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Blue-green Capital, Biotechnological Circulation and an Oceanic Imaginary: A Critique of Biopolitical Economy

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Abstract
Examining the rise and fall of a public–private marine biotechnological enterprise in Hawaii, this article analyses how promises to make products and profits from marine microbes in archipelagic waters drew upon peculiarly American sentiments about the sea as a politically uncontested treasure-chest of biodiversity. I argue that attention to the material process by which lab and legal instruments are calibrated to one another to generate biotech exchange-value must be joined by consideration of how scientists and their interlocutors imagine the meaning of biology—as discipline and as corporeal substance and process. Without such symbolic analysis, theorizations of biocapital remain incomplete. To discuss the genre of capitalism evidenced in marine biotechnological endeavors in Hawaii, I develop the concept of blue-green capitalism, where blue stands for a vision of the freedom of the open ocean and for speculative sky-high promise, and green for belief in ecological sustainability as well as biological fecundity. I show that this vision, dominant in industry–university settings, ran into direct conflict with Native Hawaiian legal epistemologies of the sea.

Keywords biocapital, biodiversity, bioprospecting, Hawaii, marine biotechnology, oceans

The 'globe' imagined in 'globalization' is a closed system, a finite sphere crisscrossed by flows of people, goods and media. Such an encircling topology coalesced from circuits of mercantilism, capitalism and colonialism. With the Cold War and the rise of environmentalism, the globe acquired a scientific icon in the image of Earth from space, a blue-green orb of mostly oceans. At the millennium's turn, the Pacific, once the westward limit of the American frontier, morphed into a futuristic force field holding together the Pacific Rim, host to new currents of transoceanic market and telecommunication processes. For believers in the end of history, West spiraled around to meet East, fulfilling a market manifest destiny.

Stefan Helmreich is Associate Professor in Anthropology at the Massachusetts Institute of Technology. He has written extensively on the rhetoric and practice of Artificial Life, a field dedicated to the computer simulation of living systems, notably in *Silicon second nature: Culturing artificial life in a digital world* (University of California Press, 1998), an ethnography of biologists and computer scientists working at the Santa Fe Institute for the Sciences of Complexity. He is now at work on a book about how scientific portraits of the oceans are transforming as marine biologists reimagine the sea through the language and techniques of genomics, bioinformatics, biotechnology, biodiversity mapping, and systems modeling. Entitled *Alien ocean: An anthropology of marine biology*, the monograph zeroes in on work in marine microbiology, reporting on fieldwork undertaken with scientists at deep-sea hydrothermal vents and in areas of the open ocean outside national sovereignty.

The ocean has been a key stage for this tale since, as Philip Steinberg argues in *The social construction of the ocean*, the West has developed an 'idealization of the deep sea as a great void of distance, suitable for annihilation by an ever-expanding tendency toward capital mobility' (2001: 163). 'The ocean', writes Chris Connery, 'has long functioned as capital's myth element' (1995: 289), a zone of unencumbered capital circulation, most evident, perhaps, in oceanic vectors of conquest and commerce, from the triangular trade to the transnational traffic of container ships. But the ocean has been more than a channel for trade; it has also been a resource. Nowadays, it is being inspected for a new kind of wealth that might travel into global markets: marine biodiversity transmogrified into biotechnology.

In this article, I consider biotechnology and globalization in the space of the sea, examining a project at the University of Hawaii to create a center for marine biotechnology dedicated to using marine microbes as raw materials for bioproducts and pharmaceuticals. Hawaii's Marine Bioproducts Research Engineering Center, chartered in 1998 to broker cooperation between US academic and industrial science, meant to deliver compounds that could yield what Catherine Waldby names *biovalue*, 'generated wherever the generative and transformative productivity of living entities can be instrumentalized along lines which make them useful for human projects' (2000: 33). Because this partnership intended to produce *profit*, such value was to be *biocapital*, defined by Sarah Franklin and Margaret Lock as a kind of wealth that depends on a 'form of extraction that involves isolating and mobilizing the primary reproductive agency of specific body parts, particularly cells' (2003: 8; see also Heller, 2001) and that also banks on promises about the commercial products such mobilizations might deliver in the future (2003: 14–15; on this second point, see also Fortun, 2002 and Sunder Rajan, 2006).[1] Biocapital would emerge when laboratory instruments could be calibrated with market and legal instruments. The present article, based on ethnographic work I conducted at and around the University of Hawaii in 2002 and 2003, recounts the rise and fall of academic and industry scientists' hopes that biocapital generated from sea creatures could circulate into world markets.

In describing how marine biotechnology in Hawaii was imagined as biocapital, I argue that theorizations of biocapital remain incomplete unless they account for how biotech practitioners (and we, as social analysts) imagine the mechanisms and meaning of *biology*. A belief in the irrepressible generativity of biological life forms themselves is often called upon to warrant the promissory character of biotechnology, as though biotech has inherited the potentiality associated with genes. Biotic substance is considered to be the source of mutations and recombinations that create 'newness', a belief described by Marilyn Strathern (1992) as a particularly Euro-American notion of biology as a platform for 'reproducing the future'. Such cultural-semiotic specificity or 'local biology' (Franklin and Lock, 2003: 21) suggests that we should attend, as well, to how particular biological substances—molecular, cellular, embryonic or, in this article, marine microbial—are made to matter in biocapitalisms and their anticipated globalizations.

1 Charis Thompson in 2000 argued that the 'biotech mode of (re)production' operates with 'promissory capital', 'capital raised for speculative ventures on the strength of promised future returns' (quoted in Franklin and Lock, 2003: 6–7). Sunder Rajan develops an independent concept of biocapital (2006), slightly different from Franklin and Lock's, centering his attention on its promissory character. Biomatter is not absent in his account—following Marx, he parses biocapital into industrial, commodity capital (such as therapeutic molecules) and speculative, commercial capital (such as stocks) (2006: 8–9)—but rather than emphasize the generativity of the biological, he calls attention to the constructedness of biological facts upon which value is predicated.

In Hawaii, marine biotechnology calls upon the cultural force of images of the islands as a tropical oceanic paradise full of natural promise for health and rejuvenation, a view held by many mainland Americans, a pool from which biotechnologists in the islands are mainly drawn. Here, marine biotechnology depends on a view of the sea as 'life' writ large. A vision of the ocean as endlessly generative mimes and anchors a conception of biology as always overflowing with (re)productivity. Taking seriously the symbolic charge of marine biotechnology in Hawaii leads me to describe a form of capitalism I term *blue-green capitalism*, where *blue* stands for (a particularly American vision of) the freedom of the open ocean and for speculative sky-high promise, and *green* for belief in ecological sustainability as well as biological fecundity (particularly, as we will see, of populations of photosynthetic bacteria). Attention to such sentiments, and their contradictions, leads me to a description of why legal instruments of biotech are fracturing in Hawaii, as some Native Hawaiians challenge the right of biologists to turn Hawaiian marine life into an alienable resource. It also allows me to situate the global dreams of American marine biotech alongside other national projects, with different visions of biology, sea and globe.

Marine biodiversity, biotechnology and blue-ocean sentiments

A late twentieth-century blueprint for marine biotechnology was offered in *Turning to the sea: America's ocean future* (1999), a report published by the US Department of Commerce. This document had biotic material from the sea as an object of commerce, transmutable into value, money, capital. Marine biotechnology would be a salve for health and environment:

> ... the tools of marine biotechnology have been applied to solve problems in the areas of public health and human disease, seafood safety and supply, new materials and processes, and marine ecosystem restoration and remediation. Many classes of marine organisms demonstrate a wide variety of compounds with unique structural features that suggest medicinal, agricultural, and industrial applications. (US Department of Commerce, 1999: 22)

The University of Hawaii's Marine Bioproducts Engineering Center (MarBEC), set up by the National Science Foundation (NSF) as a hybrid of industry and academe, aimed to 'provide the intellectual foundation for industry to collaborate with faculty and students on ... producing the knowledge base for steady advances in technology and their speedy transition to the marketplace'.[2] Students might work as interns in biotech companies, which might put money into MarBEC in exchange for rights to bioproducts, where 'products' referred to items created using organic processes as well as to commercial goods.[3] Other schools entered similar partnerships. The University of Maryland's Center of Marine Biotechnology was founded on the notion that:

> Marine biotechnology is one of the greatest frontiers of scientific exploration and commercial endeavors for the next century. Compared with the terrestrial environment,

2 www.nsf.gov/od/lpa/news/publicat/nsf0065/eng/eec.htm (accessed July 2004).

3 This alignment of two meanings of 'product' is served by US patent law, which emphasizes the novelty of *products* (such as genetically modified food) over *processes* (such as genetic engineering) (Jasanoff, 2005).

> the oceans of the world remain largely unexplored and represent a major portion of the Earth's genetic resources. Using the tools of biotechnology, this vast and diverse potential-source of new foods, pharmaceuticals, minerals, and energy could be applied to help meet the needs of the world's expanding populations and economies.[4]

On the Pacific edge of this frontier, Hawaii's MarBEC promised distinctive local biota, particularly the archipelago's blue-green algae, or cyanobacteria, which host pigments useful for colorants in cosmetics and foods. Marine organisms also offered 'the promise for discovery of new antibacterial, anticancer and antifungal agents' (MarBEC, 2003: 3).

In 2002, the university hosted the Fourth Asia-Pacific Marine Biotechnology conference. Previous conferences had been held in Japan in 1995, Thailand in 1997 and the Philippines in 1999. This one, convened at the university's East–West Center, pitched Hawaii as an ideal location for marine biotech. In an opening address, mayor of Honolulu Jeremy Harris said he believed Hawaii's 'true destiny is as a center for high-tech, knowledge-based industry'. In 2001, Hawaii's legislature offered investment incentives and tax credits to high-tech companies. Harris invoked the standard image of Hawaii as 'a bridge between East and West', emphasizing that the state's time zone would allow online investors to trade in US and Asian markets simultaneously. Next on Harris's list of archipelagic assets was Hawaii's migration history: 'We also have in Hawaii a very diverse human gene pool, good for developing new pharmaceuticals.' Global science and finance converge in a genetically imagined multiculturalism, with state citizens a ready reserve for bioeconomic experimentation. The mayor's pronouncement reframed as fortifying genetic fuel for biotech the late nineteenth-century history that saw Chinese, Japanese and Filipino labor imported to the islands for sugar plantation work.[5]

But the primary biotic substrate imagined for biotech capital accumulation, at least in the formal proceedings of the conference, was 'biodiversity', described by Eric Mathur, from the San Diego-based biotech firm Diversa, as 'the basic building block for biotechnology'. Because the ocean constitutes the majority of Earth's biosphere, marine biotechnologists imagine *marine* biodiversity to be immense—and largely undiscovered. Marine biologist William Fenical, from Scripps Oceanographic Institute, articulated this view in an interview in *Discover*. A full-page photo showing Fenical holding a sea fan against his aloha shirt has him declaring, 'The ocean's right there, It's diverse as hell, and it's waiting for us' (Mestel, 1999: 75).

This enthusiasm for diversity is a key sentiment animating biotech capitalism. Since its coinage, *biodiversity* has become infectiously polyvalent. Cori Hayden lists meanings it has accreted: 'an ecological workhorse, essential raw material for evolution, a sustainable economic resource, the source of aesthetic and ecological value, of option and existence value, a global heritage, genetic capital, the key to the survival of life itself' (2003: 52). For marine biotechnologists in America, *marine* biodiversity represents a frontier form of biodiversity: healing waters writ large, full of new genes awaiting amplification, delivering

4 www.umbi.umd.edu/~comb/ (accessed January 2001).

5 Plantations and their human labor might be seen as nineteenth-century engines of biocapital, especially since the capacities of workers to reproduce themselves at work from day to day, and even to supply children to the plantation economy, were key features of this system. As Mintz argues, plantations were 'a synthesis of field and factory', sites where cultivation and capitalization worked hand in glove (1985: 47).

what marine microbiologist Rita Colwell (director of NSF 1998–2004) early on called 'entirely new "harvests" from the sea' (1984: 3). Insofar as humans make use of this new nature by capitalizing it, the prevailing sentiment goes, they must do so 'sustainably' by protecting 'diversity', understood as a positive value. No wonder a biotech company named itself Diversa.

Biological oceanographer Paul Falkowski from Rutgers University, in his conference lecture, was impatient with such views. Marine biotechnology, he said, 'is fundamentally idea-limited. We don't think in terms of an array of *products* and this is because most of us are in academia.' More, marine biologists 'always want to work with their favorite organisms, because they've learned to sentimentalize nature, especially the sea'. We have to look closely, he said, at microbes, 'the workhorses of the ocean'. Academia and industry must work together; practitioners must recognize that—Falkowski underscored the point by shouting it—'Markets are not sentimental!'

Falkowski poured cold water on the usual PR for marine biotechnology, which emphasizes the unique bounty of the sea while also trading on a romantic, conservationist sentiment. But much as Falkowski might wish otherwise, marine biotech is difficult to disentangle from such sentiment. The Maryland center is founded on such views; their mission statement argues that the 'tools of biotechnology allow researchers to clone ... genes, reproduce them, and produce desired substances in the laboratory, leaving the organisms where they belong—in the environment'.[6]

Anthropologist Sylvia Yanagisako has argued that capitalist enterprise fundamentally involves *sentiment*. Economic action, 'including capital accumulation, firm expansion, and diversification', she writes, is 'constituted by both deliberate, rational calculation and by sentiments and desires' (2002: 21; see also Paxson, 2006). After Falkowski's talk, scientists persisted in speaking about biotech in ways infused with sentiment.[7] One remarkable instance came in a presentation about floating blue-green algae plantships.

In this talk, an elder statesman of marine biology in Hawaii, Patrick Takahashi, wed the promise of blue-green algae to a wide-open, unexploited ocean ecology. He offered a preview of a proposal he would later deliver to the Intergovernmental Oceanographic Commission of UNESCO:

> The next frontier is the open ocean. Largely not owned by any nation, nutrient-rich fluids at 4 degrees Celsius are available 1000 meters below the 20 degree latitude band surface. Just in this natural solar collector region, if only one part in ten thousand of the insolation can be converted to useful energy, the needs of society would be satisfied.... Picture, then, a grazing plantship ... supporting a marine biomass plantation with next generation ocean ranches.... Then consider several hundred, no, thousands of these productive platforms. Current international law dictates that each, under certain circumstances, can legally become a nation. Imagine the United Nations in the 22nd century.... European seafaring nations might again consider colonization, this time in the open ocean, where there are no obvious downsides, such as the sociological problems that came with the era after Columbus. One cannot guess

6 www.umbi.umd.edu/~comb/ (accessed January 2001).

7 Sunder Rajan offers a Weberian reading of sentiments behind biotech speculation; I am interested in sentiments to do with biomaterials.

> what Greenpeace might do, but there are no native populations, not even whales, as permanent residents in the middle of the ocean. (2003)

Takahashi's vision reaches into the extraterritorial sea to realize its apotheosis: an ocean brought within colonial range through humanity's planktonic emissaries, a chlorophyllic remix of the 'Blue Revolution', the promotion of fish farms in the Third World as scaled-up food resources (named, forgetfully, it would seem, after the much criticized Green Revolution of the 1970s [see Stonich and Bailey, 2000]). Takahashi himself, a man of Japanese descent born and raised on Hawaii, fashioned himself as a culture broker with Japanese attendees of the meeting, an up-to-date Pacific Rim subject.

Takahashi's dream is a perfect example of what *Harvard Business Review* authors W.Chan Kim and Renée Mauborgne in 2004 called a 'blue ocean strategy', a set of tactics for tapping into and creating 'uncontested market space'. Kim and Mauborgne imagine this blue business ethos through the figure of the uninhabited ocean and contrast it to a 'red ocean strategy', which sees competitors battling bloodily, tooth and tentacle, for limited space.[8] 'Blue oceans' are, of course, a riff on 'blue skies', zones of research or investment with no immediate applications, which may or may not come down to earth in the future.[9] Blue skies are notional spaces for such blue-ocean dreams as Takahashi's plantations without politics—aquafarms populated by generative phytoplanktonic biomass—his invitation to Europe to restage its colonial past in a solar-powered sea of sociological emptiness.

A dip into the red ocean

Within the blue-ocean ethos, however, is nested a red-ocean imaginary. When I returned to Hawaii for extended fieldwork in 2003, I was keen to discover why researchers thought marine biodiversity might be a promising resource. MarBEC literature proclaimed: 'the surface waters of the North Pacific Ocean are now recognized as a ''treasure chest'' of microbial diversity and a sea of potential for new discoveries' (2003: 50). Why would that be?

I spoke with Mark Goldman, Director of Drug Discovery at Hawaii Biotech, Inc. I had learned at the biotech meeting that MarBEC hoped to partner with this 30-person firm, which had had earlier successes with vaccines for Dengue and West Nile viruses. In 2003, Hawaii Biotech received a Department of Defense grant to develop compounds against anthrax, sifting through microbes for leads against bioterrorism. A portion of the grant enabled Hawaii Biotech to collaborate with MarBEC to identify molecules in the University's cyanobacteria collections. I asked Goldman why sea samples might be particularly interesting. He said:

> It's all about survival. The organism's role is survival—and secondarily to that to procreate. And organisms have developed unique ways to defend themselves. They can say: back off, you don't want to eat me. It's these chemical processes that promote

8 Kim and Mauborgne's view of the sea can be diagnosed via an argument of Steinberg's: 'First world capitalists have constructed the ocean in a manner that selectively reproduces and emphasizes its existence as a space apart from land-based capitalist society' (2001: 25).

9 Blue-sky schemes are mentioned in a 1917 legal opinion of Justice McKenna of the US Supreme Court, who censures 'speculative schemes which have no more basis than so many feet of ''blue sky''' (www.seclaw.com/bluesky.htm, accessed July 2005).

> survival. Most of the planet is seawater, which is an untapped resource. In a milliliter of water, there are thousands of microorganisms struggling to survive. Maybe I can get lucky and one of these organisms synthesizes something that gets at the disease I'm studying.

When I spoke with the curator of the university's collection of cyanobacteria, she told me much the same thing. Gesturing toward the collection of over 2,000 strains, she said: 'There is a huge drug-producing potential here.' Anti-microbial, anti-fungal, anti-inflammatory and anti-cancer compounds have higher biomass in cyanobacteria, she told me, particularly in tropical marine habitats, because:

> . . . they live in high density and high biomass and produce defensive chemicals so as not to be invaded by the guy next door. Humans have not evolved to recognize these large unusual compounds. They can be very new to the human body—so, we haven't evolved natural defenses.

These explanations offer a portrait of the ocean as a neo-Darwinian soup, a 'red ocean'. This vision resonates with the 'unsentimental' view Falkowski advocated, now located not just in the market, but, more, in nature itself—and constitutive of biodiversity as such. At the same time, however, this view of natural selection as a screen for possible profits also expresses a sentiment about the nature of the ocean: the red ocean morphs into a resource for frontier science, generative through competition of forces that can be harnessed, blue-ocean style, in the service of health and life.

Blue-green capital

Considering the university's treasury of cyanobacteria, it becomes obvious that a lot of work—growing algae, bioactivity screening, changing compounds into units transferable between labs—is required to convert wet wealth into a viable product. With the market purposes of MarBEC in mind, we could call the blue-green algae collection a bank of *biocapital*—where *capital*, following Marx, is that accumulated material or labor-power employed to produce surplus-values like profit or interest.

In *Capital*, Marx describes the circulation of money as capital—in which 'More money is finally withdrawn from circulation than was thrown into it at the beginning' (1976 [1867]: 251)—using the formula M–C–M′, where M stands for money, C for commodity and ′ for the surplus value gained in a profitable exchange of a commodity for money, and M′ for the total capital produced by that exchange. For the biotech imagination, we can write an analogous formula to describe the making of biology into capital: B–C–B′, where B stands for biomaterial, C for its fashioning into a commodity through laboratory and legal instruments, and B′ for the biotech product (or, perhaps, biocapital) produced at the end of this process, with ′ the value added through the instrumentalization of the initial biomaterial. *But I want to suggest here that the sentiment of many biotech boosters has them taking B′* already *to be latent in B—to believe, that is, that biological process itself* already *constitutes a form of surplus value production*. This logic naturalizes biotech.

It is not only the labor of people like the cyanobacteria curator that confers value on the collection, then, but also a conception of cyanobacteria *themselves* as little

laborers—Falkowski's 'workhorses of the ocean'. Diversa's Mathur, at the Asia-Pacific conference, described marine microbes as 'the blue-collar workers of the environment', laboring units that might be taken apart to be put back together again for new tasks. Microbial biodiversity is configured as accumulated labor power, the products of which can be harnessed to create productive futures. This belief is based on a metaphor: that organisms are laborers (an equivalence declared even by Marx, who saw the 'natural consumption' of eating entailing 'production' of the body [1978 (1857–58): 228]). On this view, biocapital can be derived from oceanic pasturage if the reproduction of the reproductive capacity of marine microorganisms—to make carotenoids, for example—can be channeled into profit-making commodities and accumulation strategies (contrast biocapital with *necrocapital*: dead matter, like fossil fuel, put to unregenerative, zombie-like work).

But we must be careful not to imagine microbial reproduction as a transparently 'natural' process, as though microbes' coming-into-being straightforwardly designates them as what Marx would have called 'means of production already produced' (quoted in Franklin, 2007: 106), as though their productivity is the essence of their *species being*.[10] To do so is to see them as natural factories or assembly lines, when they only become so in certain relations (for more ecologically minded microbiologists, for example, microbes are 'environmental stewards' rather than 'blue-collar workers'). We can add, then, to Franklin and Lock's argument that, 'biocapital is not just dependent on reproduction, it is *constituted* by it' (2003: 10), that the reverse is also the case: that the appearance of the *bio* in biocapital *as* reproductive is constituted by the capitalist enterprise that turns it into something that generates exchange-value in the first place.[11] As Hannah Landecker (2005) argues, contemporary biological science has become expert at stopping, starting, suspending and accelerating cellular processes, wedging these dynamics into processes that look like a molecular version of industrial agribusiness. Biotech geese cannot lay golden eggs without daily tending.

Biotechnologists in Hawaii seek to secure biocapital not only through rhetorics of (re)productive nature and laboratory labor like the care of cyanobacteria, but also through legal instruments. The Bayh-Dole Act, passed in 1980 by the US Congress, allowed universities and their employees to retain rights in patented inventions developed with federal monies and, if desired, to license or sell those inventions to private business. Also important are Material Transfer Agreements (MTA), which specify that if the university sends out its material property, the agency to which it is sent will be allowed to do research on the substance only in a certain problem area. Once biological materials are covered by an MTA, the university can stipulate how 'progeny, replications, derivatives or parts thereof' may be used by the recipient—allowing, for example, an industrial partner to look for pigments in the cyanobacteria collection, but not, say, a cure for cancer. Microbes are broken down into discrete varieties—'progeny, replications, derivatives or parts'—with both biological and legal meanings, with significance as at once created substance and transferable

10 Compare Thacker on '"molecular species being", a species being in which labor power is cellular, enzymatic, and genetic' (2005: 40).

11 See Harris and Young (1981) for an argument against positing a fundamental difference between reproduction and production, which they claim risks naturalizing reproduction. See also Franklin and Ragoné for a caution on 'the relegation of "reproduction" to a domain of "natural" or biological facts … considered prior to, and separate from, sociality' (1998: 2). This caution can be leveraged into a critique of the naturalization of reproduction present in Marx's work itself.

property: as products and products. The operation of instruments in biotechnology labs calibrates to the legal instrument of the MTA.[12]

Understood as *biodiversity*-become-*biocapital*, the feature cyanobacteria might have most in common with golden eggs is their status as a *fetish*, an entity thought to have its own life force apart from relations in which it becomes active. Like gold, biodiversity is imagined to be 'both symbol and reality of value' (Taussig, 2004: 23). In this sense, biodiversity is imagined as a representation of nature as well as the sedimented nature of nature itself. More, since biodiversity is understood *already* to be 'life', its materialization as a fetish is doubly mystified.

What is required to comprehend biocapitalism, then, are stories of *how* biology—as discipline, as corporeal substance, as process—is mobilized to make money, and of how biology becomes currency, coin and capital. The *bio* in biocapital is imprinted with the ends of capital: an upwardly spiraling symbiosis of production and reproduction. To speak in terms Giorgio Agamben (1998) borrows from Aristotle, *zoë* ('the simple fact of living') has been infused with the *bios* ('the form or way of living proper to an individual or a group') of capitalism.[13] In order to discern the specificity of this relation between life forms and forms of life, and in order to determine what is particular to marine biotech capitalism, I suggest we think of capital as manifesting in hues—in the instance at hand, as *blue-green capital*.

In *Modernity at sea* (2002), Cesare Casarino compares the circulation of the white whale in *Moby-Dick* to the circulation of money. Both circulations are motivating, mediating forces in relations of unequal exchange—between Ahab and his contracted but captive crew, and between buyers and sellers. But both species of circulation also direct attention away from the social relations they enforce; we follow the whale, we follow the money, instead of the animating dealings of people and institutions. This analogy in view, Casarino asks, 'what is the color of money?' and immediately answers 'White, of course' (2002: 91).[14] In *Moby-Dick*, the whiteness of the whale signals both an absence and excess of color. Casarino suggests that money, analogously, in its function as a universal equivalent, masquerades as an invisible translator of value while also everywhere appearing as the full representation of value as such. This double action defines money as a medium of circulation: it permits the transfer of value from one site to another while also embodying value itself, particularly when it stops for a moment and manifests, for example, as a coin or a sum in the bank. Such starts and stops are motivated by already existing dynamics of selling and buying that cause money to 'flow'—a transformation that hides the unequal social relations that make money 'circulate' (or 'accumulate') at all. Capitalism acquires the appearance of neutral exchange through bleaching the movement of money itself of any pre-existing history of social inequality. Just so, the imagined circuits of MarBEC capital

12 Such calibration can work the other way around, with lab practices in genomics informally producing new parsings of property (Hilgartner, 2004).

13 ... an infusion (in which $B = B' = M'$) that would probably make Aristotle frown. In the *Politics*, he writes that:

> ... money was intended to be used in exchange, but not to increase at interest. And this term interest, which means the birth of money from money, is applied to the breeding of money because the offspring resembles the parent. Wherefore of any modes of getting wealth this is the most unnatural. (1963 [*c.* 350 BCE]: Book I, part x).

14 Compare Riles (n.d.) on 'making white things white', legal moves that claim to recognize matters as they already are, but in so doing formalize them.

were supposed to run on neat transfers of extracts and contracts, at once legally transparent and proprietary.

Blue-green capital adds color to this model, accounting for the work of blue-sky speculation and the labor of getting such critters as blue-green algae to produce and reproduce meaningful substance. Blue-ocean fantasies of life-giving waters are married to the economic fecundity of biodiversity, and, in those articulations that see biotechnology 'preserving' nature by sampling only small bits of it, are wed to its ecological, 'green' value as well (creating the B′ of marine biotech). Blue-green capital also keys us into the symbolic importance of the ocean for marine biotechnology. Blue-ocean strategies in marine biotechnology, in which the immensity of the sea stands for unlimited resources, promise what Connery calls an 'economic sublime' (1995: 288).

Slime, sentiment and submerged histories

Wrapped up in the sublimity of blue-green capital, and mixed with the yet-to-be-prospected gold of collections of cyanobacteria, is another substance: *slime*. Slime is a sign of that which slips away from containment, which must be managed to make anything like biocapital circulate. Without stable boundaries—and without ends in the instrumental sense—slime exceeds and disturbs representation. While it is true, as Landecker (2005) suggests, that, 'biotechnology changes what it is to be biological'—so that if capital accumulation demands that biotic stuff be rendered 'reproductive', then this is what biology *becomes* in that relation—there are also reasons to think that slimy flow may swerve away from full appropriation. Playing with slime, we can ask, following Bill Maurer, what biotech tales would sound like if we were to write:

> . . . [a] story about an open, porous, seeping, and dripping body of global capitalism . . .? This would be a different story from the familiar one about the clean lines and fast networks of neoliberal efficiency. Less like a fiber optic network; more like a lava lamp. (2000: 672)

This is the other side of blue-green capital. Blue-sky dreams reflected in a blue ocean show biotech speculation to be a hall of mirrors (with ricocheting reflections *producing* escalating investment!). And green refers not so much to exploitable reproductivity as to muck that always threatens to undo capital, substances constantly in need of shoring up and disciplining.

Signs of such muck bubbled up at the Asia-Pacific meeting, when attendees worried about the prevalence of 'lateral gene transfer' in microbes, the within-generation, horizontal movement of genes between contemporaries, a process that makes genealogical trees and discrete species boundaries difficult to discern (see Helmreich, 2003). Following Mathur's presentation on turning microbial species into brand-name products, one audience member asked: 'How do you define a species in microbes when they're shifting their genes all around? If you have something that differs by one base from another creature? Is *that* a different species?' Mathur responded, 'a similarity of 70 percent or more at the DNA level makes a microbial species, but that's artificial and conventional'. No one was satisfied. Such questions recall an obsolete, though newly relevant, meaning of 'species': 'A particular kind or sort of coin or money' (*OED*). Incorporating the 'lateral gene transfer' characteristic of microbes into an

account of biology messes up the stability not only of taxonomy, but also of alienable species, entities that can be depended upon as stable currency, exchangeable coinage, as faithful *reproducers* of their own species-being as labor power: capital.

The blue-sky dreams of MarBEC had also run into obstacles. By the time I returned to Hawaii in summer 2003, MarBEC was floundering. In 2002, representatives from the NSF assessed MarBEC's progress and judged that funding should not be renewed. Chemical engineer Michael Cooney told me that MarBEC had invested the majority of its funds into sequencing marine microbes, something that could have been done through collaborations. And although MarBEC had initiated many projects, it had yet to patent any product.

The complexity of what MarBEC attempted was clear from the array of flowcharts I picked up at the Asia-Pacific conference, detailing MarBEC's promised pipelines of production. As Cooney acknowledged, it takes time, resources and luck to develop a bioproduct—from discovering a promising lead in an ocean organism, to extracting likely chemical compounds, to engineering these into new materials, to patenting useful modifications, to testing the effectiveness of medicines in clinical trials, to enlisting corporate partners in marketing. Still, *nothing* flowed the way the charts anticipated. Cooney compared MarBEC to a 'dot-com', one of those hyper-hyped late 1990s Internet-based companies that primed investment with savvy web presence. And, indeed, the MarBEC website had been expertly realized, giving the impression of a network of people who knew what they were doing. Perhaps their logo—a light blue spiral suggesting the profile of a tumbling wave—should have tipped me off, for it also resembled, with its Fibonacci curl, the curve of a snail shell. Maybe MarBEC had been an elaborate shell game.

Cooney compared the scramble to find marine bioproducts to the California gold rush. For mainland scientists who move to Hawaii—often in mid-career and mid-life (one told me of his dream to 'start over', taking the next step in the 'Westward migration')—this archipelago looks like the Promised Land. Indeed, European and American misapprehensions about the islands as a source of wealth are commemorated in the name of O'ahu's signature landmark, Diamond Head, so-called when explorers erroneously believed this volcanic crater was full of diamonds. The natural landscape, Cooney argued, is still playing tricks on the minds of mainland speculators. The sentiment has lately been captured by the idea that Hawaii is overflowing with *biodiversity*. In a way this is simply a scientific rendering of the pristine nature that has been sold to tourists as one of Hawaii's attractions.[15] As a vacation destination, Hawaii has become 'a site of white Edenic regeneration' (Desmond, 1999: 8). Hawaiian jungle and seaside nature—long generating a gold rush on island property values—nowadays appear as 'biodiversity'. But just because Hawaii looks to the naïve eye like a rainforest, Cooney suggested, does not mean it has the variety of the Amazon. The most isolated archipelago in the world, it is, by some measures, biologically spare, aside from introduced species. 'Volcanic islands, in the middle of deep-sea oceans', Cooney noted, 'are not necessarily the best sources of marine biodiversity.'

There are also more instrumental, less sentimental, reasons why MarBEC ultimately ran aground. On 4 June 2002, Diversa announced the signing of a biodiversity access and

15 In *Staging tourism*, Desmond writes, 'Hawai'i beckons white mainlanders because of its union of beautiful landscape, temperate weather, and "American-ness"... [T]he particular allure of the islands lies in its imaginary as a Polynesian paradise, an imaginary which is most resonant for Euro-Americans, arising as it has out of a history of European and Euro-American explorers and missionary encounters' (1999: 136, 140).

MTA with MarBEC, which drew the attention of Native Hawaiian organizations that believed they were wrongly written out of benefits from the arrangement. Native concern turned on the history of land and sea ownership in Hawaii and, in particular, on the legal disposition of resources from 'ceded lands' held 'as a public trust for the support of the public schools and other public educational institutions, for the betterment of the conditions of native Hawaiians'[16] and 'as a public trust for native Hawaiians and the general public'.[17] Some of these lands were *underwater*—'submerged lands', extending three miles out from shore. The Office of Hawaiian Affairs[18]—a quasi-governmental organization formed by an amendment to Hawaii's constitution in 1978 to manage 'any lands received for the sole benefit of native people [from, for example, the federal government], including lands awarded as reparations' (Parker 1989: 165)—oversees ceded lands.

Some biotech boosters sought to outmaneuver questions of native politics through agreeing '*not* to sample plants generally recognized as native to Hawai'i until the issues of fair access and equitable benefit have been settled',[19] a logic that, in naming 'native' plants off-limits, designates everything *else* as part of a 'common global biodiversity' and allows bioprospectors to posit themselves as ethical by prospecting away from politics. Such arguments not only assume that scientific distinctions between native and non-native have cultural meaning for Native Hawaiians, but also conflate Native people with native biota (see Helmreich, 2005a). Targeting only non-native biota represents an attempt to keep the currency of blue-green capital flowing by bypassing politics (compare Franklin, 2003, on 'ethical biocapital').

The Diversa–MarBEC dispute reveals different sentiments about what constitutes the nature of the ocean. For Diversa and MarBEC, the ocean exists as a site and source of microscopic, microbial life, molecularly understood. For these scientists, the boundaries of the sea are not those of politics, but those between the visible and subvisible world, and of large-scale ecosystems such as the North Pacific subtropical gyre. Such a view comes with a political dividend: because they are so cosmopolitan, microbes, like fish, can be found in many places, and local politics can be outmaneuvered.[20] The Native side of the debate saw things differently; nature was embedded in the history and politics of territory. On this view, scientists must abide by the laws of the state within which they forge agreements. Simply claiming that the law cannot keep pace with science will not do.

Diversa retreated, for not unlike multinational corporations that skip around the world to take advantage of shifting labor laws, wages and exchange rates, Diversa can go elsewhere—and even work with samples it already possesses, using computer techniques to explore the space of possible genetic and metabolic pathways. They can bioprospect in databases, in the uploaded ocean, leaving local places behind.

16 Section 5(f) of An Act to Provide for the Admission of the State of Hawaii into the Union (Act of March 18, 1959, Pub L 86-3, 73 Stat 4). URL (accessed July 2005): www.capitol.hawaii.gov/hrscurrent/Vol01_Ch0001-0042F/04-Adm/ADM-.htm

17 Article XII, section 4, Constitution of the State of Hawaii, as Amended and in Force January 1, 2000. URL (accessed July 2005): www.hawaii.gov/lrb/con/conorg.html

18 This organization grew out of campaigns for reparations to Hawaiians from the US, led by such organizations as ALOHA (Aboriginal Lands of Hawaiian Ancestry).

19 Fredric J. Pashkow, MD, representing BiophoriX, Pacific, Inc. opposition to SB 643, which establishes a moratorium on bioprospecting and a temporary bioprospecting advisory commission (6 February 2003, in Hawaii State Archives).

20 Hayden (2003) reports a similar case, in which Diversa sought to buy bioprospecting rights for microbial biodiversity on public land in Mexico.

Oceanic globalization

Alain Pottage (2006) has in this journal examined Craig Venter's recent circumnavigation of the globe, during which Venter sampled and sequenced marine microbes using his private yacht, *Sorcerer II*. Pottage points out that Venter's sequencing project deterritorializes genes from organisms and conjures a database topology difficult to reattach to ocean ecologies (just the complaint offered by Venter's critics in oceanography [see Helmreich, 2005b, forthcoming]). But Venter's enterprise also *does* deliver a novel vision of the sea: as a body with a genome. Employing the rhetoric of 'environmental marine genomics', an enterprise aimed at characterizing ocean ecologies in terms of gene sequences they host—without regard for how this DNA is packaged up into discrete organisms—Venter claimed, when he set out, to be engaged in the 'Sequencing of the Sargasso Sea' (Venter et al., 2004). *WIRED* made explicit the goal of Venter's 'Ocean Microbial Genome Survey': 'to sequence the genome of Mother Earth' (Shreeve, 2004: 108).[21] In this rhetoric, the sequence becomes the territory.

Venter spoke at other moments of 'categorizing the earth's gene pool'—a description that poses a scientific abstraction as something he might literally scoop up (of course, in these days of gene databasing, gene pools are not so much *abstract* as they are *virtual*—a cyberspatialized aggregation of nonlinear data that can be materially manipulated in various ways. A vision of the ocean as a space of flow comes to be mirrored in the hypertexty database). To see the sea as having a genome or embodying a gene pool configures the ocean as a unitary territory, even, in fact, as 'a ''non-territory'' ', ' ''empty'' of social relations' (Steinberg, 2001: 34, 38)—just the sort of American 'blue-ocean' view described above, and a view that got Venter into trouble for trolling without license for microbes in the national waters of Ecuador. Venter made his American-frontier view explicit when he pronounced at an MIT conference I attended, 'I thought I was just out sailing free in the ocean and somebody's claimed it all' (Venter 2004). Venter's ocean genome—both primordially biological and technologically up to date—is rhetorically mapped through circumnavigation, through a watery invocation of the global. Past and future come together. 'Ocean as source', writes Chris Connery, 'and ocean as destiny figure in the ocean's mythological temporality; it is both life-giving mother and final frontier.... The globe's finite circularity made the expansion into the final frontier also a return to putative origins' (1995: 289, 299). Eugene Thacker's notion of 'the global genome' (2005) finds an oddly literalized instantiation here, as genome and globe become one in the space of the sea.

There are other ways to conceptualize the oceans aside from naturalizing the sea as a 'global' topology.[22] Even within a 'global' imaginary, as John Law (2003) suggests, the global should be thought of as 'something that is broken, poorly formed, and comes in patches'. What Wen-Hua Kuo (2005) calls 'bioglobalization' (to describe transnational harmonization

21 Framing the ocean as a body has a lineage. Da Vinci wrote, 'As man has within him a pool of blood wherein the lungs as he breathes expand and contract, so the body of the earth has its ocean, which also rises and falls every six hours with the breathing of the world' (quoted in Ball, 2001: 22). And turn-of-the-last-century German oceanographers spoke of phytoplankton as the 'blood of the sea' (Mills, 1989). No surprise that we have moved from breath to blood to genes.

22 To take an example in which 'the global' is explicitly refused as a reading of the sea, consider Epeli Hau'ofa (1993) of the University of the South Pacific in Fiji, who argues that treating the sea as a blank space between nations ignores indigenous sovereignty in what Europeans have called 'Oceania', a space he calls 'our sea of islands'.

of pharmaceutical regulation) is uneven, diversely imagined, nonlinear (see Featherstone, 2006).

To bring together my discussion of marine biotechnology, the oceans and globalizations, consider the projects of non-American participants at the Asia-Pacific biotechnology conference.[23] The small delegation from the People's Republic of China concerned itself with seaweed aquaculture. Questions around nutrition and disease prevention in aquacultural ponds (of mostly shrimp) dominated the remarks of scientists from Thailand and the Philippines. Indian biotechnologists look to microbes in mangrove ecologies for tools for decoloring paper and textile factory effluents, while others address oil spills and other contaminants on the Indian coastline. While many such projects have discernibly 'national' frames and aims, they also certainly networked to 'global assemblages' (Collier and Ong, 2005). To offer one example, researchers at India's National Institute of Oceanography hold 40 US patents on marine biotechnologies, some of which are for pharmaceutical applications (e.g. a bioproduct from a green mussel aimed at diabetes treatment) that reach directly into Kuo's 'bioglobalization' (and that provide further evidence for Sunder Rajan's [2006] account of Indian genomics as seeking to become a 'global player'). What is not present in such projects, however, is an imagination of that globalization as grounded in the very 'nature' of the oceans as such, as following from a B′ naturalized in the figure of a blue-green ocean, a frontier for capital accumulation.

That construal of B′, it seems to me, is the signature of American visions of marine biotechnology. So it would be a mistake to see American 'global' projects as themselves outside national narratives; open access and free trade across the blue ocean may masquerade as globalizing forces, but these days also have a potent address in US expansionist projects, particularly in the Pacific (Connery, 1995; and see de Sousa Santos, 2006). The fact that the United States is not a signatory to the United Nations Convention on the Law of the Sea (UNCLOS), which legally founds national Exclusive Economic Zones around the world (which the United States claims for itself based on historical precedent, not on adherence to UNCLOS), allows the US to continue to elide the difference between its 'national' and 'global' ocean presence. Biotechnological circulation is naturalized through an oceanic imaginary, a vision in which the color of money is blue-green.

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23 Of the 101 attendees, 32 came from US institutions (of these, 25 were from Hawaii, with a few credentialed at schools in Asia, primarily China and Taiwan); 23 participants came from Japan; 8 from the Philippines; 6 each from Thailand and Korea; 4 from People's Republic of China; 3 each from India, Mexico, Italy and Germany; and a handful from Hong Kong, Taiwan, Norway, Portugal and Israel.

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