The dilemma of decontamination: A Gramscian analysis of the Mexican transgenic maize dispute

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ABSTRACT

An intense environmental dispute surrounds the maize-fields of Mexico. Mexican maize traditional varieties (or ‘landraces’) constitute a global genetic resource that may well be critical to future agricultural development and corn breeding. Many environmentalists, farmers, and consumers in Mexico are therefore concerned that their maize landraces may have been ‘contaminated’ by imported transgenic maize, grown in the USA. The criticisms of this transgenic technology are complex and call into question the nature of the boundary between political and ecological (i.e. scientific) disputes. Our paper surveys these criticisms, and this political–scientific boundary, in a three-part analysis. First, we turn to Gramsci’s notes on science from his eleventh prison notebook to rethink the political ecology of transgenic maize, i.e., the way the ecological analysis of transgenic introgression is treated as politics. Second, we present the multiple criticisms of transgenic maize as scalar phenomena. Third, we review the recent scientific literature on transgene introgression to evaluate recent calls for the ‘decontamination’ of Mexican maize. Our reading illustrates two dilemmas facing the group that occupies the hegemonic subject-position in this dispute, ecological scientists. First, the popular desire to ‘decontaminate’ Mexican maize exceeds their capacities (due to complications involved with sampling). Second, although the political debate surrounding ‘contaminated’ Mexican maize exceeds science, the boundary between the dispute’s scientific and parascientific elements cannot be adjudicated scientifically. In other words, the boundary between science and politics is porous. Thus it points to the need for a social transformation that sees science as “humanity forging its methods of research . . . in other words, culture, the conception of the world.” By exploring the dilemmas of decontamination, the dispute over transgene introgression in Mexican maize-fields provides an opportunity to elaborate upon Gramsci’s neglected insights into the politics of science.

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1. Introduction

An intense environmental dispute has grown around the maize-fields of Mexico. From Oaxaca and Chiapas east to Quintana Roo and north to the US–Mexico border, farmers, and consumers look anxiously toward maize-fields and tortillas, wondering if transgenes have made their way from the USA into Mexican maize. The Government of Mexico placed a moratorium on planting genetically modified (or ‘GM’) maize in 1999 (CEC, 2004; González Aguirre and Aguilar Muñoz, 2006; see also Cevallos, 2006; Reuters, 2007), but transgenes probably exist in Mexico today, the result, we might say, of illegal genetic immigration: transgenic maize imported from the US causing transgene introgression—the movement of transgenes into local landraces (Cleveland et al., 2005; Mercer and Wainwright, 2008).

In the roiling debate over GM agro-food, this case – what some call the ‘contamination of Mexican maize” – is exhibit A for those who would argue in favor of the precautionary principle (cf. Green-
peace, 2003). One of the world’s major food crops may have experienced transgene introgression in its center of origin and cultural hearth—in violation of the wishes of most local peasant farmers as well as a national moratorium on growing GM maize (CEC, 2004). So when transgenes were discovered in the highlands of Oaxaca in 2001 (Quist and Chapela, 2001), farmers and anti-GM activists erupted in protest throughout Mexico. When the Commission for Environmental Cooperation (CEC) met in the Hotel Victoria in Oaxaca, Mexico, on 13 November 2002 to discuss the findings of their major report on Mexican maize, transgenes, and biodiversity, their meeting was interrupted by hundreds of Oaxacan farmers. The farmers marched into the hotel, faced the scientists and policy-makers, and called for an end to imported GM maize (see McAfee, 2008).

Though much is contested about GM maize, most agree about the stakes. Maize is arguably the world’s most important crop. More maize is grown by volume than any other: 2005 global production totaled ~700 million metric tons (FAO, 2006; see also Dowswell et al., 1996). Mexico, the center of domestication of maize, is home to 59 distinct races (Wellhausen et al., 1952; Sanchez et al., 2000), and landrace maize remains grown by >80% of Mexico’s maize farmers (Aquino et al., 2001), chiefly peasant farmers in the highlands of Mexico’s rural south and south-east (Louette et al., 1997; Mann, 2004). The cultural practices of these farmers—seed sharing, mixing of seed, and farmer selection—constitute evolutionary processes acting on these populations (Bellow and Berthaud, 2006; Mercer et al., forthcoming).

Many races are grown only in certain small regions, typically under low-input conditions (CEC, 2004). These landraces are widely viewed as a genetic resource of tremendous planetary importance. Beyond this, most everything is disputed. Critics of GM agriculture argue that the incorporation of genetic elements with unknown effects may complicate future efforts at corn breeding and production (CEC, 2004) and cause the loss of important cultural resources (Mann, 2004). For advocates of GM agriculture—including powerful institutions like the US state and US-based agribusinesses—such claims are typically regarded as unobjective and unscientific. This kind of fundamental disagreement filters through the language of the GM dispute. Each side regards certain terms as legitimate and illegitimate (cf. Jefferson, 2001). Take, for instance, ‘contamination’, and its counterpart, ‘decontamination’. Some in Mexico say that their maize landraces have been ‘contaminated’ by transgenes from the USA; they call for their maize-fields to be ‘decontaminated’ (González Aguirre and Aguirre Muñoz, 2006).

Many scientists find such language problematic, arguing that ‘contamination’ is a term freighted with judgment, valuation, and subject-position. We reject this criticism as too facile and ask: how might it be possible to frame a scientific response to the call for decontamination?

To address this question, in this paper we turn to Antonio Gramsci’s writings on science, politics, and knowledge. We invoke Gramsci because the GM debate, in Mexico and elsewhere, so often hinges on conceptions of (and relations between) political and scientific practices—practices that Gramsci brilliantly analyzed in his prison notebooks. We aim to show that the criticisms of GM agriculture, and the political questions they engender, call into question the nature of the boundary between political and scientific disputes. We survey this boundary in a three-part analysis. First, we draw from Gramsci’s notes on science to rethink the political ecology of transgenic maize, i.e., the way the ecological analysis of transgene introgression is treated as politics. Second, we present the multiple criticisms of transgenic maize as scalar phenomena. Third, through a brief review of the recent scientific literature on the ecology of transgene introgression, we evaluate recent calls for the ‘decontamination’ of Mexican maize. In the concluding discussion, we return to Gramsci to argue that, notwithstanding the desires of many scientists and policy-makers, politics and ecology cannot be easily separated. But this is no reason to reject ecology qua science—or politics, for that matter. Rather, it is an argument for studying the fluid and porous boundary between science and politics.

2. Gramsci on science

Has the whole progress of science not up to now been manifested in the fact that new experiments and observations have corrected and extended previous experiments and observations? How could this happen if a given experiment were not reproducible, and if, with another observer, it could not be checked and extended, thereby giving rise to new and original connections? (Gramsci, 1995 [1932], p. 287)

Although Antonio Gramsci’s writings on hegemony and political power have drawn considerable attention among political ecologists (cf. Moore, 1996; Cohen, 2004; Robbins, 2004; Wainwright, 2005), his writings on scientific knowledge and practices in the prison notebooks have not drawn attention. Perhaps this is because most of these notes appear in his eleventh notebook, written in late 1932, for which we do not yet have a critical English edition. Breaking from his standard practice, Gramsci gave a specific title to number eleven—“Notes for an Introduction and an Initiation to the Study of Philosophy”—and marked off subsections under this heading for examining particular problems. Three of these subsections specifically concern objectivity, the concept of nature, and scientific knowledge (for the Italian, Gramsci, 1977, p. 1363–1506; for selections in English, Gramsci, 1995, pp. 278–325). Here we offer a brief, synoptic view of Gramsci’s highly original approach to science (see also Boothman, 1995, pp. lv–lxi), focusing on note number 37 from quaderno 11.

This is neither to deny the value of the other notes in this section, nor the value of a fuller Gramscian analysis of the politics of GM maize in Mexico. The latter would need to address the emergence of the EZLN movement in 1994, shortly before the widespread conversion of US maize fields to GM production; the decline of the PRI and subsequent electoral division between the north (PAN) and the south (PRD); and the intermixing of nationalist and localist discourses concerning maize, purity, race, and identity. These dynamics are beyond the scope of this paper. On the relevance of Gramsci for today’s transnational Mexican political economy, see especially Adam David Morton (2007). We have been unable to obtain Victor Flores Ola’s writings on Gramsci in Mexico. On the reception of Gramscian thought in Latin America, see Kanoussi (2000).
Gramsci defines science by two principle elements. In the first place, science is *iterated* knowledge, that is, produced repetitively and by the promise of repeatability (see epigram). In this sense Gramsci writes of scientific knowledge as a mode of *correction*: the first “aspect of scientific work,” Gramsci writes, is that it “constantly corrects our way of knowing” (Gramsci, 1995 [1932], p. 291). This leads directly to a second quality of scientific knowledge: this iterability is achieved not simply in any fashion, but by bringing the human body in collaboration with instruments that enhance our senses. Gramsci defines the second aspect of scientific work as the application of an “enssemble of instruments... to draw a dividing line between what is essential in the sensations and what is arbitrary, individual” (Gramsci, 1995 [1932]).

If science is an iterative social practice, whereby the body and instruments are connected in new ways to advance humanity’s understanding of the world, what then of objectivity? Gramsci rejects the common sense notion that science is an objective procedure for studying reality. He sees objectivity not as an existing condition, but as an ideological disposition: “‘Objective’ means this and only this: that one asserts to be objective, to be objective reality, that reality which is ascertained by all, which is independent of any merely particular or group standpoint. But basically, this too is a particular conception of the world, an ideology” (Gramsci, 1995 [1932], p. 291). Geographers familiar with Donna Haraway will relate this to her “God trick”—the very idea that one may see from a viewpoint elsewhere and thus fall victim to thinking oneself to be godlike for looking objectively (Haraway, 1997, pp. 131–138). For Gramsci (like Haraway, a Catholic-turned-Marxist) the God trick is partly about God. At the outset of this note, Gramsci writes:

> The most important question to be resolved about the concept of science is this: whether science can give us, and if so in what way, the ‘certainty’ of the objective existence of so-called external reality. For common sense the question does not even exist; but from what has the certainty of common sense originated? Essentially from religion (at least from Christianity in the West); but religion is an ideology, the best-rooted and most powerful ideology, not a proof or a demonstration (Gramsci, 1995 [1932], p. 290).

The short answer to Gramsci’s question here is no: science cannot give us certainty of the objective existence of external reality. This is because, contrary to common sense, science is not simply a method of studying the natural world that hinges upon objectivity. Gramsci’s argument here is that the concept of ‘so-called external reality’ – the ‘real world’ as it has generally been conceived in Western thought – is an effect of religious superstition. This may seem impossible, since science and religious metaphysics are typically conceived as opposing forces. Indeed they may be, except that ever since Descartes, science and Christianity usually share a common sense belief in what Gramsci calls here “the objective existence of so-called external reality”. This view of objectivity is rooted in Gramsci’s interpretation of Marxism:

> [Marxism] rejects... the common sense conception. Common sense asserts the objectivity of the real in so far as reality, the world, has been created by God independently of and before humanity; reality is, therefore, an expression of the mythological conception of the world (Gramsci, 1995 [1932]).

Gramsci does not deny the strengths of science—only its pretenses to objectivity.

But if objectivity is not the basis for scientific truths, then what is? The answer lies in science’s social iterability. “If scientific truths were conclusive”, he writes, then “science would have ceased to exist as, such as, research... [Yet] fortunately for science this is not true” (Gramsci, 1995 [1932]). Scientific truths are strong because they remain open: disagreements persist; different schools continue their research in parallel: what is today viewed as correct by scientists may come to be seen otherwise. Gramsci’s approach situates scientific practices on the same plane as all other acts involving knowledge-production. This displacement of scientific objectivity opens a way for us to recognize the distinctiveness of scientific practices without separating them from the other elements that constitute hegemony: state-society relations, class, history, and so on.

This raises a difficult question, one pertinent to the GM maize debate: how does hegemony, state-society relations, and so forth relate to the scientific analysis of transgenic introgression in Mexico? To begin to answer this question, we begin by outlining the distinct grounds on which critics of GM agriculture make their claims.

3. **Scaling criticisms of transgenic introgression**

What exactly is the problem with GM agriculture? Even for those of us who are ‘GM critics’ – we include ourselves in this category – it can be difficult to articulate a clear answer to this question. We suggest that this difficulty arises in part from the very *plurality* of criticisms of transgenic agriculture and food. We discern six discrete, substantive criticisms of GM agriculture. While inter-related, these criticisms focus on fundamentally different scales and problems. To situate the debate over transgene introgression in maize in Mexico, here we outline these criticisms, organized by geographical scale (see Table 1). We recognize that such use of scale has been criticized in human geography (Marston et al., 2005; Jones et al., 2007). Suffice to say that we do not aim to resolve the scale debate here; our intention is not to fix scale, only to relay the scalar heterogeneity of the criticisms of GM agriculture. This heterogeneity is important to recognize, we feel, for at least two reasons. First, it helps to explain differences between different responses to GM food in, for instance, the US and Europe (see Gaskell et al., 1999; Toke, 2004). Second, it clarifies the implications of recent shifts in the scale...
emphasis of the GM debate—as we will argue in this section’s conclusion.

First criticism: at the smallest scale, that of the gene, we find the argument that transgenes from GM crops may produce unwanted effects in populations of wild relatives or non-GM crops by influencing the function of natural or managed ecosystems (cf. Ellstrand and Hoffman, 1990; Tiedje et al., 1989; Snow and Moran-Palma, 1997; Marra, 2001; Snow et al., 2005; Andow and Zwahlen, 2006; Soleri et al., 2006). This could lead to several different problems. First, transgenes could introgress into closely related wild species, potentially creating intractable weeds, if, for instance, the introgression of a transgene from transgenic rice into weedy rice could create herbicide-resistant wild rice weed populations (Gealy, 2005). Second, transgenes could introgress into neighboring fields planted to the same species. This has been especially contentious where landraces of crop centers of origin could be affected or where organic farms border GM fields. Transgene introgression in landrace populations may have an evolutionary impact, altering patterns of genetic diversity (Gepts, 2005; Soleri et al., 2006) if advantageous transgenic traits, such as effective disease resistance, result in selective sweeps (Ellstrand, 2003). The fear of transgene introgression into landrace populations is often regarded as a problem in itself because the landrace population is then seen as ‘contaminated’ (Greenpeace, 2003). Also, because organic markets generally do not allow GM foods, transgene flow could cause organic farmers to lose market premiums.

A second criticism concerns the non-target effects of transgenics on the organisms within the agroecosystem or on the end users (Haslberger, 2003; NRC, 2004; Gepts, 2005). Critics cite concerns of the effects of transgenics on fauna found in agricultural environments (Andow and Zahlen, 2006) as well as unexpected allergic reactions brought on by transgenic proteins in GM food. Yet many early critics have come to accept that GM food has been widely consumed in a number of countries without major health consequences. This is not to deny, of course, that there may be undetected or long term negative effects. The total number of transgenic proteins that are widely consumed is still modest and more will enter the market in the future. Nonetheless, the absence of recognized human effects has dampened the prominence of this criticism (yet see Séralini et al., 2007).

The third line of criticism addresses the social relations of GM technology for agro-food systems. This criticism often takes two forms: one emphasizes production-side (supply) effects for political-economic dimensions of transgenic crop production for farmers, and the other the consumption-side (demand) effects on food consumers. A common criticism is that, by shifting political-economic power (or market share) toward a small number of large agro-food firms, the expansion of GM technologies will adversely affect the livelihoods of marginal farmers (Buttel, 1989; Kloppenburg, 2004). In this view, GM technology is not scale-neutral, since the benefits accrue mainly to those who manage capital-intensive, large-scale farm operations. Arguably the major proven advantage of GM technology has been to improve the effectiveness of commercial herbicides (sold, like the seeds, by only a few global corporations), making certain herbicides more efficient. Because the global seed market is oligopolistic (Kloppenburg, 2004), critics contend that the extension of GM agriculture may deepen inequalities in the control and profitability of agriculture in favor of the largest farmers and life-science companies.13 Deepening inequalities are not conducive to agricultural sustainability (IAASTD, 2008).14

The fourth criticism of GM agriculture also concerns evolutionary dynamics, albeit here at the scale of the landscape: the argument is that GM agriculture directly reduces agro-biodiversity. The landscape of the upper Midwest of the USA, presently the world’s epicenter of GM agriculture, provides evidence for this claim (Kimbrell, 2002). Since the creation of transgenic crop varieties is a time- and capital-intensive process, very few different varieties are available during the first years after the release of new GM crops. An array of conventional (non-GM) varieties may then be replaced by only a few GM varieties, thereby reducing the total genetic variation on the landscape (Gepts and Papa, 2003). However, in recent years, more GM counterparts of conventional varieties have been produced. This trend will no doubt continue.

The fifth line of criticism concerns cultural practices. In this view, landraces are not only natural objects found within the environment; they are equally social, the result of an immense collective labor, a grand collaboration with natural processes—and therefore important sociocultural things to be respected and protected on cultural grounds (Brush, 2004; CEC, 2004). A prevailing view in Mexico today is that indigenous farmers (or Mexico’s cultures) have given the world a gift by producing maize, and the world should return the favor by respecting the genetic integrity of indigenous farmers’ (or Mexico’s) maize. As one anti-GM activist explains, ‘contaminating’ maize by way of transgene introduction is nothing less than “a crime against all indigenous peoples and farming communities who have safeguarded maize over millennia for the benefit of humankind” (Mendoza, cited in ETC Group, 2003a, pp. 2–3; also see ETC Group, 2003b; Dawkins, 1997, pp. 44–46; Pilcher, 2006).

The sixth set of criticisms concerns Nature as a metaphorical totality, i.e., Nature qua natural order or Creation. Some have argued that creating transgenic organisms amounts to intervening into nature in ways that are immoral or contrary to religious values. Take, for instance, the position of the Catholic Church. Pope John Paul II spoke of transgenic technologies as “challenges to

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12 This raises the concern that farmers found to have transgenes in their field without having paid for GM seed may face legal persecution from seed companies: consider the case of Monsanto versus Percy Schmeiser (see Prudham, 2007).

13 McAfee (2003) dubs this condition “neoliberalism on the molecular scale”. See also Bridge et al. (2003); compare Evenson and Raney (2007).

14 The 2008 IAASTD report substantiates Gardiner’s claim (2006, p. 56): “[O]ne argument often presented [in favor of GM agriculture] claims that [GM seeds] offer a solution to the problem of world hunger. . . . [O]pponents of genetically-modified foods often respond by claiming that such technology is neither necessary for, nor particularly likely to bring about, a solution to global food security.” Prudham (2007) concludes his paper on the case between Monsanto and Percy Schmeiser by arguing that Monsanto’s ‘championing of the possibilities opened by genetic engineering’ – for instance, that GM agriculture will feed the world’s hungry – only reinforces “what for some has been an old theme in the biotech debate: the problem is not the technologies themselves, but rather the social relations and imperatives that develop and sustain them” (424, our italic). It is not necessarily clear, which social relations and imperatives’ sustain GM technology.
the natural order” (cited in CWNews, 2004). Of course, the Church is not alone in this, but its views are especially important in Mexico, which has more avowed Catholics than any country except Brazil.

A few observations are warranted on the relations between these six criticisms. Although they are often combined (some may say ‘jumbled together’) in different ways, these criticisms of GM agriculture do not necessarily follow from one another. They are analytically distinct, but not mutually exclusive. In Mexico and elsewhere, the boundaries between these six criticisms have proven thin as arguments over GM maize recombine these claims in often confounding ways. For instance, farmers in Mexico often indicate that maize landraces should be maintained in a ‘pure’ state, or at least that farmers should be able to choose whether or not they plant GM seeds. Where does this argument fall in our table? It could, in fact, touch upon all six criticisms. Discourses of purity are, it seems, not always pure (Douglas, 1966). If the farmers who have produced and maintain traditional maize landraces come to perceive that their seeds are contaminated – and scientists cannot prove otherwise – then cultural, in situ conservation efforts may erode (Bellon and Berthaud, 2006). The social relations of production are therefore critical to the unfolding evolutionary drama that sustains maize landraces.

As Gramsci might have argued, the first question we should ask about these distinct criticisms is how they may be relatively effective, that is, how they may shape the struggle over GM agriculture. Such analysis is especially urgent today, because notwithstanding widespread popular distain for GM agriculture (Toke, 2004), the critics are rapidly losing ground. Although the introduction of GM crops has remained limited to the major crops (particularly soy and maize), the total area in the world planted with GM seeds has been increasing steadily since the mid-1990s. In 2006, GM crops were planted on more than 250 million acres in 22 countries (BIO, 2006). ~7% of the world’s acreage was planted with GM seeds in 2007 (Hindo, 2007). While the USA alone accounts for the majority of these acres, other countries have recently reduced barriers to planting GM crops and seen swift increases, including China, India, and Brazil (Miller, 2006; Hindo, 2007). GM maize has been at the forefront of this global trend. In 2006, 158,057 acres of GM maize were planted in five western European countries—a 16% increase over the previous year. The 2006 WTO ruling against Europe’s barriers to importing GM agricultural goods (WTO, 2006a,b) will surely increase the capacity of the USA and Brazil to open export markets for GM maize (IATP, 2005; Miller, 2006).

This trend, coupled with growing global flows of GM agro-food commodities, has changed the debates over GM agriculture (cf. Hindo, 2007). The hegemonic frame around the debates is no longer whether GM agriculture is good or bad, or whether it should be allowed. Such discussions continue, but they have been sidelined. Today the one central and privileged question is how to regulate GM agriculture’s ecological effects. Whereas concerns about human health and the morality of ‘engineering’ life forms framed the arguments at an earlier stage, the debate over GM agriculture has become substantially limited to questions about the potential evolutionary and ecological effects of GM crops, specifically via transgene introgression (criticism 1 in Table 1). The preponderance of the recent debate in the WTO and other international bodies has focused here (WTO, 2006a,b). In a word, evolutionary ecology has become the hegemonic terrain for the debates over GM agriculture. Let us consider it in further detail.

4. The evolutionary ecology of transgene introgression

Recent studies document the potential ecological implications of transgene introgression in crop centers of origin. The key processes influencing transgene introgression are gene flow, selection, and drift. To understand these, we must turn to evolutionary theory. In rural southern Mexico, crop fields tend to be evolving polycultural ecosystems. While farmers conserve crop genetic diversity on their farms, they expose their plants to evolutionary forces, such as natural and artificial selection, drift, mutation, and gene flow, and thus facilitate crop evolution (Alvarez et al., 2005; Bellon and Berthaud, 2006). Due to the interest in natural hybridization and its role in shaping invasive species, boundaries, and introgression, the dynamics of gene flow and selection have been well theorized in natural ecosystems (Rieseberg et al., 1996; Ellstrand and Schierenbeck, 2000; Lenournard, 2002; Geber and Eckhart, 2005). In recent years, these concepts have been brought to bear to investigate the introgression of transgenes specifically into wild and crop populations (Ellstrand, 2003; Halls and Morley, 2005). A number of scientists have asked whether transgenes could introgress into local landraces (Belchera et al., 2005; Gepts, 2005; Arriaga et al., 2006). Much like the movement of nutrients, soil, and pesticides, the flow of genes between fields or farms is recognized as a key component of agricultural sustainability (Ellstrand and Hoffman, 1990; Tiedje et al., 1989; Snow et al., 2005).

In agricultural systems, gene flow is a constant source of genetic variability for crop landraces and facilitates their evolution. But gene flow can also be a homogenizing evolutionary force (Slatkin, 1987; Storfer, 1999; Pressoir and Berthaud, 2004) since the hybridization or mixing of different varieties can reduce the uniqueness
of each population or introduce off-type characteristics, such as changes in kernel color (Louette and Smale, 2000). Gene flow can be mediated by pollen as well as cross-pollinations between adjacent fields. Seed-mediated gene flow can occur over longer distances, as when bulk commodity maize is transported and seed is lost en route or sold at its destination. Individuals can also move quantities of seeds long distances and internationally. Shorter distance movement of seed occurs when farmers exchange seed within and between their communities. Farmers expose their maize landraces to artificial selection by selecting seed to plant the following year. The effects of the management practices, such as herbicide application, and environmental conditions likewise impose selection on the populations for fitness-enhancing traits. If transgenes are advantageous under these conditions they would likely be selected for and introgress into landrace populations.

The burning question in Mexico today remains: have transgenes in fact introgressed into Mexican landraces? The first scientific paper to be published that answered ‘yes’ to this question was that of Quist and Chapela (2001). The authors tested four landrace maize ears from the highlands of rural Oaxaca, an environment where transgenes were quite unexpected. Upon testing, all four ears were found to contain transgenic seeds (for more on this paper and responses it engendered, see: Quist and Chapela, 2002; McAfee, 2003; Worthy et al., 2002, 2005). This unexpected result inspired a set of subsequent studies that sought to confirm Quist and Chapela’s results and improve on their sampling. Most studies have focused on Oaxaca to follow up on Quist and Chapela’s discovery and because this state has more native landraces of maize than any other (a few have sampled in other states). Notably, of the studies that look for transgenes in Mexican maize that we know of, only three have been published in peer-reviewed journals; some have been published on-line, others not at all. The results of these studies vary considerably. The prevailing finding is that transgenes are to be found in rural southern Mexico, albeit at very low frequencies (CEC, 2004). Within this literature the debate has centered on methodological questions about sampling procedure and statistical extrapolation, particularly after Ortiz-García et al. (2005a,b,c) returned to Oaxaca and, employing a relatively thorough sampling protocol, found no transgenes. Ortiz-García et al. (2005a,b,c) do not claim that there are no transgenes in Oaxaca. Rather they estimate that, based on their procedures, they should have found transgenes if they were present in the population at a frequency of 0.01–0.0001. Ongoing research focuses on increasing the likelihood of finding transgenes, as well as understanding the evolutionary dynamics of transgenes that could persist in a population at low frequencies.

5. Discussion: the dilemma of decontamination

The discovery of transgenes in Mexican maize landraces has led many farmers, NGOs, and consumers to demand that the landraces of Mexican maize be ‘decontaminated’ (Anon., 2002; ETC Group, 2003b; Vera Herrera, 2004). In 2003, an anti-GM activist organization called the ETC Group published an open letter arguing that the Mexican government has facilitated “the destruction of a resource that is critical for future global food security”; they demanded “a process of decontamination” (ETC Group, 2003b, pp. 1–2; see also ETC Group, 2003c). Similar appeals were made to the Food and Agricultural Organization (FAO) by a network of NGOs gathering at its 2002 annual meeting:

GM pollution is the latest threat to food sovereignty and should be addressed with utmost urgency…. We urge…. an immediate investigation [by the FAO] as to: (1) the causes of the contamination; (2) the technical or regulatory options for preventing further contamination; (3) scientific, technical, and legal options available to governments in the region that could lead to decontamination and prevent future contamination (Anon., 2002, our italics).21

As these NGOs were calling for this UN body to take international action to decontaminate maize, however, farmers’ groups in Mexico were arguing that they should take the matter of decontamination into their own hands. One observer explains the conclusions drawn by activists at an event called the Second Forum in Defense of Maize, held in Mexico in December, 2003:

One of the main concerns was to discuss viable proposals to independently prevent contamination in places where it had not yet been detected, and to decide if it was necessary to expand the testing in search of genetic contamination to other regions of the country. Given that the contamination was already widespread and that the government had refused to close off the external sources of contamination, continued independent testing was deemed a waste of scarce time and resources. Although participants recognized a possible role for scientific research in decontamination, they stated that the problem of genetic contamination in maize can only be resolved over the long term, and the main actors of decontamination must be the farming and indigenous communities themselves (Vera Herrera, 2004, our italics).

Such demands for decontamination have been sounded in two voices. Some groups – mostly transnational NGOs working on food and agricultural issues – have sought to compel nation-states to mobilize international enforcement against genetic contamination. These organizations and the state institutions they aim to influence generally recognize the hegemony of ecological science and its studies of transgene introgression.22 Then there are farmers’ groups who are more concerned with ensuring or performing ‘decontamination’. Such groups tend to be more skeptical of scientific research, not to mention state institutions. Notwithstanding this division, the concept ‘decontamination’ has been mobilized by both groups. This raises a question that has yet to receive a careful hearing in the anti-GMO movement: what exactly would constitute decontamination? None of the texts we cite specify the meaning of this term. We interpret their arguments to mean that transgene introgression should be halted and reversed.23 Though we would affirm the spirit

21 Although this text is anonymous, it was signed by a group of NGOs, listed as follows: “This Statement is supported by Intermediate Technology Development Group (ITDG), Institute for Agriculture and Trade Policy (IATP), League for Pastoral Peoples, Community Based Livestock Initiatives Programme, Kenya (CLIP), Sustainable Environment Voluntary Action, India (SEVA), Crocevia, Italy; CENESTA, Iran; LIFE (Local Livestock For Empowerment of Rural People) Network of NGOs.” See also the 10 July 2008 announcement by the “network in defense of native corn” (RDMN, 2008).

22 This is not to say that ecologists simply dominate the conversation; they do not. Rather, their capacity to produce rigorous analyses of potential evolutionary and ecological implications of GM crops is given unique weight.

23 Similarly, a study by Bellon and Berthaud on the consequences of full-scale introduction of transgenic maize into Mexico advocated for the reversibility of transgene introgression: “if transgenic [maize] varieties are introduced on a large scale in Mexico…. procedures must be in place to ensure reversibility (i.e., the ability to return to the previous state in which the local maize populations exist without transgenes)” (Bellon and Berthaud, 2004, p. 885, our italics). Elsewhere, Bellon and Berthaud (2006) develop this concept further by contrasting the reversibility of transgene introgression to that of a product recall. When a drug is released on the market, for instance, a company may recall it if it is found to be unsafe. Yet, they note, we know very little about our ability to manage the dynamics of transgenes once they enter Mexican traditional agricultural systems and hence about how to establish a reversible system” (Bellon and Berthaud, 2006, p. 11). In the US, where most farmers purchase seed annually, seed recalls are relatively feasible. But in the Mexican context, the question remains: who would be responsible for and capable of recalling seed? A stronger understanding of the influence of evolutionary processes on the frequency of transgenes in a maize population may allow us to reduce the opportunity for transgenes to establish in maize populations.
of the appeals for decontamination, we recognize that they generate a dilemma—what we will call the dilemma of decontamination.

The dilemma resides in the fact that the popular desire to decontaminate Mexican maize exceeds the capacity of the hegemonic group, i.e., ecological scientists. The basic limitation ecologists face, again, hinges on sampling. Remember that Ortiz-García et al. (2005a,b,c) estimated that they would have found transgenic maize if transgenics were present in the population at a frequency of 0.01–0.0001. With more and better sampling, the uncertainty of these figures could be reduced. Yet, exactly how many more zeros are needed to find maize ‘decontaminated’? How many more studies in how many places would be necessary to demonstrate successful decontamination?

Turning to Gramsci to address these questions underscores that ecological science can discern degrees of uncertainty — its strength lies in this very iterability, in the way that it allows for the not-yet-known to be discerned, clarified, and encircled in a manner that does not lapse into metaphysics. Gramsci elaborates:

[[If scientific truths themselves are not conclusive and unchangeable, then science too is a historical category, a movement in continual development. Only that science does not lay down any form of metaphysical ‘unknowable’, but reduces what humanity does not know to an empirical ‘not knowledge’ which does not exclude the possibility of it being known (Gramsci, 1995 [1932], p. 292).

The essence of science for Gramsci is that it constantly changes, advancing unsteadily; it works at the margins of metaphysics, encircling that which is not known to consider it more carefully. Crucially, this conception of science does not need the myth of objectivity, and indeed cannot accept it, for again it conceives of science as a “historical category”. This rejection of objectivity is unimportant for the work of science because, as Gramsci reiterates in a lapidary passage, science is emphatically not a method for discovering the objective truth of the real:

[What is of interest to science is then not so much the objectivity of the real, but humanity forging its methods of research, continually correcting those of its material instruments which reinforce sensory organs and logical instruments of discrimination and ascertainment … in other words culture, the conception of the world, the relationship between humanity and reality as mediated by technology (Gramsci, 1995 [1932]).

Science is therefore an iterative social practice of ‘continual correction’. The resulting knowledge is social and subjective not only because it must be reproducible — open to multiple observers and inherently common to all humanity — but also because it cannot be separated from social life. Science therefore must remain bound up with human affairs and conditions of hegemony. Taking this argument alongside Gramsci’s contention that what is distinctive about science is its tendency to discern the ‘not known’ as a positive quality of knowledge, then we may say that, for Gramsci, science is a socially elaborated critique of metaphysics.

Gramsci’s approach here represents a departure from vulgar attempts to square Marxism with philosophy of science. By contending that science should not be conceived as truly objective thought (or the dialectic in action), Gramsci implicitly criticizes those who equate dialectical with scientific Marxism, or who conversely equate Marxism with the understanding the very unfolding of the dialectic in the world. Just as Gramsci rejected the myth that science = objectivity, he refused to equate Marxism with science or treat science as the means to truth; i.e., Gramsci opposed fetishizing science. Consider note 180 from quaderno 6:

The ambiguity surrounding the terms ‘science’ and ‘scientific’ stems from the fact that they have acquired their meaning from one particular segment of the whole range of fields of human knowledge, specifically from the natural and physical sciences. The description ‘scientific’ was applied to any method that resembled the method of inquiry and research of the natural sciences, which had become the sciences par excellence, the fetish sciences. There are no such things as sciences par excellence, a ‘method in itself.’ Each type of scientific research creates a method that is suitable to it, creates its own logic, which is general and universal only in its ‘conformity with the end’ (Gramsci, 2007, p. 131; see also Q6, n165).

Since there is no such thing as science par excellence, then Marxism cannot act as the scientific approach to history, or political economy, or anything else. Science is one element within a broad ensemble of activities in the “relationship between humanity and reality as mediated by technology” (Gramsci, 2007).

This brings us back to the question of ecology in the GM maize dispute. What is the ‘relationship between humanity and reality as mediated by technology’ here? In a word, humanity’s relations to maize – more narrowly, Mexican farmers’ and consumers’ relations to maize – have become mediated by transgenes and the scientific methods for detecting them. This condition is structured today by a paradoxical hegemony. Evolutionary ecological concerns have come to define the terrain on which the debate over GM agriculture is playing out. Yet the capacities of these scientists remain modest. Ecologists cannot claim that the maize has been ‘decontaminated’ or that the corn is pure. These claims are not so much beyond the purview of ecology as they are dependent upon concepts that cannot be tested scientifically. ‘Decontaminated maize’ is thus an object of scientific analysis and yet also an object of a dispute that ecology cannot resolve.

6. Conclusion

We conclude by drawing out three arguments from our analysis.

First, we have seen that the evaluation of transgene introgression by state institutions has privileged ecology at the exclusion of other forms of analysis. From a Gramscian perspective, this is not entirely bad, since scientific knowledge has many positive qualities. The problem arises in the gap between ecology’s authority and capacities. Ecology’s strengths in method and inference are matched by its inability to decontaminate maize. Still, the inequalities of authority in the debate persist. And the breadth of the scientific debate will continue to be shaped by, and in turn shape, political debates over transgenic maize in Mexico. The relations between science and politics is not static. The preponderance of recent policy debate has focused on the effects of transgenes.

See Engels’ Dialectics of Nature (1987, written 1873–1982). Although Gramsci did not advance views like those of Engels — which places him closer to Marx than Gramsci could have known in 1932 — Gramsci affirmed science, dialectical thought, and Marxism as three non-equivalent, overlapping ways of producing truths. For Gramsci’s Marxism, “being cannot be separated from thinking, humanity from nature, activity from matter, subject from object” (Gramsci, 1995 [1932], p. 292). The same could also be said of Marx’s Marxism. On Marx’s conception of science, see Thomas (1976) and Farr (1991).
introduction for wild or crop populations. Today the debate over transgene flow in Mexican maize-fields centers on the results of laboratory tests for the presence of transgenes and statistical questions about sampling.25 Without denying the importance of these questions, we argue that this emphasis, coupled with the rhetoric of decontamination, is unwarranted. As McAfee concludes in her study of transgene flow in maize in Oaxaca:

Too narrow a focus on ... the biological hazards of genetic engineering risks losing sight of the greater dangers to agricultural sustainability and rural well-being posed by the global restructuring of agro-food systems and the growing predominance of the industrial paradigm in agriculture. The terms of the debate over ‘genetic pollution’ ... have focused mainly on the reliability of laboratory data ... (McAfee, 2003, p. 35).

This is not to deny that the introgression of transgenes into maize landraces in the crop’s center of origin is a concern. Nor is it to slight the importance of the ongoing debate over “the reliability of laboratory data” (we would prefer to say ‘relative uncertainties of results’).26 It is rather to indicate the stakes of the conflicts over the scientific basis of the debate. If the hegemonic conditions surrounding GM agriculture change, as they are sure to do, other issues may come to the fore. Like Prudham and McAfee, we would be pleased to see greater attention paid to the social relations of GM agriculture. Yet we recognize that the political surfaces are shifting in another direction.

Following Gramsci, we should neither make science the enemy nor retreat into metaphysics. As the GM maize dispute under-scores, science is always already political; it is not an objective method, but an historical and social ensemble of practices that is always already bound up with hegemonic conditions. While it is critical to reaffirm science, we must recognize that science is defined by its relation to non-scientific thought and there is no way to scientifically discern the scientific from the parascientific. The transgenic maize dispute clearly demonstrates that what counts as ‘scientists’, not ‘ecologists’).

Some advocates [of GM agriculture] claim that the application of the precautionary principle ignores the fact that the main alternative to genetic modification of food crops – industrial pesticides [sic] – also have serious negative environmental effects. And they often assume that this counts against the precautionary principle itself. But this need not be so. Again, what might be at issue is ... the claim that relative to the context, the introduction of genetically modified foods constitutes an unacceptable outcome. For example, opponents of genetically modified foods are likely to admit that the environmental effects of pesticides [and herbicides] are deplorable, but claim that they are better understood, and of a lesser magnitude than the potential effects of introducing new organisms. Once again, the real debate seems to be about the reasonableness of such claims, and so about the application conditions of the [precautionary principle], rather than about whether the precautionary principle itself ... is acceptable (p. 56, our italics).

We concur and add a Gramscian rejoinder: the “real debate” here about the relative “reasonableness of ... claims” in the debate plays out not within a neutral space but under hegemonic conditions. The evaluation of risk, effects, certainty, understanding, and so forth exceeds science and is political.

This leads to our third conclusion, concerning Gramsci’s analysis of science. His writings on science in the prison notebooks crystallize around three key points: first, science is not defined by objectivity. Science is an ensemble of social and subjective practices that connect our bodies with “logical instruments of ascertainment” and that elaborate our conception of the world. Science is manifest through iterative, bodily, interconnected acts of communication and labor (and may therefore produce value).27 Second, scientific practices are to be affirmed, not by transforming science into Marxist metaphysics but by practicing science as a social critique of metaphysics that works by encircling the ‘not known’. Gramsci’s analysis points to the need for a social transformation that sees science as “humanity forging its methods of research”—and in such a way that brings about an improvement of the quality of life for subaltern social classes. Third, the boundaries of science cannot be determined scientifically. Neither Nature (the so-called real world) nor science (qua objective view of Nature) may be treated as unquestionable sources of truth. From this it follows that science and politics cannot ultimately be separated. Scientists are merely another social group of traditional intellectuals who should receive no special reverence from the public. In fact, their work should be analyzed as part of the conditions of hegemony. A Gramscian purview therefore validates science as a critical means of producing truths while simultaneously denying its purported objectivity and calling into question its authority.

Put this way, these arguments are no doubt familiar to geographers who have read, for instance, philosophers of science like Popper (1972 [1934]) and Khun (1970 [1962]), sociologists who study science, like Gieryn (1999) and Yearley (2004), and nature-society theorists like Haraway (1976, 1997, 2008) and Latour (1987, 1991, 1999); yet Gramsci made these arguments long before these ideas...

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25 As well as the question: who takes the sample? Most of the Mexican scientists who have sampled for GM maize are affiliated with Mexican state institutions. This has raised suspicions on the Mexican left that the science is ‘biased’. A Gramscian approach suggests that this critique is misplaced, since it presupposes that science’s strength lies in objectivity.

26 McAfee (2008) argues that the persistence of “disagreements among academics” concerning the presence or absence of transgenes “reflect[s] incomplete scientific data and differences over how to interpret the evidence found thus far” (McAfee, 2008, p. 155). This is broadly correct but does not address the nature of the data’s incompleteness or the debates over its interpretation. Nor does McAfee discuss the fact that this data is ecological data (she refers consistently to the many ecologists she cites as ‘scientists’, not ‘ecologists’).

27 Science is not alone in this regard, since other forms of intellectual labor are also social and bodily. Gramsci writes: “The mistake is to think that such phenomena happen only in scientific experiments. In actual fact, in any factory for certain high-precision industrial operations, there exist individual specialists whose ability is based solely and exactly on the extreme sensitivity of their sight, touch, and manual dexterity” (Gramsci, 1995, p. 288 [Q11, n36]).
became fashionable among social theorists.28 While Gramsci is hardly alone in articulating these views, he was prescient in making arguments that still matter for geography. Of course, since Gramsci’s time, there has been considerable elaboration in the history and philosophy of science. What distinguishes Gramsci’s arguments about science from later writers is not his bracketing of objectivity or his emphasis on iteraibility and sociality, but the way he situates these against the broader analysis of hegemony. So the prison notebooks, we suggest, may assist geographers in linking analyses of scientific practices with political economy. Those interested in the relations between hegemony and scientific practices will benefit from Gramsci’s texts.

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28 This is not to say that his writings on science have directly influenced subsequent debates. In fact, they have been largely missed. We know of no substantial study of Gramsci’s writings on science.