# Global Rifts Over Biotechnology:
## What Does India's Bt Cotton Experience Tell Us?

Ronald Herring

IEG Distinguished Lectures 1

सत्यमेव परमो धर्मः

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**V. T. Krishnamachari Memorial Lecture**

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# INSTITUTE OF ECONOMIC GROWTH

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This paper is based on Ronald Herring's V.T. Krishnamachari Memorial lecture delivered on December 2, 2009. The first VTK lecture was given by V.K.R.V. Rao in 1984. Subsequent speakers included K.N. Raj, P.N. Dhar, André Béteille, M.S. Swaminathan, C. Rangarajan, Richard Norgaard, and Ashis Nandy.

Sir V.T. Krishnamachari (1881–1964) was the first Deputy Chairman of the Planning Commission and made major contributions to India's first two Five Year Plans. Prior to that, he served as the Dewan of Baroda (1927–1943) and drew up detailed plans for rural development in the state. Later he served as Prime Minister of Jaipur state. In 1933, he was knighted by the British government. Sir Krishnamachari was a delegate to all the three Round Table Conferences held in pre-Independence India during 1930–1932, and to the League of Nations during 1934–1936. He was also a member of the Constituent Assembly of India.

Sir Krishnamachari wrote several books including *Planning in India: Theory and Practice* (New Delhi: Orient Longmans, 1961), and *Fundamentals of Planning in India* (Calcutta, Madras, New Delhi: Orient Longmans, 1962). Maurice Zinkin, in his 1963 review of the latter book in *International Affairs* 39 (3): 467–68, wrote: 'Sir V.T. Krishnamachari is the most distinguished of India's older administrators …. [and] uniquely qualified to explain how the Indian plans are put together, how conflicting interests are reconciled and how the achievement is evaluated. Nobody has ever done it better. What is more important still in Sir V.T. Krishnamachari's book, however, is that it also reveals the underlying political process which has been at work'.

We hope the papers in this distinguished lecture series will provoke further debate on cutting-edge issues that are of current significance for our economy, polity and society.

Bina Agarwal, Director IEG
December 2009

## RONALD HERRING

Ronald Herring is Professor of Government at Cornell University. He has taught political economy and political ecology at Cornell since 1991, where he has been Director of the Mario Einaudi Center for International Studies and Director of the South Asia Program. He has also held the John S. Knight Chair of International Relations, and headed the Department of Government. He has been editor of *Comparative Political Studies*, and remains on its editorial board. Among his many writings are several books including *Land to the Tiller: The Political Economy of Agrarian Reform in South Asia* (Yale UP and Oxford UP, winner of the Edgar Graham Prize); *Carrots, Sticks and Ethnic Conflict: Rethinking Development Assistance* (ed. with Milton Esman, University of Michigan Press); and *Transgenics and the Poor* (Routledge). He has written extensively on genetically engineered organisms and, along with Ken Roberts, is team leader of a project on 'Contentious Knowledge: Science, Social Science and Social Movements, 2006-2009'. He is currently editing a new *Handbook of Food, Politics and Society* for Oxford University Press. On himself he writes: 'His origins, if not his heart, lie in Texas'.

# Global Rifts over Biotechnology:

## What Does India's Experience with Bt Cotton Tell Us?[1]

*The primal global rift around genetic engineering is between agricultural crops and all other uses, such as pharmaceuticals and medicine. Agricultural crops alone have been segregated into an object of politics and governance termed 'GMOs' (Genetically Modified Organisms). This framing is ensconced in contentious politics, law and trade, and whether or not the cultivars are used in food. A second, and logically derivative, global rift divides rival advocacy networks supporting and opposing GMOs—that is, agricultural biotechnology. This rift is politically charged and administratively consequential. It hinges on two inter-related dimensions: bio-property and bio-safety. Global opposition forms around critiques of genetically engineered crops on both dimensions. New claims of intellectual property in seeds enabled by the genomics revolution in biology created conflicts over what can be owned, by whom, under what conditions, and in which nation. Claims of novelty by firms seeking intellectual property reinforce a further aspect of contention: if novel, might products of genetic engineering raise special risks in comparison with cultivars bred by different techniques? Transnational advocacy politics succeeded in framing 'GMOs' as uniquely risky plants, with corresponding global soft law for special regulation. Farmers have responded to restrictions of both regulation and property claims with stealth strategies. The widespread adoption of Bt cotton in India illustrates why and how evasion of both bio-property and bio-safety regimes is pervasive globally. Such grassroots challenges to formal institutions embarrass both sides of the global rift; neither bio-property nor bio-regulations prove so robust as antagonists in advocacy networks contend. The Indian experience also uncovers a fundamental contradiction in mobilization to halt diffusion of biotechnology in agriculture. Successful demands for stronger regulation of transgenics strengthen property-like rights of multinational firms that find it difficult to enforce their property claims in any other way. Bio-safety regulation often functions as bio-property.*

1 This paper is a revised version of presentations made at Princeton University in February 2009 under the title: The GMO as Generative Frame: Global Networks, Contested Science, and Epistemic Brokers, and at the Pontifical Academy of Sciences, The Vatican in May 2009, under the title: `Opposition to Transgenic Technologies'. My debts to colleagues in India and elsewhere are deep and are expressed in my published work on this topic.

## The Nature of the Rift: Rival Networks

His Royal Highness Charles, the Prince of Wales, stated in 2008, in Delhi: 'I blame GM crops for farmers' suicides.'[2] The declaration seems at first blush counter-intuitive: where affordable and available, farmers have adopted transgenic crops rapidly and widely over the last twelve years. India in particular has seen very rapid and broad-based adoption of Bt cotton. In much of the world, farmers have purchased new seeds at premium prices, mobilized politically for access to biotechnology, and frequently planted illegal 'stealth' seeds, even at risk of prosecution.[3] Few, if any, innovations in agriculture have spread so rapidly across the globe. Why would people whose livelihoods depend on planting the right seeds select ones that are driving their neighbours to suicide? Why would rural people, who are typically disadvantaged in formal-legal institutions, take risks in acquiring and planting illegal seeds unless they had good reasons to expect rewards in the fields? Farmers adopting underground seeds conform to a pattern of resistance to global property regimes—and, in the case of agricultural transgenics, soft-law bio-safety regimes as well—but this behaviour is more likely to indicate concrete interests in the technology than a death wish.[4] But then the question for Prince Charles becomes doubly puzzling: why would farmers assume the risk of illegal activities to put themselves and their families on a suicidal path? Does global diffusion of agricultural biotechnology indicate false consciousness on the part of farmers? Are they duped? Innumerate? Incapable of learning?

Prince Charles did not concoct his conclusion from whole cloth, nor is he alone in his outrage over the continuing holocaust of poor farmers

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2 Geoffrey Lean, "Charles: 'I blame GM crops for farmers' suicides." *The Independent*. 5 October 2008. By 'GM' he means products of recombinant DNA techniques, not other forms of genetic modification such as protoplast fusion or mutagenesis.

3 See, e.g., James 2008; Jayaraman 2001; 2004; Joshi 2003; Roy et al. 2007; Herring 2007b; Herring 2009a.

4 Moises Naim (2005) subtitles his book *Illicit* with a strong claim: *How Smugglers, Traffickers and Copycats are Hijacking the Global Economy.*

at the hands of GMOs. Widespread anxiety and outrage drive a politics that has divided the world into 'GMO-free' and 'GMO-friendly' nations, counties, departments and farms.[5] This essay will argue that the strategy to halt global diffusion of agricultural biotechnology succeeds—though differentially and intermittently—because of diffusion of authoritative knowledge claims in transnational advocacy networks. Both elements are critical: diffusion could not happen without the networks, and the content of the political attack on transgenics could not have power without authoritative knowledge claims. The suicide narrative is such a claim; its common features include monopoly pricing, dependency, debt and agrarian crisis exacerbated by failure of biotechnology in the fields. Claims of 'bio-serfdom' and 'bio-feudalism' mark the subjugation of the peasant to intellectual-property regimes. This *bio-property* narrative is functionally related to a critique invoking *bio-safety*: if transgenic seeds are novel enough to claim patent protection in some countries, are they not novel enough to be especially risky? These two strands—bio-property and bio-safety—are linked in global resistance to a special construction of agricultural biotechnology: the 'GMO' (Herring 2008a). The GMO is political shorthand for any agricultural product involving recombinant DNA (rDNA) techniques. The single most politically efficacious culmination of this merger is the positing of so-called Terminator Technology, or 'Monsanto's Terminator gene,' that renders second generation seeds sterile. The terminator in theory would marry commercial control of bio-property to unnatural processes constructed by Prince Charles as realms that 'should be left to God and God alone.'

Narratives may have independent political power—consider 'weapons of mass destruction' as a reason for support of a war of aggression in Iraq—but durable effects result from embedding values in institutions. Institutions in turn affect incentives for actors, and thus alter outcomes over time. As a result of the primal rift, the GMO was

5 On Europe, see www.gmo-free-regions.org. (accessed April 2009).

invented as an object of governance, then enmeshed in global regulatory institutions that increased its vulnerability to opposition by networks of skilled advocates. We will discuss below the Cartagena Protocol as an outcome of advocacy politics that reified the bio-safety narrative for some products of genetic engineering but not others. Networks opposing biotechnology have succeeded in much of the world through diffusion of powerful knowledge claims around bio-safety and bio-property and the use of global soft law reflective of Cartagena. Rival networks promote diffusion of biotechnology with similar appeals to authoritative knowledge. *AgBioWorld*, for example, introduces its website text with: 'More than 3400 scientists support the use of biotechnology to improve agriculture in the developing world, including 25 Nobel Prize winners' (http://www.agbioworld.org/). Corporate claims diffuse through these networks and associated public forums. These political forces reflexively form each other. Much of the dialectic is precisely mirrored: the anti-biotech narrative perfectly inverts, for example, proponents' framing of authoritative knowledge—from 'GMOs: Tested and Safe' to 'GMOs: Unsafe and Untested.' Unlike control of international air traffic or infectious diseases, no authoritative knowledge provides consensual norms for products of genetic engineering (Jasanoff 2005), nor is there any consistent property regime across nations.

Each network claims success. Some nations have approved (25 officially)[6] or promoted biotech crops through the logic of the developmental state: China first and most vigorously. Many others prohibit these crops or regulate so heavily as to effectively ban agricultural biotechnology (Potrykus 2004; Paarlberg 2001). From initiatives in civil society, 'GMO-free zones' have been created around

6 The usual authoritative source is James 2008 and his ISAAA updates. James' data are criticized by opponents for reflecting pro-GMO bias. My critique is that the official data seriously understate diffusion of agricultural biotechnology for reasons of evasion—stealth seeds—discussed in the text. The figure 25 does not, for example, include a number of countries where transgenics are known to be in use—Vietnam, Thailand, Pakistan, Ukraine come to mind just from my own experience.

the world. Europe after 1998 has been the epicenter of opposition to agricultural biotechnology, but moratoria are contested globally—from India to California, Poland to Japan—often through diffusion of this spatial tactic. Table 1 indicates the growth of 'GMO-free zones' in Europe between 2007 and 2009.

Table 1: GMO-Free Resolution Signed by European Regions[1] by Political Unit: 2007 And 2009

| | 2007 | 2009 | % Change |
|---|---|---|---|
| Region | 167 | 196 | 14.8 |
| Provinces, Prefectures & Departments | 53 | 93 | 43.0 |
| Local Governments | 4,278 | 4,567 | 6.3 |
| Individuals | 27,100 | 30,370 | 10.8 |

*Source:* www.gmo-free-regions.org. Accessed April 2009

[1] The EU has specific designations of regions defined by the Assembly of European Regions (AER)

Although much of the political discourse poses a North-South architecture of contention around the second global rift, the axis exhibits neither income nor areal clustering. The top five nations utilizing transgenic crops after the United States are Argentina, Brazil, India, Canada and China (James 2008). The three most recent countries to legalize transgenics formally are Slovakia, Burkina Faso and Egypt. Although there is a distinctive European politics of aversion to foods produced from transgenic plants, and a distinctly American politics of pressure for expansion of agricultural biotechnology, fissures within and across these divides do not follow any neat pattern of risk perception. India for some time was poised between these two positions, until becoming on 26 March 2002 the sixteenth nation in the world to de-regulate a transgenic cultivar: Bt cotton. What light does India's experience shed on the politics of the global rift? We first consider how the rift came to be, then look to India's experience as influenced by and influencing global claims in the rift. In this exploration, intermediaries of knowledge, or what I will call epistemic brokers, played a significant role.

## Etiology of the Rift

The primal global rift surfaced in the process of deciding how to frame, understand, and govern products of genetic engineering. By 1973, molecular biology had developed new capacity to move discrete genes across species, through recombinant DNA techniques (rDNA), creating new organisms. As with all novel technologies, alternative frames were both available and arguably necessary to provide meaning and valence. Transgenic techniques might be framed either as radically unnatural or as a continuation of plant genetic modification with more efficient tools (McHughen 2000; Winston 2002). Scientists working with rDNA techniques expressed early concerns about the ethics, regulatory implications, responsibilities and best practices for utilizing new and powerful techniques; the Asilomar conference followed in l974 in California. However natural or unnatural, property in these biological inventions became possible in 1980 in the United States, the global promulgator of strong property rights. The U. S. Supreme Court, in a close 5-4 decision, ruled in *Diamond v. Chakrabarty*[7] that a bacterium (genus *Pseudomonas)* engineered to clean up oil spills by Ananda Mohan Chakrabarty could be patented. This decision added the specter of corporate control of new forms of property in nature to worries about the safety of the new technology itself. *Pseudomonas* had important environmental applications but was created with a then-novel technology and opened a new field for commoditization. Such products were subsequently normalized globally. But, in agriculture, rDNA technology generated a politically charged divide eventually pitting novel threats against technological promise: FrankenFoods versus a solution to the Malthusian dilemma of global hunger (Pinstrup-Anderson and Schiøler 2000).

7 United States Supreme Court 447 U.S. 303 (1980) No. 79-136 Argued 17 March 1980; Decided 16 June 1980. Certiorari to the United States Court of Customs and Patents Appeals.

Inventions of the sort patented by Chakrabarty have entered species life with little disruption; industrial uses of rDNA technology do not raise a global protest. But in cultivars, transgenic plants are widely held to produce novel threats in comparison to existing plants, necessitating at least surveillance and regulation, perhaps prohibition. This frame of unique threat is now so thoroughly naturalized that it is easy to miss its fundamental dependence on a prior framing: the invention of a special category of plants called 'GMOs.' The GMO frame was constructed through both lumping and splitting of rDNA technologies. Most important, the frame excluded transgenic organisms in fields other than agriculture, both plant and animal. In agricultural crops, products of rDNA technology were lumped together into one ominous category, regardless of trait, genetic event or species (Herring 2008a). This framing outcome is critical in a path-dependent way. Without this framing, there could be no targeting (and torching) of GMO test plots, or campaigns against GM-food, or mobilization for GMO-free zones.

The GMO frame is now dominant in political discourse, media usage and law. Alternative framing is equally plausible biologically. Genetic modification of plants has always involved putting new traits into existing cultivars (McHughen 2000: 80-84, *passim*). Some of these techniques—prior to rDNA technology—are quite radical, invasive and 'unnatural' by the standards of Gregor Mendel; all involve genetic modification (Miller and Conko 2000). The GMO frame splits some forms of genetic modification from others, and classifies plants by how traits got into the organism, not by characteristics of the plant itself. A conventionally bred potato, for example, may contain toxic levels of solanine but requires no special regulatory regime, labeling or even testing. Since there are risks of gene flow and other ecological disturbances from introduction of all new cultivars into agricultural systems, and all plant breeding involves alteration of a plant's genetic material, plausible policy could center on specific risks of particular traits, in particular plants, and particular ecologies, regardless of how the trait got into the plant. In the *Agbios* data base of 2008 (http://www.agbios.com/main.php), for example, 14 traits from transgenes had been commercialized globally—insect resistance, virus resistance, fatty acid composition, pro-Vitamin A production, for example. In total, 45 different transgenes representing 117 unique genetic events had been inserted into 22 crops by 2008. The permutations are quite large, and each may raise different issues of regulation: cotton, for example, represents little risk of gene flow to wild and weedy relatives in comparison with rice.

Lumping and splitting alter regulatory and political responses, and thus the interests of actors. We normally avoid lumping 'chemicals' as an object of governance, but instead disaggregate chemicals into meaningful categories: useful, poisonous, inert, allergenic, unknown, tasty, etc. Likewise, disaggregation of transgenic plants would yield a different set of political possibilities. The 'sustainable-development' frame, for example, is globally authoritative, well-funded and widely shared in advocacy networks concerned with human welfare. Synthetic insecticides are the iconic non-sustainable treadmill technology. Insecticides increase farmers' costs, drive development of pest resistance, and have especially deadly effects on field laborers in poor countries and in fragile agro-ecologies generally (Shelton 2007; Jeyaratnam 1990; Pray et al. 2002).The second most prominent transgenic trait is insect-resistance. Specifically, Bt technology claims to reduce pesticide applications and externalities by enabling plants to manufacture insecticidal proteins in their own tissues, targeted on specific pests. There were questions from the beginning. Would Bt technology work? Would insect resistance develop quickly? Would its ecological effects be better or worse than existing synthetic sprays? These were big questions, difficult to answer without extensive field testing.

Responses to Bt technology illustrate the power of framing. Before there was systematic evidence on actual results in cropping systems, Bt crops were opposed in coalitions for which sustainable agriculture and development are primary goals. Because introduction of the insect-resistant trait into Bt plants involved genetic engineering, the plants were coded as 'GMOs.' Even field trials to determine environmental effects were opposed, and sometimes destroyed (Boal 2001). In some networks, GMO threats were held to be so obvious that field tests were seen as both pointless and dangerous (Shiva, Emani and Jafri 1999). The global Pesticide Action Network, for example, pursues sustainability specifically through reductions in pesticide use, but rejects Bt crops (Pesticide Action Network International 2007). The utility of the trait—insect resistance—was eclipsed by how the trait was introduced. Exclusion of Bt technology from a sustainable-development frame depended on this decisive framing and its centrality to oppositional networks: one technique for modifying plants was unacceptable, whatever its utility to the farmer or environment. Finding out about these effects was complicated by direct attacks on field trials or court action to block them. One of these actions, in the Karnataka state of India (Adur village, Haveri *taluq*), was resisted by a farmer who did not want his field burned and provided decisive refutation of the movement's claims about terminator technology, but his experience had no impact on 'Operation Cremate Monsanto,' as discussed below.[8]

To illustrate the arbitrary nature of the GMO frame, one might compare a parallel means of genetic modification of plants that escapes the GM stigma: mutagenesis. Mutagenesis employs chemicals such as ethyl methanesulfonate or dimethyl sulfate, or radiation, or transposons to rearrange plant DNA. The object is to induce more mutations with which breeders can work; disruption of plant genetic material may well be more extensive than in transgensis, which typically involves insertion of limited quantities of DNA, often a single gene (Batista et al. 2008). This was the case of first-generation Bt cotton in India. Mutagenic cultivars receive no special regulation or political attention; they are unlabeled, acceptable in global commodity trade, thoroughly naturalized. Moreover, mutagenesis is used by the same multi-national life science

8 On the movement and farmer organizations, Madsen 2001; Herring 2005; and Omvedt 2005. On the controversy generally, see Shantharam (2005).

firms as transgenesis. The initial lumping and splitting of technologies that produced the 'GMO' was only one among many possible outcomes, but it is the outcome that defines the rift.

Invention of the GMO as an object of special suspicion and regulation coincided with and enabled a decisive shift in European law and policy, which in turn altered incentive structures for farmers and nations trading agricultural crops with Europe.[9] Initial enthusiasm for transgenic technology in Europe was replaced by increasingly restrictive practice towards agricultural transgenics in the late 1990s and early 2000s. This outcome was in no sense inevitable—indeed, it is the obverse of regulatory practice in the United States. Authoritative framing of transgenic crops evolved over time in Europe, reflecting interactions among firms, social movements, industries, public perceptions of risk and institutions of governance in a specific historical context.[10] Biotech firms, for example, walk a fine line in co-production of the frame: to claim intellectual property, they must claim novelty; to avoid anxiety, they must claim continuity with 6,000 years of plant breeding. Moreover, history matters. The European U-turn on molecular plant breeding in 1999 was a conjunctural lucky hit for opponents of genetic engineering. The Bhopal gas disaster (1984) in India, the Chernobyl nuclear accident (1986) in Ukraine, coupled with 'mad cow' disease (bovine spongiform encephalopathy, 1986) in Britain, along with other instances of regulatory failure, eroded trust in government, science, and assurances of safety from the state.

Nevertheless, even in this period of intense activism, skepticism about official science and corporate control did not apply to all transgenics. Pharmaceuticals produced by rDNA techniques—beginning with human insulin in 1978—were exempted from the GMO frame. There was no mass mobilization for banning genetically

9 Barboza 2003; Paarlberg 2001; Tiberghien 2007; for definition, see 'The European Parliament and The Council.' Off. J. Eur. Commun. (L106) (2001), 1-38.

10 Tait 2001; Chataway, Tait, and Wield 2006; Bonny 2003; Jasanoff 2005.

engineered pharmaceuticals. As a consequence, global trade has not been segmented around 'GM drugs;' that category, that object of governance, does not exist, although the use of recombinant DNA technology is common in pharmaceuticals, and indeed much supported by public opinion in Europe (Gaskell et al. 2006: 15-22). Despite trade disputes over livestock feed containing transgenic elements, Europe is a leader in some fields of rDNA technology. To take a recent example, an anticoagulant protein derived from the milk of transgenic goats with a human gene in their mammary glands—ATryn—was approved in Europe three years before the Food and Drug Administration approved it in the US in 2009 (Kling 2009). Only transgenic seeds, only agricultural biotechnology, carry the stigmata of the GMO. There are no FrankenPills on posters.

## European Logics of Pragmatism: Splitting the rDNA Frame

Opposition activists in Europe began with and found special resonance for the construct of 'GM-foods.' Anxiety around food is easily aroused, with good reason. Lives depend on keeping *Amanita verna* separate from supermarket mushrooms. Once introduced into international trade in the 1990s, food products relying in whole or part on plants bred with molecular techniques were branded 'GMOs' by activists. GM-foods were targeted by pre-existing coalitions of American and European groups opposed to corporate power and irresponsibility, particularly in environmental issues (Schurman 2004; Schurman and Munro 2006). Mobilizational success was dependent in part on the structure of the food industry in the UK in particular, and Europe generally, and, as critically, on a recognition of this structure by activists (Lezaun 2004). Once major distributors claimed to have GM-free food, competitors felt compelled to follow suit. Both state and farmers in France, for example, originally considered biotechnology to be essential for maintaining global economic competitiveness. Erosion set in with reframing of agricultural transgenics in terms of environmental risks, corporate (especially American) power and threats to culturally validated food norms.[11] European policy was profoundly affected, though the shifts in public opinion were not dramatic; mass-public knowledge of genetic engineering had neither depth nor complexity (Gaskell et al. 2006).

'GM-food' triggered regulatory oversight in Europe, but the category does not exist in the US regulatory scheme. The U.S. Food and Drug Administration asks instead whether or not foods from transgenic crops are 'substantially equivalent' to non-transgenic equivalents (Council for Biotechnology Information 2001; Miller 1999). It is the product, and its effect on human biological processes, that matters. If one finds the same range of variance by gross measurement in foods from transgenic and non-transgenic crops, there is no justification for a special category of food in American law. If the food is safe, it is safe, regardless of the process by which the cultivar was bred. Are foods from transgenic crops 'substantially equivalent' to other sources, or sufficiently different to warrant extra caution, labels and a separate regulatory schema? Or does the EU threshold for triggering the GMO designation of 0.9% transgenic content in food make foods safer?[12] Regulatory institutions themselves become focal points for mobilization: are they adequate? Who chooses regulators? Are there too many scientists, too few citizens on panels? Why should results be trusted? The answer for all of us depends on who we trust, hence our common dependence on authoritative knowledge, which in turn is heavily dependent on the networks in which we participate. Our dependence reflects the very high information costs in confronting technical expertise.

Splitting food products from other recombinant products was politically prudent. No rational activist mobilizes against drugs that the medical profession claims to be life-saving. Physicians are authoritative figures; from state regulation and elaborate socialization, people tend to

11 Bonny 2003; Sato 2007: 47-78; Gaskell et al. 2006: 51, passim; Fukuda-Parr 2007: 27-28. The regulatory and conceptual splitting of biotechnologies also coincided with the political economy of powerful corporate interests in Europe (Graff, Hochman and Zilberman 2009).

12 See Weighardt 2006 for an argument that the EU standard is incoherent in a scientific sense, as well as arbitrary and unenforceable.

trust their prescriptions. Ironically, pharmaceuticals constitute a sector in which risks are quite high; authoritative knowledge has often proved inadequate or worse (thalidomide and Vioxx are cases in point). But consumers expect drugs to come with risks, like surgery or air travel. European public opinion on novel and potentially risky technologies has been similarly pragmatic rather than ideological (Gaskell et al. 2006: 27-8; passim). The so-called 'white' (industrial) biotechnologies, like the 'red' (medical) biotech applications, are widely supported in Europe. Industrial applications in degradable bio-plastics and bio-fuels are supported, even to the extent of favouring government subsidies for development. Even 'pharming,' whereby pharmaceutical products with mammalian activity are produced by genetically engineered plants, has more European supporters than opponents, in every country except Austria (*Ibid*.: 24-26; Figs. 8, 9). 'GM-food' is unpopular, but of the possible benefits recognized in sample surveys, three reasons for purchasing it are all plausibly related to utility: less pesticide residue, nutritional benefits, and general environmental protection (*Ibid*.: 69-71; Fig. 32). Table 2 illustrates how little difference there is across the Atlantic divide on public optimism concerning technical change–except nuclear power.

Table 2: Optimism Concerning New Technologies

| | *Do you think each of the following technologies will improve our way of life in the next twenty years?* | | |
|---|---|---|---|
| | *% affirmative* | | |
| | Europe | US | Canada |
| Computers and IT | 82 | 86 | 83 |
| Biotechnology | 75 | 78 | 75 |
| Nanotechnology | 70 | 71 | 68 |
| Nuclear Energy | 37 | 59 | 46 |

Adapted from Table 14, p. 83, EB64.3 2005

*Source*: Gaskell et al. (2006)

The European approach to cost-benefit logic in assessing the risks of the new technology was eclipsed in a global diffusion of the GMO frame: only risk was diffused broadly in many parts of the world. A decisive step came with the global soft law governing transgenic crops, supported by the EU's collaboration with transnational advocacy networks and low-income countries (Tiberghien 2007: 60-63; Falkner 2000). Cartagena reified the rift.

The Cartagena Biosafety Protocol was passed in 2000, and brought into force on 11 September 2003. The Protocol slightly modified Europe's *Genetically Modified Organism* into the *Living Modified Organism*, but followed the same lumping frame, as opposed to the splitting logic of the United States (which opposed the Protocol). The core assumption of the Protocol—indeed its *raison d'etre*—is that rDNA techniques in agriculture pose more potential risk than other means of transforming cultivars. That a *bio-safety* protocol is needed for some plants and not others reinforced the threat scenario of the GMO. By producing an authoritative segregation of transgenic plants from all others globally, Cartagena generated nodes for mobilization and institutional development across national boundaries; it altered the political opportunity structure. Its very existence links regulation of rDNA plants (but not rDNA pharmaceuticals) to environmentalism, as Cartagena is formally a Protocol under the Convention on Biological Diversity. Although there is no evidence of environmental damage to date (Thies and Devare 2007), Cartagena expanded the ambit of anxiety and globalized special status for surveillance and governance.

The institutional map remade by Cartagena creates highly-specialized regulatory nodes, producing administrative choke points.[13] These nodes enable relatively small numbers with appropriate knowledge and skills to have disproportionately large political effects. Moreover, bio-safety

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13 Choke points derive from the same structural metaphor as 'bottlenecks,' but with stronger connotations. Military strategy has employed choke points to defeat superior forces with few soldiers; Thermopylae is a classic case.

institutions must be created, but every step of creation can be challenged in the courts, which provide choke points in all institutionalized political systems. Regulatory institutions are difficult to construct, especially in countries with little expertise in this still-esoteric field. Inertia works against approval. If a nation 'lacks capacity' to create mandated institutions, biotechnology cannot proceed, at least openly. The absence of bio-safety laws and institutions has meant delays in official authorization of transgenics in many countries (though farmers are not always so legalistic). Intra-governmental differences in interest have likewise delayed or blocked institutional development; for example, because of their constituencies, ministries of the environment typically offered more resistance to GMOs than ministries of agriculture.[14] Ironically, the legal hurdles created by bio-safety regulations dramatically increase the cost of deploying new seeds, and thus become functional equivalents of property; only large firms with deep pockets and testing expertise—multinational life science corporations—can surmount hurdles that block small and local seed companies. Bio-safety regulation functionally substitutes for bio-property. Bt cotton in India provided an archetypal case (Herring and Kandlikar 2009).

Predictable difficulties in creating regulatory institutions—whether for lack of capacity or political opposition—not only slow diffusion of transgenic crops by directing interests of firms toward other sectors and places, but offer significant resources to oppositional networks. The World Bank, the EU, bilateral aid programmes, the UNEP and other international funders have programmes for building 'bio-safety capacity.' Capacity-building may mean foreign training for activists—and thus patronage resources for NGOs in the network—in tightening regulations so as to block approval of transgenics (Paarlberg 2008: 117-134, passim). Cartagena logic created niches for salaried employees and consultants in global regulation, education, and testing activities—what Bownas

14 Transgenic soy in Brazil created a conflict over what expertise would control the choke point of bio-safety approval. Lula's Agriculture and Environment ministries contested the terrain from opposite positions. Herring 2007b: 140-145. More generally, Pray and Naseem 2007; Paarlberg 2001.

(2008) calls the 'technocratic NGOs.' These are material consequences of framing and they produce incentives for actors.

### *Diffusion of the Threat Construction: Epistemic Brokers I*

The threat construction of the GMO connected the two strands of bio-property and bio-safety: threats to national independence, in the form of dominance of agriculture by multinational corporations; threats to farmers, in the form of bondage to monopoly seed corporations ('bio-serfs,' 'bio-feudalism'); threats to nature, in the form of 'biological pollution' (horizontal gene flow); and threats to human health, in the form of undiscovered allergens.[15] Resonance of anxieties was conditioned by fears of neo-colonialism. Intellectuals in the ex-colonial world made critical contributions to theorizing genetic engineering as especially catastrophic for development (Shiva 1997). Diffusion of this intellectual work was facilitated by international non-governmental organizations (INGOs) such as Greenpeace International and Friends of the Earth International. INGOs carry considerable authority: their imprimatur ratifies authoritative knowledge, particularly in fields where complexity and distance from everyday knowledge limit access to information. Within networks and between networks, intermediaries—or brokers—translate information into terms useful for political action.[16] A prominent broker of knowledge about genetic engineering, for example, is Mae-Wan Ho (2000). Her book *Genetic Engineering* elaborated 'serious hazards inherent in the technology.' The book's sub-title query—'*Dream or Nightmare*?'—was answered decisively on the nightmare side. The sub-sub-title was: *Turning the Tide on the Brave New World of Bad*

15 On the intellectual work involved in theorizing the GMO, see Schurman and Munro 2006. On framing in globally contentious politics more generally, Tarrow 2005: 59-76; 203. For examples of the narrative in the text, Friends of the Earth International 2006; Greenpeace International 2007; Madsen 2001; Assayag 2005; Herring 2006; Heins 2005; Shiva, Jafri, Emani and Pande 2000; Scoones 2008.

16 See Mosse and Lewis 2006 on theoretical origins and usefulness of the concepts "brokerage" and "translation."

*Science and Big Business*. The Appendix contains two calls to action: *Global Moratorium on GE Biotechnology* and *No to Patents on Life*. As a cover endorsement, the publication *Earth Matters* from Friends of the Earth International states:

> The battle to stop genetic engineering is nothing less than a struggle for human freedom itself. Mae-Wan Ho's book provides excellent ammunition for us all.

The 'ammunition' in Ho's book claims the authority of science. The author is identified as a British scientist and Fellow of the US National Genetics Foundation. The appendix contains the text of a *World Scientists' Statement* 'signed by more than 100 scientists from twenty-four countries' (p. 299). Included in this statement is reference to transgenic potatoes that reportedly had deleterious biological effects on the rats that ate them. No one who believes this account would support rDNA work in food, much less eat the potatoes. Epistemic brokers are critical for inducing doubt in settings of high information costs and ambiguity. The aphorism 'where there's smoke, there's fire' is folk wisdom in at least fifty-five languages (Heath and Heath 2007: 11-12). This aphorism recognizes the salience of smoke over other forms of evidence—such as a thermometer. After all, dry ice (solid carbon dioxide) produces the smoke we see in films and stage shows where there is no fire. The poisonous potatoes exemplify a class of political acts: accounts of extreme events diffused through consonant networks that attempt to unsettle an emergent scientific consensus with difficult-to-assess evidence from 'the field' or 'the laboratory.'

Dr. Ho's poisonous potatoes were included in Alan McHughen's chronicle of 'scary myths' about transgenic crops (2000: 114-121; 258). The experiment that produced the scare was not scientifically credible, but has become a mainstay of oppositional knowledge. Moreover, we know that potatoes with excess solanine are toxic regardless of how bred. Much of the world read about these poisonous potatoes, along with fish genes in tomatoes and grave threats of 'FrankenFoods' and other horror stories.[17] These stories enter politics and have political effects first because of their resonance with a master narrative of risk: 'GMOs' are different from, riskier than, other products of plant-breeding. Second, the stories gain some traction because the cognitive precautionary principle is rational and widely deployed: because few of us read peer-reviewed journals of plant science, it seems prudent to code smoke as an indicator of fire, not dry ice. The threat construction often came to ex-colonies from sources in former colonial powers, and carried thereby a kind of ironic authority in the ex-colonial world, particularly in Africa (Paarlberg 2008: Ch 4). Refutations of junk science, or counter-narratives, were missing from networks opposing GMOs. The power of information networks to select and slant facts is critical for understanding ideological cleavage. In the contemporary United States, networks in which Fox News is central are, for example, more receptive to messages that President Obama has no birth certificate or is planning 'death panels' for sick Americans.

Refutations of extreme claims carried a special burden because of the connection between bio-safety and bio-property. Assurances that 'GMOs are tested and safe' were widely dismissed as self-serving corporate propaganda. The property connection was critical. Because transgenics were produced and owned by MNCs, effective regulation—or even objective assessment—was widely discounted in TANs (Transnational Advocacy Networks) organized to stop genetic engineering in agriculture (Friends of the Earth 2006). MNC science was held to be suspect; MNC political power rendered government science untrustworthy as well. In the ex-colonial world, permissive regulation in the US—the source and political supporter of GMOs—was seen as a predictable reflection of corporate power under neo-liberalism. However much actual transgenic diffusion derived from public-sector seeds, or farmer-bred stealth seeds, or seeds controlled by a Humanitarian Board, the GMO was seen as wedded symbolically

17 See Agin (2006), especially pp. 59-72.

to the United States, to strong property regimes, and to multinational corporations. Much of this work reflected the authority of epistemic brokers in advocacy networks with global reach.

## Diffusion of the Bio-Property Narrative: Epistemic Brokers II

Bio-safety brokers diffused alarming accounts of biotechnology as risky biological business. The GMO came to India, as to many countries, as a multi-faceted threat. In return, as we shall see below, international brokers found claims from India of biological catastrophe in the form of dead sheep in Andhra Pradesh a confirmation of their larger narrative. In parallel, claims about bio-property posed quite specific threats that affected the views of non-farmers; much of this narrative is meant to exclude GMOs from the frame of development, particularly for poor farmers.

Bio-property entered the rift in three modes: *market, developmental* and *catastrophic*. The *market mode* constructed the plants as technological progress that comes with a cost, but a cost that is fundamentally open to free choice. Farmers can and will pay more if they believe the added marginal revenue exceeds the marginal cost. The analogy is Microsoft Word: you can choose alternatives, from pencil and paper to open-source processors—but Word will cost you money if you choose it. For many years, enforcement of software IP in the US was lax, and in much of the world remains extremely lax. In market logic, farmers can buy or reject more expensive seeds just as businesses and individuals can buy or reject products of Microsoft; their experience will lead to subsequent dis-adoption or re-purchase. Firms believe that enhanced utility will convince farmers to pay extra for transgenic seeds just as they paid more for hybrid seeds: the financial bottom line will determine farmer choices. Empirically, the market model receives some confirmation: benefits are in fact shared out across firms and farmers (Pray and Naseem 2007). Were this not the case, it would be very hard to explain the diffusion of transgenic plantings in countries with strong property rights such as the US and Canada. The role of the state in this mode is to enforce contracts freely chosen among economic agents.

The *developmental mode* adopted by international development institutions qualifies the market version (Herring 2007a). Transgenic seeds in poor countries are problematic because of unequal access. Poor farmers and nations might lack access, or need special institutional support, to participate in the 'gene revolution.' Technology fees and their enforceability matter greatly. In the worst-case scenario, poor farmers might be disadvantaged by aggregate market forces generated by the new technology, but have no voice in the matter. Poor farmers would lose if technology fees are prohibitive—and enforceable—and yields improved on farms of those who can afford fees. 'Farmers' as a class could still benefit, but poor farmers would be caught in a backwash of lower output prices because of increased yields on adopter-farms, but with no reduction in input costs or increased yields on their own farms (Lipton 2007). Enforcement of intellectual property claims would in this scenario accelerate concentration of land and the ruin of small farmers. In the developmentalist version, intellectual property that raises costs or restricts access may rebound to the disadvantage of the poor, whatever the success of the technology in the aggregate. The conclusion is that development policies must anticipate these outcomes.[18]

The assumption behind both market and developmentalist arguments is that biotechnology is agro-economically favourable for farmers. The *catastrophic mode* escalates the cautions posited by developmentalists from inequality to catastrophe. There, the rDNA seeds are not valuable for agriculturalists of any size class, but rather represent a path toward a new form of subjugation and agrarian crisis. India as an empirical case came to be internationally powerful as a confirmation of the catastrophic mode: the 'failure of Bt cotton' on agronomic and economic grounds was widely accepted as established fact and decisive case in networks opposing globalization (eg. Greenpeace International 2007; Herring 2009b). The primary epistemic broker in this development was Vandana Shiva, whose account illustrates the oppositional property argument in pure—and widely influential—form:

18 Among the many examples, see Fukuda-Parr 2007; Nuffield Council 1999; 2004; UNDP 2001.

> Pushed into deepening debt and penury by Monsanto-Mahyco and other genetic-engineering multinationals, the introduction of Bt cotton heralds the death of thousands of farmers. High costs of cultivation and low returns have trapped Indian peasants in a debt trap from which they have no other escape but to take their lives. More than 40,000 farmers have committed suicide over the past decade in India—although the more accurate term would be homicide, or genocide.
>
> These seeds kill biodiversity, farmers, and people's freedom—for example, Monsanto's Bt cotton, which has already pushed thousands of Indian farmers into debt, despair, and death. Bt cotton is based on what has been dubbed 'Terminator Technology,' which makes genetically engineered plants produce sterile seeds. (Shiva 2006a: 86)

In this narrative, there are no choices, only compulsion and traps. Vandana Shiva's *Biopiracy: The Plunder of Nature and Knowledge* was published in 1997, before there was any legal transgenic in India; its themes provided the main frames for the connection between globalization and transgenics in India. Chapter One posits the mechanism: *Piracy Through Patents*. Chapter Two throws down the rhetorical gauntlet: *Can Life Be Made? Can Life Be Owned*? Dr. Shiva's over-riding concern with biotechnology is that techniques are being made available for 'the control of agriculture by multinational corporations (1997:91).' In the resulting movement in India, concern with intellectual property rights and corporate power was married to nationalist and cultural themes of self-reliance, nonviolence, local knowledge and biodiversity (Herring 2006). Predictably, this narrative was accepted within a section of the Indian middle classes and intelligentsia; the resonance is powerful. But Shiva's accounts are important to the argument of this essay because of their empirical claims, which became authoritatively established in global networks opposing biotechnology.

The mechanisms are important. The bio-property catastrophe story—debt-driven pandemic suicides—depends on several strong claims. First, the technology does not work economically ('high costs and low returns'). Second, dependency (loss of freedom) is produced by enforcement of property rights biologically via the 'Terminator Technology.' This is important for two reasons. First, patents on plants are by no means universal; in the Indian case Dr. Shiva analyzed, there were no patents on any plants, including Bt cotton, nor on any gene. Second, the Indian case illustrated precisely why such property claims, if they were to exist, would be very hard to enforce. The claim of monopoly is perplexing.

The Government of India approved the three original Mahyco-Monsanto Bt hybrids with one genetic event [Cry1Ac] for cultivation on March 26, 2002, the day after a rally of the Kisan Coordinating Committee demanding de-regulation of Bt cotton. National civil disobedience was threatened by farmer groups if the Government did not approve transgenic cotton hybrids. In fact, approval was largely a *fait accompli*, as two state governments—Gujarat and Maharashtra—had already agreed to farmer demands and permitted Bt cotton cultivation [Herring 2006]. Stealth seeds had been in fields for three years by the time of official approval. Bt cotton was not officially for sale until the cropping season of 2002-2003; by 2003, the area under official Bt hybrids came to 230,000 acres; in 2004 this area expanded to 1.2 million acres and to 3.2 million acres by 2005; the figure for 2009 is over 19 million acres. By 2007 India's cotton seed sector had been radically transformed. There were by then four genetic events approved for insertion into hybrids from three companies, one of which used the Chinese public-sector genetic material [from Nath Seeds], and one was indigenous [J.K. Agri Genetics Pvt. Ltd].[19] Dozens of hybrids were implemented by numerous seed firms under licensing arrangements.

19 The genetic events were (i) cry1Ac gene (MON 531 Event) by Maharashtra Hybrid Seeds Company Ltd; (ii) cry1Ab-Ac gene (GFM cry1A Event) by Nath Seeds Ltd; (iii) cry1Ac gene (JK Event 1) by J.K. Agri Genetics Pvt. Ltd; (iv) cry1Ac genes (MON 15985 Event) by Maharashtra Hybrid Seeds Company Ltd.

This process continued with more firms, more hybrids, and stacked-gene implementation; officially sanctioned hybrids now number 281, with stealth seeds continuing to occupy a small but sizable share of the market. New Bt cotton cultivars have recently come from India's public sector [NACR/CIRC] as well. Monopoly is hard to find in this dynamic system, but to the extent there has been monopoly, it was a function of bio-safety regulation, not property law.

In the early years of Bt cotton diffusion in India, the most successful cultivars were illegal derivatives of Monsanto's Cry1Ac implementation of insect resistance in cotton (Roy et al. 2007). The rapid diffusion of Bt cotton in India began with stealth seeds that neither the government nor Monsanto—nor the suicide seed coalition that Dr. Shiva led rhetorically—discovered until a massive bollworm incursion in 2001 wiped out the non-transgenic cotton in Gujarat. This particular stealth seed—Navbharat 151—gave rise to the 'Robin-Hood' characterization of Dr. D. B. Desai of Ahmedabad (Herring 2005). The discovery of stealth seeds was made not by the state, nor civil society in surveillance mode (*bija nigrani samithi*), but by Mahyco-Monsanto (MMB) trying to recoup their investment in cotton seeds and testing procedures. No property rights adhered to these seeds, but Robin Hood could be and was quashed for violation of the bio-safety regime—specifically the *Environment (Protection) Act, l986*, and Rules (l989) that regulate transgenic organisms. The only transgenic cotton under-going bio-safety testing to become legal belonged to MMB. Forcing Navbharat Seeds out of the cotton business for failing to comply with bio-safety regulations eliminated one (very effective) competitor to MMB. But in true insurrectionist style, dozens rose up to take this place, using Navbharat 151 germplasm as a starting point for creating new hybrids. A cottage industry of transgenic Bt cotton was born, mostly in Gujarat,[20] while the legal Bt seed market was left to Mahyco-Monsanto and its

20 See Sahai 2002; Gupta and Chandak 2005; Jayaraman 2004; Roy 2006.

licensees. Terminator technology was decisively over-thrown in the field, but not in advocacy networks.

### *'Monsanto's Terminator Gene' as Archetype*

'Monsanto's terminator gene' provides an archetype of the political deployment of powerful intellectual-property claims by epistemic brokers in networks. The claim was of a patented gene incorporated into Bt cotton and brought into India through collusion of the Indian state (obtained with bribes) with Monsanto specifically and with a global neo-liberal regime more generally. The terminator summarized in one construct the multiple threats of GMOs: the bio-cultural abomination of seeds that could not reproduce resonated with a narrative of corporate greed and acts against nature (Gold 2003). Everything about this story is false, as we shall see. But how could it become so widely believed? I think the authority of epistemic brokers in networks of solidarity on topics with high information costs and potential anxiety strengthened such belief.

The story of the 'Monsanto's terminator gene' came to India through international networks, most proximately a Canadian NGO (Rural Foundation International, now ETC) through web communications (ETC 2007). It was promulgated within India by networks centered on Vandana Shiva and *Navdanya* (Herring 2006). The terminator would in theory force farmers to return each season to buy new seeds—generating a biological dependence of farmers on firms unmatched by customary arrangements. More important symbolically, the venerable cycle of 'self-organizing' agriculture would be replaced by dependency and a cash nexus dominated by patents. That India had no patents on plants would be largely unknown in networks where the patented terminator gene story about Bt cotton was promulgated. That the concept patent itself has not led to the completion of a biological invention, nor field tests, and is jointly owned by the United States Government—that is, a public sector technology—is little known as well.[21] Moreover, few people would have known that the original germplasm had been crossed into Indian cultivars numerous times since the mid-1990s to produce viable seeds for field trials. In an arena of low information and high anxiety, symbolic appeals have extra-ordinary power (Edelman 1964). The narrative of Monsanto as alleged creator and owner of terminator technology provided a powerful condensation symbol: multinational, American, wielding an unnatural and exploitative technology. Real attributes of the firm's record were combined with a false attribution of property rights in genetically engineered sterile seeds.[22] Clubbed together with Dow Chemicals, which together 'brought us Bhopal and Vietnam,' Monsanto was accused of planning to 'unleash genetic catastrophes'.[23]

Monsanto's representative in India rebutted charges of suicide seeds: 'Since the so-called terminator gene does not exist today in any plant in any country in the world, the question of its involvement in the field trials currently on in India does not arise.' Mahyco-Monsanto Seeds chairman BR Barwale emphasized that the seeds being tested had been approved

21 The patent was granted to Delta and Pine Land Company, in collaboration with the United States Department of Agriculture's Agricultural Research Service—U.S. Patent 5,723,765 entitled "Control of Plant Gene Expression," granted 3 March 1998 for a 'Technology Protection System (TPS).' Monsanto subsequently bought Delta and Pine Land in 2007 (United States Securities and Exchange Commission Form 8-K Pursuant to Section 13 or 15(d) of the Securities Exchange Act of 1934, dated 1 June 2007). Despite its political prominence, terminator technology was not commercialized, due in large part to vigorous international protests and intervention of the President of the Rockefeller Foundation, Gordon Conway (personal communication). See also, Scott Kilman. 'Monsanto Won't Commercialize Terminator Gene,' *Wall Street Journal,* 5 October 1999. There have to my knowledge been no applications for field testing of this technology, nor has it been deployed in any crop anywhere in the world.

22 Male sterility in plants is commonly induced for breeding purposes through non-rDNA techniques, but this practice has to my knowledge not raised political objections. Sterility in potentially invasive species such as the grass carp is commonly used for ecological protection, again without political effect.

23 Press Release, Asian Social Forum [Hyderabad] Seminar, 2003, 'Beyond Bhopal and Bt.: Taking on the Biotech Giants.' Research Foundation for Science, Technology and Ecology. Delhi. January 4.

by the Government of India's Department of Biotechnology for trials and have 'nothing to do with the so-called terminator genes.' [24] Nevertheless, the notion of suicide seeds was deployed politically to link technology to intellectual property to neo-colonial threats to the nation. Vandana Shiva and colleagues (2000:98) wrote:

> Freedom from the first cotton colonisation was based on liberation through the spinning wheel ... Freedom from the second cotton colonisation needs to be based on liberation through the seed ... The freedom of the seeds and freedom of organic farming are simultaneously a resistance against monopolies ... like Monsanto and a regeneration of agriculture ... The seeds of suicide need to be replaced by the seeds of prosperity.

Monsanto was tried *in absentia* and convicted, preceded by press releases and enacted with extensive media coverage.[25] Terminator seeds were specifically banned by the Government of India in response to this movement, as announced in assurances in the *Lok Sabha* and *Rajya Sabha*, and via Office Memorandum No. 82-1/98 PQD, dated 25 May l998. None of these assurances stopped the campaign against terminator technology.

The campaign targeting terminator seeds proved cognitively powerful. Even today, people all over the world firmly believe that farmers cannot save and replant 'GMO seeds,' despite extensive evidence to the contrary (Herring and Kandlikar 2009). The original import of Bt cotton seeds into India was one-hundred grams; there were by 2006 millions

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24 Quoted in Dow Jones Agnet 20 November 1998; Sharad Mistry, *Indian Express,* 1998, 'Terminator Gene a Figment of Imagination: Monsanto Chief,' December 4.

25 See Pimbert and Wakeford 2002 for an explanation of 'citizen juries' as a mechanism to counter-balance established 'experts' with knowledge of the people. For a report of Monsanto on trial before the Permanent Peoples' Tribunal in Rome, see the Law, Social Justice & Global Development, *Electronic Law Journal,* http://www.grisnet.it/filb (published 21 June 2001, accessed 15 June 2009).

of acres under dozens of unauthorized transgenic cottons in the field.[26] Fallout from the decidedly un-terminated Cry1Ac transgene continues to reverberate through India's cotton sector. Though approved Bt hybrids increased from 3 in 2002 to 137 in 2007 to 281 in 2009, *deshi* Bt or *Navbharat variants* continue to circulate.[27] No one knows the extent of stealth seeds; as prices of official seeds have come down dramatically, one would expect the stealth seed market to recede. Underground seeds are less expensive, but entail greater risk, not of prosecution, but of adulteration. Dr. K.R. Kranthi, a scientist with India's Central Cotton Research Institute made a hard estimate based on admittedly limited sampling:[28]

> On average, 28 per cent of the illegal seed brands are non-Bt … Among samples collected and tested by CICR, only 26 per cent of the Bt cotton was true first-generation hybrid, while 46 per cent was contaminated with non-Bt cotton.

These counterfeit seeds may account for some reports of Bt failure: some farmers purchased seeds of dubious parentage labeled as Bt but did not get the insect protection of the transgene. Not surprisingly, among

26 No one knows precise numbers. Data from Navbharat Seeds, progenitor of the first and most successful of the underground Bt lines, and parent to most, puts sales at 52.45 lakh packets of illegal Bt cotton for kharif 2005, enough seed cotton to plant 5.245 million acres, or roughly 25% of India's cotton acreage (pers comm). Legal Bt sales were simultaneously increasing rapidly as well. Conversations with seed producers in Gujarat suggest more stealth seeds than figures from Delhi, but the precise acreage remained unknown, since farmers produced Bt hybrids on their own farms and some still used transgenic F2 seeds (Roy 2006; Roy et al. 2007; Gupta and Chandak 2005; Jayaraman 2004; Herring 2005).

27 The highest yield report I found—by accident—in Warangal district in 2006 was 15 quintals/acre from an unmarked package of loose seeds known only as 'Gujarat Bt,' almost certainly a descendent of the Navbharat 151 line so popular with farmers (Herring 2008b).

28 On 'duplicates' and counterfeits, as opposed to genuine Bt stealth seeds, see Herring and Kandlikar 2009. For Kranti's perspective, (http://www.scidev.net/en/features/gm-in-india-the-battle-over-bt-cotton retrieved 3April 2008).

the first demands of farmers is some system of reliable seed certification. As we shall see, the terminator myth so decisively disconfirmed on the ground in India continues to circulate in other countries on the authority of the Indian experience, largely through the international campaigning of Indian opponents of agricultural biotechnology.

Global and distal narratives of bio-property are less dramatic than mass die-offs of livestock, but exhibit similar dynamics. The narrative of a global tyranny of monopoly and patent-controlled GMOs has proved inconsistent with facts on the ground, institutional evolution, farmer ingenuity and state institutional capacity.

First, property rights are not self-enforcing; states will be involved, one way or the other, by intervention or failure to intervene. Monsanto expends great energies trying to collect technology fees in Latin America, with spotty results.[29] High prices of Monsanto's Bt cotton in India spurred development of the stealth alternatives and eventually legal competition. Some transgenes have spread so widely underground that they resemble open-access or open-source technology more than monopoly, more Linux than Microsoft.[30] Collective action in India demanded a ban on Monsanto's hybrids—with success in one state (Andhra Pradesh)—and compensation for crop failure (Herring 2008b). Continuing resistance to high prices compelled the state government to pursue a case before the Restrictive Practices Commission (MRTPC) in 2006. The state government eventually won its case and fixed a price

29 I recently received a communication from Argentina stating that 80 per cent of the soy is illegal. This is significant because Argentina denied Monsanto a patent for glyphostate-resistant soy in 1995, resulting in the spread of stealth transgenic soy all over South America, most egregiously Brazil (Herring 2007b).

30 Pray and Naseem (2007) note that descriptions of many proprietary laboratory technologies have been published. Moreover, '[S]ome genes are in commercial use and can be obtained through reverse engineering, and some techniques have made their way to developing countries by way of unauthorised routes.' Patents either cannot or have not been obtained in many—perhaps most—low-income countries, and are unenforceable in others.

ceiling on transgenic cotton seeds (Rs 750 per 450 gm packet) and ordered all seed companies to abide by its administered price for a 'trait value.' Other state governments then fixed prices at the same level, a reduction of some 40-50% of the purchase price at seed shops. Even in strong property regimes such as the United States, Monsanto is forced into admittedly undesirable publicity to collect technology fees (Liptak 2003: 18).[31] Such strong manifestations of intellectual property have not proved practicable in very many countries for reasons of transactions costs, politics and law. Global monopoly power of multinational property in biota is difficult to discern on the ground.

Though enforceable bio-property seems elusive, bio-safety regimes have to some extent provided a functional alternative. Strict control and testing regimes raise costs of seed development beyond what is affordable by small firms, enhancing the power of deep-pocket corporations. Indian farmer and seed organizations have charged that bio-safety officials colluded with Monsanto to give its seeds alone the status of approved hybrids, forcing everyone else to license the technology from Monsanto or give up a rapidly expanding transgenic market. There were demands for regularization of illegal transgenics, especially Navbharat 151—the original stealth seed—and especially in Gujarat. Nevertheless, most seed firms with serious cotton markets chose to license Cry1Ac technology from Mahyco-Monsanto, even at prices they considered extortionate.[32] Nor is there evidence of a super-profit gold-mine in biotech dominance. Private firms have been decreasing their investments in agricultural biotechnology, whereas public-sector institutions in low-income countries are increasing investment

31 Monsanto says: 'Since 1997, we have only filed suit against farmers 138 times in the United States. This may sound like a lot, but when you consider that we sell seed to about 250,000 American farmers a year, it's really a small number. Of these, we've proceeded through trial with only nine farmers. All nine cases were found in Monsanto's favor.' http://www.monsanto.com/monsanto_today/for_the_record/monsanto_farmer_lawsuits_followup.asp (accessed 26 October, 2009).

32 Interviews with seed company officials in Gujarat in 2005 laid out this logic for me.

(Cohen 2005).Pray and Naseem (2007) conclude from their analysis that the primary beneficiaries of increased farm revenues to date are not multinationals but farmers and consumers, even in countries that enforce strong intellectual property rights.

Monsanto had no patent in India for the Bt seeds, but it did have the only technology legally approved after lengthy and complex bio-safety testing procedures. These facts are largely unknown outside specialized knowledge communities. Therefore, reports of epistemic brokers in media-connected networks substituted for knowledge that incurs high information costs. Who can track patent law in numerous countries? Who can assess terminator claims without advanced molecular biology training? Empirically, intellectual property in seeds has generally proved difficult to claim or enforce (Sainath 2005; Herring and Kandlikar 2009; Jayaraman 2001; 2004). In the field, opportunistic appropriation of technology has been common, as with films, pharmaceuticals, music, and software (Naim 2005). In some countries—most notably China—public-sector research and firms have been important in biotechnology (Cohen 2005). Public-sector universities have produced important breakthroughs—e.g., the virus-resistant papaya (Gonsalves, Lee and Gonsalves 2007; Davidson 2008). Humanitarian-use transfers offer an institutional alternative to private property, as developed in pro-vitamin A 'golden rice'(Potrykus 2004; Lybbert 2003). Epistemic brokerage within networks shields partisans from these contradictions in the narrative, just as cognitive and physical distance shields reports of dead sheep in Warangal from disconfirmation.

Transnational opponents of genetic engineering built their critique in part on the presumed monopoly power of multinational corporations, with a parallel critique of bio-piracy enabled by the genomics revolution in biology. When the BBC characterized the small Indian firm Navbharat Seeds's appropriation of Monsanto's Bt cotton gene as 'bio-piracy,' the rhetorical tables were turned. The assumption that genetic flow can move only from South to North was suddenly rendered problematic. Moreover, the episode illustrated concretely that only a deep urban cultural bias can construct farmers as hapless victims incapable of the kind of agency that makes the illicit sector so pervasive a global phenomenon. If every urban area witnesses unauthorized appropriation of the latest technology, why should farmers be cognitively condemned to passive 'bio-serfdom?' Business software and pharmaceuticals are widely appropriated against standing rules, but it is agricultural biotechnology that is presumed to exert power beyond the agency of its users. Terminator technology offered in theory a way out: the 'monopoly' and 'patent' construction of corporate power over farmers and nations presupposed an esoteric biological mechanism engineered into seeds. Genetic engineering could, in this view, enforce property claims that were politically and legally unavailable in most countries. How else could patents in seeds have power? But the terminator remains curiously on the shelf. Its political framing outran the technology; there is today no parallel in seeds to copyright protection built into DVDs, music, and software. Biology is hard to control; nature finds a way, to paraphrase Dr Malcolm in *Jurassic Park*—with a little help from interested agents.

The so-called T-GURT form of terminator technology would allow farmers to save seeds minus the transgenic trait (Thies and Devare 2007), and would thus incur less opposition, while reducing the risk of gene flow. But the bio-cultural abomination of terminator technology remains, evidently, politically untouchable. Though mass publics have (grudgingly) come to accept terminator-like controls in software, videos and music—with much resistance among the young—the biological expression of termination seems to cross some threshold of hubris and abomination (Gold 2003). It could be that this evocation of the unacceptably un-natural exhibits decisive threshold effects, defining what Prince Charles called 'realms that belong to God and God alone.' But I doubt it. After all, the world has almost universally accepted rDNA pharmaceuticals and industrial products. It may be that the real explanation is less culturally driven and more biological: perhaps the terminator, despite its international notoriety, simply does not work.

## *Campaigns and Brokers: The 'Failure of Bt Cotton in India'*

Claims about terminators in Bt cotton were egregiously inaccurate, but conform to familiar patterns of campaigning. Nuanced findings and conditional conclusions do not work in advocacy politics dependent on clear messages for media releases and campaign slogans (Bob 2005; Heath and Heath 2007). Diffusion of a narrative of Bt-driven suicides enabled and fortified Prince Charles' pronouncements on farmer suicides that gained international press attention, and thus reinforced the urgency of global opposition to GMOs. A more recent article from Dr. Shiva in 2009 appeared in *The Huffington Post*,[33] raising the death toll significantly and stating flatly that organic farmers 'are earning 10 times more than the farmers growing Monsanto's Bt-cotton.' Dr. Shiva has achieved the status of epistemic broker for all things Indian in much of the Western media. Fact-based refutations (e.g. http://www.geneticmaize.com/2009/06/shameful-shiv/) have appeared in what the Bush administration sometimes dismissed as the 'reality-based community,' but nowhere with the prominence of Dr. Shiva's original article. Few *Huffington* readers will search out Narayanamoorthy and Kalamkar (2006) or Gruère, Mehta-Bhatt and Sengupta (2008). Information costs surrounding genetic engineering are so high that few of us cross networks and compare sources. And although there is strong media selection for extreme events, it is also important that the GMO frame itself provides resonance for extreme claims: these plants are fundamentally different from all other plants, and carry special risks.

Brokerage niches are created by the intersection of global and local networks. Relationships may be asymmetric, but there is clear mutual dependency. Funders need local partners, local NGOs need resources and legitimation (Heins 2008). Brokers function as hinges in several dimensions; most critical for the puzzle at hand is epistemological. What is true about transgenic crops? What is happening on the ground in remote villages where farmers use the new seeds? The hinged-

33 See,http://www.huffingtonpost.com/vandana-shiva/from-seeds-of-suicide-to_b_192419.html (accessed 4 June 2009).

brokerage dynamic can be illustrated with one example. Warangal district in the state of Andhra Pradesh, South India, is perhaps the most widely cited location of catastrophic effects of GMOs (Bt cotton) on local people.[34] From a ground view, Warangal also seems especially densely populated by agricultural NGOs, though comparative data are not available. The Centre for Sustainable Agriculture (CSA) in the regionally cosmopolitan city of Secunderabad, for example, funds four local NGOs in Warangal district, including CROPS, which oversees the 'GMO-free zone' of Yaenabaavi[35]—a hamlet of 30 families sustained distally by Oxfam Trust, HIVOS-Netherlands, and *Aide à l'enfance de l'Inde* (AEI), Luxembourg. The Deccan Development Society (DDS) of Secunderabad, also active in study and work in the district, lists 18 international funders, all in Europe or Canada, and 6 Indian government agencies. Reports from both CSA and DDS figure prominently in critical assessments of Bt cotton in India in a major publication by Friends of the Earth International (2006), *Who Benefits from GM Crops?*

From Warangal emerged internationally circulated stories of 'failure of Bt cotton,' suicides of farmers and finally reports of sheep, then cattle, dying from ingestion of Bt cotton leaves. Sheep-death reports are less subject to external validation than are stories of agronomic failure, especially when the new technology spread so rapidly in the district (Stone 2007). Sheep-death reports were attributed to mobile shepherds and publicized by state-level NGOs; they entered the global political and policy stream via INGOs that fund national and state-level organizations

34 See, Shiva et al. 2000; Stone 2001; 2007; Herring 2008b.

35 Phonetic transliteration; press accounts often use 'Enabavi.' The hamlet is located in the Kalyanam revenue village, Lingala Ghanapur Mandal. See GM Watch, 12 October 2006. The Hindu (12 October 2006) *relied on the same press release from CSA to announce that* 'Enabavi farmers create history.' A similar story covered by NDTV *referred to 'an island of prosperity.'* The Centre for Rural Operations and Programmes Society (CROPS), Janagam (Jangaon), and the Centre for World Solidarity (CWS), Secunderabad, have oversight functions concerning this project and others in the Warangal and Khammam. The CSA is supported by Aide à l'enfance de l'Inde (AEI), Luxembourg, for this specific work.

in the area. A press release from Dr. Mae-Wan Ho was entitled 'Mass Deaths in Sheep Grazing on Bt Cotton.' Dr. Ho is leader of the Independent Science Panel in London (http://www.i-sis.org.uk/MDSGBTC.php) and the author of *Genetic Engineering: Dream or Nightmare* (2000). *The Guardian* (UK) published a week later John Vidal's 'Outcrop of Deaths' citing 1,600 sheep killed by Bt cotton leaves on 10 May, 2006.[36] Sheep deaths came back to metropolitan and English-reading India via the GM Watch report: 'Mortality in Sheep Flocks after grazing on Bt Cotton fields - Warangal District, Andhra Pradesh.'[37] Americans read the account via the Organic Consumers Association of Finland, Minnesota, which campaigns for 'Health, Justice, Sustainability, Peace and Democracy.' Their coverage was entitled: 'More on Mass Death of Sheep in India after Grazing in Genetically Engineered Cotton Fields,' accompanied by a line 'Straight to the Source.' The source was the Centre for Sustainable Agriculture, Secunderabad. The link was dead when an attempt to access was made in 2008, though the story itself remained online. In direct interviews, leadership at CSA Secunderabad demurred on published claims: the number 1600, the certainty of diagnosis, the evidentiary base.[38]

The Bt-dead-sheep story is biologically impossible, as recognized by Delhi's Genetic Engineering Approval Committee, the chief regulatory institution in India (Venkateshwarlu 2007). There is no biological mechanism for the Bt insecticidal protein to kill sheep, nor any evidence that it has ever done so; more broadly, there is no mammalian activity of the Cry1Ac protein at all. There are many reasons sheep may die, but Bt cotton is not one of them. The story did, however, resonate with the GMO frame in activist networks and their media contacts. The following year, reports from the same area escalated to deaths of cattle from eating Bt cotton leaves, in almost exactly the same numbers.[39]

36 See, http://society.guardian.co.uk/societyguardian/story/0,,17...

37 See, http://www.gmwatch.org/archive2.asp?arcid=6494

38 For team members, methods and findings, see Herring 2008b; Rao 2007a; 2007b.

39 Deccan Herald 7 February 2007; The Hindu 2 March 2007; GM Watch 4 March 2007.

Vertical diffusion of empirical claims by epistemic brokers strengthens advocacy networks in both directions; dependency is mutual. But horizontal diffusion also contributes to network strength and expands GMO-free space. In neighbouring Pakistan, Najma Sadeque, in Financial Post, 12 May 2008, wrote a piece entitled: 'After a disastrous track record in 40 countries, Bt cotton is "welcomed" in Pakistan.' Sadeque's article is an exemplar of the coherent and compelling narrative of disaster from GMOs (Herring 2009b). She wrote that in 2002 farmers in Madhya Pradesh (India) planted Bt seeds and 'ended up with 100 per cent failure.' The article asked: 'How could farmers fail to see the figures that showed it really didn't make sense to grow Bt cotton? They were deceived by false claims.' The authority is indigenous: 'Deccan Development Society (DDS), an Indian grassroots NGO… found [that] those who grew non-BT cotton made six times more profits than the BT cotton farmers!' Agro-economic failure was accompanied by alarming externalities:

> Other reports have emerged from India on the ill health effects of Bt cotton on both people and animals. It is being held responsible for causing 'untimely deaths, decline in milk quality and quantity, and serious reproductive failures.' Many workers in cotton gin factories have to take antihistamines daily before they can start work.

Sadeque tells her readers that after grazing on Bt cotton leaves, 'In just four villages in Andhra Pradesh, 1800 sheep died horrible, agonising deaths within 2-3 days from severe toxicity.' The same website repeated a version of the terminator hoax long-discredited in India: 'Monsanto - Genetically modified BT Cotton "terminator" seeds being introduced in Pakistan.' Ironically, Pakistan already had Bt cotton, smuggled from India, which would have laid this claim to rest had anyone checked with farmers.

Extreme claims get both the instant dissemination and authoritative standing enabled by more and more distal circulation. If overwhelming farmer adoption has in effect settled the agro-economic questions around

Bt cotton in India, new claims are needed to justify continuing the struggle. Reports of dead sheep are notoriously difficult to disconfirm—the animals are mortal—and frightening. Shepherds are among the most vulnerable of the poor, and often marginalized by ethnicity. Tethering reports to distal and obscure sources prevents any decisive confrontation with facts. Ironically, Bt-dead-sheep knowledge became authoritative precisely because it was unverifiable. Keeping uncertainty alive is in the interest of all brokers in global coalitions against biotechnology, as the empirical evidence on development and poverty is settling on the other side of the cognitive rift (Herring 2007c; Pontifical Academy of Sciences forthcoming).

The internet was a necessary condition for this diffusion of alarming claims. Web communities of knowledge and action are readily identifiable and can be mobilized quickly. Some 'civil society organizations' are essentially a few individuals with access to a server; it is difficult to discern this fact distally. Without the web, there would be no counter-weight to international science panels and peer-reviewed journal publications that find no empirical support for GMO disaster narratives on the farm or in the stomach. Websites also become products to convince funders and donors that good works are being done: diffusion of knowledge claims itself constitutes a product. Press releases permit cross-fertilization of media in different sites, multiplying incidents as they go; media reports from local press then feed international coverage, lending an air of authenticity to the knowledge thus displayed. Local NGOs have credibility, partly from indigeneity, partly from the eye-witness nature of their reporting. NGOs carry not only an aura of civil action (non-governmental), but in the contemporary international political opportunity structure, have a legitimate place at the table, and a means of acting.[40] They also have concrete interests in the failure of biotechnology; failures legitimate continuing oppositional campaigns, and new campaigns for alternatives: organic farming, sustainable agriculture, and 'GMO-free zones.' These

40 Chapter 27 of Agenda 21authorized the role of NGOs and other 'stake-holders' around sustainable development. Article 71 of Chapter 10 of the UN Charter granted consultative status in global representation.

alternatives are popular and well-funded through European networks and official aid programmes in India (Bownas 2008).

Knowledge diffusion in TANs is bi-directional, if often asymmetric. Local activists depend on their networks for extra-local authoritative knowledge about esoteric and complex issues: gene flow, terminator technology, allergenicity, intellectual property. What they learn has political consequences. If local activists stand for poor farmers and sustainable development, and GMOs destroy farmers, their animals and their environment, campaigns against GMOs are imperative. Funders of NGOs likewise find action imperative if their information is so compelling as reports of extreme events from India—GMO-driven mass suicides, livestock deaths, crushing patents. Moreover, outcomes attributed to GMOs violate universal values embedded in numerous global agreements—sustainability, development, equity—and thus motivate global collective action. The normative structure is largely consensual: no one wants poor farmers or their livestock to die. It is not normative dissensus, but dissonant knowledge claims that drive opposition to GMOs. The urgency generated by these reports from the field quite reasonably motivates remedial actions: mandatory labeling, moratoria, GMO-free zones, and financial contributions to NGOs furthering these objectives.

These claims have resonance and credibility for reasons suggested above, but lack empirical validity.[41] I know of no peer-reviewed study

41 The farmer-suicide narrative is contradicted by available evidence on the economics of Bt cotton, on which we will here only scratch the surface. See Bambawale et al. 2002; Naik et al. 2005; Gupta and Chandak 2005; Dev and Rao 2006; Bennett, Ismael and Morse 2006; Narayanamoorthy and Kalamkar 2006; Herring 2008b; 2009b; Gruère, Mehta-Bhatt, and Sengupta 2008; Sadashivappa and Qaim 2009. Yield arguments are only part of the story; see the correspondence of Matin Qaim, Arjunan Subramanian and Prakash Sadashivappa in Nature Biotechnology, 27 (9), September 2009, on their studies of village-wide impact of Bt cotton. The dead-sheep narrative contradicts the mechanism for the Cry1Ac insecticidal protein's effect on Lepidopterans – a mechanism that cannot function in mammals for want of sufficient alkalinity and appropriate gut receptors (Thies and Devare 2007; Shelton 2007; Rao 2007a; 2007b).

that indicates worse economic performance of a Bt hybrid than its isoline; many studies suggest superior performance to control cultivars. There seems to be no mechanism for a single gene producing an insecticidal protein to harm farm income unless the seed price constitutes a large percentage of the cost of cultivation and enhanced harvestable yields do not cover the additional cost after counting the saving on pesticides. There is no credible evidence of this outcome as a general phenomenon. Cultivars vary, pest loads vary, soils vary, rainfall critically varies; there will be huge variance across time and space. But surely the best indicator of agro-economic success is the behaviour of farmers and firms: their stake in success of technology is large, their counting must be careful, their numbers should count. The evidence seems quite clear: far from catastrophe, Bt cotton in India has proved useful and popular—no magic bullet, no miracle seed, but a trait that contributes to success in growing cotton.

## *Comparative Politics of Transgenic Advocacy*

One could argue that mis-information, exaggeration and spin are present in all politics: there is nothing unusual about extreme claims as tactic. Indeed, Saul Alinsky captured the dilemma of social activists in his *Rules for Radicals.* Alinsky summed up his experiential wisdom in fighting for social justice:

> if your organization is small in numbers, then do what Gideon did: conceal the members in the dark but raise a din and clamor that will make the listener believe that your organization numbers many more than it does… if your organization is too tiny even for noise, stink up the place.[42]

Nevertheless, GMO brokerage does differ from that in other advocacy networks; the extreme claims defy obvious ground truthing

42 Cohen (2009).

and plausibility. *Human Rights Watch* and *Amnesty International*, for example, rest their credibility on factual accounts that face intense scrutiny and refutation by interested authoritative sources: national governments. They strongly resist diffusion of erroneous claims, even to the distress of their supporters. INGOs involved with biotechnology work in a field in which cognitive distance of supporters from science and from agriculture are significant, and the possibility of decisive refutation is perceived to be remote. Torture, we intuitively understand; how insecticidal proteins kill sheep is inaccessible. New technologies are especially susceptible to both framing and epistemic brokerage for valence and evaluation. Because genetic engineering is cognitively distal, it requires interpretation, mediation by expertise: people who understand gene networks, horizontal gene flow, gene-use restriction technology (*aka* the terminator). The distance of this discourse from ordinary experience necessitates epistemic brokerage; information costs for most of us are very high. Certain brokers command trust because of their position in networks united by ideological commitments. Fox News viewers received very different knowledge about weapons of mass destruction in Iraq compared to readers of TomDispatchBlogspot.com. All citizens of our species depend on trusting the right brokers on global warming and recovery from economic crisis.

Moreover, the strength of oppositional networks benefited from timing. Transgenic technologies entered world history at a point when transnational social networks opposed to corporate power and environmental irresponsibility were connected and active (Schurman 2004; Schurman and Munro 2006). Such networks offered skills, personnel, finances and legitimacy—and authoritative knowledge. By partnering with selected brokers in national and local networks in the poorer world, the transnational coalition against transgenic crops enhanced its claims to authority and legitimacy through dissemination—and celebration—of knowledge 'from below' (Assayag 2006), however filtered and translated such knowledge may be (Mosse and Lewis 2006). Despite the importance of Europe in this global dynamic, the GMO narrative became a truly global production. It has been remade by diffusion through transnational networks of solidarity and trust. GMOs came to India authoritatively coded as a threat of corporate monopoly imposed through a terminator technology; epistemic brokers legitimated by their command of this new and esoteric knowledge incorporated this modular component into existing networks seeking farmer welfare and autonomy (Bownas 2008). These same brokers in turn released into the same networks accounts of transgenic failure, debt, dependency, suicides, and dead sheep. Disaster stories reinforced the master narrative's core of risk, and confirmed with hard numbers, names and places the devastating effects of the GMO, effects not even imagined at the time of Europe's U-turn on transgenic technology in agriculture (Tiberghien 2007).

The greatest success of this mobilization, combining EU member states and international social movements was the Cartagena Bio-safety Protocol (Falkner 2000; Herring In Press). The strong presumptions in the language of the protocol, if implemented, would create an even greater transgenic divide globally. The poorer the state, the less likely that it can create bio-safety institutions. Likewise, compliance by the smallest seed firms would be extremely difficult, if not impossible: the Navbharat Seeds case is generalizable. Multinationals with bases in rich and highly regulated nations have demonstrated capacity to operate under strict regulation. Regulation can function as property if the costs are high enough to restrict entry and monitoring regimes can enforce rules. The more stringent the regulation, the greater the selection for firms with deep pockets, staying power, political connections and compliance experience. This *de facto* assignment of property rights by regulatory authority then rests fundamentally on a biological argument that 'GMOs' require more regulation than other crops; to date, this is an argument without scientific basis (Pontifical Academy of Sciences, forthcoming; Batista et al. 2008;

Miller and Conko 2000). The special status of the GMO is a political, not biological, outcome, and one that empowers states and their regulatory agents over farmer interests. Because regulation applies only to rDNA plants, and no others (mutagenics, for example), the bio-safety regime advantages large multinational biotech firms over small and indigenous ones.

India's experience is illustrative. Bt cotton took eight years to come to market legally but the stealth seeds were available at least three years earlier. Tying up of capital, along with costs of compliance with Delhi's bio-safety regime, meant that obtaining approval for Cry1Ac cotton cost about US$2 million before a single seed could be sold (Pray et al. 2005). Regulatory restriction conferred property-like rights on holders of approved transgenic cultivars: Monsanto and its partner Mahyco (MMB). Because only their seeds were legal (adjudicated bio-safe), monopoly rents became available to MMB in licensing their technology to competing seed firms. Advocates for small firms accused the Genetic Engineering Approval Committee of market-rigging via expensive and onerous regulation. But the GEAC was acting in accordance with global norms around transgenic plants, though additional delays and significant costs were added by successful social-movement mobilization demanding more stringent testing (Herring 2005). Navbharat Seeds—a small firm in Gujarat—lacked the resources to go through this regulatory maze. It produced the first and ubiquitous stealth seed of India—Navbharat 151. NB 151 was registered by the state government as a hybrid, but the GEAC was not informed of its existence. Accordingly, it was ruled illegal and banned for failing to obtain bio-safety approval from Delhi. Banning NB 151 on bio-safety grounds left the field open to MMB to license their technology to other seed firms at high prices, in effect to operate as a monopoly in a nation with no patents on genes or seeds. But the ban simultaneously prompted the vigorous cottage industry in illegal cottons using the NB 151 germplasm in new combinations with new names: *Agni, Luxmi, Rakshak*, *151*, *Sunny, Kavach*, etc. Had bio-safety institutions worked better, the underground market would have been suppressed, farmers would have had fewer and less attractive choices, and MMBL's *de facto* monopoly would have been strengthened.

Intellectual property claims of commercial firms raise prices of official, approved transgenic seeds; costs of testing raise seed prices; bio-safety regulations restrict competition and options. Strong bio-property rights and demanding bio-safety regimes therefore together drive high prices of official seeds and thus invigorate underground markets. Both artifacts drive farmers to seek illicit seeds whenever these provide agronomic advantages but are too expensive to buy or prohibited by law (Herring 2007b).[43] Bio-safety regulation sought by oppositional movements generates *de facto* bio-property, to which activists are opposed.

## Limits to Framing

The literature on collective action indicates that framing strategies can have powerful effects on the differential success or failure of social movements.[44] There is, however, no robust, parsimonious social theory on what makes for successful framing. Nevertheless, much of the politics around agricultural biotechnology illustrates how framing can affect both politics and institutional change. Ideas matter. But limits to framing are suggested as well: much of this story is driven by interests, but interests themselves require cognitive processing to be actionable.

43 In nations where farmers have some political power, access to expensive seeds may eventually produce pressure on governments for administered prices, as in the case of Bt cotton in India.

44 See the review of theory and substantive chapters in Givan, Roberts and Soule (eds). In Press.

This essay has argued that two framing effects have been critical in a path-dependent way: (i) lumping all rDNA crops together regardless of difference and (ii) splitting rDNA crops from other applications of the technology ('red' and 'white' biotechnologies). This is the primal global rift. The consequence of lumping and splitting frames has been creation of the 'GMO' as an object of politics and governance. The GMO then became the object of a second and logically derivative rift: GMOs are either 'tested and safe' or uniquely susceptible to risky outcomes and corporate control. These two narratives of bio-safety and bio-property formed the core of mobilization against agricultural biotechnology. Their objects of concern then permitted the insertion of GMOs into two networks with appropriate receptors: environmental TANs found resonance in and use for the bio-safety narrative; anti-globalization TANs found resonance in and use for the bio-property narrative. Both narratives found resonance in developmentalist networks, producing cautionary caveats and cautionary institutions (Fukuda-Parr 2007). Without these framing successes, rDNA cultivars might well have been globally naturalized and assessed on utility-risk grounds no different than those of non-transgenic products, as happened with rDNA pharmaceuticals.

Bt cotton in India played an important role in global debates around transgenic crops. It first hinted at the pervasive character of stealth seeds that embarrasses both sides of the global political divide. Opponents of biotechnology ground their critiques in monopoly and control of seeds by MNCs. Developmentalists supporting biotechnology cite assurances of states and firms that bio-safety regimes will be in place and effective. The heroic assumption is of a rural Panopticon with enforcement powers. As Bt cotton illustrated, both arguments presuppose a stronger state vis-à-vis rural society than is typical in nations with large agricultural populations, and particularly agricultural populations with the right to vote. Moreover, the construction of Bt cotton as a 'GMO' threatening rural life proved to have little resonance with most cotton farmers. What was important to farmers was whether or not the bollworm-resistance trait would work in the field and improve revenues, not how the trait entered the plant. In practice, they found a trait that proved broadly useful: in terms of agronomics, economics, and environment. That some cultivars did better than others, that irrigated cotton did better than rain-fed cotton, that popular seeds gave rise to counterfeit seeds that sometimes tricked farmers–all these outcomes are predictable and no different from those of cultivars bred by different techniques.

Farmer rejection of the threat framing was driven by strong interests. Insect control is a major problem for Indian cotton farmers, large and small; it is sometimes a catastrophic problem, as in what Sharad Joshi called the 'bollworm rampage' of 2001 in Gujarat. The pesticide treadmill, and its frightening ecological effects, is very much on the minds of cotton farmers—who use disproportionately large amounts of pesticides and suffer the consequences. Big farmers can more easily afford pesticides than small, and have a better chance of aid or credit through superior connections, but have no great love of toxins on their land. Small cotton farmers have struggled with pesticide costs and often incur unmanageable debts on a treadmill that consumes more money with less protection over time. Worse, the global cotton market has been rigged by American subsidies; Indian cotton yields have historically been extremely low. Bt entered this difficult environment. The Bt transgene turned out to aid in insect control at a cost that was covered by increases in harvestable output and less than alternative controls with serious externalities (e.g. are toxic to farmers, workers, soils, water, non-target insects, birds, and so on). The insect-resistance trait has thus been understandably popular with farmers of all size classes. Claims that this single trait would wreck havoc with farm accounts, cause bolls to wilt and roots to rot, kill sheep or terminate themselves altogether, were met with skepticism. With close margins and precarious livelihoods, farmers cannot afford a lot of ideology;

rather, their approach to Bt cotton has been largely experimental and empirical (Roy et al. 2007).

The bio-safety narrative about development of resistance in bollworms and gene flow to wild relatives, likewise, did not engage the interests of cultivators: recommended *refugia* are somewhat rare in cotton fields. Shankarikoppa Mahalingappa, the farmer who asked for police protection against the burning of his Bt trial field in Karnataka, said of bio-safety: 'The genes cannot be taken back,' which sounds worrisome. But he was not worried about any bad effects; he'd seen none, and experience trumped hypotheticals. The Bt foliage in his fields seemed not to harm insects other than bollworms, nor mammals.[45] Hypothetical evolutionary risks or improbable claims of suicide seeds were hard to sell to farmers in constant struggle to make a living. The global bio-property narrative did have reverberations on the ground, but was met with alternative measures rather than supine acceptance. From the beginning, Indian farmers preferred cheaper Bt seeds, legal or illegal; some took risks in the underground market, as both producers and buyers, some were tricked by unscrupulous dealers and counterfeiters. But over time, the Bt premium on seed prices came down significantly, partly as a result of political action.

The developmentalist narrative that insists on preparing the institutional structure so that poor farmers may benefit proved inconsistent with ground realities. Transgenic seeds spread widely and rapidly through farming communities outside the reach of formal institutions and without assistance. Bt seeds were saved and planted as F2s, cross-bred, packaged, sold, exchanged and used in networks that defied surveillance and control of firms and states. That outcome was more pro-poor than alternative modes of diffusion, but undermined a growing consensus in the international development community on appropriate bio-safety and

45 Interview with Shri Mahalingappa June 7, 2004.

intellectual-property institutions for biotechnology. A second concern for the developmentalists must be the effect of conflict on coalitions for the poor. Such coalitions are hard to conjure, much less sustain. Bt cotton divided leadership of nominally pro-farmer political coalitions, driven by the ideational divide on transgenics: the *Shetkari Sanghatana* and *Karnataka Rajya Ryotu Sangham* represent poles of the continuum (Omvedt 2005). Ideational divisions lessen farmer power collectively. Nevertheless, stealth practices, contrary to wishes of firms, states and many NGOs, suggest a different model of the farmer than that often encountered in both anti-'GMO' and developmentalist discourse: more active, creative and autonomous; less hapless and supine; more farmer, less peasant.

If farmer interests drive strong limits on framing, what of interests—whether financial[46] or political—of activists or supporters in advocacy networks? If globally circulated reports of Bt cotton catastrophes in India were true, few of us would hesitate to lend our voices and support to opposition, as we do with Amnesty International or Human Rights Watch in cases of egregious harm to innocents. If there were a holocaust of Indian farmers from GMOs, no one who cared about India or farmers could fail to respond. That is, our interests—whether individual or other-regarding—by necessity depend on a cognitive screen through which we process information. That screen is the object of politics in the global rift. The catastrophe story of Bt cotton reinforced opposition to agricultural biotechnology generally, and often crowded out the more empirically robust story of farm-level success. This effect was strong not only in advocacy networks, but in the media more generally. It is not just GM Watch, but the Huffington Post. Why? This essay has argued that there is a critical role for epistemic brokers at the hinges between local, national, and international advocacy groups within larger advocacy networks. Reports of Bt catastrophe in

46 For a conceptualization of the 'protest industry,' with some data on the size of financial flows, see, Byrne 2003.

India are not sustainable scientifically, but do serve concrete interests. Since the networks stand for unassailably strong valence issues, their reports provide re-definitions of interests even for those without jobs and positions.

India's Bt cotton episode then sheds some light on the meta-theoretical question of ideas and interests. Epistemic brokers have a strong interest in continuing controversy around Bt cotton, and are un-tethered from empirical constraints. Rural India is not where the audience lies. Farmers in India have strong interests in technologies to control insect pests, avoid pesticide indebtedness, and increase harvestable yields. In choosing a transgenic cultivar, they exhibited the same utilitarian calculus as European consumers choosing rDNA pharmaceuticals. Transgenic crops are only marginally useful to European consumers; transgenic 'red' and 'white' biotechnologies are very much in their interest and very much supported. Europeans assess biotechnologies with the same risk-benefit calculus with which they assess surgery or air travel. Ironically, many European advocates in TANs deny that 'third world peasants' can make the same rational calculations.

Why should advocacy groups find Bt cotton so threatening? Selection criteria for protest are murky. The threat story is about agriculture, in which small percentages of people in rich countries have a material interest. It is not about food; cotton is a fibre, not a food crop. Opposition is not to risk generally—cell phones have more evidence of risk than Bt cotton.[47] Pharmaceuticals as a sector have experienced dangerous products such as thalidomide and Vioxx, but are widely accepted on grounds of expert certification. Nor can the cause be multinational corporate power: pharmaceuticals, computers, and software technologies exhibit

47 As a new technology, cell phones were charged with risks early on, then worries subsided as utility became apparent—even indispensible. But there is recent evidence for risk in regard to brain damage from a presumably authoritative source: the Director of the University of Pittsburgh's University Medical Center Cancer Center. See, http://www.dailyrecord.com/apps/pbcs.dll/article?AID=/20080724/UPDATES01/807240310

high levels of concentration of multinational capital and yet their utility as products makes them universally acceptable. The more plausible construction is of an ideationally screened interest for opponents of agricultural biotechnology: the belief that disasters wrought by GMOs in low-income countries endanger vulnerable people. The 'failure of Bt cotton in India' provides a powerful case in point. To end where we began, Prince Charles may well believe the accounts of GM-driven mass suicides, but he also has plans for expanding his Duchy Originals organic foods globally, and to India in particular. Even Princes have interests.[48]

48 Dipankar De Sarkar reported on 14 August 2008. on statements by Andrew Baker, chief executive of the Prince Charles's Duchy Originals line of organic products, announcing plans to launch the brand in India (and the US), in line with a five-year strategy to quadruple annual revenues 'from 50 million pounds to 200 million pounds ($93-373 million).' The commercial venture would be 'linked' to the Prince's 'Bhumi Vardaan Foundation,' established to help the poorer farmers of the Punjab. See, Thaindian News, London. See, http://www.thaindian.com/newsportal/world-news/is-charles-anti-gm-outburst-linked-to-india-business-plans_10084027.html (accessed 26 October 2009.)

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