOTES

1. Robert Evans, Morris Barer and Theodore Marmor, *Why Are Some People Healthy and Others Not? The Determinants of the Health of the Population*, New York, Aldine de Gruyter, 1994, pp. 6–7.
2. Adrea Mach, *The British Medical Journal*, September 19, 1998, p. 317/767.
3. Jeremy Rifkin, *The Biotech Century: Harnessing the Gene and Remaking the World*, New York, Tarcher/Putnam, 1998, pp. 8, 109–110.
4. 'Extinctions caused by human activity risk more than just the loss of species: they may threaten the biosphere's ability to capture energy through photosynthesis,

cycle nutrients and resist the vagaries of climate', Bob Holmes, 'Life Support', *New Scientist*, August 15, 1998, p. 30.

5. See *America's Vital Interest in Global Health*, Institute of Medicine, United States National Academy of Sciences, Washington DC, June 21, 1997, on links between global trade and travel and diseases discussed in this section
6. See Arno Karlen, *Man and Microbes: Disease and Plagues in History and Modern Times*, New York, Touchstone, 1995. See also Judith Hooper, 'A new germ theory', *Atlantic Monthly*, February 1999, pp. 41–55.
7. Laurie Garrett, *The Coming Plague: Newly Emergent Diseases in a World Out of Balance*, New York, Penguin, 1994, pp. 575–6.
8. David Fox, 'UN announces significant increases in HIV/AIDS', Reuters/*Infobeat*, November 18, 1997. The UN estimates that 30 million people worldwide are infected with AIDS. On patterns of diffusion, see Hooper, p. 49 and Garrett, pp. 334–361.
9. Richard Preston, *The Hot Zone*, New York, Anchor, 1994
10. L. Garett, *The Coming Plague*, 1994, various chapters. In March, 1999, *New Scientist* reported: 'A mystery virus is complicating attempts by the Malaysian authorities to control an outbreak of encephalitis near pig farms which has already claimed 55 lives. There were 145 suspected cases, 42 of which had been confirmed as Japanese encephalitis. But a second, unrelated virus has cropped up in the spinal fluid from 5 patients. A team at the university of Malaya in Kuala Lumpur says that the unknown virus resembles the "Hendra" virus, first isolated near Brisbane, Australia, in 1994. It killed 15 horses and 2 out of the 3 people it infected.' 'Double Trouble', *New Scientist*, March 27, 1999.
11. See 'New TB "Hot Zones" Threaten Epidemic', *The Globe and Mail*, Toronto, October 23, 1997, p. A1 (re Joint Report of the WHO, the US Centers for Disease Control, and the International Union against Tuberculosis and Lung Disease). For a summary report on tuberculosis epidemics in countries of the former Soviet Union, see 'World's next epidemic: Resistant tuberculosis', *The Gazette*, Montréal, March 18, 1999, World Section.
12. See Gene Emery, 'Bubonic plague grows resistant to antibiotics-study', April 9, 1997, and 'Bubonic plague squirrels found in California', *Science Wire*, November 6, 1998.
13. Trevor Hancock, 'Mosquito-born diseases will rise', *The Globe and Mail*, Toronto, November 4, 1997, p. A19.
14. 'Insurance companies have paid out $918 billion in losses from weather-related natural disasters in the 1990s so far, close to four times the weather-related claims handed out during the entire decade of the 1980s . . . The rising insurance claims of the last decade have coincided with rises in global temperatures: six of the ten warmest years on record have occurred since 1990.', *World Watch Institute*, Washington DC, March 30, 1999.
15. Richard Rhodes: *Deadly Feasts: Tracking the Secrets of a Terrifying New Plague*, New York, Simon and Schuster, 1997.
16. 'WHO experts say "mad cow" epidemic possible', *Marketwatch Live Internet News*, February 12, 1998. 'In last three months of 1998, there were nine confirmed new cases in the United Kingdom. In the previous three years there had been no more than five new cases in a quarter.' From *The Lancet* (vol. 353, 979) as reported in *New Scientist*, March 27, 1999, p. 5.

17. See Theo Colborn, Dianne Dumanoski, and John Peterson Myers, *Our Stolen Future: Are We Threatening Our Fertility, Intelligence and Survival? A Scientific Detective Story*, Dutton, New York, 1996, pp. 137–139.
18. See 'Hazardous chemicals a top priority for global environment', UNEP press release, Geneva, April 1998, and *Le plastique de PVC et le dereglement hormonal*, Greenpeace, Montréal, 1997. For studies reporting that 'much of the precipitation in Europe contains such high levels of dissolved pesticides that it would be illegal to supply it as drinking water', and for links between pesticides and rising cancer rates see Fred Pearce and Debora Mackenzie, 'It's raining pesticides', *New Scientist*, April 3, 1999.
19. See T. Colborn, et al., *Our Stolen Future*, 1996, pp. 101–109.
20. T. Colborn, et al., *Our Stolen Future*, 1996. See also Lois Marie Gibbs, *Dying from Dioxin: A Citizen's Guide to Reclaiming our Health and Rebuilding Democracy*, Montréal, Black Rose Books, 1997.
21. For a discussion of sperm damage, see T. Colborn, et al., *Our Stolen Future*, 1996, pp. 68–86. The evidence of deformations due to endocrine disruption in other animals continue to accumulate. There have been many reports of deformed and hermaphroditic fish and frogs in the great lakes region and it was recently reported that 'female mollusks in a Lisbon lagoon are developing male characteristics apparently caused by pollution.', *The Gazette*, Montréal, January 16, 1999, p. J8. Note also 'low sperm count increases risk of testicular cancer', a report on a recent Danish study that links the two, *EXN Science Wire*, February 28, 1999.
22. See Maggie Fox, 'Report confirms fears – men are losing their sperm', Reuters/*Infobeat*, November 24, 1997
23. T. Colborn, et al., *Our Stolen Future*, 1994, pp. 186–194. See also 'Canadian study ties birth defect to solvents', Michael Conlon, *Reuters/Yahoo News*, March 24, 1999. Some experts have begun to suggest that despite its other benefits, women in heavily industrialized regions, or in regions where POPs are deposited, should forego breast-feeding for the developmental health of their children.
24. J. Rifkin, p. 15. See also 'Seed industry: Who owns whom?', RAFI Communique, July/August 1998, Rural Advancement Foundation International, Winnipeg.
25. J. Rifkin, *The Biotech Century*, 1998, p. 68.
26. Ibid., p. 18.
27. See Naomi Perrian, 'Strange new world: Genetically-engineered foods usher in an era of biological pollution', *Greenpeace Magazine*, Spring, 1999. See also Martha Crouch, 'How the terminator terminates: An explanation for the non-scientist of a remarkable patent for killing second generation seeds of crop plants', Edmonds, WA, *The Edmonds Institute*, 1998.
28. See Nicholas Wade, 'Scientists' plan: Map all DNA within 3 years', *The New York Times*, May 10, 1998. For information about Venter and TIGR, including its corporate partners, go to www.tigr.org
29. Although some researchers have raised the possibility that gene therapy could affect the sex cells of recipients, and thus cause transgenerational consequences Nell Boyce, 'Fertile is fine', *New Scientist*, March 20, 1999, p. 22.
30. 'Where no chip has gone before', Jonathan Knight, *New Scientist*, March 20 , 1990, p. 15. On the same page: 'Human bar codes'. 'Third Wave Technologies of Madison, Wisconsin, has developed a genetic screening method, called

Cleavage Fragment Length Polymorphism, that represents DNA samples as bar code patterns . . . claims their technique is faster than 80 per cent of conventional screening technologies . . . Comparing codes will allow researchers to quickly spot genetic mutations and will help in the treatment of hereditary disease.'

31. See Louise Vandelac, 'l'Embryo-économie du vivant … Ou du numéraire aux embryons surnuméraires', *Le Magasin Des Enfants*, Jacques Testart (ed.), Paris, Gallimard, Folio Actuel, 1994, pp. 161–193.
32. Peter Hadfield, 'Japanese pioneers raise kid in rubber womb', *New Scientist*, April 25, 1992; 'Here's looking at you, kid', *New Scientist*, July 26, 1997.
33. See Gina Kolata on Princeton molecular biologist Lee Silver G. Kolata, *Clone: The Road to Dolly and the Path Ahead*, New York, William Morrow, 1998, pp. 241–2. In agriculture, cloning is seen as an important way to reproduce transgenic animals such as sheep and pigs for farming and xenotransplantation. Hence cloning and transgeneticization are tied together. For an explanation of this, see Ian Wilmut, 'Cloning for medicine', *Scientific American*, December 1998, pp. 58–63. For some serious risks involved in cloning plus transgeneticization in mammals, see Philip Cohen, 'The great divide', *New Scientist*, December 12, 1998, p. 16.
34. See Mona Eltahawy, 'Egypt holds inquiry on sale of body parts', *Guardian Weekly*, March 28, 1999, p. 5.
35. While a very important theme in science fiction, and a major force in biotechnology, the term mutation is strangely absent from public discourse about biotechnology. Québecois sociologist Louise Vandelac has recently drawn attention to the need to assess and address the question of the mutation of life in research and in public policy. Louise Vandelac with Marie-Helen Bacon, 'Will We Be Taught Ethics by Our Clones? The Mutations of the Living: From Endocrine Disrupters to Genetics', *Ethical Problems in Obstetrics and Gynaecology*, Claude Sureau and Françoise Shenfield, eds., Baillières's Clinical Obstetrics and Gynaecology, London and New York, International Practice and Research, forthcoming 1999.
36. Laurie Garrett, *The Coming Plague*, 1994, pp. 573–5.
37. See 'Genetics and "Germ Warfare",' *The Gene Letter*, vol. 2, no. 2, March 1998, and Richard Preston, 'The Bioweaponeers', *The New Yorker*, March 9, 1998, pp. 52–65.
38. See Uzi Mahnaimi and Marie Colvin, 'Israel reported developing "ethno bomb",' *The Gazette*, Montréal, November 15, 1998, p. A11. It is difficult to believe that such a project could succeed, given the overlapping genetic heritage of many Israeli Jews of Arab extraction and Palestinians. Nevertheless, the report cites 'Israeli scientists' as making this claim while also naming South African and American military experts.
39. U. Mahnaimi and M. Colvin, 'For sale: Deadly germs. Cheap', *The Gazette*, Montréal, November 22, 1998, World Section.
40. See V. Burstyn, 'Making Babies', *Canadian Forum*, March 1992, pp. 12–17; 'Making Perfect Babies', *Canadian Forum*, April 1992, pp. 13–19, anthologized in Patricia Elliott, ed., *Rethinking the Future*, Saskatoon, Fifth House Publishers, 1993; and 'Breeding Discontent', *Saturday Night*, June 1992, pp. 15–17, 62–67, anthologized in Gwynne Basen, Abby Lipman, Margrit Eichler, *Misconceptions: The Social Construction of Choice and the Reproductive and Genetic Technologies*, Hull, QC, Voyageur Publishing, 1993.

41. L. Vandelac, 'Will we be taught ethics by our clones: The mutations of the living, from endocrine disrupters to genetics', *Ethical Problems in Obstetrics and Gynaecology*, 1998.
42. See 'British lab creates frog embryo without head', *Toronto Star*, October 13, 1997, p. A22.
43. See Richard E. Sclove, *Democracy and Technology*, New York, Guilford, 1995, and Daniel A. Coleman, *Ecopolitics: Building a Green Society*, New Brunswick (NJ), Rutgers University Press, 1994.
44. David Ransom, 'Red and green: Ecosocialism comes of age', *New Internationalist*, November, 1998, p. 9.
45. *Impacts du genie genetique sur agriculture*, Union des Productuers Agricole [de Québec], August, 1998, p. 11.
46. For a discussion of how economic incentives drive science, see Martha Crouch, 'The very structure of scientific research mitigates against developing products to help the environment, the poor, and the hungry', *Journal of Agricultural and Environmental Ethics*, 1991, and M. Crouch, 'Debating the responsibilities of plant scientists in the decade of the environment', *The Plant Cell*, Journal of the American Society of Plant Physiologists, April, 1990, pp. 275–277.
47. For some discussions of the potential of the non-profit, public interest sector of non-governmental organizations to play a large role in the reconstitution of civil society and politics, see Ulrich Beck, *Democracy without Enemies*, Polity Press, Cambridge, UK, 1998, and Jeremy Rifkin, *The End of Work: The Decline of the Global Labor Force and the Dawn of the Post-Market Era*, New York, Putnam, 1995
48. R. E. Sclove, *Democracy and Technology*, 1995, and D. A. Coleman, *Ecopolitics: Building a Green Society*, 1994, and Wolfgang Sachs, *Greening the North*, Zed, London, 1998.
49. For a larger discussion of the issues and models for green and red energy production, see D. A. Coleman, *Ecopolitics: Building a Green Society*, 1994, pp. 182–200. For an assessment of the disastrous consequences of deregulation of energy in the United States, see Harvey Wasserman, 'The Last Energy War', *The Nation*, March 16, 1998, pp. 11–15.
50. Ewald also points to chronic microbial infections as causes of diseases long thought to be degenerative, not infective, in nature (eg., heart disease, cancer, multiple sclerosis). See also Hooper, note 6 above.
51. See A. Karlen, *Man and Microbes: Disease and Plagues in History and Modern Times*, 1995.
52. For an example of these issues at work, see Michael Day, 'The hype about herpes', *New Scientist*, October 12, 1998, pp. 24–5.
53. T Colborn, et. al., *Our Stolen Future*, 1994, p. 245.
54. Two thematic issues of the *New Internationalist*, no 284, October 1996 ('Sun, wind, water, earth, air . . . The energy revolution') and no. 307, November 1998 ('Red and Green: eco-socialism comes of age') provide multiple examples of issues and developments in progressive technological organizing globally.
55. See W. Sachs, *Greening the North*, 1998, and Anders Hayden, 'The price of time', *New Internationalist*, November 1998, p. 17.

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