2003

From Gunboats to Transgenic Seed: The Western Quest for Tools of Enforced Global Dependency

Geoffrey Kain
Embry-Riddle Aeronautical University, kaing@erau.edu

From Gunboats to Transgenic Seed: The Western Quest for Tools of Enforced Global Dependency

Geoffrey Kain
Embry-Riddle University

Historian Daniel Headrick has pointed out that "among the many important events of the nineteenth century, two were of momentous consequence for the entire world. One was the progress and power of industrial technology; the other was the domination and exploitation of Africa and much of Asia by Europeans. Historians have carefully described and analyzed these two phenomena, but separately, as though they had little bearing on each other" (*Tools* 3). The two forces are inextricably linked, however; technological development has long played a central and fundamental role in the imperialist enterprise, not only in the physical effecting of appropriation and control, but also in defining attitudes toward "the other." The historical centrality of technology to colonialist expansionism presses one to consider the current status of the technology/imperialism bond, to reflect on the continuum from cannon-mounted warship to genetically modified organism, and to speculate about the likely shape and possible methods of future imperialism.

There is little dispute that the accelerated growth of scientific knowledge and its application in new technologies during the nineteenth century enabled the cause of high imperialism, and one is inclined to wonder whether the very activity of "technology practice" (in the full sense that Arnold Pacey defines it in *The Culture of Technology*)[1] has embedded within it the seeds of imperialist aggression. In the first chapter of his classic text *Technics and Civilization* (1934), Lewis Mumford argues that the practice of technology grows out of, and is an expression or manifestation of, the "will to order" (3). This impulse has found its expression, generally, in two large enterprises, namely (1) the manipulation and exploitation of the external environment, and (2) the domination of less well-defended peoples. The specific tools and

South Asian Review, Vol. XXIV, No. 1, 2003.

methods that have made the latter effort possible are well detailed by Headrick and, since publication of his work, others. Most notably, of course, we recognize the significant contribution of quinine prophylaxis in the penetration of Africa's interior; of steam power coupled with iron in the earlier gunboats, followed by the steel-hulled ship; of breech loading rifles—and the machine gun; railway technology and its tremendous importance in moving soldiers, raw materials, and information; telegraph cables allowing for dramatic improvements in communication between metropole and colony.

The list can be continued, but the point remains that specific technologies have allowed for imperialist success and, to some extent, have encouraged (or even required) aggressive appropriation. Lenin reminds us in *Imperialism, the Highest Stage of Capitalism*, of the "monopolist capitalist" motives driving colonialism: competition for the raw materials to feed the industries of the industrializing nations; competition for new markets made poised to receive those materials; and struggles to establish the "spheres of influence" that may ensure the longevity of these arrangements (148). The technological/industrial reorganization of western nations and their impassioned exportation of the ideals essential to this reorganization—what Mumford describes as following from a fundamental "change of mind" and revealing itself ultimately as a vast social "surrender to the machine" (4)—is another of the more lauded aspects of the marriage of technology and imperialism.

Mumford and a number of scholars since have noted the dislocation of technological development from the larger ideal of *Progress* as that notion came to be defined by various figures of the European Enlightenment (183-184). As Neil Postman has described the assumptions informing what he terms "the great narrative of Progress" that emerged in Renaissance Europe,[2] perhaps most notably in Francis Bacon's scientific utopian vision in *The New Atlantis* (published posthumously in 1627): "Science and technology were the chief instruments of Progress, and in their accumulation of reliable information about nature they would bring ignorance, superstition, and suffering to an end" (60). During the nineteenth century and into the twentieth century, technological development and innovation became less one of the *means* to achieve progress than—as most came to conceive of it—the actual *embodiment* of progress itself. The conception that technological innovation *is* progress certainly, and largely, informed the emergent hierarchical arrangement of peoples that notoriously litters the literature of imperialism and racism and which still, in the most general sense, continues to inform assumptions of western superiority among the mass public and to define notions of what it means to be "modern," "civilized," "advanced," or "developed."[3]

Looking at history, then, there can be little dispute that technological

development (and possession) has been central to both the motives or ideology of imperialism and to its successes. Nevertheless, *is* the imperialism of the present moment (its ideals, assumptions, motivations) centered in the implementation and development of specific technologies...and *will* the imperialism of the future be similarly informed?

One intriguing element in this broad historical view is that a number of the cultural/geographic areas appropriated during the era of high imperialism—via, again, assumptions of cultural superiority stemming from development and ownership of particular technologies (railroad and bridge building, as well as weapons technologies, e.g.)—have themselves, in turn, become today world centers of leading edge technological development. A substantial share of the energy in software (and computer hardware) development has now centered itself in South Asia, for example, with Bangalore being a leading, though by no means isolated, example (Chennai and Coimbatore are a couple of other booming locations that spring to mind). Significant investments are also being made in India to accelerate work in the emerging areas of bioinformatics. China has become a global center in developing nano-technology and, Japan obviously continues to remain in the front lines of developing a wide range of electronic and wireless technologies. As Michael Adas has pointed out, Japan's emergence as an industrial power prior to World War I "shattered [or should have shattered] the illusion that industrialization [and technological innovation] [were] uniquely Western processes" (357). Clearly, the specter of non-western industrialization, at a relatively early stage, excited dread in the West over the potential for lost colonial markets, new competition for resources, and the longer range threat of shifting bases of power (and post-colonial retaliation). The violent upheavals in China and India in the decades following WWI forestalled some of these anxieties, but recent and current trends certainly serve to rekindle the questions or to reawaken the uneasiness about the decline of the West—so long as the link between technological and political (and *cultural*) dominance is assumed.

In recent electronic correspondence, prominent historians of technology and imperialism Daniel Headrick and Michael Adas expressed themselves on the topic of imperialism and technology in the present and in the coming decades; their impressions are similar and not terribly surprising. Headrick indicates that:

> Like everyone else, I hear a lot about globalization, the internet, etc. Some people see globalization as a form of American economic imperialism, similar to the role that Great Britain played in Latin America in the 19th century. The internet, in English and with all its content, shocks many people; is it a form of cultural imperialism?... Military imperialism ("punitive expeditions" the British used to call it) still happens, as in Panama, Grenada, perhaps Iraq. As for the "classic" imperialism, in which one country conquers and annexes another, that is out of fashion these days: but for how long? We have the means but lack the motivation.
>
> Technology will certainly have an impact. "Smart" bombs and rockets make it possible to attack and damage a poor country at minimal human cost (but even that can be too much—consider Somalia, e.g.) in exchange for enormous financial cost (consider the Gulf War). As I read the situation, we are in a state of "informal empire." (Jan. 22, 2001)

Similarly, Adas refers to the new weapons introduced in the 1991 Gulf War, but sees them as "less pervasive than the web technologies which showcase the 'American way' to development and social stability."

Nearly sixty years ago, Pierre Teilhard de Chardin preempted both of these historians by optimistically claiming that despite the violent forces of "dispersal and divergence" unleashed by WWII, we are witnessing "an irresistible physical process: the collectivization of mankind" ("Great Event" 126). Citing increasing population, accelerated migration, and rapid advancements in communication and transportation technologies, he envisioned pressures to which, out of the need to survive, a "unanimization or collectivization" would have to emerge. Similarly, and more familiarly, we have Marshall McLuhan's arguments about the emerging "global village," a world in which fragmentation would give way to "implosion," to global integration and homogeneity. These are just a couple of the arguments anticipating the heated debates over the economic realities of globalization that have become so prominent since the 1990s.

Such exuberant visions of a communal or at least economically globalized future also seem to inform the accelerating growth of computer networking. "Absolute connectivity" would appear to be the highest ideal implicit in this development, with the ultimate goal being universal real time access. We all know that borders have melted away as monies are transferred in a perpetual flux in the global economy. Work proceeds apace to link database to database to database in an effort to arrive at the realization of a "docuverse," or universe of documents in which all publicly accessible hypermedia will be linked.

Navigating within this increasingly and elaborately linked hypermedia world reveals, however, that its structure is without any specific *center*; instead, what we find are innumerable sites or nodes that each, in turn, becomes central only while under our attention. This suggests that while web-based technology does indeed move toward globalized connectivity, it also rests upon a format that dissolves centrality. George Landow has described the web of information sites as "a society of conversations in which no one conversation, no one discipline or ideology,

dominates...the other" (7), a beautifully egalitarian image, but many will maintain that, because it largely emanates from the West, principally North America, and is pervaded by English language text, the internet has become, as a tool of imperialism, the railway or machine gun of our era.

It remains to be seen, of course, as to what extent and in what specific guises the emerging telecommunications technologies of the coming decades lend themselves to either the dissolution or the perpetuation of imperialism—just as it remains to be seen as to what extent cultural indigenousness or exclusivity remain feasible, or whether the various geo-political "sites" or "nodes" can establish a polycentric world becoming, as the model of hypermedia posits, simply an array of conversational points in an emerging, interdependent network. Following the logic of this trajectory, privileging the computer technology model above other modes, this more diffused, democratic image of the future would seem plausible.

However, we may be better served to focus on another emerging technology that, rather than encouraging our sentiments for power sharing and global diffusion, reinforces the more traditional model of western ingenuity in developing new tools of domination and enhanced methods of ensuring continuing dependence and indebtedness in the former colonies: biotechnology, specifically, the development of genetically modified organisms. The coming decades will predictably see rapidly increasing inroads being made by such "Gene Giants" as Monsanto, Aventis DuPont, Novartis, and Astra-Zeneca as they gain greater control of world food production, primarily via intellectual property rights attached to the pest and drought resistant seed that they develop, manufacture, and market across the world. Through the development of transgenic seed,[4] the proliferation of genetically engineered crops, despite resistance movements such as those arising in India in the late 1990s, and the corporations' aggressive protection of their patents, new dependencies are quickly emerging that have given rise and poignant significance to neologisms such as "genetic imperialism" and "bioserfdom." In other words, it may be that the more telling association of technology and global imperialism is to be found, and will continue to be found, at the molecular level, and not necessarily so gaudily visible as what we readily witness on our nineteen inch computer monitors. As Rafael Mariano, chair of the Peasant Movement of the Philippines, recently remarked in the face of the advancing genetically modified (GM) crop presence: "The peasants of the Third World, already hard pressed by competition from heavily subsidized food imports from the EU and the US, will be driven from their lands to make place for corporate farming" ("Genetic Imperialism").

To be sure, the developing world is witnessing the expansion of

GM crops, although progress in the "gene revolution" has actually been sporadic. Data compiled by the International Service for the Acquisition of Agri-Biotech indicate that the heaviest commitment to GM crop cultivation is in the United States, Canada, and Argentina, with China rapidly emerging as a significant locus of transgenic agriculture; approximately five million acres outside of these countries are committed to GM agriculture worldwide, according to a study recently completed by Fred Buttel of the University of Wisconsin, Madison. Buttel points out that "farmers have adopted transgenic varieties more rapidly than any agricultural technology in the history of the world," but also cautions that the GM "explosion" has to this point, from 1996-2001, been primarily limited to a relatively small number of nations and a restricted range of crops (Buttel). Although soybeans, corn, and cotton dominate, GM food and fiber sources range also to rape seed to chilis to papayas to petunias. Although globally there are specific areas of GM saturation, the overall escalation and spread continues. Because GM crops have generally delivered, at least in the short term, on their promise of higher yield with less reliance on chemical pesticides or herbicides, those who have embraced them have also thereby placed pressure on competing nations to embrace GM technology—in order to keep pace with the increased (GM) yield and therefore also the likely gain in market share—or to discover some other alternative to GM technology while also remaining agriculturally viable and competitive.

Because of its practical and symbolic significance during the colonial and "Quit India" periods of modern Indian history, cotton serves as an especially appropriate focus in the national and global maelstrom of information and emotion involving genetically modified organisms. The image of Gandhi sitting and spinning khadi is engraved on global consciousness, not just South Asian; Gandhi insisted that khadi is the soul of swadeshi, and that swadeshi is the essence of swaraj. Cotton is at the very core of Indian self-reliance and independence, and yet at present cotton serves as what some in India may perceive as the symbol of the nation's surrender to another wave of colonization. Efforts to introduce GM cotton into Indian fields have been publicized since the mid-1990s. Boll-resistant varieties of cotton, especially, have long been the dream of the cotton cultivators in India, and with the advent of Bt cotton[5] and its introduction into fields in the U.S., first, then other nations afterwards, it seemed that a tremendous boost to cotton production in India was at hand. However, resistance to GM technology on a variety of fronts posed serious obstacles to its introduction in India. Along with the usual skepticism involving potential (but as yet unsubstantiated) long term detrimental effects to the environment following from transgenic alteration of any life form, fear of declining biodiversity due to a zealous monoculture of any crop, fear of pest-resistant crops losing

their pest-resistant capability once parasites adapt to the engineered toxin produced by the plants themselves, fear of cross-pollination with non-GM crops, etc., there have been profound suspicions expressed about the small farmer being pushed from his land as the wave of corporate GM farming moves in to replace traditional methods of cultivation.

For example, in November and December 1998, the Karnataka State Farmers Association, in what became known as "Operation Cremate Monsanto," marched on four Monsanto Corporation field-test sites in Karnataka and then in Andhra Pradesh, pulled up the GM cotton plants, piled them high, and burned them. The organization issued a declaration that "those who have invested in Monsanto in India and abroad [must] take your money out now, before we reduce it to ashes" (Kingsnorth). The movement also evolved into the "Monsanto Quit India" campaign, launched on August 9, 1998, on the anniversary of Gandhi's "Quit India" proclamation; the effort has included mailing thousands of signed petitions directly to Monsanto headquarters. Members' expressed fears have centered on a "future in which farmers everywhere will be dependent on global corporations for their livelihood" (Kingsnorth). To further identify the anti-GMO movement in India with the Gandhian independence struggle, the Bija Satyagraha was launched on March 5, 1990, sixty-nine years to the day after Gandhi's Salt Satyagraha began. The Bija Satyagraha has claimed involvement of more than 1500 groups from across India, all bound by their shared opposition to new patent laws threatening to compromise local "control of seeds, medicinal plants, and traditional knowledge and heritage" ("Genetic Engineering Movement").

Suspicion and antagonism have been exacerbated by popular claims during the late 1990s that Monsanto had been "sneaking" GM plants into cultivation on farmers' property, then in late 2001 the Indian environment ministry brought a suit against Navbharat Seeds (Ahmedabad) for violating the Environment Protection Act (1986) by planting more than 11,000 hectares of unauthorized GM cotton. The crops were ordered burned by the Genetic Engineering Approval Committee (GEAC) since, at that time, no transgenic crops had been approved. The cotton seized and burned had been pirated from Monsanto, who owns the patent, but Monsanto could not prosecute Navbharat because Monsanto's own patent had not been recognized and protected in India (Jayaraman, "Illegal Bt Cotton"). The case highlighted the prospect of widespread unregulated use of GM technology, and encouraged Monsanto to press harder still for approval of their genetically modified seed, recognizing that only recognition of their patent and regulated cultivation of the crops would possibly offset violations of their intellectual property rights and ensure prosecution of unwarranted

biotechnologies.

After these initial public convulsions, covert introductions of biotech crops, and corporate pressures to act, in April 2002 the Indian government approved the introduction of the first transgenic crop: three varieties of Bt cotton, an insect-resistant hybrid developed by Monsanto together with its Indian partner Maharashtra Hybrid Seed Company (Mahyco), following field testing begun in 1996. The GEAC, under the Indian Ministry of Agriculture and Foods, granted approval to Monsanto-Mahyco for a three year period, with certain conditions to be followed, most notably that for every field where Bt cotton is planted there must also be a "refuge" (non-Bt area) of 20%;[6] enforcement of the refuge area is the farmer's responsibility, not the company's ("Approval").

Naturally, proponents of GM technology hail the Indian government's approval of GM cotton as a momentous and benevolent decision. As K.S. Jayaraman points out, by supporting the introduction of Bt cotton, advocates feel that India has clearly indicated that it is inviting farmers to use biotechnology "to raise their competitiveness towards the production levels of China and the U.S.," and the GEAC's decision could open the doors for growing more varieties of GM crops in India, thus also encouraging "fence-sitters in Asia such as Thailand to join in the GM race" ("India Approves"). There is little doubt that if the three year trial period proves encouraging, GM technology in India will spread geographically and then also include other crops, and registered successes will likely apply pressure to India's neighbors, as Jayaraman predicts. In fact, as a first concrete indication of the spread of GM technology within India, the GEAC appeared also on the verge of approving a GM mustard in November 2002, but then delayed its decision pending further review of field test data, a decision that annoyed the Proagro seed company (an Indian Aventis subsidiary), developer of three GM mustard varieties which, it maintains, offer a twenty percent yield improvement ("Proagro Upset").

The success of Bt cotton or other GM agricultural crops will, as biotechnology advocates emphasize, provide the benefits of increased yield with a decreased dependency on synthetic toxins. Advocates regard the technology as having enormous potential to offset hunger and alleviate poverty as drought- and pest-resistant foodstuffs and fibers are harvested in greater abundance and allow for a transition beyond mere subsistence farming. Future benefits of genetic modification seem almost unlimited, as the creation of "golden crops," for example, has suggested: Monsanto-funded research led by the mid-1990s to the development of "golden rice," a GM vitamin A-enriched grain that has the potential to significantly offset blindness, reduced immune function, and inability to absorb protein, all curses of the developing world; the more recent development of "golden" mustard and canola stands to extend

the same benefits to other areas of the world ("'Golden' Crops").

On the other hand, the corporations whose research and development lie behind the new GM products own the intellectual property rights to the transgenic seed. The corporations have aggressively protected their IPRs and they have of course done whatever possible to legitimately place their products in the global marketplace. As GM technology expands and the market share of GM products increases, a relatively small number of corporations stand to profit immensely. While it is clear that no individual, farmer, or state is literally forced to sow transgenic seed, the pressures of the marketplace and the promise of the new technology supply pressure (or opportunity) enough that the technology continues to expand rapidly, with no clear end in sight. Regarding its revolutionary potential, some contend that what physics was to the twentieth century, biotechnology will be to the twenty-first.

If the global progress of biotechnology be viewed as a "battle," then there are surely those within India, as elsewhere, who see the battle as far from lost. Most notably, within India the Navdanya movement has been especially active and vocal in its opposition. Directed by Vandana Shiva, the organization "believes that biological diversity cannot be conserved on the basis of centralized, globalized and hierarchical programs. Diversity and decentralization go hand in hand" ("Navdanya"). The organization seeks to halt the "colonization of seed" through such programs as maintaining community seed banks. As Shiva explains:

> in India we still have a lot of seed diversity. We do not [save seed] as a museum activity. I started Navdanya as a political act so that farmers would have free seed in their hands. Using that free seed they would be able to resist the kind of control system that the new corporations, corporate control, was trying to establish in India. Through these seeds they can establish sustainable organic agriculture again. ("An Interview with Dr. Vandana Shiva")

Aside from saving local seed, Navdanya also pushes for IPR legislation to protect local farmers' methods and knowledge.

It is precisely the farmers' loss of knowledge via corporate monopoly on seed that D. Parthasarathy points to in his "Globalization, New Agricultural Technologies, and IPRs":

> There are very real fears of farmers losing access to traditional knowledge and resources and becoming enslaved to multinational corporations who patent [seed] varieties....The loss of knowledge—which is a key community endowment and is used to prevent entitlement failures by providing the ability to adapt—is a major outcome of modern technologies and laws associated with them.

Parthasarathy cites the capability of the new technology to "perpetuate inequalities among groups within a community and between nations and economies," primarily through erosion of skills and loss of techniques. Those who stand opposed to globalized GM technology routinely cite loss of local skill and knowledge, insensitivity to local culture and physical environment, and loss of biodiversity as foremost concerns.

Following from their own suspicions about the economic, political, and possibly environmental effects of expanding global presence of genetically modified foods, representatives of the European Union have increased pressure on some developing nations to reject GM seeds and products, making economic aid in some cases contingent upon this refusal. Looking specifically to Zambia, where widespread hunger and famine have reached a critical point, U.S. Trade Representative Robert Zoellick recently labeled European attitudes and methods "immoral," as Zambian president Levy Mwanawasa refused 26,000 tons of U.S. food aid in October 2002, fearing GM contamination. Zoellick cited the "European anti-scientific view spreading to other parts of the world" as a clear threat to the best existing means to offset suffering ("'Immoral' Europe").

While the passion of advocates such as Zoellick is met by the passion of resistance movements such as Navdanya and the Pesticide Action Network-Asia and the Pacific (PAN/AP) which has become very active in the anti-GMO movement, GM technology continues its expansion. Although the potential for biotechnology to solve some significant problems of food production and nutrition is plausible and consistent with the Enlightenment-inspired commitment to Progress as science/technology-based utopia, the deep concerns over loss of autonomy and the retreat before increasingly powerful multi-national corporations are equally and simultaneously real. Ela Gandhi, granddaughter of Mahatma Gandhi, a peace and gender activist with the African National Congress and a member of the South African parliament, indicates that the ANC has not taken a stand staunchly opposed to GM technology, wishing to carefully weigh available evidence before doing so, but she echoes the concerns of others in formerly colonized regions:

> from the literature that I have received I've seen the harm the GMOs can do to biodiversity, the harm that it can do to self-sufficiency, because we will be forever dependent on somebody to give us seeds. It's a different type of colonialization because you can't make your own seeds any more. If you can't make your own seed you are dependent on them. They can set any price and you can't do anything about it in the end. That would be a total disaster for the world if that is what happens. ("Interview with Ela Gandhi")

While Monsanto emphasizes the tremendous potential benefits of "golden" mustard, for example, arguing that "successful development and adoption of golden mustard oil could help hundreds of thousands of children suffering from vitamin A deficiencies, particularly in northern and eastern India, where mustard oil is used for cooking," noting that "recent estimates are that over 18 percent of the children in India suffer some level of vitamin A deficiency" ("'Golden' Crops"), the recent intention of India's Genetic Engineering Approval Committee to authorize the introduction of GM mustard in north India was met with intense animosity and protests from activists and farmers in the Punjab. As Devinder Sharma complains, "The average citizen, who uses mustard for various purposes, including its common use as edible oil, for body and hair massage and for fodder purposes, is not even being consulted" ("GM Mustard").

The dislocation between popular opinion/local voice and the mandate of state or imperial authority is, of course, virtually timeless and ubiquitous, but in the case of India and the current tensions over corporate GM technology and national policy, it is tempting and perhaps instructive to note the parallel between the inroads being made by the biotech multinationals in India and the early history of the British East India Company's expanding power base. From the time of Akbar, European traders pressed the Mughal emperors for *farmans* (imperial directives) that would formally establish their status, trading privileges, and trading terms, allowing them to override the various local impositions, demands, refusals, etc. they invariably found themselves frustrated by in differing locales. The British East India Company solicited the Mughals until they finally received their *farman* from the emperor Farrukhsiyar in 1716. So significant was the document that it has often been referred to as the "Magna Carta of the East India Company." The original English translation of the farman, held in the British Library, declares that

> We hereby think fitt to grant [the Company's] request and confirm...that whatever Goods the Company imports or exports to or from all parts of India, shall be excused paying any Duty's...and we do hereby strictly charge you all to see that none attempt to Molest or interrupt the English Company in their Mercantile Affairs....That if the Company have a mind to settle a Factory in any part, you are to give them all reasonable assistance. ("A Translate of the Fhirmaund")

This "open door" declaration clearly assisted in the "Company's direct participation in the emasculation of the [Mughal] empire" (Keay 375).

The Indian government's ruling of April 2002 to approve of GM cotton cultivation may indeed be considered the "new farman." Following

localized field testing, product exhibitions, and tireless entreaties to the government, and in the face of much public resistance, Monsanto-Mahyco received the official approval/protection they needed. Should the three year trial period prove successful, as it likely will (despite some initial difficulties)[7], commitment to GM cotton cultivation will predictably expand and accelerate. The approval of additional GM crops, including, first, GM mustard, will likely follow. Also quite likely, the Indian economy will reap benefits following from an increased production of robust cotton, followed by other products, later. The alliance with Monsanto-Mahyco will have evident economic benefits. At the same time, the Corporation's profits and power base will be greatly enhanced, as well. Riding the privileges afforded by the 2002 "farman," as well as the protection and profits guaranteed by its intellectual property rights, Monsanto and its GM seed will literally represent the visible spread and deepening roots of its claim over Indian soil. Ironically, the vehicle of this expansionism is cotton, the product that provided a rallying point for and potent symbol of Indian anti-colonialism, independence, and national subsistence during the independence movement of the first half of the twentieth century.

Notes

1. Pacey discusses problems of accurately defining "technology"; he divides the concept of technology into several interrelated components: the organizational aspect, including administration and public policy, as well as the activities of designers, engineers, et al, and the concerns of users and consumers; the technical aspect, which includes technique, knowledge, the structure of machines, etc. (what most people probably think of when they hear the word "technology"); and the cultural aspect, which entails the values, beliefs, and habits of thinking that lie behind technology-practice, the cultural preparation that encourages and allows for creation and implementation of particular technologies (see especially chapter 1, "Technology: Practice and Culture," chapter 2, "Beliefs about Progress," and chapter 7, "Value-conflicts and Institutions.")

2. Postman subordinates western cultural history since the Middle Ages to three "great narratives": (1) that of religion, which assumes that Biblical explanations largely suffice to answer life's most difficult questions; (2) that of Progress, which assumes that information gathered about nature will lead to technologies capable of leading toward Utopia; and (3) that of information, which assumes that information is an end in itself (see *Technopoly*, chapter 4, "The Improbable World").

3. In *Machines as the Measure of Men*, Michael Adas cites as examples Julien Virey and Arthur de Gobineau in France, Johann Blumenbach in Germany, and Benjamin Kidd and A. H. Keane in England, several of the

numerous late 19th century voices that espoused racist ideology resting upon evidence of western European achievements in technological innovation (151-153). James Hunt, first president of the Anthropological Society of London, took exception to arguments for African equality with whites, challenging advocates to name one black African who had distinguished himself in any field. The categories he proposed had at their head "man of science" (301).

4. "Transgenic" denotes the splicing of at least one gene from an organism of one species to the genetic composition of another, unrelated species in the laboratory; distinguished from "hybrid," "transgenic" necessarily indicates the fusion of genetic material from organisms that could not be cross-bred naturally.

5. Bt, or bacillus thuringiensis, is an insecticidal bacterium that has been used extensively in farming for approximately the past half century. Since 1996 a number of agricultural plants have been genetically modified to contain the toxic gene from the bacterium.

6. The "refuge," an area of field free from the GM seed/crop, is designed to harbor susceptible insects, thus retarding the development of resistance to the Bt (or other selected) gene. However, there are common anxieties that without rigorous enforcement, farmers will not "give up" twenty percent of their crop to greater insect infestation. Failure to comply with the refuge regulations could well lead to the faster emergence of Bt-resistant pests.

7. During the first year of approved GM cotton cultivation, there have been reported problems with both pest resistance and with adequate yield in central India; Monsanto blames the difficulties on drought, not flaws with the seed technology.

Works Cited

Adas, Michael. Electronic correspondence. Feb. 5, 2001.

—. *Machines as the Measure of Men: Science, Technology, and Ideologies of Western Dominance.* Ithaca: Cornell UP, 1989.

"Approval of First Transgenic Crop: Bt Cotton in India." *Enviro News* 6 (April-June 2002) <http://envfor.nic.in/news/aprjun02/aftcbci.html>.

Buttel, Fred. "The Adoption and Diffusion of GM Crop Varieties: The 'Gene Revolution' in Global Perspective, 1996-2001." *Program in Agricultural Technology Series,* Paper No. 6, March 2002 <http://www.wisc.edu/pats/pubsp.htm>.

"Genetic Engineering Movement in India—'Bija Satyagraha.'" *Environment News Service* <http://liberated.tao.ca/399indiaseeds.htm>.

Headrick, Daniel. Electronic correspondence. January 22, 2001.

—. *The Tools of Empire: Technology and European Imperialism in the Nineteenth Century.* New York: Oxford UP, 1981.

"'Golden' Crops: Part of a Sustainable Solution to Global Vitamin A Malnutrition." *Monsanto: Imagine* <http://www.monsanto.com/monsanto/layout/media/oo/12-07-00c.asp>.

"'Immoral' Europe." *Wall Street Journal* 13 Jan. 2003: A10.

"An Interview with Dr. Vandana Shiva." *In Motion Magazine* <http://www.inmotionmagazine.com/shiva.html>.

"Interview with Ela Gandhi: The Gandhian View on Sustainable Development." *In Motion Magazine* <http://www/inmotionmagazine.com/global/eg1.html>.

Jayaraman, K.S. "Illegal *Bt* Cotton in India Haunts Regulators." *Nature Biotechnology* 19 (December 2001): 1090.

—. "India Approves GM Cotton." *Nature Biotechnology* 20 (May 2002): 415.

Keay, John. *India: A History.* New York: Grove, 2000.

Landow, George P. and Paul Delany. "Hypermedia and Literary Studies: The State of the Art." *Hypermedia and Literary Studies.* Eds. Landow & Delany. Cambridge: MIT, 1991. 4-19.

Lenin, Vladimir. *Imperialism, the Highest Stage of Capitalism.* 1917. Beijing: Foreign Languages, 1965.

Mariano, Rafael. "'Genetic Imperialism' and 'Bio-Serfdom': The Implications of Genetic Engineering for Farmers and Agriculture." <http://www.mindfully.org/GE/Genetic-Imperialism-Bio-Serfdom.htm>.

McLuhan, Marshall. *Understanding Media.* New York: Mentor, 1964.

Mumford, Lewis. *Technics and Civilization.* 1934. New York: Harcourt, 1963.

"Navdanya." <http://www.vshiva.net/navdanya.htm>.

Pacey, Arnold. *The Culture of Technology.* Cambridge: MIT, 1983.

Parthasarathy, D. "Globalization, New Agricultural Technologies and IPRs: Implications Of Modern Biotechnology and Genetic Engineering for Capabilities, Exclusion and Livelihoods in Developing Countries." <http://dlc.dlib.indiana.edu/documents/dir0/00/08/97/dlc-00000897-00/parthas>.

Postman, Neil. *Technopoly: The Surrender of Culture to Technology.* New York: Vintage, 1992.

"Proagro Upset Over Delay in GM Mustard Decision." 9 November 2002 *Busines Line: Internet Edition of the Financial Daily from THE HINDU Groups of Publications.* <http://www.blonnet.com/2002/11/stories/2002110901301100.htm>.

Sharma, Devinder. "GM Mustard: Playing Havoc with the Food Chain." 12 November 2002 *Business Line: Internet Edition of the Financial Daily from THE HINDU Group of Publications.* <http://www.Blonnet.com/2002/11/12/stories/2002111200040800.htm>.

Teilhard de Chardin, Pierre. *The Phenomenon of Man.* New York: Harper, 1959.

"A Translate of the Fhirmaund Granted by the Great Mogull Furrukseer to the English Company,...5th January 1716." Ms. H/misc/632. British Library, London.