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Bioprospecting's Representational Dilemma

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This article is about the politically and epistemologically charged endeavor of turning medicinal plants and 'traditional knowledge' into pharmaceutical products. In Mexico, where I conducted ethnographic research on one such endeavor in the late 1990s, the project of eliciting pharmaceuticals from traditional or popular remedies has belonged as much to vaunted national(ist) scientific traditions (Lozoya, 1984) as to processes we might diagnose as an extractive colonialism or the 'needs' of transnational capital, foreign drug companies, and researchers from abroad. Here, as elsewhere, efforts to tease out the 'efficacy' of traditional knowledge have not been framed as a particularly symmetrical project. Plant- and ethnobotanically-guided drug discovery—whether conducted by, for example, the researchers in Mexico's National Medical Institute in the late nineteenth century, by the US National Cancer Institute in the 1950s, or by the San Francisco-based bioprospecting company Shaman Pharmaceuticals in the 1990s—has been an effort to render 'traditional' or popular medicine actionable in terms established by the exigencies of industrial drug discovery, biochemistry, and intellectual property. As such, it has focused on the form of the isolated, bioactive chemical compound.

Certainly, many researchers I know in Mexico and in the US take an equitable view if these wrenching efforts at transformation or corroboration 'fail', often pointing to the narrowness or inadequacy of biochemical models rather than simply concluding that traditional remedies or particular plants simply 'don't work' in the ways people say they do. But the ideological charge of the overall project does not thereby evaporate: plant- and ethnobotanically-guided drug discovery is, by definition, an effort that relies on biomedical models and 'strong' patent provisions as its ultimate source of legitimation and value. The uneven epistemological weight that is built-in to this 'corroborative' project significantly complicates the well-intentioned efforts of many activist ethnobotanists and chemists to 'prove' the veracity of traditional knowledge by demonstrating that it *really* works—in pharmacological terms (Adams, 2002).

Such questions about belief, knowledge, and efficacy are well-worn in anthropology and in the sociology of knowledge. But, in recent years—more specifically, since the early

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1990s—this already heavily-freighted political–technical project has become differently charged. The 1992 UN Convention on Biological Diversity (CBD) ushered in some significant shifts in the relationship between indigenous knowledge and pharmaceutical research and development, particularly when such articulations cross north–south lines. Giving institutional form—albeit uneasily—to many years of activist and policy efforts, the CBD included a novel and hotly contested benefit-sharing mandate, in which corporations are required to ensure some form of 'equitable returns' to source countries and source communities, should they desire continued access to Southern biogenetic resources and cultural knowledge. In the wake of the CBD, plants and 'traditional knowledge', formerly considered part of the global commons and hence ostensibly (though this is of course a point of serious contest) 'free for the taking', have become different sorts of resources. Once unencumbered, they now come with potential claimants attached. The ethic and (soft) mandate of benefit-sharing indexes, in part, what we might call a certain Lockean activism; that is, an idea that plants come with the innovative labor of 'local' or 'indigenous' people *already embedded.* These people, long excluded from the rewards granted to patent-holders on new drugs, should thus have the right to stake a claim should these plants prove to be the key to, for example, the ever elusive 'cure for cancer' (Kloppenburg, 1988; ISE, 1988).

As we might imagine, in this context, the already overdetermined question of the pharmacological 'efficacy' of traditional remedies has taken on new technico-political life. Bringing traditional knowledge (and its academic proxy, ethnobotanical knowledge) into the process of drug discovery is not simply meant as a short-cut to new pharmaceutical products. It is now also meant to bring dividends—in the form of compensation or other types of material reward—to the people who provided this knowledge. The 'valorizations' at stake for resource providers (a dreadful term) are not simply symbolic or epistemological, but potentially *material* as well.

In the years leading up to and then following the 1992 CBD, one of the key mechanisms for setting (the promise of) this enhanced chain of value productions in motion has been the benefit-sharing or bioprospecting contract—a formalized arrangement in which corporate access to plants, microbes, and 'knowledge' now include provisions for giving something back. In agreements implemented in Mexico and beyond, these benefit-sharing provisions have taken many forms: promises of royalty-sharing, community development funds or projects, up-front access fees, technology transfer, infrastructure-building. They have also set up a number of different kinds of actors as potential benefit-recipients, including indigenous or local 'communities', scientists in the source country, non-governmental organizations, groups of traditional healers, and national biodiversity institutes.

There is much in these arrangements that would seem ripe for an analysis framed by something called postcolonial science studies. As other contributions to this issue highlight, any attempt to think about a postcolonial science studies will necessarily run into the problem of definitions—we face significant questions about what will count as either postcolonial or science studies, not to mention what the combination itself might mean. In this article, I want to try and think about one of many potential versions of just such a combined analytic project through a critical engagement with bioprospecting practice. Broadly stated, I am interested in the work—simultaneously biochemical and political—that 'local' or 'ethnobotanical' knowledge is expected or asked to do as it travels into drug discovery circuits, and, ostensibly, back out again in the form of

benefits-to-be-shared. In a formulation that I draw as much from science studies as from postcolonial studies, I pose this question as a matter of the *representational capacities of knowledge*—or, differently stated, as a question about the 'interests' that local knowledge is expected to bear, represent, or animate in these agreements. It is an abstract formulation, but as we shall see below it comes alive in the conduct of one particular US–Mexico benefit-sharing collaboration, in which the promise of benefits to local resource providers depends in large measure on whether or not the plants and knowledge they provide actually succeed in becoming a patented drug. It is this dual notion of efficacy that interests me here, in which the bioactive potential of 'local knowledge' holds the promise of activating benefit-sharing claims for 'local people'. Taking at face value, for now, the terms set by one prospecting agreement, this article poses a simple ethnographic question: what *is* the contribution of 'local' knowledge to the process of drug development? How, in turn, does the relationship between ethnobotanical leads and pharmaceutical measures of value bear on the claims and entitlements that prospecting participants might expect in the future?

On 'Representation'

The idea that people have an interest in their knowledge is not of course limited to the terrain of contemporary bioresource appropriation. Concern with the representational work that knowledge does is, arguably, what brings certain strands of postcolonial studies and science and technology studies into conversation with each other—and what seems to drive them apart, as well. To start, we might consider one of the key arguments of a specific strand of science studies. Actor–network theory (ANT), associated with the work of Bruno Latour, Michel Callon, Annemarie Mol, John Law, and others, holds as one of its primary suppositions the argument that scientific knowledge does not simply represent (in the sense of depict) 'nature', but it also represents (in the political sense) dense and diffuse webs of 'social interests' (Latour, 1993, p. 27; Callon, 1986; Callon and Law, 1982). That is, in order for facts and artifacts to become authoritative, they must mobilize, or gather in their name, a robust network of interested parties. The interests in question may belong to scientists, microbes, scallops, or any one of a number of potential 'allies', human or non-human.

This argument that 'representation' always carries a double meaning—as depiction (a picture of) and as proxy (an act of speaking for)—has a long lineage in social theory.[1] Echoing a distinctly Marxian formulation while deliberately casting aside Marx's central preoccupation with class, Latour and other actor–network theorists insist that speaking of (nature) is always also a mode of speaking for (interests). In *We Have Never Been Modern* (1993), Latour argues that the task of science studies should be to reunite these two meanings and domains of representation, by working to identify the (social/political) interests of the 'actants' who come to be wrapped up in, and thus represented by, technoscientific facts and artifacts.

Postcolonial studies scholars, particularly those who have developed critical conversations between poststructuralism and Marxist subaltern studies, take this question of speaking-of and speaking-for somewhere else altogether.[2] Arguing that intellectual knowledge production (especially that which seeks to 'restore a voice to the silenced') is always complicit in the very power relations it hopes to critique, writers such as Gayatri Spivak and Dipesh Chakrabarty insist on a differently inflected understanding

of the doubleness of representation (Spivak, 1988; Chakrabarty, 1999). Here, the question is framed with reference to the historiography of the colonized or the subaltern: the problem with 'representation'—speaking *for* the subaltern by speaking *of* her (restoring her voice to the historical record)—is fundamentally, its impossibility.[3]

A group of Latin American scholars working in conversation with the South Asian subaltern studies group has eloquently taken up this point. Alberto Moreiras, for example, argues that the distinctive task of a subaltern political and analytical stance is in fact to be 'counter-representational'—to insist on the impossibility of representation. 'Subalternism is on the side of negation', he argues: it is a very different stance than a populism, for example, in which scholars might actually claim to 'represent the people' (Moreiras, 1997, quoted in Beverly, 1999, p. 97; see also Moreiras, 2001; Rabasa, 2001).[4] [This is not to say, of course, that questions about agency and representation have not been rehearsed in STS, in characteristically idiosyncratic ways: recalling Callon (1986), we might ask, can the scallop speak?][5] In short, a subaltern studies approach entails highlighting the epistemological and political violences that are constitutive of efforts to 'speak of' and (thus) to 'speak for' the marginalized or excluded.

We might say, then, that actor–network theory shades towards the positivities if not the positivist dimensions of knowledge production as an act of representation, while much postcolonial studies in South Asia and Latin America (specifically, the work of subaltern studies scholars) asks us to attend to its negativities—its violences and elisions. As such, ANT and the kind of postcolonial/subaltern studies developed by Spivak, Moreiras, and others seem implicated in two fundamentally distinct, if not opposing, ways of thinking about the political/social/epistemological work that knowledge does. 'It' (knowledge) includes, and shores up; it elides, and does violence. Where, and how, might these divergent theoretical perspectives take us with regard to bioprospecting?

One route would certainly be to address historiographic and epistemological questions about the effacements enacted through the 'translation' of traditional knowledge into pharmacological value.[6] What, for example, is lost and gained (and by whom) when complex indigenous ontologies of illness and therapeutics are rendered in the very different language of the single chemical compound and its patentable effects (Adams, 2002; Lozoya and Zolla, 1984)? Many potential kinds of assimilation and effacement are at stake in these 'corroborations': in Mexico, India, and elsewhere, such translational efforts have been crucial to postcolonial nationalist endeavors to incorporate 'the indigenous' into the modern nation-state (Prakash, 1999; Hayden, 2003b; Soto Laveaga, 2001). In these terms, the constitution of traditional knowledge as raw material for pharmaceutical development should be (and has been) classic terrain for a postcolonial studies analysis.

But we could also take our inquiries into bioprospecting's representational project in some other directions. We could think about questions of representation here in the dual mode flagged by actor–network theory—the depictive doubling as the political, in an 'affirmative' and indeed incredibly explicit sense. Here, I think of the ways in which engaged ethnobotanists and plant chemists have long used their field studies and laboratories precisely like courtrooms; that is as staging grounds for proving the veracity of 'indigenous knowledge'. In this sense, ethnobotany has been figured by some activist practitioners as a form of what I call 'epistemological advocacy'—a commitment to translate 'indigenous knowledge' into the language of biochemical efficacy, and to use these assertions of the scientific rationality of indigenous knowledge as an axis of political mobilization and even court-room defense (Hayden, 2003b).[7]

It is precisely in the mode of advocacy that some ethnobotanists view bioprospecting as an enterprising mode of representation in the affirmative sense. In the view of prominent US ethnobotanists who have been involved in promoting ethnobotanically-guided drug discovery within US government and corporate sectors, bioprospecting is not just a way to show the (pharmacological) veracity and thus the 'value' (to the world) of traditional knowledge. It is also a way to turn this epistemological/biochemical correspondence into a revenue stream for the stewards of traditional knowledge themselves (Plotkin, 1995; Balick and Cox, 1996). It is in *this* sense—a bid to 'include people' (in new idioms of political participation) by 'including their knowledge' (in processes of drug discovery)—that some architects and proponents of bioprospecting make strong representational claims themselves.

In the remainder of this discussion, I take my cue from the machinations of one prospecting contract to try and gain some ethnographic purchase on the overly thick question of representation, and some of its many positivities and negativities. If we are interested in the politics of representation we cannot, I suggest, ignore the mechanics of representation: the practices through which bioprospecting contracts aim to animate, activate, construct, and protect the interests of 'local people' through the inclusion of their knowledge in the drug discovery process.

Bioprospecting

Despite the US legislature's continued failure to ratify the 1992 UN Convention on Biological Diversity, an interagency US government program has been among the most prolific sponsors of benefit-sharing agreements in the world. In 1993, the US National Institutes of Health (NIH) began coordinating a bioprospecting initiative called the International Cooperative Biodiversity Groups (ICBG) program. Extending the reach of programs within the NIH (specifically, the National Cancer Institute) that have promoted plant- and ethnobotanical drug discovery, the ICBG program funds US academic researchers to set up royalty-sharing collaborations between developing country communities/researchers and US drug companies (Rosenthal, 1997; NSF, 1993; Timmermann, 1997; Schweitzer, 1991; Reid *et al.*, 1993).

One of the first five projects funded under this program in 1993 was the 'Bioactive Agents from Dryland Biodiversity of Latin America' initiative (hereafter, the 'Latin America ICBG'), based at the University of Arizona and working in Mexico, Chile and Argentina (Timmermann, 1997). Participating Mexican researchers from the National Autonomous University (UNAM), together with their colleagues in Chile and Argentina, collected medicinal plants and knowledge about their uses, and sent their collections to the pharmaceutical and agricultural divisions of American Cyanamid, a US-based firm. In exchange, the researchers were offered research funds, in order to conduct the required collections, and a percentage of future royalties on any resulting drugs.

The fraught question of 'how much' was and remains very much deferred: if a drug is produced at all, it is likely to take 15–20 years (the usual time frame for a new drug to emerge out of the pipeline). In this case, the participating company would share with the University of Arizona between 1 and 5% of the net profits. Roughly half of that 1–5% would return to the source country, where it would be distributed among participating research institutions and the appropriate 'source communities'. This ethnobotanically-guided drug discovery initiative has been one of the many collaborations instituted in

Mexico and across the world which attempt to bring some degree of 'reciprocity' into corporate research and development based on the material and intellectual resources of the south. But as we might surmise from this project's speculative calculus of redistributed royalties, the CBD's notion of 'equitable' returns (meaning 'just', and not necessarily 'equal') is extraordinarily, constitutionally, fragile.

This sense of fragility was compounded in Mexico in the late 1990s, when the legitimacy of plant collections for drug discovery became a deeply unsettled matter. Policymakers, scientists, and indigenous and *campesino* organizations have been grappling not only with the new promises of the CBD, but also with the injunctions of the North American Free Trade Agreement (NAFTA), the World Trade Organization (WTO), and their combined imperatives to remove 'barriers' to the traffic in biogenetic resources and to introduce stronger intellectual property protection for pharmaceutical and biotechnological products. Intimately entwined with associated shifts towards the 'liberalization' of intellectual property, land tenure, and agricultural policy, the question of indigenous political and territorial sovereignty became intensely and violently vexed, most visibly but certainly not exclusively in the southern state of Chiapas (Nash, 2001). Meanwhile, national legislation regulating access to genetic resources (required by the CBD) has been pending since the mid-1990s, so that bioprospecting contracts have proceeded on more or less an ad hoc basis. That is, they have gone forth under the watchful eye of the National Institute of Ecology (INE) but without binding national guidelines, legislation—or, many activists argue, legitimacy (Nadal, 2000; Hayden, 2003b).

Making and Severing Connections

Whence 'legitimacy', then? For ICBG-funded principal investigators, one of the main challenges raised by benefit-sharing agreements is, borrowing an apt turn of phrase from Marilyn Strathern, to ensure that (the appropriate) people are included, and that they are included *well*—that is, that they are not exploited through their very participation (Strathern, 2000, pp. 292–294). This is a dilemma that applies to a growing number of arenas in which information/sample collection and property claims promise and threaten to mingle. Prospecting joins genetic databases, tissue banking, and Internet data management as domains in which modes of including people 'well' often pull in two opposed directions. First, they must set the ground for potential redistributive or even property claims, but second, they must also 'protect' subjects by invoking privacy rights or confidentiality—and thus *cutting off* the relations of identity or provenance that make those redistributive claims possible in the first place (Strathern, 2000, pp. 292–294). This seemingly contradictory play of making and severing connections between people and what they 'give' proves to be an extraordinarily fitting template for understanding the management of knowledge, plants, and the 'interests' of resource providers in the Latin America ICBG project.

Elsewhere, I have discussed in great detail the practices through which the Mexican ethnobotanists working with the Latin America ICBG navigate their new imperative not just to collect plants, but to collect the benefit-recipients who come with those plants—e.g. the people who shall receive a portion of royalties should Mexican plants turn into patented drugs (Hayden, 2003a, 2003b). The UNAM ethnobotanists' task is indeed to make connections—not just to identify, but to forge them—between collected resources and the (appropriate) participants. For the sponsoring agency, the US National Institutes of

Health, there is a very straightforward logic to the ways in which such connections *should* be made. The NIH stipulates that funded researchers are to sign benefit-sharing contracts (modeled on and serving as informed consent forms) with the people who provide plants and information. These contracts are supposed to produce an ethnobotanical paper trail. They are the crucial documentation that will produce a continuity between 'local' people and the plants/knowledge that might become the drugs that are to become the royalties to be shared (see Hayden, 2003a).

But, alongside this imperative to produce continuities lies another move: the deliberate *disconnection* of people from biochemical specimens within the same circuits of exchange.[8] The agreement between UNAM and Arizona has some powerful confidentiality requirements written into it—most notably, the provision that plant extracts traveling from Latin America to participating US companies be stripped of all identifying and ethnobotanical information, and labeled only by a project code. The purpose is to keep valuable identifying information out of the hands of the participating companies, so that they will not be able simply to go elsewhere (e.g. outside of the contractual bounds of this agreement) to resources that look promising. Thus, once back in their own laboratories, the Mexican researchers are charged with making the 'connections' between people and their knowledge disappear from public sight, and from the gaze of most other participants in the project.

This appeal to secrecy has some important implications for the work, representational and otherwise, that ethnobotanical knowledge is allowed to do at all as a guide to identifying new drugs. For the incitement to secrecy dramatically undercuts the animation of ethnobotanical knowledge as both a valuable guide for drug discovery and as a conduit for carrying local people into these processes of value production. Rather than keeping people and their knowledge attached to specimens, this project's confidentiality provisions do precisely the opposite—they deliberately anonymize specimens (strip them of identity and connections) as they travel out of Mexico and into the laboratories of the participating companies and US academic institutions. Crucially, in the view of project managers in the US, these two divergent practices are enacted toward the same end: *protecting the interests of southern resource providers.*

One of the implications of this move is that this prospecting network is cut off from itself, from within. There is thus no single answer to the seemingly straightforward question which I had hoped to pose here: how much or in what ways does 'ethnobotanical knowledge' participate in the drug discovery process? Assessments of the role of ethnobotanical knowledge in the drug discovery process vary dramatically across this rather patchy network—in large part because 'it' (ethnobotanical knowledge) does not travel freely among the institutions and actors involved. Ethnobotanical knowledge matters provisionally, or contingently, in the process of drug discovery—according to who is allowed access to it, when, and how.

On the Uses of Knowledge

If we are to speak of confidentiality here, it is not primarily people but plants whose identities are at stake and under intensified management: much of the management of plants and information in this project involves stripping specimens of their markers of identity. The linchpin in this strategy of information management is the project code that links each extract to its associated data sheet—and thus its crucial identifying information. The

information on this form, including plant uses, taxonomic and popular names, and location, is what makes collected samples viable outside of the laboratory. Most importantly, without a species name, no-one can go forward with product development.

Neither outsiders such as myself, nor insiders such as the participating companies, are allowed access to the information that connects data about people, knowledge, and place to specific collected plants. Thus, when the Mexican chemists send plant extracts to the participating companies, they are labeled only with the project code. All identifying and supplemental information (i.e. the data sheet) is sent directly to the University of Arizona. Even at annual project meetings, where the Latin American academic researchers, US academic chemists, and corporate representatives gather behind closed doors, the project director at Arizona prohibits participants from revealing sensitive information to each other. Thus, the researchers find themselves treading cautiously and counter-intuitively, trying desperately (for example) not to name the plant whose chemical structure they are discussing on their brand-new slide.

What, though, of those at Arizona who do have access to the information that accompanies each collected plant specimen? In the field of natural products chemistry, there are a number of approaches to the question of how one uses information about plants—e.g. the conditions they treat, their methods of preparation and 'administration' (as a tea or a salve, for example), what they might be combined with, when and in what doses they are to be consumed. A nuanced, ethnobotanically-guided drug discovery enterprise is likely to take much of this information into account. Thus, if a plant is used primarily as a tea, a chemist might, at a minimum, start by investigating whether the plant yields bioactive compounds at high temperatures. But this (minimal) attention to the 'specificities' of the local or the 'ethno' is not the only approach circulating in the world of natural products chemistry.

For one key participant in this project, ethnobotanical information is valuable not for its specificities but rather for its generalities: that is, as a general beacon of bioactivity, the nuances of which are left for later elucidation. For this Arizona-based natural products chemist, the 'uses' attributed to plants are of interest not primarily for their specific content but rather for the sheer fact of their existence. As he explained it to me, the knowledge that, for example, '*gordolobo* is good for coughs' is truly interesting only insofar as there is information that the same plant has some use in other locations—that is, he is looking for signs that the plant has a wide history of use of any sort, which in turn signals a good chance that it contains some active compound. In this view (common to much natural products drug discovery as well as economic botany), the 'uses' box on the data sheet might just as well be prompting Latin American researchers to answer 'yes' or 'no', rather than 'gastro-intestinal' or 'upper respiratory'.

Honing in on the fact, rather than the content, of ethnobotanical knowledge is a well-established approach to natural products drug discovery, but there is room in this project for yet another kind of engagement with 'the ethno'. As the director of this collaboration, Arizona chemist Barbara Timmermann is perhaps particularly attuned to the politics of participation or inclusion swirling around this endeavor. She assured me that the content of the 'uses' box does potentially hold some usefulness in itself. It can matter, in large part, because she, uniquely in this collaboration, knows not just what the 'uses' box contains but is also in a position to relate it to other relevant information. When she is considering which plants to pursue for further analysis, ethnobotanical information serves as one piece of the puzzle, alongside an array of other information. 'Future promise' congeals when this information clusters in fortuitous ways—corporate bioassays

that suggest a good fit between plant sample and industrial priorities; strong bioactivity readings in the preliminary UNAM tests; and crucially, a literature review that assures that a particular plant or compound is still up for grabs (Timmermann, personal communication, 1997). Too much already-published work on the matter removes a sample from the running, as it ruins both its patent appeal and the Mexican and US chemists' ability to extract some intellectual capital (in the form of publications) from this process (The plant cannot be too useful, then).

From Timmermann's vantage point, ethnobotanical information may further solidify the association of an extract with certain bioactivities; that is, if a plant is supposed to be good for treating wounds, she might lend a particularly careful eye to the results of any anti-microbial screens. Still, the screens continue to proceed according to pre-established company priorities; they do not morph to accommodate the ethnobotanical information to which Timmermann might be privy. Arguably, then, ethnobotanical knowledge holds enough value to help confirm or buttress industrial tests, but it is not nearly weighty enough to contradict these bioassays, much less to direct industrial protocols.

But of course the design of this ICBG project is such that ethnobotanical knowledge is not *permitted* to direct corporate screening protocols. Regardless of the information that the UNAM ethnobotanists may have included on their data sheets, the companies involved subject all of the samples that come to them (identified only as the provenance of one of the three source countries) to the same battery of screens. US government researchers and policymakers affiliated with the ICBG wrote in 1999 that indeed, despite the high profile of ethnomedical and indigenous knowledge in the program, 'it is difficult to effectively integrate ethnomedical knowledge into the large-scale high-throughput systems commonly used by the industrial partners . . . Traditional knowledge may be more often useful in academic environments, government labs and with companies that have flexible systems that can be easily customized to take advantage of the information' (Rosenthal *et al.*, 1999, p. 17).

Yet this approach is *not* the one the corporate liaison to the project says he might have chosen himself. In a 1997 interview, he suggested that the ICBG's approach to using ethnobotanical knowledge—and more explicitly, the blocks placed on its travel—was a bit of a novelty, and not always an effective one at that. From this researcher's perspective, ethnobotanical information just gets 'put away'. And what if, he asked me (not quite rhetorically), his company does not happen to be screening in an area corresponding to the uses attributed to a particular plant? From his point of view, ethnobotanical information is not emptied of content. It simply disappears.

Importantly, he noted explicitly that this disappearance is a reflection of the interests being represented through plant-based drug discovery. He posed the dilemma this way: wasn't the *requirement* that the company test the extracts *blind* doing 'a massive disservice to the researchers who collect this information'? This question brings to the fore the many layers of interest that ethnobotanical knowledge presumably bears here. The explicit doubleness of the term comes to life. If actor–network theory has prepared us well to think about scientists as having an 'interest' in 'their' knowledge, this suggestion is complicated by the ambiguity of a term which is used just as often in drug discovery and academic circuits to refer to what 'local' or 'indigenous' people know as to what ethnobotanists produce on data sheets and publications, as experts.

As is suggested by an increasing body of work, postcolonial and otherwise, on natural-historical and botanical knowledge produced in 'encounter', the kind of authorship

we might identify here is indeed complex (Goonatilake, 1984; Grove, 1991; Raffles, 2000; Pratt, 1992). In fact, it is not only rural or 'local' participants who are being recruited into the prospecting fold in this agreement. UNAM ethnobotanists and their chemist colleagues are considered participants and potential benefit-recipients as well. For, among the most concrete forms of returns in this exchange are research funds, training for graduate students, promises of equipment and database management tools, and other infrastructural goods destined for the UNAM ethnobotany and chemistry labs (see Hayden, 2003b). It is with these provisional returns in mind, perhaps, that the disappearance of 'ethnobotanical knowledge' strikes the corporate liaison as problematic—because it seems to remove ethnobotanists themselves from the visible field of participants in prospecting's brand of redistributed value-production.

Blocks and Flows

Many participating researchers lamented to me and to each other the uncomfortable novelty of the truncated travels of information in this agreement. One of the US-based chemists helping orchestrate the traffic of plant samples in this agreement complained that he is used to being able to collaborate with corporate partners in a much more open way. In this agreement, in contrast, he is not allowed to 'share' what he knows in order to help guide the bioassays. What, he asked in exasperation, is the point of this collaboration? Neither the academic scientists (from either side of the salient geopolitical divide) nor the corporate representatives managing their company's involvement in this project were completely sold on the ICBG's injunction that knowledge of plant identities and plant uses shall be so dramatically partitioned and redistributed.

On the surface, such laments might seem to resonate strongly with recent critiques of the quasi-privatization of academic bioscience research. The truncation of information flow is widely seen as one of the most pervasive and negative effects of the increasing prevalence of industry–university partnerships and of patenting as a commonplace part of research in the life sciences (see Soley, 1995). Commenting on this situation in the idiom provided by actor–network theory, Marilyn Strathern notes that Latour's famous ever-multiplying networks of knowledge production and interests are indeed interrupted by patent claims. Ownership brings these relations to a stopping point, even if only temporarily (Strathern, 1999, p. 177).

But something distinctive is going on in the case of the ICBG project: it is not ownership itself which blocks the flow of information, but rather the threat of property claims made out of place—at least in the early stages of plant collection, screening, and testing for future promise. Once property claims are ready to be actualized, in the form of a patent, things that were at first kept channeled into very limited avenues of access will start flowing within the agreement. The companies will have to know what the molecule and plant source is. The Latin American researchers will have published articles naming their specimens and perhaps the results of some corporate bioassays, and the potential for royalty-generation is set in motion.

This is not an argument for the liberatory possibilities of intellectual property rights. Certainly, many kinds of claims and types of access stand to be proscribed if a chemical compound from a Mexican plant is patented by the University of Arizona, and licensed to Wyeth-Ayerst. We might point to a long list of examples—the neem tree in India, the enola bean in Mexico, the vines used to make the hallucinogenic beverage ayahuasca in

the Amazon basin—of corporate patents taken out by US or European companies on compounds derived from popularly used plants, followed by actions by the companies to sue the long-term users or distributors of these plants for patent infringement. I would suggest that it is precisely the threat of these kinds of 'property gone wrong' (or 'right', depending on one's perspective) that make provisional sense of the modes of representation on offer in this prospecting agreement.

In other words, the 'unconventional' information blocks that most irk participating researchers are not necessarily those imposed by the companies. They are, rather, aimed primarily at upsetting conventional power relationships within industrial–academic, not to mention north–south, collaborations. Secrecy, at least in terms of keeping identifying information out of the hands of corporations, is meant as a form of sanction—a built-in mode of enforcement power within the prospecting contract itself. It is thus a sign of good faith to participating source countries that corporations will not be allowed to circumvent the other 'unconventional' aspect of this collaboration—the return of royalty payments to the providers of resources. Thus we arrive at a somewhat paradoxical situation: what could seem like a violation of the spirit of collaborative, ethnobotanically-guided research—the virtual erasure of 'local' knowledge—is in fact a measure to protect against its undue exploitation.

Limits of Representation?

What are we to make of these presumed connections and unsettling truncations? The combination produces some notably odd effects. Far from the idea that a continuous chain of value production will be extended from 'local people' to ethnobotanical knowledge to a drug and back again, this project coughs up a complex and choppy network of provisional connections and truncations, of short (if not short-circuited) loops of representation and elision. Even in its own terms, the modes of representation on offer in this agreement seem to run into some intriguing self-imposed limits, as the mechanisms in place for asserting and protecting the interests of knowledge providers end up defusing the declared potential (simultaneously biochemical and political) of the resource in question. One consequence of the ICBG's mode of information management is, we might argue, that ethnobotanical knowledge is *marginalized* within the very processes meant to *valorize* it.

I noted at the outset that bioprospecting's self-description seemed eerily suggestive of a world according to Latourian science studies—that is, a world in which people's (and things') interests are spoken for, represented, through their inclusion in processes of knowledge production. But the processes charted above seem to turn that premise inside-out. This bioprospecting agreement and its information- and interest-management practices, on second look, seem to call up a different set of theoretical conversations, leaning more toward the deconstructive denials and negations that inform much postcolonial theory and subaltern studies. Moreiras and other subaltern studies scholars might not be surprised to find the figure of 'the indigenous' or of 'local people' and their interests constantly invoked in this agreement and yet endlessly deferred. In such circumstances, the inclusion of 'people' (and their knowledge) can only be imagined or conducted through their effacement, or their exclusion.

The deferrals enacted in this agreement have a distinctive shape: they come to us, in large part, through recourse to confidentiality, and they highlight the complex representational project that prospecting managers set up for themselves. This is an effort to

speak *for* ('local interests') by not necessarily speaking *of* ('local knowledge'). We might argue that if the mechanics of this bioprospecting agreement constitutively refuse to tell us very much (for better or for worse) about the pharmacological 'value' of 'local knowledge', they do show in vivid detail what a *technics of counter-representation* might look like.

Efficacy, Transformed . . .

The story I have told here might have been rather different, and certainly much more straightforward. The annals of natural products chemistry, ethnobotany, and medical anthropology are full of rich and nuanced discussions of the ways in which plants and 'traditional' medicine have demonstrated their value to drug discovery—and thus, of how, presumably, they can continue to do so. Proponents of natural products chemistry repeatedly point out that 'one in four' prescription drugs has been derived from plants (others move the mark up to three-quarters) while still others note that bioprospectors can increase their chances for success from one in 10,000 samples (the skeptical calculus often cited by synthetic chemists) to one in two, by using 'ethnobiological' knowledge as their guide (see Rodríguez Stevenson, 2000, p. 1132). We might expect bioprospecting agreements to provide more fodder for such success stories, or (if not), then to help us think about how the complexities of plant-based therapeutics might resist assimilation into pharmacological accountings of efficacy and value. (Examples of such 'resistance' are not hard to come by. I think here of the epic difficulty one US-based prospecting company had in synthesizing the plant-based compound that was to lead to its one marketable product. There are also the stories many natural products chemists in Mexico and the US tell about how the process of 'isolating' compounds, necessary to produce a patentable pharmaceutical product, often simply does away with all signs of biological activity that plant extracts initially produce.) But, as we saw in the Latin America ICBG project, these always-charged engagements between something imagined as 'traditional medicine' and pharmaceutical research have been displaced, even short-circuited. They have become something else altogether.

In the introduction to a thought-provoking 2003 workshop entitled, 'Plants, Medicine, and Power: Emerging Social and Medical Relations', historian Gabriela Soto Laveaga argued that in the context of bioprospecting initiatives, the articulation between traditional medicine and pharmaceutical research and development has undergone a subtle but important shift. It is, she argues, a relationship that has become thinkable *less* as matter of the 'efficacy' of traditional medicine, and *more* as a matter of the exigencies and complexities of 'compensation' (Soto Laveaga, 2003). I would second this formulation and go one half-twist further. With the Latin America ICBG project firmly in mind, I might be tempted to argue that bioprospecting is not primarily about comparative therapeutic efficacies, or 'the power of plants' *at all.* It is a strong point, but I say it with the assessments of key project participants in Washington, DC, firmly in mind. In a 1999 article detailing the contours and accomplishments of the ICBG program up to that point, Joshua Rosenthal, director of the initiative at the NIH, and 21 co-authors from other participating government agencies issued a cautionary note on the relationship between drug discovery and benefit-sharing agreements. In fact, they make clear just how touchy *is* the question of drug discovery within what is, among other things, a natural products (i.e. plant- and microbe-based) drug discovery initiative. Seeking to dispel the 'popular' conception

that bioprospecting's success as a conservation strategy depends on a new drug making it to market (and selling well), Rosenthal and colleagues caution their readers,

> ... drug discovery is a high risk science. That is, a very small proportion of the research endeavors result in a major drug that will yield financial benefits to the research organizations and their partners. The ICBG program approaches bioprospecting in a more multi-dimensional way, such that progress in any one of the three goals [drug discovery, promoting scientific and economic activity in developing countries, and conservation] ideally strengthens efforts of the other two. By integrating research and development efforts toward all three objectives from the outset, the ICBG aims to make substantial and incremental contributions toward their achievement without pinning all hopes for success on the relatively low probability of producing a major pharmaceutical or agricultural product (Rosenthal *et al.*, 1999, p. 7).

Rosenthal and colleagues label the ICBG's challenge as one of 'Combining high risk science with ambitious social and economic goals' (to quote the title of their article). I might take their self-diagnosed combination of high ambition and low pharmaceutical expectations and pose a different question about ethnobotanically-based drug discovery as a mode of representing people, knowledge, and 'interests'. After Soto Laveaga, my question is as follows: how are notions of comparative efficacy being re-calibrated with the promise of benefit-sharing (and its ever-present twin, the accusation of biopiracy) on the horizon? Certainly, the processes I charted above seem to make little sense from the point of view of an effort to turn medicinal plants into drugs. But my argument is that this project has had its sights on the activation of other kinds of value and (counter-)representational projects altogether.

As with many things, the world of bioprospecting does not stand still for long. With one eye on the 'difficulties' of eliciting leads out of plant compounds, and another on the fallout from international conflagrations concerning 'biopiracy' in Chiapas (following a controversy surrounding a sibling ICBG project), the participating company and the project director at the University of Arizona have decided to dramatically re-tool their collection strategies. These have been orientated away from Mexican plants and the people who come with them, and towards collecting sites that seem to promise more bioactivity and less social-political complexity. As of the fall of 2003, the Mexican team was no longer part of the Latin America ICBG. The UNAM scientists continue to search for new sources of funding for their interdisciplinary plant research, while microbe screening, deep sea bioprospecting (outside of the limits of territorial sovereignty), bioinformatics and combinatorial chemistry, and even pharmacogenomics beckon a new generation of corporate prospecting initiatives, in which neither plants nor their efficacy are very much at the heart of the matter, at all. In its own terms and in a relatively short timespan, the newly inclusive project of bioprospecting has produced its own impossibilities, and is poised to raise some new representational dilemmas altogether.

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Notes

[1]We might follow George Hartley and frame the 'problem' of representation via Marx and Gayatri Spivak (Hartley, 2003, pp. 247–252). Hartley notes that in Spivak's famous essay, 'Can the subaltern speak?', she works through a critical engagement with the problem of colonialism, marginality, and academic knowledge production in part through an explication of Marx's *Eighteenth Brumaire* (Spivak, 1988). As Spivak reads Marx, representation takes on two meanings: as depiction, and as proxy. Representation works in the sense of a depiction, when, for example, peasant proprietors can form a picture of themselves as a class. We might think of representation as 'proxy', a mode of speaking for 'interests', when these same peasants fail to conceive of themselves as a class, and instead turn to someone else (in Marx's example, Bonaparte) to represent their interests for them (see Hartley, 2003, p. 248). A notion of the fundamental doubleness of representation—as depiction, as proxy, and often as both at the same time—matters a great deal to Spivak's notion of the politics of knowledge production, and, I suggest, it matters a great deal to an analytic project forged in the name of a postcolonial science studies, particularly in the case of bioprospecting.

[2]As have, significantly, feminist technoscience studies. Donna Haraway in particular has pointedly remarked upon the gendered and race-d notions of agency and identity that underlie Latourian understandings of representation (Haraway, 1997, pp. 23–39).

[3]As Spivak argues, if the subaltern subject is only knowable through the archives and traces of colonialism, then any effort to speak *for* the (interests of) the subaltern by speaking *of* (depicting) her runs into the fundamental problem that 'knowing' is to perpetuate a violence—thus all that is left to the intellectual is to 'mime' an act of unknowing (see Spivak, 1988; see also Hartley, 2003, pp. 235–259).

[4]Beverly here draws on an unpublished paper by Alberto Moreiras from 1997, though the point is elaborated in various ways in other conversations in an emerging school of Latin American subaltern and postcolonial studies. See Moreiras's elaborations of a notion of negativity as a critical stance in Moreiras (2001); see also Rabasa (2001).

[5]Michel Callon's well-known article on the agency of scallops has been a touchstone for science studies debates over how a 'symmetrical' approach to sociological analysis shall distribute attributions of agency among human and non-human entities (Callon, 1986).

[6]A note on my use of the word 'translation' is in order here. A few readers of my work have (mis)understood my argument by assuming that translation must simply mean giving a different name to the 'same' substance or knowledge. To the contrary, I draw on work in both science studies and postcolonial and poststructuralist theory which holds that translations are always, necessarily, *transformations.*

[7]In a longer discussion of this point (Hayden, 2003b), I discuss various modes of epistemological advocacy, and the difference it makes to make truth claims for indigenous knowledges and resource management strategies in the idiom of sustainability (see Posey, 1985), a structuralist interest in the fundamental similarities of 'scientific' and 'traditional' classification structures (see Hunn, 1999), or in the language of bioactive chemical compounds and their commercial potential (Schultes and von Reis, 1995; Plotkin, 1993; Balick and Cox, 1996).

[8]See Warwick Anderson's fascinating account of the ways in which such moves of attaching and detaching shaped colonial clinical research in the 'peripheries' in an era in which the 'benefit-recipient' was not an operable category (Anderson, 2000).

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