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DELIBERATE EXTINCTION: Whether to Destroy the Last Smallpox Virus*

David A. Koplow†

I. INTRODUCTION

This essay presents an extended legal analogy. It proceeds by examining two broad areas of law; extracting some salient underlying principles that have been created in those disciplines over the years for important, context-specific reasons; and then considering whether those international and domestic law teachings can usefully be introduced, if not truly "applied," in a very different sector—a field in which there currently reposes very little law, but from which ongoing events urgently press us for some answers. This sort of logical reasoning exercise can be treacherous. I do not contend that borrowing law in this way can cede us any reliable, dispositive answers, or that it will tell us what we *must* do with the novel topic to be explored. Still, I am hopeful that presentation of the animating spirit of some second-hand jurisprudence, and exploration of its motivations and its rhetoric, may yet shed some light on what we *should* responsibly consider doing in the admittedly quite different milieu.

The target problem to be examined is smallpox. Specifically, what should

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we (the United States and the entire world) now do with the last known residual samples of the virus that causes this uniquely horrific disease? The illness itself has virtually disappeared from the catalogue of human afflictions: due to a stunningly imaginative, concerted, and resolute campaign of the World Health Organization (WHO) through the 1970s, no one has contracted this deadly impairment for twenty-five years. Yet the causative element, an insidious scourge known as the variola virus, still remains, housed for now in high-security freezers at the U.S. Centers for Disease Control and Prevention (CDC) in Atlanta, at the comparable Russian facility, denominated "Vector," in Siberia, and perhaps at other, clandestine locations as well.

WHO member nations have repeatedly demanded the complete destruction of the known variola repositories, as a fitting coda to humanity's millennial struggle against the disease, and the organization has by consensus decreed a series of persistently unmet deadlines for shipping the nasty germs to their final elimination in laboratory autoclaves. Despite fifteen years or more of those earnest multilateral resolutions, however, the infective substances remain with us, and their two caretaker governments have recently announced a decision to retain them indefinitely for research and other purposes.

Incineration of the last variola virus samples would be a monumental event. It would be the world's first *deliberate* extermination—the first time that human beings (who have, to be sure, routinely driven numerous other species over the brink into extinction, often with little awareness or concern for their fates) consciously decided, and purposefully acted, with the direct goal of eliminating another life form from the planet. Asserting that power, arrogating unto ourselves the right to intentionally consign to oblivion any other scrap of the earth's genetic legacy, is a moment of supreme moral importance, worthy of the closest analysis.

Remarkably, there are no legal materials to guide us authoritatively in this matter. There are no precedents, cases, statutes, or treaties that speak to deliberate extinction of a microscopic creature. Neither international law nor domestic United States law has yet contemplated what should be done in this awe-inspiring biological/sociological/jurisprudential moment. No court has yet been called upon to render a judgment or issue an injunction; no environmental impact statements have been drafted to assess the implications of the choice; no parliament has joined the debate.

Still, there are some shreds of law that may prove helpful. Two reasonably well-developed legal fields—environmental law and animal rights law—provide at least a starting point, a set of cognate principles, and some thought-provoking language that may inspire (or constrain) the current smallpox inquiries. In each area, there is a wealth of traditional legal materials—treaties, statutes, judicial opinions, scholarly analyses, etc.—that were intended to dispatch problems far different from the variola virus, but that may nonetheless

inform our thinking here, too. What lessons can be drawn from these black-letter areas of legal literature, and how well do they translate into the novel world of microbiology?

This article proceeds in the following steps. After this Introduction, Part II presents the story of smallpox, including the early centuries of humanity's mostly unsuccessful struggle against the deadly microbe, the gradual rise of effective medical prophylaxis and treatment, and the current research aimed at an improved pharmacology. It also describes the WHO's various adventures, including the heroic 1970s global campaign against the disease and the subsequent diplomatic wrangling that has repeatedly brought variola to the global chopping block, but then always hesitated at the last moment.

Part III highlights one particularly noteworthy aspect of the smallpox story of great moment for the present inquiry: the troubled, erratic intersection, expressed in different ways in diverse cultures through the centuries, between the scientific/medical community, on the one hand, and the religious/philosophical community, on the other, regarding questions that touch variola. It notes, for example, the remarkable incidence of societies around the world—from Africa to India to China to the Carribean—identifying specialized gods or goddesses dedicated to smallpox. It recounts how that worship, as well as other religious expressions of devotion to divine providence instead of to "modern" anti-smallpox medical initiatives, conflicted with physicians' evolving efforts to ameliorate disease outbreaks. The article also notes how contemporary genetic engineering techniques have exacerbated the traditional debate about humans' proper relationship to nature: who are we, after all, to claim the ultimate powers to create, to alter, and now perhaps to eradicate, life?

Part IV addresses a set of important threshold questions: Is a virus "alive," and does that matter? Because a virus fails to meet many of the traditional biological definitions of a "living thing," some would argue that a decision to dispose permanently of it should not rise to the level of "extermination of a species," and accordingly does not engage the most pressing ethical obligations. Here, the article argues that the operative definition of life is a contestable and evolving matter; that the dividing line between favored and disfavored creatures is ultimately arbitrary and socially constructed, not grounded exclusively in irrefutable science; that a virus is certainly close to the elusive borderline, perhaps marginally just on one side or the other; and that, in any event, authoritative resolution of that definitional question does not matter so very much: we can, and should, hold moral or ethical commitments—at least where extermination is concerned—even toward non-living entities.

Part V then turns to the first source of analogous law: environmental protection. In particular, it describes the growing global appreciation of biological diversity (biodiversity), and the importance of preserving the widest possible array of natural specimens on earth: plants, animals, and—although

most of the traditional legal materials do not quite say so—microscopic entities, too. In this inquiry, the article surveys an array of international documents—treaties, authoritative pronouncements of global conferences, and resolutions of the United Nations General Assembly—as well as domestic U.S. legislation regarding protection of endangered species. It concludes that although the diplomatic and congressional drafters of these enlightened instruments did not contemplate their possible application to an execrable creature like the variola virus, some of the spirit, and even some of the operative language, might reasonably be extended that far.

Part VI undertakes a similar analysis in a distinct, somewhat less well-entrenched, area of law, regarding the putative rights of animals (and by extension, of other types of entities). At various points in legal culture, it was widely considered absurd or impossible to accord any sort of direct legal recognition to non-human actors of any kind, but in modern practice, corporations, estates, and other fictional legal creations have emerged as valid possessors of legal personality. Animals, too, have increasingly been ceded direct legal rights and liabilities, and an emerging strain of literature strongly commends that evolution. Is it imaginable that other categories of things—unborn future generations of people, feral animals, or even insentient creatures, such as trees, rivers, or rocks—could gain some type of independent legal status? Where would a virus fit in that pantheon of rights-holders, and what specific sorts of claims could it possibly assert?

Finally, Part VII ties together the strands of analysis, plucking from the established areas of practice the various snippets of law and rhetoric that may be relevant in the consideration of smallpox. It concedes that the question whether to destroy or preserve the variola virus is truly a case of first impression, in which no controlling authority—legal or moral—can be located. Just as surely, however, this is not the *last* occasion upon which our collective sensitivity and resolve will be tested by an opportunity for deliberate extinction: within the next several years, the polio virus, perhaps the measles virus, and maybe even selected non-viral pathogens may be globally conquered, and available for similar WHO-managed extermination. Whatever legal principles we develop now—either the echoes from traditional areas of jurisprudence or specially-crafted standards created for just this purpose—will be repeatedly engaged. The article concludes by suggesting that humans should back away from the precipice of intentional extermination of the variola virus—not because that creature deserves our pity or our mercy, but because it does deserve our respect. It is a part of nature's grand scheme, with a unique role in our own history and environment, and we should be loathe to extinguish it, absent the most compelling justification.

II. THE ANCIENT SCOURGE OF SMALLPOX

A. Smallpox through history

No other infectious disease can match smallpox's millennial record of inflicting death, pain, blindness, and scarring upon generations of human beings all around the world. English historian T.B. Macaulay called it "the most terrible of all the ministers of death,"[1] and the sight of the characteristic red pustules—the "speckled monster"[2]—has terrified both nobility and peasants from time immemorial. Dreadfully communicable, smallpox could sweep through a community with devastating speed, and it was fatal to 20-30% of the people who acquired it. There was, and still is, no cure and little by way of palliative treatment. In the twentieth century alone, up to half a billion people were killed by this one cause; and as late as 1967, it was still endemic in thirty-one countries (embracing 31% of the world's population), striking perhaps fifteen million people per year, and summarily killing two million of them.[3]

No one knows when variola first emerged on earth. It may have evolved in India as early as 8,000-10,000 B.C. from some prehistoric animal-infecting pathogen.[4] (The orthopox virus genus, to which variola belongs, is a remarkably large and diverse collection, including distinct species that differentially infect monkeys, cows, camels, mice, and other mammals—sometimes mortally, but sometimes with only quite mild effects.[5])

Once variola had obtained its purchase on the human body, it flourished, eventually insinuating itself into every corner of the inhabited world. Egyptian mummies from as long ago as 1580 B.C. reveal evidence of the scarring characteristic of smallpox; Hittite armies were said to have acquired a devastating pox illness in 1350 B.C.; Greek and Roman literature, too, hand down accounts of destructive smallpox-like diseases relentlessly striking soldiers and civilians alike in the pre-Christian era. Ancient cultures as diverse as China, India, and northern Africa likewise fell under variola's power, as

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1. 4 THOMAS BARRINGTON MACAULAY, HISTORY OF ENGLAND FROM THE ACCESSION OF JAMES II 115 (1906).

2. Nicolau Barquet & Pere Domingo, *Smallpox: The Triumph over the Most Terrible of the Ministers of Death*, 127 ANNALS OF INTERNAL MED. 635 (Oct. 15, 1997), *available at* http://www.acponline.org/journals/annals/15oct97/smallpox.htm (on file with author) (using name given to smallpox in seventeenth century England).

3. FRANK FENNER ET AL., SMALLPOX AND ITS ERADICATION 175, 395-97, 519 (1988); Lawrence K. Altman et al., *Smallpox: The Once and Future Scourge?*, N.Y. TIMES, June 15, 1999, at F1.

4. FENNER ET AL., *supra* note 3, at 116-19 (noting certain population size necessary to sustain variola in humans). A local population of perhaps two hundred thousand people—attained only after the development of irrigated agriculture ten thousand years ago—would be necessary to sustain variola in a human population. DONALD R. HOPKINS, PRINCES AND PEASANTS: SMALLPOX IN HISTORY 13-14 (1983).

5. FENNER ET AL., *supra* note 3, at 73-75 (some members of the genus can infect a wide range of vertebrates; others have a much narrower set of hosts).

smallpox ravaged human populations for centuries without remission. Among the last to encounter the terror of smallpox were the native peoples of the Western Hemisphere, where variola was introduced only in the sixteenth century. It was this virus, rather than the technology and manpower of the Spanish conquistadors, that sequentially obliterated the Aztec, Mayan, and Inca civilizations, as smallpox achieved record-breaking levels of fatalities when injected into virgin communities.[6]

Two important and unusual features characterize the variola virus, and helped define the progression of smallpox cases in a society. First, the disease is human-specific; variola has no alternative host in animals or plants, and cannot persist indefinitely in the natural environment. Without a niche in the human body, the virus cannot sustain itself, or even survive in any other natural reservoir.[7] Second, smallpox is ordinarily non-recurring; once a person had contracted the disease and luckily survived it, he or she was probably immune for life against any subsequent re-infection by variola.[8]

B. Treatment Regimens

The horror of smallpox inspired legions of creative efforts through the ages to forestall or ameliorate the dread disease, emerging from each era's prevailing medical mores. Some experts advocated leaching the body of excessive humors; some applied a variety of purgatives, liniments, or herbs; some invented potions composed from sheep dung or other repugnant sources, designed to expel demons or other occult influences; some alternatively promoted ascetic or otherwise pure lifestyles. Many cultures—overreacting to the evocative color of the smallpox rash—adhered to "red treatment" by encircling the patient with red clothing, linens, and curtains, and allowing only red food and drink.[9] Heat therapy was a likewise prolonged popular expedient for much of the world—fight the illness by keeping its victim unnaturally warm—but several centuries later, the leading medical authorities suddenly

6. FENNER ET AL., *supra* note 3, at 209-44 (tracing spread of smallpox around the world before 1900); HOPKINS, *supra* note 4, at 14-21, 204-15. Many of the early reports about deadly diseases are fragmentary and imprecise, so it is often impossible to be certain whether the illness reported was smallpox or some other malady; only in the modern era has accurate differential diagnosis been feasible. JOEL N. SHURKIN, THE INVISIBLE FIRE: THE STORY OF MANKIND'S TRIUMPH OVER THE ANCIENT SCOURGE OF SMALLPOX 41-64, 101-17 (1979).

7. FENNER ET AL., *supra* note 3, at 117-18, 479-80, 1333-34 (discussing survival of smallpox disease). Eradication of smallpox might have been impossible if the virus were able to persist in animals or in the environment after transmission in humans was interrupted. *Id.*

8. FENNER ET AL., *supra* note 3, at 51-52, 146-47 (reporting on incidence of smallpox). Data were incomplete, but a 1972 study found one repeat smallpox attack per one thousand cases, with an average interval of 15-20 years between occurrences. *Id.*

9. HOPKINS, *supra* note 4, at 9-13, 27-33, 295-300 (noting red treatment seemed to be especially compelling protocol as it was adopted in diverse societies and persisted for centuries); SHURKIN, *supra* note 6, at 53-64; FENNER ET AL., *supra* note 3, at 228.

reversed that protocol by 180 degrees, promoting cooling treatment, with no better success.

None of those early medical algorithms afforded meaningful relief to the smallpox patient, and we now believe many may have exacerbated the symptoms and reduced the survival rate. However, two important therapeutic options—variolation and vaccination—both popularized in the eighteenth century, did offer genuine contributions and provided major milestones in the world's struggle against smallpox.

Variolation amounted to deliberately incurring a relatively minor case of the disease, in the hope that it could be managed at a non-fatal level and thereby provide lifelong immunity against any subsequent attacks. The technique had been practiced, in different forms, for centuries: in China, a powder concocted from dried crusts scraped from the skin of a current smallpox sufferer was inhaled like snuff by the person to be variolated; in India and Turkey, a small amount of pus from an active smallpox lesion on one person was injected into a fresh scratch on the arm of another. Smallpox acquired artificially in this way was ordinarily less fearsome: the symptoms were milder, and there was only a 1-2% chance of dying. On the other hand, the variolated person could still communicate full-strength smallpox to other nearby people, spreading the virus and perhaps triggering an outbreak of the very disease sought to be avoided. A privileged individual might therefore be protected by variolation, but only at the cost of jeopardizing the rest of the community.[10]

Variolation was famously introduced into England in 1721 by Lady Mary Wortley Montague, the wife of the British ambassador to the Ottoman Empire, who had observed the practice in Turkey. She successfully employed it on her own children, and persuaded the wife of the Prince of Wales to expose the royal heirs. Despite considerable immediate opposition from the conservative British medical establishment, the technique flourished, spreading to France, Russia, and elsewhere.[11] At the same time, Boston's Reverend Cotton Mather, who had independently learned of the technique from his African slave, Onesimus, sponsored variolation in America. Again, considerable hostility (as elaborated below) eventually gave way to general grudging acceptance of the liberating, but also quite hazardous, procedure.[12]

Vaccination, the first unreservedly positive treatment for smallpox—indeed, the first effective prophylactic procedure for any infectious disease—was developed by the English country physician Edward Jenner in 1797. Jenner

10. FENNER ET AL., *supra* note 3, at 245-53; HOPKINS, *supra* note 4, at 114-15; SHURKIN, *supra* note 6, at 119-29.

11. HOPKINS, *supra* note 4, at 46-56, 66-69; FENNER ET AL., *supra* note 3, at 253-56; SHURKIN, *supra* note 6, at 122-27; William L. Langer, *Immunization against Smallpox before Jenner*, 234 SCI. AM. 112 (1976).

12. HOPKINS, *supra* note 4, at 248-57; FENNER ET AL., *supra* note 3, at 256-57; SHURKIN, *supra* note 6, at 152-72.

observed that local milkmaids who had previously acquired the mild skin disorder of cowpox appeared immune to subsequent infection by smallpox. Although he could only guess at the underlying cellular linkages, Jenner conducted empirical experiments to corroborate the association between the two illnesses, publicized his findings, and sponsored what quickly became a world-wide program of deliberate cowpox infection as a mechanism to ward off variola. The immunizing technique was marvelously successful, with cowpox saving countless lives and providing the model to be imitated by dozens of other types of vaccinations against a menagerie of viral and bacterial pathogens.[13]

As vaccination proliferated around the world, the concept emerged of pursuing the complete eradication of smallpox, but nearly two centuries were to elapse before that flickering hope approached reality. In the interim, some countries (especially the wealthy states of Europe and North America) eventually became relatively smallpox-free, but the disease continued to exact its prodigious toll in Africa, Asia, and Latin America. For example, vigorous national vaccination campaigns eradicated endemic[14] smallpox from Norway in 1898, Germany in 1922, and France in 1936.[15] In contrast, Russia suffered 439,000 smallpox deaths between 1900 and 1909; the Philippines reported 64,000 deaths in 1918-19; Nigeria incurred approximately 10,000 deaths per year in 1932-34; there were 63,000 cases in Thailand in 1945-46; and the disease was still endemic in virtually all of the forty-seven countries in Africa as late as 1945.[16]

By the 1950s, an effective *cordon sanitaire* largely excluded variola from the United States (where the last smallpox case occurred in 1949[17]) and Europe (despite occasional re-introductions by travelers who had acquired the illness elsewhere[18]), but India reported 83,423 cases in 1963; Zaire had 5,523 in 1963;

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13. FENNER ET AL., *supra* note 3, at 258-73; HOPKINS, *supra* note 4, at 77-86; SHURKIN, *supra* note 6, at 129-43; Langer, *supra* note 11, at 112. Jenner called his new procedure "vaccination," which he derived from the Latin *vacca* for "cow." FENNER ET AL., *supra* note 3, at 292; HOPKINS, *supra* note 4, at 95. In 1881, Louis Pasteur generalized the use of that term to cover the full range of immunizing injections aimed at preventing other diseases, too. FENNER ET AL., *supra* note 3, at 292; HOPKINS, *supra* note 4, at 95.

14. FENNER ET AL., *supra* note 3, at 117-18, 215, 224 (comparing endemic and epidemic disease). An "endemic" disease is one that is sufficiently well-established in a particular country or region that continuous transmission to new victims is perpetual. *Id.* In contrast, an "epidemic" occurs when a pathogen is introduced to a population, works its way through the available victims, and then fades away. *Id.* Smallpox was endemic—always present, at some varying level—in most of the world for centuries; particular areas that were too sparsely populated to sustain endemicity (an island or an isolated rural community, for example), on the other hand, might suffer periodic epidemics when the virus was occasionally introduced by a traveler. *Id.*

15. FENNER ET AL., *supra* note 3, at 318-23. By the late 1930s, endemic smallpox had been eliminated from most of Europe, except Spain, Portugal, and Turkey. *Id.* at 323.

16. FENNER ET AL., *supra* note 3, at 321-63.

17. FENNER ET AL., *supra* note 3, at 328-32.

18. FENNER ET AL., *supra* note 3, at 317-27, 1073-81 (reporting thirty-four importations of smallpox into thirteen European countries between 1959 and 1978).

Indonesia had 56,000 cases in 1965; and there were still several thousand cases reported annually in Brazil in the late 1960s.[19]

C. *World Health Organization Efforts*

After World War II, the fledgling World Health Organization (WHO), under the aegis of the United Nations, undertook to battle smallpox, launching a doomed Smallpox Eradication Program in 1959 and a more concerted Intensified Smallpox Eradication Program in 1967.[20] A remarkable decade of unprecedented international public health cooperation ensued, characterized by dazzling displays of generosity from donor countries (the USSR, for example, contributed 1.4 billion doses of vaccine); by the untold tenacity and dedication of a small but extraordinarily talented cadre of health care professionals (led by D.A. Henderson, detailed to WHO from the U.S. Public Health Service); and by astonishing self-restraint and good judgment on the part of recipient countries (who frequently set aside any traditional false pride and graciously accepted foreign guidance and oversight, and who occasionally even interrupted civil and international wars to allow teams of WHO vaccinators to reach remote population groups). Finally, in 1977, the heroic achievement was recorded when the last case of smallpox was detected, isolated, and treated in Somalia; no one on earth has suffered from a natural case of smallpox in the subsequent quarter century.[21]

WHO officials, anticipating this crowning event, had undertaken to manage the remaining inventories of variola virus materials. For years, of course, every country on earth had unfettered access to the unwelcome virus: it was plentiful everywhere, and many laboratories, hospitals, and other facilities held infectious samples for routine reference, diagnostic, research, and other purposes. Under WHO auspices, countries were led to report, categorize and secure, and then to destroy or consolidate those inventories, so that in 1975 at least seventy-five laboratories held variola stocks; but within two years that number was reduced to eighteen. Upon further prodding, the number of variola repositories was cut to eight in 1978. By 1983, only two publicly

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19. FENNER ET AL., *supra* note 3, at 346-47, 610, 635, 721, 914. Public health statistics from much of the world were notoriously inadequate during this period; some authorities estimated that only 1% of the actual smallpox cases were reflected in published accounts. *Id.* An early set of challenges for the WHO anti-smallpox campaign was to train health care workers to recognize smallpox cases, to develop procedures and equipment for competently recording them, and to reward accurate and timely reporting, so the full nature of the global smallpox problem could be identified. *Id.* at 173-75, 320, 476-78.

20. *Smallpox Eradication Programme*, Resol. 20.15, WORLD HEALTH ASSEMBLY (May 17, 1967); *Smallpox Eradication*, Resol. 11.54, WORLD HEALTH ASSEMBLY (June 12, 1958).

21. FENNER ET AL., *supra* note 3, at 421-538; SHURKIN, *supra* note 6, at 257-404. Ten months after that last "natural" case of smallpox, there was one additional outbreak, caused by the virus accidentally escaping confinement in a research laboratory at the University of Birmingham, England, resulting in one fatality. FENNER ET AL., *supra*, at 1097-99.

acknowledged variola inventories remained: CDC in the United States and the Moscow Research Institute for Viral Preparations, both of which were officially designated as WHO Collaborating Centers.[22] In 1994, the Russian samples were precipitously transferred to the Vector facility in Koltsovo, near Novosibirsk, and it has subsequently assumed the mantle of a WHO Collaborating Center.[23]

There may, of course, also be covert stocks of smallpox materials, hidden from WHO accounting and oversight for these many years by rogue laboratories, military services, or national governments; current speculation focuses on North Korea and Iraq, as well as a fistful of others, as suspect states.[24] Likewise, it is still possible that more innocent unknown residual inventories of viable variola may yet linger in the inner recesses of some forgotten laboratory deep freeze cabinet,[25] or perhaps in the frozen cadavers of ice age peoples who may have acquired the disease in prior centuries and been buried, and cryogenically preserved, in the northern permafrost.[26]

Today, the two variola stocks the public knows about—the only acknowledged smallpox infective materials left on earth—are now confined to CDC (which holds a witches' brew of some 450 diverse samples contributed by laboratories and others around the world) and Vector (which houses 120 specimens, including some overlap with the CDC inventory). Security at both facilities is—appropriately—tight, although neither installation will release

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22. FENNER ET AL., *supra* note 3, at 1338-41; *Smallpox Eradication Programme: Current Status and Certification*, Resol. 31.54, WORLD HEALTH ASSEMBLY (May 24, 1978); *Smallpox Eradication*, Resol. 30.52, WORLD HEALTH ASSEMBLY (May 19, 1977); *Smallpox Eradication Programme*, Resol. 29.54, WORLD HEALTH ASSEMBLY (May 19, 1976); *see* JONATHAN B. TUCKER, SCOURGE: THE ONCE AND FUTURE THREAT OF SMALLPOX 134-36 (2001).

23. World Health Org., Rep't by the Dir.-Gen., *Communicable Disease Prevention and Control: Smallpox Eradication: Destruction of Variola Virus Stocks*, Executive Board Provisional Agenda Item 7.1, EB97/14 (Sept. 13, 1995).

24. Barton Gellman, *4 Nations Thought to Possess Smallpox*, WASH. POST, Nov. 5, 2002, at A1 (identifying Iraq, North Korea, Russia, and France as holding secret variola stashes); William J. Broad & Judith Miller, *Government Report Says 3 Nations Hide Stocks of Smallpox*, N.Y. TIMES, June 13, 1999, at 1 (discussing classified U.S. government report alleging North Korea, Iraq, and Russia maintained covert variola virus inventories); Central Intelligence Agency, *Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions*, Jan. 1–June 30, 2001 (surveying countries suspected of pursuing biological weapons); Richard Preston, *The Demon in the Freezer*, NEW YORKER, July 12, 1999, at 44, 46 (asserting that U.S. government lists Russia, China, India, Pakistan, Israel, North Korea, Iraq, Iran, Cuba, and Serbia as having or seeking clandestine stocks of variola virus).

25. FENNER ET AL., *supra* note 3, at 1341 (noting many laboratory deep freeze cabinets rarely cleaned out and staff turnover may lead to loss of institutional memory about older holdings). Two or three incidents (in California and in Tanzania in 1979, and perhaps in London in 1985) have been reported in which long-forgotten variola inventories surfaced in a laboratory. TUCKER, *supra* note 22, at 136-37.

26. Richard Stone, *Is Live Smallpox Lurking in the Arctic?*, 295 SCI. 2002 (2002) (describing attempts to find variola in Arctic). Russian scientists failed in a 1991 attempt to recover viable variola from cadavers of nineteenth century smallpox victims frozen in far north, but are still pursuing the possibility. *Id.*; Wendy Orent, *Escape from Moscow*, THE SCIENCES, May-June 1998, at 26; TUCKER, *supra* note 22, at 161-62.

many details. Until recently, very little research or other activity had been undertaken on smallpox at either locale, but in the last couple of years, the frozen variola dormitories have been increasingly disturbed by researchers attempting to discover new vaccines, develop suitable antiviral medications, or otherwise plumb some of the microscopic secrets of this arcane creature.[27]

For the WHO, "out of sight" has never meant "out of mind," and the organization's various specialized expert groups, as well as its top policy decision-making bodies, have kept the question of the future of the variola virus under continuous active consideration. In 1986, for example, the WHO Committee on Orthopoxvirus Infections, after surveying sixty prominent virologists in twenty-one countries, unanimously recommended that the remaining variola samples be destroyed.[28] In 1990, a similar WHO group reached the same conclusion, this time proposing a specific deadline of December 30, 1993.[29] When that date slipped past, WHO authorities next established June 30, 1995 as the target,[30] but WHO's Executive Board soon granted another reprieve, fixing June 30, 1999 as the day of reckoning.[31]

In early 1999, a survey of WHO's member states reported that seventy-four favored eradication of the variola inventories on the prescribed timetable, while four were undecided and only one opposed destruction—seemingly another strong consensus behind the chosen course, until it was understood that the four "undecideds" were the United States, Britain, France, and Italy, and the lone opponent was Russia.[32] On May 24, 1999, the World Health Assembly retreated again, unanimously postponing variola's destruction until December

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27. World Health Org., Dep't of Communicable Disease Surveillance and Response, *WHO Advisory Committee on Variola Virus Research: Report of a WHO Meeting, Geneva, Switzerland*, WHO/CDS/CSR/2000.1 (Dec. 6-9, 1999); World Health Org., Rep't by the Secretariat, *Smallpox Eradication: Temporary Retention of Variola Virus Stocks*, A54/16 (Apr. 11, 2001), at 2; World Health Org., Rep't by the Secretariat, *Smallpox Eradication: Temporary Retention of Variola Virus Stocks*, A53/27 (May 2, 2000); Preston, *supra* note 24, at 44; TUCKER, *supra* note 22, at 223-30; SHURKIN, *supra* note 6, at 17-25.

28. *Scientific Activities: Orthopoxviruses*, 64 BULLETIN OF THE WORLD HEALTH ORGANIZATION NO. 6 801, 802 (1986); D.A. Henderson, Deliberations Regarding the Destruction of Smallpox Virus: A Historical Overview, 1980-1998 (Nov. 20, 1998) (working paper for meeting of a Committee of the Institute of Medicine).

29. *Memoranda: Destruction of Variola Virus: Memorandum from a WHO Meeting*, 72 BULLETIN OF THE WORLD HEALTH ORG. NO. 6 841, 841 (1994) [herinafter *Memoranda*]; Henderson, *supra* note 28.

30. *Memoranda*, *supra* note 29, at 841-42 (listing supporters of destruction of virus). The Executive Board of the International Union of Microbiological Societies, the Presidium of the Russian Academy of Medical Sciences, the Council of the American Microbiological Society, and the Board of Directors of the American Type Culture Collection all supported prompt destruction of the virus. *Id.*

31. World Health Org. Exec. Board, *Smallpox Eradication: Destruction of Variola Virus Stocks*, Resol. 97.R24 (Jan. 24, 1996); *Smallpox Eradication: Destruction of Variola Virus Stocks*, Resol. WHA 49.10, WORLD HEALTH ASSEMBLY (May 25, 1996); World Health Org., Rep't by the Secretariat, *Smallpox Eradication: Destruction of Variola Virus Stocks*, A52/5 (Apr. 15, 1999).

32. World Health Org., Rep't by the Secretariat, *Smallpox Eradication: Destruction of Variola Virus Stocks*, A52/5 (Apr. 15, 1999); Meredith Wadman, *Scientists Split on US Smallpox Decision*, 398 NATURE 741 (1999).

31, 2002, to allow a range of additional, closely-monitored research on anti-smallpox pharmaceuticals.[33]

With seeming inevitability, even that deadline was breached. In the fall of 2001, after the September 11 disasters had brought the specter of modern terrorism to the forefront of global attention, and especially after the subsequent wave of mailed anthrax spores had highlighted our shared vulnerability to *biological* terrorism in particular, the Bush Administration announced that it would not destroy the CDC variola inventory as scheduled. Instead, a reinvigorated scientific research program of undetermined duration would be undertaken, designed to invent, *inter alia*, a better, safer vaccine, two new types of antiviral medications, and the capability to defeat even genetically-engineered types of novel smallpox agents.[34]

Shortly thereafter, the WHO reluctantly acquiesced in the suspension of the variola destruction schedule, and this time, it declined even to establish yet another revised target date. While some have interpreted the new posture as licensing indefinite years of additional retention of, and open-ended experimentation on, variola, WHO has pledged to keep a close watch on the progress of the experiments, and to revisit the destruction question regularly.[35]

D. The Variola Virus

The creature at the center of all this activity, the variola virus, is a most unusual entity, even in the dazzling world of the microscopic. It is one of the largest and most complex viruses, measuring 250 x 200 x 200 nanometers—almost the size of small bacteria, and large enough to be visualized under a good light microscope. Its genetic material is likewise massive and sophisticated, contained in a single strip of double-stranded DNA comprising almost two hundred genes.[36] The virus exists in multiple variants: the

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33. *Smallpox Eradication: Destruction of Variola Virus Stocks*, Resol. 52.10, WORLD HEALTH ASSEMBLY (May 24, 1999); World Health Org., Rep't by the Secretariat, *Smallpox Eradication: Destruction of Variola Virus Stocks*, EB 106/3 (Apr. 10, 2000).

34. U.S. Dep't of Health and Human Servs., *Statement by HHS Secretary Tommy G. Thompson Regarding Remaining Smallpox Repositories* (Nov. 16, 2001); Judith Miller, *U.S. Set to Retain Smallpox Stocks*, N.Y. TIMES, Nov. 16, 2001, at A1; David Brown, *U.S. Wants the Smallpox Virus Preserved for Further Research*, WASH. POST, Nov. 17, 2001, at A9.

35. World Health Org., Rep't by the Secretariat, *Smallpox Eradication: Destruction of Variola Virus Stocks*, EB109/17 (Dec. 20, 2001); World Health Org., *Statement by the Director-General to the Executive Board at Its 109th Session*, EB109/2 (Jan. 14, 2002); World Health Org., Rep't by the Secretariat, *Smallpox Eradication: Destruction of Variola Virus Stocks*, A55/21 (Apr. 5, 2002); *Smallpox Eradication: Destruction of Variola Virus Stocks*, Resol. 55.15, WORLD HEALTH ASSEMBLY (May 18, 2002); Richard Stone, *World Health Body Fires Starting Gun*, 296 SCI. 1383 (2002) (reporting director of Russia's Vector laboratory interpreted WHO action as forecasting "another 5 to 7 years" of continued retention and research on samples).

36. FENNER ET AL., *supra* note 3, at 71-76; Committee on the Assessment of Future Scientific Needs for Live Variola Virus, Institute of Medicine, National Academy of Sciences, Assessment of Future Scientific Needs for Live Variola Virus, at 12, 17-21 (1999) [hereinafter IOM]; THOMAS A. SCOTT, CONCISE

complete genomes for ten distinct strains have now been sequenced (and much of that genetic coding has been published).[37] Variola is a member of the orthopox virus genus, a remarkably diverse collection that includes specimens infecting a wide range of animal hosts, with effects ranging from mild to deadly. The several different species may be 95% identical, with the crucial genetic differences, affecting virulence and host-virus interactions, clustered at the ends of the respective DNA chains.[38]

Variola is also unusual in several aspects of its cellular functioning. The virus exists in both an "enveloped" and "naked" form (either encased in a protective outer membrane or not), and has the ability to recognize and bind to certain distinctive features on a target cell's exterior and then be drawn inside the cell in two corresponding modes. Once the viral Trojan horse has entered, it immediately commences operations by suppressing the cell's normal functioning, commandeering its energy and resources, and converting it into a miniature "variola factory" to replicate additional copies of the invader. Remarkably, variola is one of the few viruses that accomplishes all this while remaining in the cell's cytoplasm, instead of invading the nucleus. Variola is also unusual because it is self-contained: it carries with it many of the enzymes necessary to seize control of the cell, instead of relying upon the target's own enzymes to assist.[39] Additionally, variola possesses another near-unique ability: it can secrete proteins that cling to, and thereby neutralize, interferon gamma, the human body's leading natural anti-viral agent, according variola an important advantage in the molecular warfare between an invading infection and a defending host.[40] Finally, variola exhibits a distinctive capability of "transfection:" if a cell is simultaneously infected with killed but physically intact variola and a healthy specimen of some other orthopox virus, then the enzymes from the latter virus can help reactivate the former, and fully effective

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ENCYCLOPEDIA BIOLOGY 1244, 1245-46 (1996) (describing "Virus Diseases"); Human Pox Viruses, http://www.mni.uwo.ca/Bio221a/virus3.html (on file with author); Poxviruses, http://www.micro.msb.le.ac.uk/335/Poxviruses.html (on file with author)

37. World Health Org., Rep't by the Secretariat, *Smallpox Eradication: Destruction of Variola Virus Stocks*, EB109/17 (Dec. 20, 2001); Poxvirus Bioinformatics Resource, http://www.poxvirus.org/viruses.asp (last visited Jan. 16, 2004) (listing two strains of variola major and one of variola minor, as well as three substantial fragments, for which full DNA encoding publicly available).

38. FENNER ET AL., *supra* note 3, at 71-75, 90-95, 102; IOM, *supra* note 36, at 12; Poxviruses, *supra* note 36.

39. FENNER ET AL., *supra* note 3, at 71, 76, 86-89; SHURKIN, *supra* note 6, at 33-36; Human Pox Viruses, *supra* note 36; Poxviruses, *supra* note 36; World Health Org., Dep't of Communicable Disease Surveillance and Response, *WHO Advisory Committee on Variola Virus Research: Report of a WHO Meeting, Geneva, Switzerland*, WHO/CDS/CSR/2000.1, at 7 (Dec. 6-9, 1999).

40. Wolfgang K. Joklik, *The Remaining Smallpox Virus Stocks Are Too Valuable to Be Destroyed*, THE SCIENTIST, Dec. 9, 1996, at 11 (describing pox viruses). Pox viruses have a multifaceted ability to counteract the human body's defenses by blunting the effects of interferon in several different ways: by impeding the production and functioning of cells that would attack the virus, and by defending themselves against the killing of the cells they have already infected. *Id.*; Human Pox Viruses, *supra* note 36.

variola is once again produced.[41]

E. If Smallpox Returned Today

If this vile, long-dormant disease should be re-visited upon the world today—through an accidental release from one of the Collaborating Centers, through the hostile action of a terrorist or military force, or in some other way—the results could be catastrophic. Unlike prior generations, relatively few people today possess reliable immunity: only a small minority of the global population now consists of survivors of earlier smallpox incidents, having permanent protection against another attack. Others who were vaccinated as children (the United States stopped routine smallpox vaccination in the 1970s; most other countries likewise halted national programs within a decade after that) have little residual natural protection left.[42]

Renewed vaccination programs could provide a safety net,[43] but until very recently, the global inventories of viable vaccine had been allowed to fall disastrously low.[44] A sudden surge in new production, prompted by the 2001 terrorism, has quickly re-established adequate supplies, both in the United States and elsewhere.[45] Public policy officials have developed, and at this

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41. FENNER ET AL., *supra* note 3, at 80.

42. Jon Cohen, *Smallpox Vaccinations: How Much Protection Remains?*, 294 SCI. 985, 985 (2001) (noting vaccination does not confer *lifelong* immunity against variola similar to contracting and surviving case of smallpox infection). Although definitive studies were never conducted, it appears that vaccination would provide robust protection for only 5-10 years, after which a repetition would be required. *Id.* A relatively old vaccination might accord some degree of protection against a subsequent smallpox attack, perhaps lessening the severity of the disease or its communicability. *Id.*; *see* William J. Bicknell, *The Case for Voluntary Smallpox Vaccination*, 346 NEW ENG. J. MED. 1323, 1323 (2002) (noting 119 million Americans born after termination of mass vaccinations fully vulnerable to smallpox); Lawrence K. Altman, *Effect of Smallpox Vaccine May Be Longer, Study Says*, N.Y. TIMES, Aug. 29, 2002, at A19; World Health Org., *WHO Fact Sheet on Smallpox*, at 10-12 (Oct. 2001); D.A. Henderson, Risk of a Deliberate Release of Smallpox Virus; Its Impact on Virus Destruction, at 4 (Jan. 1999) (working Paper, Center for Civilian Biodefense Studies) (asserting "in most communities, at least 90% of the population will be fully susceptible to smallpox with perhaps 20% of adults having some protective immunity and none of the children"); *see also* FENNER ET AL., *supra* note 3, at 42-44, 52-53, 311.

43. World Health Org., *WHO Fact Sheet on Smallpox*, at 4 (Oct. 2001) (noting vaccination even four days after exposure to variola sufficient to ward off or at least attenuate smallpox); Donald A. Henderson et al., *Smallpox as a Biological Weapon: Medical and Public Health Management, Consensus Statement of the Working Group on Civilian Biodefense*, 281 J. AM. MED. ASS'N 2127, 2132 (1999).

44. *See Global Smallpox Eradication*, Resol. 33.4, WORLD HEALTH ASSEMBLY, Recommendations 3-6 (May 14, 1980); FENNER ET AL., *supra* note 3, at 1267-70; World Health Org., Rep't by the Secretariat, *Smallpox Eradication: Destruction of Variola Virus Stocks*, A55/21 (Apr. 5, 2002); Donald A. Henderson et al., *supra* note 43, at 2131-32; James LeDuc & John Becher, *Current Status of Smallpox Vaccine*, Letter to the Editor, 5 EMERGING INFECTIOUS DISEASES 593, 593 (July-Aug. 1999). In 1980, WHO had resolved to maintain a permanent global vaccine inventory of at least two hundred million doses, but that commitment gradually eroded, and by 2001, the organization's stockpile had declined to no more than five hundred thousand doses. *Id.* Some individual countries sustained their own vaccine inventories, but many of these were of questionable viability. *Id.*

45. By 2001, the United States held only 6-15 million doses of vaccine, but upon prodding by expert

writing, are beginning to implement, plans for disseminating those new inventories—vaccinating some eleven million military personnel, health care workers, police, and other "first responders" who might constitute the immediate reaction to a new smallpox emergency. At the moment (in view of the sometimes dangerous and occasionally fatal complications of the vaccination itself), the general public is not being offered the vaccine, and even many of those who are targeted for the first phases of the vaccination program have resisted voluntarily assuming the inherent risks.[46]

The public health infrastructure had also largely let down its guard against smallpox: few doctors had been trained to recognize its symptoms; few hospitals were equipped with adequate isolation and treatment structures; and few mechanisms had been established to report suspicious outbreaks of disease or to coordinate the efforts among various tiers of federal, state, and local health officials. Efforts are underway to upgrade those capabilities, re-establish an effective legal framework for combating a modern resurgence of infectious disease, and facilitate the expedited delivery of supplies and expertise to locales in need, but the process is still graded as far from adequate.[47]

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groups, the government undertook programs to procure additional supplies, and in the aftermath of September 11, those contracts were accelerated and expanded, with the goal of obtaining sufficient vaccine to treat everyone in America. Subsequently, additional vaccine supplies were serendipitously discovered, and the United States could soon have access to five hundred million or more doses of vaccine. Other countries, too, have moved swiftly to procure additional anti-smallpox vaccine. IOM, *supra* note 36, at 52-53; LeDuc & Becher, *supra* note 44, at 593; James W. LeDuc et al., *Smallpox Research Activities: U.S. Interagency Collaboration, 2001*, 8 EMERGING INFECTIOUS DISEASES (July 2002); William J. Broad & Judith Miller, *Others Follow U.S. on Smallpox Vaccine*, N.Y. TIMES, Apr. 25, 2002, at A6 (indicating Britain, Israel, Germany, France, and other countries recently procured additional smallpox vaccine supplies); Martin Enserink, *Smallpox Vaccine: New Cache Eases Shortage Worries*, 296 SCI. 25 (2002); Judith Miller & Sheryl Gay Stolberg, *Attacks Led to Push for More Smallpox Vaccine*, N.Y. TIMES, Oct. 22, 2001, at A1.

46. Ceci Connolly, *Bush Smallpox Inoculation Plan Near Standstill*, WASH. POST, Feb. 24, 2003, at A6; Joan Stephenson, *Smallpox Vaccine Program Launched Amid Concerns Raised by Expert Panel, Unions*, 289 J. AM. MED. ASS'N 685 (2003); *Bush's Comments on His Plan for Smallpox Vaccinations Across the U.S.*, transcript, N.Y. TIMES, Dec. 14, 2002, at A8; Richard W. Stevenson & Sheryl Gay Stolberg, *Bush Lays Out Plan on Smallpox Shots; Military Is First*, N.Y. TIMES, Dec. 14, 2002, at A1; U.S. Dep't of Health and Human Servs., CDC Telebriefing Transcript, *HHS Teleconference on Smallpox Policy*, http://www.cdc.gov/od/oc/media/transcripts/t021214.htm (Dec. 14, 2002); U.S. Dep't of Health and Human Servs., *Protecting Americans: Smallpox Vaccination Program*), *at* http://smallpox.gov/VaccinationProgramQA.html (Dec. 13, 2002).

47. Lawrence K. Altman & Denise Grady, *Smallpox Shot Will Be Free for Those Who Want One*, N.Y. TIMES, Dec. 15, 2002, at A23 (noting CDC preparing to send 150,000 educational CD-ROMs to doctors, and train 140,000 physicians through other programs); Sheryl Gay Stolberg with Lawrence Altman, *New Plan to Meet Smallpox Attack*, N.Y. TIMES, Sept. 24, 2002, at A1; William J. Broad, *U.S. Guide for Mass Smallpox Vaccinations: Recipe with Missing Ingredients*, N.Y. TIMES, Sept. 24, 2002, at A17; Lawrence K. Altman, *Smallpox Vaccine Knowledge Found Lacking*, N.Y. TIMES, May 10, 2002, at A28; Matthew K. Wynia & Lawrence Gostin, *The Bioterrorist Threat and Access to Health Care*, 296 SCI. 1613 (2002); Sheryl Gay Stolberg, *Some Experts Say U.S. Is Vulnerable to a Germ Attack*, N.Y. TIMES, Sept. 30, 2001, at A1; Sydney J. Freedberg, Jr. & Marilyn Werber Serafini, *Be Afraid, Be Moderately Afraid*, NAT'L J., Mar. 27, 1999 at 806, 813; Lawrence O. Gostin et al., *The Law and the Public's Health: A Study of Infectious Disease Law in the United States*, 99 COLUM. L. REV. 59 (1999); U.S. Centers for Disease Control, *Smallpox Vaccination Clinic Guide*, Sept. 16, 2002; Press Release, U.S. Centers for Disease Control, CDC Initial Review of State Smallpox

In sum, this survey of the medical and social history of smallpox suggests three important conclusions regarding the current dilemma of whether to eradicate the final known repositories of the variola virus. First, the microbe itself is biologically unusual: no other virus is quite like variola, in terms of its size, structure, operative mechanisms, or impact upon human hosts. A few of its viral cousins are tantalizingly similar, but something—we still do not know what—makes variola stunningly different, providing it a unique capability for insinuating itself into, and resisting the defenses of, its human hosts. Second, the human dimension of the smallpox narrative is likewise remarkable: no other infectious disease has so profoundly impacted *homo sapiens* over such a long period of time and in such global proportions. The variola virus has been a much feared, much loathed fellow traveler with people all over the planet for millennia. It has exerted a powerful influence on our literature, our religions, and our popular culture, as well as upon our personal and collective medical well-being, marking an indelible part of the human experience.

Finally, humans have long been collectively muddled, or at least conspicuously indecisive, regarding variola's ultimate fate. People have had it within their power for at least a quarter century to destroy the last known residual samples of variola, and have repeatedly resolved, with all due solemnity, to do so, but have on each occasion blanched when the moment of truth arrived. The WHO has stridently declared itself in favor of prompt disposal of variola to culminate the success of its marvelous campaign against smallpox—arguably the greatest single public health accomplishment in history—and at various times representatives of all countries, including the United States and the Soviet Union/Russia, have concurred. But at the last moment, something has always interrupted the march to the autoclaves, and the long-sought global consensus on eradication still seems beyond reach.

The next part of the article elaborates that third point—the disconcerting inability to come to final terms with the future of variola—and describes several aspects of humanity's collective ethical, religious, and philosophical inconclusiveness.

III. RELIGION VS. MEDICINE

A. Gods and Goddesses of Smallpox

Although different societies around the world and through the ages have confronted the horror of smallpox in diverse ways, one feature that has characterized a strikingly vast array of human responses has been the designation of a particular god, goddess, or patron saint devoted to this

Vaccination Plans Complete, (Dec. 12, 2002) (on file with author).

prominent and uncontrollable disease. The hagiology begins with the short-tempered Hindu goddess Shitala mata, one of the most popular objects of worship in India for 2000 years or more, as both the source of, and the salvation from, smallpox. Depicted as a beautiful young woman sitting cross-legged on a donkey, she could capriciously inflict the illness or withhold it; she traditionally carried both a broom (to whisk away the disease or to sweep up nonbelievers) and an urn (to convey the seeds of infection or, depending upon her mood, to dispense soothing water to the victims). Both feared and venerated, Shitala mata demanded cool food and drink, red clothing and powders, and fanning with leaves of the nim tree. The characteristic disease pockmarks were revered as representing the "kiss of the goddess." Into the twentieth century, many of her followers resisted vaccination, to avoid antagonizing the volatile goddess, but some localities managed to adapt their traditional customs to accommodate both prayer to Shitala mata and invocation of modern vaccination, "lest the goddess not be listening or be in a pernickety and malevolent mood."[48]

The counterpart in China, T'ou-Shen Niang-Niang, was likewise more feared than loved, yet she inspired widespread fealty from Buddhist, Taoist, and Confucian adherents alike. Originating in the eleventh century with a Buddhist nun who introduced the practice of variolation into China, T'ou-Shen Niang Niang became one of the most popular deities in the empire. Shrines and images were erected in her honor in many private homes, and members of smallpox-afflicted families were dispatched to convey offerings to local temples—a routine which, sadly, probably helped propagate the virus still further.[49]

Shapona, the god of smallpox for the Yoruba and affiliated tribes in West Africa, was one of the highest ranking officials in the indigenous pantheon, controlling both the earth and its inhabitants, nourishing them with food, and punishing them with the disease. Each village had its shrine to Shapona, and local priests, referred to as "fetisheurs," controlled the worship ceremonies. To some extent these rites may have proven beneficial: for example, the tradition of prohibiting drumming during an epidemic, "so that people may not congregate and be attacked by the smallpox god who may also come to dance" can be interpreted as, in effect, a quarantine. But the fetisheurs also proved a most obdurate hurdle to the WHO vaccination campaign: some priests practiced variolation for hefty fees, and either spread smallpox deliberately, to retain the profitability of the franchise, or at least persuaded local communities that their true salvation lay with the traditional practices, rather than with the

48. HOPKINS, *supra* note 4, at 159-63; SHURKIN, *supra* note 6, at 295-99; FENNER ET AL., *supra* note 3, at 219-20; GEORGE MACMUNN, THE UNDERWORLD OF INDIA 233 (1932).

49. HOPKINS, *supra* note 4, at 135-38; FENNER ET AL., *supra* note 3, at 219, 222.

intruding medical foreigners. Sometimes WHO teams dared to "declare war" on Shapona and the fetisheurs; on one occasion, vaccinators were met in response by villagers with drawn knives, defending their traditional mores.[50]

The leading European manifestation of this evocative cross-cultural phenomenon was St. Nicaise, the Roman Catholic patron saint of smallpox. Nicaise had been the bishop of Rheims; he was beheaded on the steps of his cathedral by invading Huns in 451 or 452 A.D. Because the bishop had recovered from smallpox shortly before his martyrdom, and because the invaders were compelled to retreat from Gaul shortly thereafter due to a raging epidemic of their own, he became indelibly associated with the disease. Later, St. Sebastian and St. Roche were credited with miraculous intercessions on behalf of smallpox victims, and in the twentieth century, St. Barbara inspired fervent goddess-like cult worship in Soviet Georgia and Armenia, and in Luxembourg, where her followers steadfastly resisted vaccination for fear of angering her spirit.[51]

Finally, Latin America, too, hosted smallpox deities, as African slaves imported their Yoruba traditions and syncretized them with Catholic norms. The most popular personification was the god Obaluaye or Omolu. He was represented at ceremonies by a male dancer in a straw costume, who performed while doubled over, simulating the pain, fever, itching, and trembling of a smallpox sufferer.[52]

B. Religion vs. Medicine I: The Introduction of Variolation

As noted above, there were sound scientific reasons to resist variolation in the seventeenth century: sometimes, the person subject to the treatment died from it; and even if he recovered, he could still transmit full-strength smallpox to others in the community, perhaps initiating a wider outbreak. In any event, the whole notion of voluntarily incurring such a fearsome, life-threatening disease seemed bizarre to many.

An additional category of theological objections to variolation also erupted. Traditionalists vigorously opposed variolation as (a) unchristian, since it originated in Turkey or China, or among African slaves, and was therefore unlikely to succeed among godfearing Caucasians, (b) unnatural, attempting to usurp the divine plan for the ebbs and flows in human existence, which had to include even tragic illnesses such as smallpox, and (c) blasphemous, expressing doubt about God's compassion for fragile humanity, his diligence in protecting his flock, and his wisdom in determining each individual's fate.

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50. HOPKINS, *supra* note 4, at 200-03; SHURKIN, *supra* note 6, at 251; FENNER ET AL., *supra* note 3, at 219, 223.

51. HOPKINS, *supra* note 4, at 23, 100-02; FENNER ET AL., *supra* note 3, at 219.

52. HOPKINS, *supra* note 4 at 231-33; FENNER ET AL., *supra* note 3, at 219, 23.

In 1722, for example, English minister Edmund Massey sermonized "Against the Dangerous and Sinful Practice of Inoculation," invoking the spirit of Job, who bore heroically a loathsome disease "which might be what is now conveyed to men by some such way as that of inoculation which is derived from the same part of the World as was Job's scene of action." Massey went on to proclaim:

> The fear of disease is a happy restraint to men. If men were more healthy, 'tis a great chance they would be less righteous. Let the Atheist and the Scoffer inoculate. Their hope is in and for only this life. Let us bless God for the Afflictions He sends upon us, and grant us patience under them.[53]

Cotton Mather's concurrent attempts to popularize variolation in Boston met with similar resistance, due partly to skepticism about the efficacy of the procedure, and partly to his opponents labeling it "a sin to propagate infection by this means" and warning that the Lord was apt to be so offended by the practice of variolation that he might intensify the predations of smallpox. Sometimes the opposition was not confined to mere rhetoric: in November 1721, a crude bomb was thrown through Mather's window at three a.m. with a note reading, "You Dog, Damn You. I'll inoculate you with this, with a Pox to you." Thirty years later, the theological aspects of the debate still raged, even as statistical proof of the efficacy of the process was accumulating, and American defenders of variolation wrote:

> [t]he chief argument used against Inoculation by scrupulous Persons, is from conscience. It is Presumption, they say, to tempt the Almighty by inflicting Distempers without His Permission. So say I, but the great Success of the Practice not only shows the Permission of God for, but his immediate Blessing on our Endeavors by the extraordinary Recovery of so many more, in this, than in the natural way, as it is called, of the Disease."[54]

C. Religion vs. Medicine II: The Introduction of Vaccination

In a similar vein, Jenner's promulgation of vaccination promptly generated both support and knee-jerk opposition, some of it religion-based. One adversary declared that "smallpox is a visitation from God, but the cowpox is produced by presumptuous man; the former was what heaven ordained, the

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53. SHURKIN, *supra* note 6, at 126-27; HOPKINS, *supra* note 4, at 49-50; TUCKER, *supra* note 22, at 16-18; Michael Radetsky, *Smallpox: A History of Its Rise and Fall*, 18 PEDIATRIC INFECTIOUS DISEASES J. 85, 87 (1999) (noting inoculation as another term for variolation at that time).

54. SHURKIN, *supra* note 6, at 158-67; HOPKINS, *supra* note 4, at 250-53; ELIZABETH FENN, POX AMERICANA: THE GREAT SMALLPOX EPIDEMIC OF 1775-82 36 (2001). In England, the church leadership was generally opposed to variolation, but the medical community came to support the practice; in the United States, in contrast, the clergy tended to support Mather, while the medical community resisted. Langer, *supra* note 11, at 113 (comparing reactions to vaccination in England and United States).

latter is perhaps a daring violation of our holy religion." Vaccination was "against God's law," as it boldly attempted to disrupt the natural order of life.[55]

In contrast, many village priests in Italy, Germany, Switzerland, and England not only urged parishioners to seek the preventative treatment, they became wholesale vaccinators themselves. Pastors in Bohemia charged parents with responsibility "before God for neglecting the vaccination of their children." In 1814, the Pope himself endorsed vaccination as "a precious discovery which ought to be a new motive for human gratitude to Omnipotence."[56]

The early difficulty in winning popular acceptance for the Jennerian revolution was exacerbated by the fact that vaccination entailed not only deliberately incurring a disease, but directly injecting fluid (the pus containing the cowpox virus, traditionally harvested from lesions on the flank of an infected calf) from an animal into a human being. Antagonists viewed that procedure as unclean, abominable, and dangerous—political cartoonists of the era "unabashedly depicted people who grew horns, tails, or acquired other bovine characteristics after being vaccinated."[57]

The empirical success of vaccination—the ability to prevent smallpox in an individual or even in an entire community—soon dispelled most of those base objections, but even in the 20th century, the WHO smallpox eradication campaign had to confront theological obstacles. In India, for example, the vaccine's origin in cows was sometimes a negative factor in its acceptance among Hindus. In Nigeria, worshipers of Shapona, under the sway of fetisheurs-variolators, were often reluctant to submit to a procedure not authorized by those local authorities, fearful of offending the protective deity.[58]

D. Religion vs. Medicine III: The Introduction of Genetic Engineering

The most recent incarnation of some similar sympathies arises in the realm of genetic engineering. Although detailed discussion of the marvelous technology underlying this field lies well beyond the scope of this article, it is irresistible at least to note briefly some of the possible applications—and some of the concomitant dangers—associated with this latest biotechnology

55. HOPKINS, *supra* note 4, at 83-84; SHURKIN, *supra* note 6, at 183-84. As with the introduction of variolation, there were many other reasons why experts of the day might legitimately resist vaccination. Radetsky, *supra* note 53, at 87. No one could claim to fully understand how or why the vaccination procedure succeeded in warding off smallpox; it was an imperfect routine, and due to impure or nonviable vaccine doses, or simple incompetence by the administrator, it sometimes failed to ensure protection; and vaccination would frequently convey other viral or bacterial diseases (e.g., syphilis) along with the cowpox vaccine. *Id.*

56. HOPKINS, *supra* note 4, at 83; FENNER ET AL., *supra* note 3, at 267-70.

57. HOPKINS, *supra* note 4, at 84; FENNER ET AL., *supra* note 3, at 269; TUCKER, *supra* note 22, at 26-27.

58. HOPKINS, *supra* note 4, at 147, 157.

revolution.[59]

Through exquisite manipulation of natural genomes, scientists today can routinely craft modified organisms, joining together the characteristics of entities that could never otherwise unite: bacteria that remediate pollution from heavy metal spills or that fix nitrogen more efficiently; trees that grow taller and straighter with less fertilizer and insecticide; sheep that produce rare human hormones or whole organs for transplantation into people. New capabilities, new hereditary features, entirely new product lines are spilling out of laboratories, promising life-saving and life-enhancing breakthroughs in agriculture, industry, pharmaceuticals, and other adaptations unimaginable to Lady Montague or Dr. Jenner.[60]

The latest incarnation of this dazzling, but perhaps star-crossed, prowess is the ability to construct a life form "from scratch" in the laboratory. In 2002, researchers in New York managed to synthesize viable polio virus, starting with mail-order chemicals and then following the genetic blueprint available on the Internet. The artificial creature was able to function much like the natural version, generating questions about whether larger, more sophisticated viruses and other entities could be endlessly manufactured in a similar fashion. Experts debate how readily the sequencing technology could be adapted to variola, but the newfound capability certainly raises stark questions about the feasibility of ever truly eradicating the smallpox virus and permanently preventing its possible return.[61]

There are other dangers in the new genetic engineering innovations as well. Experiments can go awry, sometimes disastrously so; our ability to predict the outcome of even the most carefully-designed cutting-edge enterprises has sparked human fear and revulsion dating back to the Frankenstein myth.[62]

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59. *See*, GEORGE B. JOHNSON & PETER H. RAVEN, BIOLOGY: PRINCIPLES AND EXPLORATIONS 203-09 (1996); ALTON BIGGS ET AL., BIOLOGY: THE DYNAMICS OF LIFE 376-85 (2d ed. 1995); PAUL BERG & MAXINE SINGER, DEALING WITH GENES: THE LANGUAGE OF HEREDITY 79-103 (1992); Sarah Crawford Martinelli, *Genetic Engineering*, *in* ENCYCLOPEDIA OF GENETICS 243-48 (Jeffrey A. Knight ed., 1999).

60. Rick Weiss, *Biotech Research Branches Out*, WASH. POST, Aug. 3, 2000, at A1; Carol Kaesuk Yoon, *If It Walks and Moos Like a Cow, It's a Pharmaceutical Factory*, N.Y. TIMES, May 1, 2000, at A20 (discussing that chickens, cows, goats, sheep, and pigs genetically modified to produce array of products, ranging from medicines to fibers used in bulletproof vests); R. Michael Blaese, *Gene Therapy for Cancer*, SCI. AM., June 1997, at 111; Dora Y. Ho & Robert M. Sapolsky, *Gene Therapy for the Nervous System*, SCI. AM., June 1997, at 116; William H. Velander et al., *Transgenic Livestock as Drug Factories*, SCI. AM., Jan. 1997, at 70; *see* ENGINEERING GENESIS: THE ETHICS OF GENETIC ENGINEERING IN NON-HUMAN SPECIES, *passim* (Donald Bruce & Ann Bruce eds., 1998).

61. Andrew Pollack, *Scientists Create a Live Polio Virus*, N.Y. TIMES, July 12, 2002, at A1; Rick Weiss, *Polio-Causing Virus Created in N.Y. Lab*, WASH. POST, July 12, 2002, at A1; Andrew Pollack, *With Biotechnology, a Potential to Harm*, N.Y. TIMES, Nov. 27, 2001, at D6.

62. Andrew Pollack, *Scientists Ponder Limits on Access to Germ Research*, N.Y. TIMES, Nov. 27, 2001 at D1 (raising issue of whether some biology experiments and activities are so dangerous that they should simply never be undertaken); Kathryn Brown, *Seeds of Concern*, 284 SCI. AM. 52 (2001); Eliot Marshall, *Gene Therapy on Trial*, 288 SCI. 951 (2000) (reporting death of patient involved in gene therapy study at University

Variola, in particular, has already been the subject of a loathsome technological prowess: the Soviet Union, in its insatiable quest for cold war era biological weapons, reportedly employed its best scientific minds and facilities to create a "chimera" virus—a novel pathogen combining the worst features of smallpox and Ebola or other noxious weapons agents.[63]

People are conflicted about all of these technological curtain raisings. To some extent, we are thrilled by the newfound capabilities, basking in the joy of expanding human competence, and luxuriating in the benefits of the new creations. To some extent, however, we are frightened about potential adverse or evil consequences, worried about where the limits ought to be drawn, and repulsed by the strangeness of it all.[64]

In addition, I submit that some of the innate resistance to our careening new technology springs from a source not too dissimilar to those considered above: a distrust of human ambition in intervening in areas formerly reserved for nature; a concern about the appropriateness of undertaking such deft, divine-like manipulations of the natural order of things; and a reluctance to "play God" in creating new biological possibilities and ushering novel life forms into existence. As with variolation and vaccination in the eighteenth and nineteenth centuries, it may be that the sheer power of genetic engineering in the twentieth and twenty-first centuries will prove irresistible, as the new technology may

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of Pennsylvania resulted in suspension of program pending exhaustive reviews); Rick Weiss, *Biotech Research Branches Out*, WASH. POST, Aug. 3, 2000, at A1 (noting political and scientific risks in creation of genetically modified fruit trees); Robert P. Lanza et al., *Xenotransplantation*, 277 SCI. AM. 54, 59 (1997) (evaluating possibility that transgenic organ transplants, such as from pigs into humans, could inadvertently spread new, deadly viral diseases).

A particularly pointed example of these dangers was revealed by the experience of Australian researchers in 2001, who were seeking to develop a novel method of controlling mouse populations, by genetically modifying the mousepox virus (another member of the orthopox virus genus that includes variola) to craft an infectious contraceptive. Jon Cohen, *Designer Drugs*, ATL. MONTHLY, July/Aug. 2002, at 113; Elizabeth Finkel, *Engineered Mouse Virus Spurs Bioweapons Fears*, 291 SCI. 585, 585 (2001); William J. Broad, *Australians Create a Deadly Mouse Virus*, N.Y. TIMES, Jan. 23, 2001, at A6. However, they stumbled instead upon a relatively simple mechanism for transforming that normally benign virus into a deadly killer, one that might even evade vaccine defenses, and might have implications for artificially enhancing other pathogens, too. Cohen, *supra*, at 113; Finkel, *supra*, at 585; Broad, *supra*, at A6.

63. KEN ALIBEK, WITH STEPHEN HANDELMAN, BIOHAZARD 258-62 (1999); TUCKER, *supra* note 22, at 157-59; Jonathan B. Tucker, *Biological Weapons in the Former Soviet Union: An Interview with Dr. Kenneth Alibek*, 6 NONPROLIFERATION REV. NO. 3 1, 8 (Spring-Summer 1999); Wendy Orent, *Escape from Moscow*, THE SCIENCES, May-June 1998, at 26, 29-30.

64. *See Where Will the Next Plague Come From?*, N.Y. TIMES, Nov. 1, 1999, at A13 (advertisement by Campaign for Responsible Transplantation, et al.). "Most human beings have an instinctive revulsion at the very idea of combining animal and human parts to invent new creatures. Maybe we can call this nature's warning. Many religions say that creation and integrity of species is God's domain." *Id.* (quoting advertisement); Jonathan Knight, *Biology's Last Taboo*, 413 NATURE 12 (2001) (noting opposition to genetic engineering of humans). The article points out that "[f]or some people, tampering with our genetic inheritance in this way is fundamentally wrong." Knight, *supra*; *see* BERNARD E. ROLLIN, THE FRANKENSTEIN SYNDROME: ETHICAL AND SOCIAL ISSUES IN THE GENETIC ENGINEERING OF ANIMALS 22-24 (Cambridge U. Press, 1995) (discussing "theology and the alleged intrinsic wrongness of genetic engineering").

simply work so well that it succeeds inexorably in reforming the world. Similar to those earlier scientific revolutions, however, this one is unlikely to be easy, smooth or completely harmonious from the ethical, religious, or philosophical point of view.[65]

In sum, review of the interactions between religion and medicine on the subject of smallpox suggests two conclusions. First, two distinct world views have routinely collided here, without systematic resolution. Throughout history, the teachings of religious leaders have occasionally supported, but frequently undercut, the medical effort to provide preventative or therapeutic care for smallpox victims. Disease—especially infectious disease, and smallpox in particular—has always roiled the human psyche and triggered some of our most problematic thinking. Some have seen smallpox as an inevitable, inescapable feature of life; some called it a visitation from the gods, a punishment for our individual or collective sins; some railed that any resistance to the virus—other than through the power of prayer—would conflict with an almighty plan for human existence.

If we have through the centuries repeatedly experienced such discord in thinking rationally about the virus and its impact upon humans, it should come as no further surprise that our contemporary society is again tied in knots about smallpox as it futilely seeks to reach a consensus about the future of the last remaining CDC and Vector samples. Smallpox has always confounded our moral and scientific judgments; it still does so today.

Second, we can observe that human responses in this sphere have not been determined solely by notions of "utility." We are surely interested in "what works" when dealing with smallpox, and have explored all manner of bizarre treatment regimens in the effort to escape the virus's devastating effects. Yet at the same time, people also exhibit a profound concern for "doing the right thing" more broadly defined. We pursue social and moral rectitude, as much as physical health, where smallpox is concerned. We bow to both the ethical and the scientific standards, and pursue—even at some cost—an elusive, evolving sense of what is appropriate, natural, or suitably restrained for our species. We instinctively shy away from the immodest claims to superhuman strength, knowledge or skill, and if we have learned to play God (or to play Dr. Frankenstein) with some frequency and adroitness, we are nonetheless permanently uncomfortable in doing so.[66]

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65. Nils Holtug, *Creating and Parenting New Life Forms*, *in* A COMPANION TO BIOETHICS 206 (Helga Kuhse & Peter Stinger eds., 1998); Bernard Rollin, *Animal Pain*, *in* ANIMAL RIGHTS AND HUMAN OBLIGATIONS 21-24 (Tom Regan & Peter Singer eds., 1989); *see generally* STEVEN GOLDBERG, CULTURE CLASH: LAW AND SCIENCE IN AMERICA (N.Y.U. Press, 1994).

66. *See* STEPHEN R. KELLERT, THE VALUE OF LIFE: BIOLOGICAL DIVERSITY AND HUMAN SOCIETY 9-34 (1996) (outlining nine basic values people associate with nature).

IV. WHAT IS A VIRUS?

The next key to unlocking the multi-dimensional mystery of smallpox is to study briefly the nature of the variola virus itself, asking in particular whether it is "alive," and whether that bottom-line judgment should make a critical difference to our incipient social policy-making.

A. The Contestable Definition of Life

Most biologists do not consider a virus to be properly within the realm of "living things." Unable to produce or consume energy, to move, to grow, or to reproduce on its own without first invading a living cell and usurping the host's internal mechanisms, a virus is nature's ultimate parasite, appreciably less life-like than even other microorganisms such as bacteria and rickettsia.[67] Other authorities would, perhaps more generously, consider a virus to be a minimal "living organism,"[68] or, under various circumlocutions, to lie "on the threshold of life,"[69] "somewhere between complex aggregates of macromolecules and actual living organisms"[70] or "half alive."[71]

The difficulty in reaching a conclusive epithet for viruses is not unique: many genres of microorganisms seem to confound the conceptual categories created by traditional science. For example, prions (the proteinaceous fragments, devoid of any nucleic acid, that have been implicated in "mad cow"

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67. JOHNSON & RAVEN, *supra* note 59, at 455-56; COMPTON'S ENCYCLOPEDIA ONLINE, http://www.optonline.com/comptons/ceo/05045_A.html (on file with author) (defining virus and asserting virus "cannot even properly be called an organism"); Natalie Angier, *Defining the Undefinable: Being Alive*, N.Y. TIMES, Dec. 18, 2001, at D1 (noting "scientists have had a devilishly difficult time specifying, delimiting and agreeing on the characteristics that define life"). The article quotes one expert who calls viruses "about as alive as is sugar or salt," and another who says "I've always thought of them as alive, although in a dormant state." Angier, *supra*, at D1. Ricksettia are a class of often-pathogenic microorganisms formerly classified as viruses but now considered to be more akin to bacteria, although they are smaller than bacteria and cannot reproduce outside of living cells. Thomas P. Monath, *Rickettsia*, *in* 16 WORLD BOOK ENCYCLOPEDIA 335 (1991) (describing rickettsia).

68. *Viral Infections*, *in* 3 MAGILL'S MED. GUIDE 1784 (1998) (stating "[s]ome scientists classify viruses as living organisms based on their ability to reproduce inside an appropriate host cell."); *see Virus*, *in* TABER'S CYCLOPEDIC MED. DICTIONARY 2087 (18th ed. 1997) (calling virus both "smallest living organism" and "obligate intracellular parasite[]"); David O. White, *Virology, Medical*, *in* 7 ENCYCLOPEDIA OF HUMAN BIOLOGY 771, 772 (Renato Dulbecco ed., 1991) (referring to viruses as "living creatures").

69. B. Innes, *Viruses*, *in* 10 ENCYCLOPEDIA OF LIFE SCIENCES 1398 (Marshall Cavendish Corp., 1996); John J. Holland, *Virus*, 20 WORLD BOOK ENCYCLOPEDIA 441 (1991) (noting "[v]iruses are so primitive that many scientists consider them to be both living and nonliving things."); *see also* Charles Siebert, *Smallpox Is Dead, Long Live Smallpox*, N.Y. TIMES MAG., Aug. 21, 1994, at 30, 35 (quoting another medical source describing viruses as "entities on the borderline between the living and nonliving").

70. BERG & SINGER, *supra* note 59, at 57 (noting that in view of their enormous diversity, "viruses constitute a whole underworld of nature"). With regard to viruses' persistent pursuit of a viable niche in the environment, "viruses are no different from complex organisms; they are only smaller and less independent." *Id.* at 57, 194.

71. Michael D. Lemonick, *The Killers All Around*, TIME MAG., Sept. 12, 1994, at 62, 68.

disease and in Creuzfeld-Jacob disease in humans) and viroids (a cluster of similar plant-infesting creatures containing a snippet of RNA, but none of the other accouterments that even viruses contain) are even less lifelike than viruses. Other microscopic entities of all description also challenge our ability to construct reliable, meaningful demarcations in the still largely unexplored netherworld of biology.[72]

Few of these tiny creatures are well-understood at this point; many have not yet even been definitively identified or catalogued. As noted above, variola is unusual for a virus—large, complex, and multi-functional—but other viruses and bacteria also hold mysteries that current science is unable to unravel. Whether additional study would alter our contemporary demarcations about "life," or whether such future inquiries would enhance our appreciation for, and our ability to extract other useful lessons from, these novel beings, is anyone's guess.[73]

In short, there is not, and may never be, a valid, determinate definition of "life" or an authoritative mechanism for interpreting it in the closest cases—this may be one of the topics on which even the best of modern science can offer only fleeting judgments. Biologists and others may cobble together their competing standards, but there is a large quantity of arbitrariness in any such delineation—perhaps we may ultimately require different definitions for different social, scientific, and political purposes. As one leading bio-ethicist commented, "[u]ltimately, the definitive debate over what life is and when life begins is up to us as a society."[74]

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72. Jennifer Couzin, *In Yeast, Prions' Killer Image Doesn't Apply*, 297 SCI. 758 (2002); Clare Thompson, *In Search of a Cure for CJD*, 409 NATURE 660 (2001); Innes, *supra* note 69, at 1401; Viroids and Virusoids, *at* http://www.tulane.edu/~dmsander/WWW/335/Viroids (on file with author); *see* Andy Purvis & Andy Hector, *Getting the Measure of Biodiversity*, 405 NATURE, 212, 212, 213 (2000) (describing controversy surrounding another proposed discovery). The article contemplates "whether or not the 100-nm-diameter nanobacteria found in, among other places, kidney stones are living organisms." Purvis & Hector, *supra*, at 213. Researchers under the auspices of the Minimal Genome Project, endeavoring to discern what is the smallest number of genes necessary to sustain a living organism, have succeeded in knocking out many genes as redundant in a simple one-celled organism, but have also concluded that the definition of "life" is relative, because such a creature might be able to survive in artificial laboratory conditions, but not in nature. Rick Weiss, *Genetic Find Could Lead to Creation of Life From Scratch in Lab*, WASH. POST, Dec. 10, 1999, at A8 (citing research on definition of life); *see Case Study: Prions*, *in* EPIDEMIC!: THE WORLD OF INFECTIOUS DISEASE 50-51 (Rob DeSalle ed., 1999).

73. Rita R. Colwell, *Microbial Biodiversity and Biotechnology*, *in* BIODIVERSITY II 279, 282 (Marjorie L. Reaka-Kudla et al. eds., 1997) (discussing identification of bacteria and viruses). Only three to four thousand species of bacteria have been described, but there may be three million species on earth; only five hundred out of a total of approximately five thousand species of viruses have been identified. *Id.*; Richard O. Roblin, *Resources for Biodiversity in Living Collections and the Challenges of Assessing Microbial Biodiversity*, *in* BIODIVERSITY II, *supra*, at 467, 470 (noting researchers identified four thousand bacterial species in single gram of soil from Norwegian forest).

74. Rick Weiss, *Genetic Find Could Lead to Creation of Life From Scratch in Lab*, WASH. POST, Dec. 10, 1999, at A8 (quoting Arthur Caplan); *see* Natalie Angier, *Defining the Undefinable: Being Alive*, N.Y. TIMES, Dec. 18, 2001, at D1.

B. The Importance of a Definition of Life

Even if we were able to conclude, with a confidence that now eludes modern science and society, that a virus was not worthy of the moniker "life," would that end our moral inquiry? If we could satisfy ourselves that a virus was even one inch on the disfavored side of a stark dividing line between living and non-living entities—as if the difference between virus and bacteria was so crucial—could we then dispense with any lingering questions about the morality of preserving the variola stockpiles?

I contend that labeling a virus as "non-living" would not fully dispose of the problem. Humans can, and should, hold as proper subjects of ethical inquiry even some objects that are clearly non-living, non-biological, insentient, abstract and inert. For example, monumental natural phenomena (Niagra Falls or the Everglades), historically significant creations of human beings (Old North Church or the Golden Gate Bridge) and numerous cultural treasures that combine the majesty of both (Mt. Rushmore or the Erie Canal) are not "biological," and certainly not "living," yet surely there would be some ethical component in any debate about destroying or permanently altering them. Likewise, we can properly feel some obligation to (or about) unborn future generations, even if none of them breathes today, and we cannot currently identify any one of them, or survey them for their preferences and goals. For comparison, we can recall that at various stages, legal culture in the United States and elsewhere had regarded it as nonsensical or impractical for fictional legal creatures such as corporations, partnerships or estates to hold legal rights comparable to those of human beings, yet modern legal systems now routinely cede those artificial entities the capacity to own property, sue and be sued, and hold at least some of the same important rights as real persons.[75]

This is not to say that all non-biological entities should enjoy the full panoply of human legal privileges, should possess the legal competence to pursue judicial causes of action in their own names, or should even hold an absolute right to preservation. The claim here is much narrower: simply that even non-living things can earn the right to be taken seriously as subjects of moral inquiry, and that humans can feel a mandate for searching introspection and ethical assessment before we destroy even what we might characterize as non-living collections of chemicals. Even if a virus is not alive in the traditional sense, it is still properly a subject of human attention, moral and legal regard, and even obligation.[76]

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75. *See generally* EDITH BROWN WEISS, *in* FAIRNESS TO FUTURE GENERATIONS: INTERNATIONAL LAW, COMMON PATRIMONY, AND INTERGENERATIONAL EQUITY (1989); ROLLIN, *supra* note 64, at 51-60.

76. *See generally* STEVEN M. WISE, RATTLING THE CAGE; TOWARD LEGAL RIGHTS FOR ANIMALS 49-61 (2000); CHRISTOPHER D. STONE, SHOULD TREES HAVE STANDING AND OTHER ESSAYS ON LAW, MORALS, AND THE ENVIRONMENT (1996); TOM REGAN, THE CASE FOR ANIMAL RIGHTS 266-97 (1983); *see also* PAUL

In sum, two points emerge from this reflection upon the nature of a virus. First, science is not going to rescue us from the obligation to think hard about how to deal with the last variola residues. It is insufficient to note simply that since a virus is not biologically "alive," we do not need to ponder its fate. Admittedly, this is not quite the same problem as if we were contemplating the possible extinction of the last bald eagle or snail darter—the fact that a virus is located at the very periphery of the grand chart of life forms does make a difference—but we cannot in good faith simply consign this inquiry to the realm of pure science. There is, and can be, no fully reliable definition of life, no way that biology alone can place even an execrable creature like the variola virus beyond the purview of moral inquiry.

Second, just as science inevitably fails to provide the sort of hard, permanent truths that resolve complex social judgments, so, too, does our experience with moral philosophy provide precious little guidance here. A virus is different from a whooping crane or a redwood, but also different from an oil slick or a plasm of inert chemicals; how much those contrary differences matter in contemplating our moral posture is still indeterminate. We might appropriately feel a responsibility to preserve the last residues of even the most torpid substance—not merely from sentimentality for a passing era, but due to some sense of collective ethical obligation to ourselves, to our posterity, and even to the thing itself. We might likewise feel compelled to sustain the CDC and Vector variola inventories, even if we were to acknowledge the virus's "lifelessness."

V. ANALOGY 1: ENVIRONMENTAL LAW

We turn now to the first proffered analogy: environmental law. To recall, my thesis is not that this body of learning and jurisprudence "controls" the question of destruction of variola, because the established instruments and doctrines in the field were crafted with very different purposes and entities in mind. Instead, I propose only that careful study of a handful of environmental

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EHRLICH & ANNE EHRLICH, EXTINCTION: THE CAUSES AND CONSEQUENCES OF THE DISAPPEARANCE OF SPECIES 50 (1981) (discussing rights accorded to entities).

> [T]he extension of the notion of "rights" to other creatures—indeed, even to such inanimate components of ecosystems as rocks and land forms—is a natural and necessary extension of the cultural evolution of *Homo sapiens*. We believe it not only to be in our immediate physical self-interest to do so, but in our moral self-interest as well. For in our view the moral concerns of a human being must extend beyond fellow *Homo sapiens* and family pets to embrace the entire system in which humanity is embedded.

EHRLICH & EHRLICH, *supra*, at 50.

For purposes of this analysis, it does not matter much whether we think of these inchoate responsibilities as duties owed *to* non-human entities, as commitments *about* them, or as rights held *by* them; while those distinctions may well matter when we get to the level of framing the possibilities for judicial or other enforcement of the obligations, they need not be resolved at this early stage.

law documents, principles, and precedents can suggest lessons and provide hints of an approach that may be instructive in the matter at hand.

A. Biodiversity

The niche in environmental law within which the question of retention or destruction of the known variola inventories most nearly fits is that concerning biodiversity—the concern for preserving as much as possible of this rich planet's marvelous genetic variability. This article is not the place for recounting the general importance of safeguarding our dwindling inventory of rare species, nor for recapitulating the sad history of human predation, neglect, or wastage that has driven so many genres of irreplaceable creatures—large and small, animals and plants, dangerous and useful—over the brink and into extinction.[77]

Instead, the task here is simply to marshal the fistful of most prominent legal tools that America and the world have assembled, largely within the past thirty years, to resist that rapacious onslaught and to assess them for their possible relevance to smallpox.[78] Foremost among these is the Convention on Biological Diversity, concluded at the United Nations Conference on Environment and Development (the "Earth Summit") in Rio de Janeiro in June 1992.[79] This treaty, which has been joined by a remarkable 187 countries (with the conspicuous exception of the United States[80]) broadly declares the key principles regarding conservation of species, sustainable development of economic resources, and exploitation of biotechnology. Its preamble earnestly describes the participating states as being "[c]onscious of the intrinsic value of biological diversity and of the ecological, genetic, social, economic, scientific,

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77. *See generally* DAVID HUNTER ET AL., INTERNATIONAL ENVIRONMENTAL LAW AND POLICY (2d ed. 2002); JOHN COPELAND NAGLE & J. B. RUHL, THE LAW OF BIODIVERSITY AND ECOSYSTEM MANAGEMENT (2002); ROBERT L. FISCHMAN & MARK S. SQUILLACE, ENVIRONMENTAL DECISIONMAKING (3d ed. 2000); CHARLES C. MANN & MARK L. PLUMMER, NOAH'S CHOICE: THE FUTURE OF ENDANGERED SPECIES (1996); LAKSHMAN D. GURUSWAMY ET AL., INTERNATIONAL ENVIRONMENTAL LAW AND WORLD ORDER (1994); WILLIAM H. ROGERS, JR., ENVIRONMENTAL LAW (2d ed. 1994); EDWARD O. WILSON, THE DIVERSITY OF LIFE (1992); THE PRESERVATION OF SPECIES: THE VALUE OF BIOLOGICAL DIVERSITY (Bryan G. Norton ed., 1986) [hereinafter THE PRESERVATION OF SPECIES]; BIODIVERSITY II, *supra* note 73; EHRLICH & EHRLICH, *supra* note 76.

78. HUNTER ET AL., *supra* note 77, at 455 (discussing environmental treaties). One source has tabulated nearly nine hundred bilateral and multilateral treaties having at least some degree of environmental protection mission; most of them have been created within the past thirty years. *Id.*

79. Convention on Biological Diversity, June 5, 1992, 31 I.L.M. 818 [hereinafter Biodiversity Convention] (entered into force Dec. 29, 1993). The United States is not a party to the Convention. *Id.*

80. Parties to the Convention on Biological Diversity/Cartagena Protocol on Biosafety, http://www.biodiv.org/world/parties.asp (updated Dec. 17, 2003). In 1993, President Clinton signed the Biodiversity Convention, but the U.S. Senate has declined to provide its advice and consent to ratification; the Bush Administration is opposed to the treaty, so there is little prospect of the United States joining in the immediate future. *Id.*

educational, cultural, recreational, and aesthetic values of biological diversity and its components."[81] Its parties therefore commit themselves to a variety of strategies to conserve and sustainably use biological diversity.

The Biodiversity Convention affirms "that the conservation of biological diversity is a common concern of humankind" and defines "biological diversity" as "variability among living organisms from all sources including . . . diversity within species, between species and of ecosystems." In addition, "biological resources," over which each state retains sovereign rights, include "genetic resources, organisms or parts thereof, populations, or any other biotic component of ecosystems with actual or potential use or value for humanity." In turn, "genetic resources" means "genetic material of actual or potential value," and "genetic material" is defined as "any material of plant, animal, *microbial* or other origin containing functional units of heredity."[82]

The treaty also requires (albeit in rather general language) that each party "shall endeavor to create conditions to facilitate access to genetic resources for environmentally sound uses by other" parties;[83] to permit others (especially those countries which supply the genetic resources) to participate in biotechnology research activities;[84] and to share, "on a fair and equitable basis . . . the results and benefits arising from biotechnologies based upon genetic resources provided by" other states.[85]

Multilateral treaties established prior to the Biodiversity Convention echo its concern for husbanding scarce biological and related resources on a regional level.[86] The 1940 Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere[87] declares that the American republics wish "to protect and preserve in their natural habitat representatives of all species and genera of their native flora and fauna,"[88] as well as "scenery of extraordinary beauty, unusual and striking geologic formations, regions and natural objects of aesthetic, historic or scientific value, and areas characterized by primitive

81. Biodiversity Convention, *supra* note 79, at first preambular paragraph.

82. Biodiversity Convention, *supra* note 79, at third preambular paragraph, art. 2 (emphasis added).

83. Biodiversity Convention, *supra* note 79, at art. 15.2.

84. Biodiversity Convention, *supra* note 79, at art. 19.1.

85. Biodiversity Convention, *supra* note 79, at art. 19.2.

86. *See also* International Treaty on Plant Genetic Resources for Food and Agriculture, adopted Nov. 2001 by the United Nations Food and Agriculture Organization, *at* http://www.fao.org,ag/cgrfa/itpgr.htm (on file with author) (stating intent of treaty). The participating countries are described as "[a]ware of their responsibility to past and future generations to conserve the World's diversity of plant genetic resources for food and agriculture." *Id.* at preamble. The relevant "genetic material" is defined as "any material of plant origin, including reproductive and vegetative propagating material, containing functional units of heredity." *Id.* at art. 2.

87. Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere, Oct. 12, 1940, 161 U.N.T.S. 193 [hereinafter Western Convention] (entered into force May 1, 1942).

88. Western Convention, *supra* note 87, at first preambular paragraph.

conditions."[89] Likewise, parties to the 1968 African Convention on the Conservation of Nature and Natural Resources[90] were "[f]ully conscious that soil, water, flora and faunal resources constitute a capital of vital importance to mankind,"[91] and they undertook to adopt measures to ensure "conservation, utilization, and development" of those "irreplaceable assets."[92] Both of these regional biodiversity pacts incorporate annexes that list the endangered species to be particularly protected, embracing scores of mammals, birds, reptiles, amphibians, fish, and plants (but not, of course, any microbes).

B. Convention on International Trade in Endangered Species

The 1973 Convention on International Trade in Endangered Species (CITES)[93] expresses similarly ambitious objectives, with the parties "[r]ecognizing that wild fauna and flora in their many beautiful and varied forms are an irreplaceable part of the natural systems of the earth which must be protected for this and the generations to come"[94] and "[c]onscious of the ever-growing value of wild fauna and flora from aesthetic, scientific, cultural, recreational and economic points of view."[95]

CITES promotes biodiversity by choking off international commercial opportunities for exploitative export and import of rare (living or dead) plants, animals, their body parts, and products derived from them. The treaty's annexes embrace some thirty-four thousand varieties of plants and animals, including multitudinous mammals, birds, amphibians, reptiles, fish, molluscs, and one insect (the mountain apollo butterfly), but no microscopic creatures, and certainly not the variola virus.[96]

Notably, CITES does not shackle *all* trade in the endangered species: if a

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89. Western Convention, *supra* note 87, at second preambular paragraph.

90. African Convention on the Conservation of Nature and Natural Resources, Sept. 15, 1968, 1001 U.N.T.S. 3, [hereinafter African Convention] (entered into force June 16, 1969).

91. African Convention, *supra* note 90, at first preambular paragraph.

92. African Convention, *supra* note 90, at art. II, fourth preambular paragraph.

93. Convention on International Trade in Endangered Species of Wild Fauna and Flora, Mar. 3, 1973, 27 U.S.T.1087, 993 U.N.T.S. 243 [hereinafter CITES] (entered into force July 1, 1975). *See generally* ENDANGERED SPECIES, THREATENED CONVENTION: THE PAST, PRESENT AND FUTURE OF CITES (Jon Hutton & Barnabas Dickson eds., 2000) [hereinafter ENDANGERED SPECIES].

94. CITES, *supra* note 93, at first preambular paragraph.

95. CITES, *supra* note 93, at second preambular paragraph.

96. CITES, *supra* note 93, at appendices. The treaty classifies plants and animals on three appendices, depending upon how endangered the particular species has become. *Id.* Appendix I, the most tightly protective, lists 830 species, including several varieties of monkeys, whales, falcons, alligators, sturgeon, and mussels. *Id.* Appendix II includes over twenty-five thousand species, again from many orders. *Id.* Appendix III provides the least protection, but allows any country to identify quickly its own jeopardized species in need of greater protection. *Id.*; 50 C.F.R. § 23.23 (2001); *see* Robert W.G. Jenkins, *The Significant Trade Process: Making Appendix II Work*, *in* ENDANGERED SPECIES, *supra* note 93, at 47-56; HUNTER ET AL., *supra* note 77, at 1005-08; NAGLE & RUHL, *supra* note 77, at 873-83.

particular transaction is certified as being not detrimental to the survival of the species, it may be licensed to proceed,[97] and an exception for scientific research exchanges also allows the transport for "noncommercial loan, donation or exchange between scientists or scientific institutions . . . of herbarium specimens, other preserved, dried or embedded museum specimens, and live plant material."[98]

C. Non-binding Instruments

Some of the most stirring rhetoric demanding conservation of species, language that extends even into the realm of microscopic creatures such as the variola virus, emanates from non-legally-binding instruments, such as resolutions of the United Nations General Assembly, or declarations of important and well-attended international conferences.[99]

The World Charter for Nature[100] is a primary example. This 1982 resolution of the United Nations General Assembly, adopted overwhelmingly (albeit, over the dissent of the United States),[101] expresses the most strident, all-encompassing commitment of a broad duty to all creatures: "[e]very form of life is unique, warranting respect regardless of its worth to man, and, to accord other organisms such recognition, man must be guided by a moral code of action,"[102] and "[t]he genetic viability on the earth shall not be compromised; the population levels of all life forms, wild and domesticated, must be at least sufficient for their survival, and to this end necessary habitats shall be safeguarded."[103] Likewise, it demands, "[n]atural resources shall not be

97. CITES, *supra* note 93, at art. III, IV, V.

98. CITES, *supra* note 93, at art. VII.6; *see* Wendy Williams, *CITES Puts Off Plan to Hasten Shipments*, 288 SCI. 592 (2000) (discussing CITES). Opposition from both the United States and developing countries resulted in the defeat of a proposal that would have eased the often-cumbersome permitting process for international shipments of genetic and other scientific research samples covered by CITES. Williams, *supra*. CITES also contains a provision ceding lesser protection for specimens "bred in captivity" or "artificially propagated," which could also, in principle, be relevant for variola operations. CITES, *supra* note 93, at art. VII.5. CITES also exempts from coverage specimens that were acquired before the treaty entered into force, or before that particular species became listed. *Id.* at art. VII.2.

99. *See* RESTATEMENT (THIRD) OF THE FOREIGN RELATIONS LAW OF THE UNITED STATES §§ 102, 103 (Am. L. Inst. 1986) [hereinafter RESTATEMENT] (discussing effect of General Assembly Resolutions). Resolutions of the General Assembly are not, of themselves, ordinarily legally binding; they may, however, provide persuasive evidence of an emerging norm of customary international law, obligatory through that route. *Id.*

100. *World Charter for Nature*, G.A. Res. 37/7 (Annex), U.N. GAOR, 37th Sess., Supp. No. 51, at 17, U.N. Doc. A/37/51, 22 I.L.M. 455 (1983) (adopted by U.N. General Assembly Oct. 28, 1982).

101. *Supplement of Basic Documents*, *in* LAKSHMAN D. GURUSWAMY ET AL., INTERNATIONAL ENVIRONMENTAL LAW AND WORLD ORDER 1267 (1994) (detailing General Assembly vote endorsing World Charter for Nature). The vote was 111-1 with 18 abstentions, and the United States cast the sole opposition vote. *Id.*

102. *World Charter for Nature*, *supra* note 100, at third preambular paragraph.

103. *World Charter for Nature*, *supra* note 100, at art. I.2.

wasted, but used with a restraint appropriate to the principles set forth in the present Charter."[104]

Three other far-reaching "soft law" illustrations may suffice to make the point. First, the "Final Act" of the authoritative 1975 Helsinki Conference on Security and Co-operation in Europe reflects agreement among the participating states (including the United States) to work together on "[p]rotection of nature and nature reserves; conservation and maintenance of existing genetic resources, especially rare animal and plant species."[105]

Second, at the path-breaking 1972 United Nations Conference on the Human Environment in Stockholm,[106] the countries stated their common conviction that "natural resources of the earth including the air, water, land, flora and fauna and especially representative samples of natural ecosystems must be safeguarded for the benefit of present and future generations"[107] and that "[m]an has a special responsibility to safeguard and wisely manage the heritage of wildlife and its habitat which are now being gravely imperiled by a combination of adverse factors."[108]

A final illustrative expression in this vein would be "Agenda 21," the clarion call from the 1992 Rio de Janeiro Earth Summit, which is comparably broad in asserting that "[u]rgent and decisive action is needed to conserve and maintain genes, species, and ecosystems, with a view to the sustainable management and use of biological resources."[109]

D. Domestic U.S. Environmental Law

Paralleling these instruments of international law, the United States and other like-minded countries have enacted various forms of domestic environmental protection legislation codifying and progressively developing the cognate biodiversity principles as binding internal law.[110] Two leading

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104. *World Charter for Nature*, *supra* note 100, at art. II.10; *see Historical Responsibility of States for the Preservation of Nature for Present and Future Generations*, G.A. Resol. 35/48, U.N. GAOR, 35th Sess., Supp. No. 48 at 15, U.N. Doc. A/35/48 (1981) (adopted by U.N. General Assembly Oct. 30, 1980).

105. Final Act of the Conference on Security and Co-operation in Europe, 14 I.L.M. 1292, § 5 (1975) [hereinafter Helsinki Final Act] (adopted at Helsinki, Aug. 1, 1975).

106. Stockholm Declaration of the United Nations Conference on the Human Environment, U.N. Doc. A/CONF.48/14/Rev. 1, at 3 (1973), 11 ILM 1416 (1972) [hereinafter Stockholm Declaration] (adopted June 16, 1972).

107. Stockholm Declaration, *supra* note 106, at Principle 2.

108. Stockholm Declaration, *supra* note 106, at Principle 4.

109. *Agenda 21*, U.N. Doc. A/CONF 151/26, Chapter 15.3 (1992) (adopted by U.N. Conference on Environment and Development, at Rio de Janeiro, June 13, 1992).

110. *See generally* ROGERS, *supra* note 77; BIODIVERSITY AND THE LAW (William J. Snape III ed., 1996). Several other U.S. statutes have important bearing on the preservation of species, but are not included in this brief survey, because they are limited to dealing only with selected species or geographical areas. *See* National Forest Management Act of 1976, 16 U.S.C. §§ 1601, 1604(g)(3)(B) (2003) (requiring that forest land management plans "provide for the diversity of plant and animal communities"); 36 C.F.R. §§ 219.11, 219.20

American legislative vehicles are of special note here.

First is the National Environmental Policy Act of 1969 (NEPA),[111] the cornerstone of all environmental legislation. NEPA is essentially a procedural device, mandating a thorough, multi-disciplinary examination of the environmental consequences of each major federal action, the possible alternatives to it, and the mechanisms for mitigation of its adverse consequences, before making the decision whether to proceed. In addition, NEPA was the first major declaration of a newfound Congressional attitude of sympathetic appreciation for nature and humanity's role in it: Congress declared "that it is the continuing policy of the Federal Government . . . to use all practicable means and measures . . . to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans."[112]

Both in rhetoric and in effect, NEPA aims to "encourage productive and enjoyable harmony between man and his environment," and to "promote efforts which will prevent or eliminate damage to the environment and biosphere."[113] NEPA also contains suggestive language highlighting the value of preserving "important historic, cultural, and natural aspects of our national heritage" and conserving an environment that "supports diversity,"[114] foreshadowing the emergence of notions that were only dimly recognized at the time of the statute's enactment, but that have subsequently assumed a much more prominent role in legislation and public appreciation.

No environmental impact statement or environmental assessment has ever been prepared regarding the decision whether to destroy the CDC variola inventory, and none is currently in progress. Arguably, such a drafting enterprise ought to be undertaken now: the projected action would seem to satisfy the applicable criteria, in entailing a "major federal action[] significantly affecting the quality of the human environment."[115] The critical variable in the statutory analysis would be whether to characterize the brief employment of laboratory autoclaves as "major," a description that usually connotes long-term, expensive construction activities that occupy lengthy periods of time and alter the landscape appreciably. But in the NEPA universe, the term "major" also embraces federal decisions that are "more than merely routine,"[116] that entail

(2002).

111. National Environmental Policy Act of 1969, 42 U.S.C. §§ 4321-4335 (2003).

112. 42 U.S.C. § 4331(a) (declaring Congress' national environmental policy).

113. *Id.* (stating NEPA's purpose).

114. *Id.* § 4331(b)(4) (setting forth national environmental policy).

115. 42 U.S.C. § 4332(C).

116. OLGA L. MOYA & ANDREW L. FONO, FEDERAL ENVIRONMENTAL LAW: THE USER'S GUIDE 65 (2d ed. 2001).

"any irreversible and irretrievable commitments of resources,"[117] that carry "highly controversial"[118] effects which "are highly uncertain or involve unique or unknown risks,"[119] that may "establish a precedent" for future, nominally independent decisions,[120] or that "affect[] public health or safety."[121] Even "beneficial" effects—policy decisions undertaken deliberately to improve the environment or to promote public well-being—may be significant under NEPA, requiring thorough documentation and public examination.[122] Notably, if the contemplated action "may cause loss or destruction of significant scientific, cultural, or historical resources,"[123] then NEPA documentation is indicated.

The other relevant U.S. statute is the Endangered Species Act of 1973 (ESA).[124] Like NEPA, and also like many of the international environmental law documents surveyed above, ESA vigorously promotes environmental protection objectives, including biodiversity goals, and does so with flush rhetoric. In it, Congress declares that "species of fish, wildlife, and plants are of esthetic, ecological, educational, historical, recreational, and scientific value to the Nation and its people,"[125] that "the United States has pledged itself as a sovereign state in the international community to conserve to the extent practicable the various species,"[126] and that the purpose of the enactment is to "provide a program for the conservation of such endangered species and threatened species,"[127] so "all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance" of those purposes.[128]

As the Supreme Court expressed it, in the landmark (some say "absolutist") ESA legislation, Congress concluded that the value of any endangered species is "incalculable," and that "this statute was to halt and reverse the trend toward species extinction, whatever the cost."[129] For plant and animal species covered

117. 42 U.S.C. § 4332(C)(v) (listing mandatory topics for inclusion in environmental impact statement, not whether such statement must be prepared).

118. 40 C.F.R. § 1508.27(b)(4) (2003).

119. § 1508.27(b)(5).

120. § 1508.27(b)(6).

121. § 1508.27(b)(2).

122. § 1508.27(b)(1).

123. § 1508.27(b)(8).

124. 16 U.S.C. §§ 1531-1544 (2003); *see* MANN & PLUMMER, *supra* note 77, *passim*; NAGLE & RUHL, *supra* note 77, at 117-296.

125. 16 U.S.C. § 1531(a)(3) (detailing congressional findings).

126. 16 U.S.C. § 1531(a)(4) (citing series of treaties regarding preservation of species, including the Western Convention).

127. 16 U.S.C. § 1531(b) (declaration of Congressional Purposes).

128. 16 U.S.C. § 1531(c) (statement of Congressional Policy); *see* 16 U.S.C. § 1536 (directing federal agencies to ensure that actions do not jeopardize species).

129. Tennessee Valley Authority v. Hill, 437 U.S. 153, 184, 187 (1978); *see* Loggerhead Turtle v. Volusia County Council, 896 F. Supp. 1170, 1180 (M.D. Fl. 1995) (holding that harming even one specimen of listed

by ESA protection (a roster that clearly does not include any microscopic entities), a complex and sometimes costly set of remedies is created: the Secretary of the Interior is to "list" the endangered and the threatened species, taking into account even "manmade factors" affecting the "continued existence" of the species;[130] designate a "critical habitat" within which the species may be protected and sustained; and craft a "recovery plan" to enable the species to achieve renewal and flourish.[131] Federal agencies, including the CDC as an arm of the U.S. Department of Health and Human Services, have an affirmative obligation in the course of their other responsibilities to assist in the protection and recovery of the fragile life forms.[132]

In sum, none of these benighted instruments controls, and few even directly apply to, the circumstances of the variola virus. The negotiators, legislators, and drafters were typically operating on a much more "macro" scale, with only the larger and more prominent creatures in mind: they address "plants and animals" (or "flora and fauna"), without contemplating the vastly more numerous, and sometimes equally imperiled, but invisible and still largely unknown, denizens of the microscopic universe. This observation is not intended as a criticism—it has proven to be enough of a job, enough of a struggle against difficult odds, to raise global consciousness about the importance of the concept of biodiversity and its application to elephants and redwoods, without also automatically picking up the brief on behalf of rare viruses and bacteria.

Still, sometimes even this first generation of biodiversity instruments extends beyond the more familiar, charismatic megafauna and flora. When the World Charter for Nature urges respect for "every form of life,"[133] for example, or when the Biodiversity Convention focuses attention on "genetic material" as a precious resource that includes "any material of plant, animal, microbial or other origin containing functional units of heredity,"[134] the deliberately-chosen vocabulary stretches even into the world of the microbes. Likewise, the Helsinki Final Act calls for "conservation and maintenance of existing genetic resources"[135] and "Agenda 21," from the 1992 Rio de Janeiro Earth Summit, is

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species is sufficient to invoke authority of ESA). The court further held that it will not balance the equities, but will enjoin threatened danger to turtles, even at price of severe economic cost to proposed beach development. *Loggerhead Turtle*, 896 F. Supp. at .1180.

130. 16 U.S.C. § 1533(1)(E) (2003).

131. 16 U.S.C. § 1533.

132. 16 U.S.C. § 1536; *see also* ROGERS, *supra* note 77, at 996-1023 (discussing ESA). The statute also explicitly contemplates the creation and sustenance of "experimental populations" of endangered or threatened species, as in the case of release of a small number of animals into a non-native habitat. 16 U.S.C. § 1539(j) (2003); 50 C.F.R. § 17.22 (2001).

133. *World Charter for Nature*, *supra* note 100, at third preambular paragraph.

134. Biodiversity Convention, *supra* note 79, at art. 2.

135. Helsinki Final Act, *supra* note 105, § 5.

comparably broad in asserting that "[u]rgent and decisive action is needed to conserve and maintain genes, species, and ecosystems."[136]

I believe that this rhetoric reflects what humans instinctually realize, what we believe even when we have not yet taken the time to think it though with great care or to trace all the ramifications: preservation of *all* life forms is important, worthwhile, and necessary, regardless of the size and prominence of the creature, regardless of the utility (or danger) that the species poses to mankind, and regardless of how well it fits into the scientific categories of the plant and animal kingdoms. When we are at our best, when we think, write and act with maximal foresight and humility, we do not confine our conservationist instincts to plants and animals that we can see, recognize, and consume. At our most generous (and the sort of generosity I promote here is not generosity toward the variola virus itself, for that creature needs and deserves none of that human sentimentality; I mean, instead, generosity toward ourselves and our posterity, who deserve the benefits of the same flush biodiversity we have inherited), we extend ourselves even to retain a hateful villain like variola.[137]

The documents and principles surveyed in this section are noteworthy in one additional respect. They generally promote the importance of biodiversity in the most difficult of circumstances: when the goal of preserving a rare, diminishing species is challenged by the offsetting economic imperatives of development, industrialization, and commerce. That is, these treaties and statutes fly in the face of even the drive to convert rain forest into farmland, to churn dormant fields into highways, or to drain wetlands or shopping malls. Even when there are jobs, money, and human welfare at stake, these instruments reflect a social judgment to try to put a thumb on the scale on the side of preserving species.

How much more obvious is it then to reinforce that instinct when the

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136. *Agenda 21*, *supra* note 109, at ch. 15.3.

137. *See* DAVID EHRENFELD, THE ARROGANCE OF HUMANISM 207-08 (1978) (articulating reasons for preserving all life).

> This non-humanistic value of communities and species is the simplest of all to state: they should be conserved because they exist and because this existence is itself but the present expression of a continuing historical process of immense antiquity and majesty. Long-standing existence in Nature is deemed to carry with it the unimpeachable right to continued existence.

Id. (emphasis omitted).

> The fabric of planetary life is under siege as vast expressions of creation are ripped from their evolutionary moorings by varying combinations of greed, arrogance, and apathy. Thousands of singularly distinctive species, each a unique expression of millions of years of adaptational travail, oblige us to devote whatever wisdom and ethics we can to the task of slowing and then reversing this tide of ultimately self-defeating destruction. We need to alter what, in our collective insanity, we have come to regard as normal.

KELLERT, *supra* note 66, at 214; *see* WEISS, *supra* note 75, at 38 (arguing in favor of conserving options for future generations by preserving natural and cultural resource base). *But see generally* MANN & PLUMMER, *supra* note 77 (critiquing view that preservation of species is of paramount importance).

extermination would be accomplished deliberately, not as the accidental or unintended consequence of competition with other socially important goals, and especially when the costs of species preservation would be so low? When the price for continued husbanding of the known variola inventories amounts to only trivial marginal expenditures for electricity and security guards, the biodiversity concerns should apply *a fortiori*. In short, *why not* retain the virus, as the last exemplar of a unique, historically important life form, when it is so easy and inexpensive to do so?

VI. ANALOGY 2: ANIMAL RIGHTS LAW

The second proffered source of analogy, the concept of legal or moral rights for animals—and by extension, perhaps for insentient creatures such as the variola virus—is currently far less well-established than the field of environmental law surveyed above. This section of the article therefore surveys not treaties and U.N. General Assembly resolutions, but the writings of leading progressive voices in the field, which are only just beginning to find recognition in mainstream legal instruments and a few *avante garde* judicial cases.[138]

The core notion is simply that creatures other than human beings matter—they matter in implementing nature's grand scheme, they matter in sustaining a healthy ecological balance, and they should matter in refining our notions of social justice and morality. Non-human actors should, therefore, be treated with due consideration (with, to be sure, some considerable cacophony regarding exactly what is their due) and they should be acknowledged as holding some constellation of rights (or, alternatively, as subjects to, or about which, humans owe some form of obligation). Homo sapiens, being the most highly evolved (or at least the most powerful) creatures currently inhabiting the planet, accordingly have a special responsibility for stewardship of the diverse range of fellow species.[139]

In some literature, the suggestion is to expand the vocabulary from

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138. *See generally* ENCYCLOPEDIA OF ANIMAL RIGHTS AND ANIMAL WELFARE (Marc Bekoff ed., 1998); ANIMAL RIGHTS AND HUMAN OBLIGATIONS, *supra* note 65; IN DEFENCE OF ANIMALS (Peter Singer ed., 1985); CHRISTOPHER STONE, *supra* note 76; WISE, *supra* note 76; REGAN, *supra* note 76; ROLLIN, *supra* note 64.

139. The literature here reflects something of a division between those who emphasize the importance of preserving rare *species* (to protect the variability of the planet's gene pool) and those who would instead protect *individual* creatures, regardless of the scarcity or plentifulness of their groups (arguing that the concept of a species is an abstraction, and only real, live beings can experience pain). *See* Michael Pollan, *An Animal's Place*, N.Y. TIMES MAG., Nov. 10, 2002, at 58, 64; REGAN, *supra* note 77, at 359-61; EHRLICH & EHRLICH, *supra* note 76, *passim*; WILSON, *supra* note 76, at 35-50; J. Baird Callicott, *On the Intrinsic Value of Nonhuman Species*, *in* THE PRESERVATION OF SPECIES, *supra* note 77, at 138; Elliott Sober, *Philosophical Problems for Environmentalism*, *in* THE PRESERVATION OF SPECIES, *supra* note 77, at 173, 174-75; Lily-Marlene Russow, *Why Do Species Matter?*, *in* ANIMAL RIGHTS AND HUMAN OBLIGATIONS, *supra* note 65, at 266-72.

traditional emphasis on "human rights" (protection of life, liberty, etc.) into a broader conceptualization of "natural rights," in which animals, too, could partake of some of the core freedoms.[140] Sometimes, this instinct is expressed in the language of "utility" (arguing, for example, that if we protect animals and sustain diverse species, including even those for which we today do not have important uses, people will be better off, and our planet will be healthier for us).[141] But more often, it is asserted as a sort of bottom line judgment that does not admit of further rationalization: we should protect animals, and respect their dignity and their right to live and prosper, just because it is the right thing to do.[142] Peter Singer, for example, urges the adoption of "an attitude which considers the quality of the life at stake rather than the simple matter of whether the life is or is not that of a member of the species *Homo sapiens*."[143]

This is a deeply radical notion, alien to much of traditional law. The allegation that disregard for animals is "speciesism," comparable to, and just as offensive as, racism or sexism, strikes many as novel, outrageous, or even laughable—much as the early arguments for equality among different groups of

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140. *See, e.g.*, PETER K. MCINERNEY AND GEORGE W. RAINBOLT, ETHICS 208-13 (1994); James Rachels, *Why Animals Have a Right to Liberty*, *in* ANIMAL RIGHTS AND HUMAN OBLIGATIONS, *supra* note 65, at 122-31 (arguing liberty, as with other historically important values, should be thought of as "natural" right also applicable to animals, rather than solely as "human right"); Callicott, *supra* note 139, at 138-72 (describing sense that all creatures have theocentric right to existence).

141. A related theme is the suggestion that a society that tolerates cruelty to animals eventually becomes harsh and inhospitable to humans, too, building upon the anecdotal impression that a child who routinely abuses animals grows into an adult who is hostile and dangerous to people, too. *See* KELLERT, *supra* note 66, at 92-98; Bernard E. Rollin, *The Moral Status of Animals and Their Use as Experimental Subjects*, *in* A COMPANION TO BIOETHICS, *supra* note 65, at 411.

142. WILSON, *supra* note 77, at 351 (discussing ethics of preserving species). "The ethical imperative should therefore be, first of all, prudence. We should judge every scrap of biodiversity as priceless while we learn to use it and come to understand what it means to humanity. We should not knowingly allow any species or race to go extinct." *Id.*; Holmes Rolston III, *Endangered Species and Biodiversity*, *in* 2 ENCYCLOPEDIA OF BIOETHICS 671 (Warren Thomas Reich ed., 1995). *But see* R.G. Frey, *The Case Against Animal Rights*, *in* ANIMAL RIGHTS AND HUMAN OBLIGATIONS, *supra* note 65, at 115-18; Alan White, *Why Animals Cannot Have Rights*, *in* ANIMAL RIGHTS AND HUMAN OBLIGATIONS, *supra* note 65, *passim*; Andrew Linzey, *The Theos-Rights of Animals*, *in* ANIMAL RIGHTS AND HUMAN OBLIGATIONS, *supra* note 65, at 134-38.

143. IN DEFENCE OF ANIMALS, *supra* note 138, at 8, 130 (extending analysis beyond higher animals, which most authors focus on).

> If we are to save the world's wildlife, we must adopt an ethic that recognizes the right of all animals to exist, places equal value on the grotesque and the spectacular and shows as much concern for the crocodile as for the cheetah, as much for the condor as the eagle. We must realize that it is just as important to save a species of butterfly as the elephant, that the extinction of a species of mollusc is as great a tragedy as the loss of a bird or mammal. Even endangered plants should merit our concern, for not only do they have the right to live but also the well-being of a host of higher animals, including humans, may depend on their survival.

Id. at 130. "Any species of bug that people spray with an insecticide is 'an irreplaceable marvel, equal to the works of art which we religiously preserve in museums.'" EHRLICH & EHRLICH, *supra* note 76, at 39 (quoting Claude Levi-Strauss).

humans might have appeared in prior centuries.[144] Revolutionary, too, is the companion thesis that animals should no longer be viewed as human property or as resources subject to slavery-type ownership—whether it be cattle, house pets, or the CDC's variola.[145] Yet, there are roots in traditional legal norms for the emergence of animal rights, and they carry implications even for the most extreme offshoot of the field: the emerging question of respect for even a virus's survival.

To begin, as noted above, many diverse kinds of "entities" have now been accorded some measure of legal status within the American and other systems, despite the fact that they each suffer from some sort of important limitation or disability that in conventional thinking should have fatally incapacitated them. Corporations (to take the leading example), partnerships, municipalities, estates, and Indian tribes all are empowered to own property, to appear in court, and to exercise a panoply of constitutional rights. Ceding these authorities to them does not, as some might have originally feared, place us on an irresistibly slippery slope toward treating fictional persons fully as human beings with the right to vote, to avoid self-incrimination, or to exert the same full range of expressive opportunities as people.[146]

Even the nation-state, the fundamental unit of the practice of international

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144. STEVEN M. WISE, DRAWING THE LINE: SCIENCE AND THE CASE FOR ANIMAL RIGHTS 11-17, 25-33 (2002); MCINERNEY & RAINBOLT, *supra* note 140, at 204; REGAN, *supra* note 76, *passim*; IN DEFENCE OF ANIMALS, *supra* note 138, at 4-6; Rollin, *supra* note 141, at 411; Richard D. Ryder, *Speciesism*, *in* ENCYCLOPEDIA OF ANIMAL RIGHTS AND ANIMAL WELFARE 320 (Marc Bekoff ed., 1998); Michael Pollan, *An Animal's Place*, N.Y. TIMES MAG., Nov. 10, 2002, at 58. The legal distinction between human beings as a group and animals as a second, disfavored group is often said to be grounded in the important, inherent differences between the two—people have capabilities, emotions, self-awareness, and accomplishments that no animal can match. *Id.* In response, animal rights experts often argue that traditional human rights do not, in fact, flow from possession of those attributes—infants, people in comas, or people severely mentally retarded, for example, are often less capable of reasoning, communicating, making moral judgments, etc. than are some of the higher animals, but the humans do not forfeit their privileged position. *Id.* Why, then, should animals' underdevelopment of those capacities result in the absence of legal rights? *Id.* Instead, advocates argue, the basis for the current legal discrimination seems to be simply the conclusory observation that people are different from animals—and that type of class-based separation, divorced from a valid rationale that supports and explains it, is suspect. *Id.*

145. IN DEFENCE OF ANIMALS, *supra* note 138, at 14; REGAN, *supra* note 76, at 347-49.

146. STONE, *supra* note 76, at 3 (noting corporations, ships, and other entities can appear in court and exercise legally-enforceable rights, without being regarded as full moral actors); Rollin, *supra* note 141, at 35, 51-60. In the same vein, ceding variola a right to exist as a species would not necessarily implicate any other putative rights, such as a liberty right to remain at large in the human population. *See* Ezer v. Fuchsloch, 99 Cal. App. 3d 849, 863-64 (1979) (considering right of pine tree). In a lawsuit regarding defendants' obligations to trim their pine tree in order to allow plaintiff views of the ocean, the court considered the possible right of the pine tree itself (to exist in a natural, untrimmed state). *Id.* The court rejected that argument, and quoted Stone as noting that:

> to say that the environment should have rights is not to say that it should have every right we can imagine, or even the same body of rights as human beings have. Nor is it to say that everything in the environment should have the same rights as every other thing in the environment.

Id. at 864.

law as highlighted in the previous section, is fully "artificial" in this sense. Apart from its human agents, a country cannot (no more than a river or a mountain) think, decide, formulate goals, or act. Countries, moreover, have some freedoms that real human beings do not—the right to litigate cases in the International Court of Justice, for example, to sign treaties, or to engage in lawful international armed conflict.[147]

Applying that line of thinking into the animal world, Germany has gone so far as to grant non-human species direct constitutional protection: the state's traditional obligation to respect and protect the dignity of human beings was recently amended to extend the duty to include animals, too.[148] In a similar vein, a high court in India has written:

> If humans are entitled to fundamental rights, why not animals? In our considered opinion, legal rights shall not be the exclusive preserve of humans, which has to be extended beyond people thereby dismantling the thick legal wall with humans all on one side and all non-humans on the other side. While the law currently protects wild life and endangered species from extinction, animals are denied rights, an anachronism which must necessarily end.[149]

In the United States, a few courts have authorized animals to appear as litigants, expressly enabled to assert claims "on their own behalf," rather than only through the good offices of a person or group sufficiently specially affected to satisfy the hurdles of standing to sue.[150] In *Loggerhead Turtle v. Volusia County Council*,[151] for example, the middle district of Florida authorized a species listed as endangered under ESA to sue "in its own right" as a named plaintiff, separate from any associated rights of human individuals and organizations.[152] Likewise in *Marbled Murrelet v. Pacific Lumber Co.*,[153] the northern district of California in 1995 granted similar status to a nine-inch

147. *See* RESTATEMENT, *supra* note 99, § 206 (listing capacities, rights, and duties of states).

148. Michael Pollan, *An Animal's Place*, N.Y. TIMES MAG., Nov. 10, 2002, at 58, 60. *But see* Elizabeth Gudrais, *Chimpanzees and the Law*, HARV. MAG., Jan.-Feb. 2003, at 21 (discussing animal rights). Harvard Law School Professor Alan Dershowitz argues that animals could not possess inherent rights, but only rights vis-a-vis people, because if animals held a general right to life, then humans would be affirmatively obligated to protect smaller animals from larger animals in the wild. *Id.*

149. *See* WISE, *supra* note 76, at 1 (quoting June 6, 2000 Kerala High Court of India decision in N.R. Nair v. UOI).

150. Some cases are ambiguous regarding the status of the named animal. *See generally* Northern Spotted Owl v. Hodel, 716 F. Supp. 479 (W.D. Wash. 1988) (identifying plaintiffs as environmental organizations rather than bird, despite caption for leading ESA case). In addition, forfeiture actions are traditionally captioned against the thing itself. *See generally* United States v. One Handbag of Crocodilus Species, 856 F. Supp. 128 (E.D.N.Y. 1994) (detailing enforcement actions under ESA); Sierra Club v. Morton, 405 U.S. 727, 741 (1972) (Douglas, J., dissenting) (advancing argument for allowing environmental issues litigated "in the name of the inanimate object about to be despoiled, defaced or invaded by roads and bulldozers").

151. 896 F. Supp. 1170 (M.D. Fla. 1995).

152. *Id.* at 1177 (holding "species protected under the Endangered Species Act has standing to sue 'in its own right' to enforce the provisions of the Act").

153. 880 F. Supp. 1343, 1346 (N.D. Cal. 1995).

seabird related to the puffins in a suit to protect its habitat against logging. Trials of supposedly-vicious dogs, complete with character and occurrence witnesses, and testimony about the animal's "state of mind," have become episodic, if not frequent, in the United States, and the accused individual, rather than the owner, is directly on trial, with its life in the balance.[154]

A similar motivation finds recognition in putative legal status for certain inanimate objects, such as waterways: at least two dozen communities have created an office of "keeper" for a river, bay, or sound charged by law to enforce anti-pollution laws for the benefit of the general public—and for the stream itself, promoting its own interest in cleanliness and integrity.[155] Sometimes a government agency or private entity is designated as guardian or custodian for a disempowered entity or collective, such as endangered species of fish and wildlife, to protect or promote it, or to conserve its interests against the predations of outsiders. But sometimes even the formality of agency or trusteeship is disregarded, and the "thing" itself is ceded direct rights and responsibilities under conventional legal process.[156]

Legal history traces the progressive development of enhanced appreciation for the proper role of animals as accountable entities under a variety of increasingly sophisticated rationales. For Rene Descartes in the seventeenth century, for example, animals were not worthy of philosophical consideration: they were not "conscious" in the same sense that humans were, and—like an inanimate machine—therefore could not possess rights. Similarly, Immanuel Kant and John Locke, who conceded animals' consciousness, nonetheless held that their absence of rationality or self-awareness deprived them of the dignity of being "ends" in themselves; they could function only as "means" toward promotion of human ends, and could not hold rights.[157]

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154. STONE, *supra* note 76, at xii, 159-64 (recounting trials of two dogs, each which escaped death following presentation in court of proof regarding the animal's nature and deeds—strikingly similar to a criminal trial for a person, and several other diverse legal actions brought directly by, or against, animals); WISE, *supra* note 76, at 35-39 (noting ancient legal proceedings undertaken directly against animals—rats in France in 1522, pigs in several French towns in thirteenth through fifteenth centuries); Claudia Dreifus, *A Courtroom Champion for 4-Legged Creatures*, N.Y. TIMES, Oct. 1, 2002, at C2.

155. *See generally* JOHN CRONIN & ROBERT F. KENNEDY, JR., THE RIVERKEEPERS: TWO ACTIVISTS FIGHT TO RECLAIM OUR ENVIRONMENT AS A BASIC HUMAN RIGHT (1997).

156. *See* 40 C.F.R. 300.600 (2002) (designating Secretary of Interior, Secretary of Commerce, and other officials as trustees for natural resources including land, air, water, and biota); WEISS, *supra* note 75, at 96, 109, 120-26 (proposing appointment of a guardian to advocate interests of future generations); STONE, *supra* note 76, *passim*; *see also* Uniform Trust Code of 2000, *at* http://www.law.upenn.edu/bll/ulc/uta/2001final.htm (last visited Jan. 16, 2004) (allowing creation of trusts for benefit of animals).

157. *See* MCINERNEY & RAINBOLT, *supra* note 140, at 202-16; REGAN, *supra* note 76, at 3-33, 121-49, 174-85; ROLLIN, *supra* note 64, at 60-65; *see also* 5 ROUTLEDGE ENCYCLOPEDIA OF PHILOSOPHY 177 (Edward Craig ed., 1998) (quoting Paul Guyer and Immanuel Kant); Onora O'Neill, *Kantian Ethics*, *in* ROUTLEDGE ENCYCLOPEDIA OF PHILOSOPHY, *supra*, at 200; Donald R. Griffin, *Ethology and Animal Minds*, *in* ROUTLEDGE ENCYCLOPEDIA OF PHILOSOPHY, *supra*, at 51-59; Martha C. Nussbaum, *Animal Rights: The Need for a Theoretical Basis*, 114 HARV. L. REV. 1506 (2001) (reviewing STEVEN M. WISE, RATTLING THE CAGE:

The major conceptual watershed came with Jeremy Bentham, who famously focused attention upon sentience, translated as the ability to feel pain, rather than upon intelligence or the ability to mimic other human traits. For Bentham, "the question is not, Can they *reason*? nor, Can they *talk*? but, Can they *suffer*?"[158] Because animals were, Bentham observed, capable of suffering, they were entitled to entrance into the moral community, and humans were obligated to accord them at least minimal respect and consideration.

The inquiry now is whether to extend Bentham's insights even to frankly insentient creatures, such as the variola virus. We might adapt his eighteenth century standard, asking why should the ability to *suffer* be the beginning and the end of the inquiry into moral worth? Why is sentience the magic legal/ethical threshold upon which a creature's putative rights invariably trip?[159] As Albert Schweitzer said, "Whenever I injure life of any kind I must be quite clear as to whether this is necessary or not. I ought never to pass the limits of the unavoidable, even in apparently insignificant cases."[160]

Most people, even those quite aggressive in promoting some progressive notion of animal rights, are unwilling to contemplate that additional step. They assert that only primates, or only mammals, or only higher animals, are entitled to full moral consideration.[161] Often, the whole notion of legal consideration for lesser beings is dismissed out of hand, and ruminating on the notion of "variola rights" is presented as the *reductio ad absurdum.* For many—even for some who progress quite far down the jurisprudential road toward recognizing some categories of animal rights—the specter of promoting rights for, or obligations toward, microbes, plants, or conglomerates of inert chemicals is about as silly as one can get.[162]

TOWARD LEGAL RIGHTS FOR ANIMALS (2000)).

158. JEREMY BENTHAM, AN INTRODUCTION TO THE PRINCIPLES OF MORALS AND LEGISLATION 311, n.1 (1789).

159. WISE, *supra* note 76, at 33-34; Bernard E. Rollin, *The Moral Status of Animals in Their Use as Experimental Subjects*, *in* A COMPANION TO BIOETHICS, *supra* note 65, at 411, 413.

160. Albert Schweitzer, *The Ethic of Reverence for Life*, *in* ANIMAL RIGHTS AND HUMAN OBLIGATIONS, *supra* note 65, at 32, 36 (providing example of unnecessarily harming single flower).

161. *See* WISE, *supra* note 76 (arguing for differentiating among higher and lower animals, and ceding them different degrees of legal rights depending upon varying capacities).

162. Typically, the animal rights literature at most merely raises the question of smallpox, declining to discuss it in any depth or offer an opinion or analysis to resolve it. *See* STONE, *supra* note 76, at 135 (discussing inconsistency of ethical principles). Ethical principles seem to point inconsistently toward a moral commandment both to preserve the last vial of smallpox, and to destroy it as a threat to other forms of life. *Id.*; MANN & PLUMMER, *supra* note 77, at 136 (citing variola as "ultimate example" of concern for species preservation); Donald H. Regan, *Duties of Preservation*, *in* THE PRESERVATION OF SPECIES, *supra* note 77, at 195, 209 (discussing reasons for preserving smallpox virus). The author argues that humans have reason to preserve the smallpox virus, as any other creature, but if the consequential costs of preserving the virus (i.e., protection against its dangers to people) are too great, then on balance we should destroy it. *Id.* "But the fact that the smallpox virus is dangerous to people does not mean it is not worth knowing about or that we may not take pleasure in knowing about it." *Id.*; Stephen Toulmin, *The Case for Cosmic Prudence*, 56 TENN. L. REV.

If there were to be any recognition of viral rights, what would the content of that vessel be? The discussion becomes almost hopelessly abstract at this point—a microbe cannot formulate preferences, express its cares, or prioritize its goals. How could human beings conceptualize what would be "in the best interests" of a creature so different from ourselves?

Still, we do manage to muddle through conundrums of that sort in other areas. We try to contemplate what "future generations" of people would want us to do for them, even though our ability to know much about our descendants, their desires, and their milieu is surely limited. We bring lawsuits and take other consequential actions in the name of corporations, hospitals, and even the United States government, notwithstanding the inability of those abstractions to formulate objectives or communicate instructions to us, other than through human representatives. We protect historic buildings, rare works of art, and unique geological formations, partially for the benefit of human beings, but sometimes even when few if any people would actually be positioned to enjoy the treasured object. Likewise, we can conclude, somehow, that it is better for a river to be less polluted—better for the river itself, not just for the human beings who would seek to use and enjoy it—even if we cannot quite discern how we know that it is "better."[163]

The case of extermination of variola is no more or less ineffable than those. If a virus has any claim, any bottom line preference or interest, it would have to be in sheer survival of the species. That is the most basic right, the right that precedes and underlies any other freedoms that might be contemplated. It is certainly tricky to try to translate our familiar legal discourse into the realm of the microscope, but it may still be sensible to claim at least this much: that even a virus can assert an interest in avoiding the irreversible harm of deliberate, unnecessary extinction.[164]

29, 35 (1988) (questioning necessary lengths for preserving smallpox). The author asks, but does not answer, "[t]o take an extreme case, does it follow that even smallpox viruses are entitled to respectful consideration, and thus be targets of conservation programs?" *Id.*; Lynn White, Jr., *The Future of Compassion*, 30 ECUMENICAL REV. 99 (1978).

163. WEISS, *supra* note 75; STONE, *supra* note 76, at 52-60, 65-80 (asking what it might mean for lake, for example, to "prefer" one state of affairs over another—how can we formulate values and interests for inanimate object?); Elliott Sober, *Philosophical Problems for Environmentalism*, *in* THE PRESERVATION OF SPECIES, *supra* note 77, at 173, 184-85 (arguing impossible to make meaningful any analysis of desires or "natural tendencies" of mountain range or species); *see* Bryan G. Norton, *Future Generations, Obligations To*, *in* ENCYCLOPEDIA OF BIOETHICS, *supra* note 142, at 892.

This difficulty in divining our descendants' preferences is exacerbated in the case of smallpox. Would future generations view the preservation of variola as an exercise of the precautionary principle (conserving a rare asset for future humans to ponder) or would our successors regard retention of the CDC and Koltsovo archives as being more akin to foisting toxic waste products upon them, perpetuating a grave danger that the current generation should dispose of forever?

164. Leslie E. Sponsel & Poranee Natadecha-Sponsel, *The Potential Contribution of Buddhism in Developing an Environmental Ethic for the Conservation of Biodiversity*, *in* ETHICS, RELIGION AND BIODIVERSITY: RELATIONS BETWEEN CONSERVATION AND CULTURAL VALUES 75, 77 (Lawrence S. Hamilton

In this connection, it may be instructive to consider what human beings can, and should, do in our opposition to other, larger and more familiar forms of "pests." That is, people for millennia have waged continuous, mostly unsuccessful, campaigns against rats, mosquitoes, zebra mussels, red algae and a variety of other persistent antagonists. Sometimes we have achieved noteworthy local or temporary triumphs in these wars; certainly we have not felt moral inhibitions restraining our efforts to control, kill, or otherwise neutralize these enemies.[165] Occasionally, we wonder what the world would be like without those foes, and we fantasize about complete freedom from those competitors who bite us, cause us illnesses, or steal our food.

Humans have never managed to totally subdue any of those rival species, and in our more insightful moments, we realize that even success might be pyrrhic: removing one key species, such as a lowly mosquito, could have unintended adverse consequences on other creatures, cascading through the food chain to disrupt fish, frogs, snakes, predatory birds, and others. Likewise, in our more philosophical moments, we should concede that even noxious beings have a niche, and that it is simply inappropriate for us to truly exterminate a species, absent the most compelling justification.[166]

It is worth noting in this context that much of international environmental law—driven both by practical/political considerations and by ethical instincts—favors preservation of species in their "natural habitats," and preferably in their "country of origin."[167] Zoos, nature preserves, museums, gene banks, and the like also have a role to play—often a crucial role for husbanding the most rare and delicate species—but ordinarily the preferred outcome is preservation *in situ*, and the hope is for ultimate restoration of the diminished species, and its

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ed., 1993) (asserting that "[a]ll species have an inherent right to exist."); *see* Nils Holtug, *Creating and Patenting New Life Forms*, *in* A COMPANION TO BIOETHICS, *supra* note 65, at 206, 208-09.

165. In this regard, it is noteworthy that even the Endangered Species Act contains an express exception allowing actions that might jeopardize rare insects designated by the Secretary of the Interior as dangerous pests. *See* Endangered Species Act, 16 U.S.C. § 1532 (2003).

166. EHRLICH & EHRLICH, *supra* note 76, at 11-12; KELLERT, *supra* note 66, at 24-26, 101-11, 124 (arguing some species provoke negative reactions from people, but even ugly, dangerous, or loathsome creatures have right to exist).

167. *See, e.g.*, *Agenda 21*, *supra* note 109, at Ch. 15.5(g) (discussing actions necessary for preservation of biological diversity). States should "[t]ake action where necessary for the conservation of biological diversity through the *in situ* conservation of ecosystems and natural habitats, as well as primitive cultivars and their wild relatives, and the maintenance and recovery of viable populations of species in their natural surroundings, and implement *ex situ* measures, preferably in the source country." *Id.* *In situ* measures are "fundamental" for preservation of species, and *ex situ* activities (preferably in the country of origin) "also have an important role to play." Biodiversity Convention, *supra* note 79, at preamble (discussing distinction between *in situ* measures and *ex situ* activities); Rio Declaration on Environment and Development, U.N. Doc. A/Conf.151/26, 31 I.L.M. 874 (1992) (adopted by U.N. Conference on Environment and Development, Rio de Janeiro, June 13, 1992); Leslie J. Mehrhoff, *Museums, Research Collections, and the Biodiversity Challenge*, in BIODIVERSITY II, *supra* note 73, at 447-465; Richard O. Roblin, *Resources for Biodiversity in Living Collections and the Challenge of Assessing Microbial Biodiversity*, *in* BIODIVERSITY II, *supra* note 73, at 467-74.

reintroduction to its former, natural range.

In the case of smallpox, of course, such a strategy would be absurd. The only natural habitat for the virus is the human body, where it rampages against our immune defenses and causes deadly and debilitating disease. The only tolerable environment for securely sustaining the remaining variola samples—no matter how many or how few exemplars we retain—would have to be in tightly locked deep freezes, with nothing "natural" about them. Still, reliance upon even such wholly artificial environments has precedent: under the Endangered Species Act, for example, there are quixotic illustrations of a rare crustacean being sustained only in a collection of manmade concrete bathtubs; likewise a disappearing breed of thistle has been preserved in a single, fenced California wetland area.[168] If we can exercise ourselves to try to husband those tiny, barely-noticeable entities indefinitely in those non-natural settings, maybe the CDC and Koltsovo reliquaries seem less bizarre.

In sum, the variola virus makes a most unsuitable poster child for the concept of animal rights, but perhaps there is some force to the analogy. Some of the same instincts that might drive people to enact anti-cruelty legislation, to become vegetarians, or to demand in various subtle ways that we treat non-human animals with respect could apply even here. Traditional moral notions and principles of law once created a stark dividing line between humans on the one side and all other creatures on the other; some voices already advocate, in one fashion or another, that the line should become less bright, and that it should be shifted enough to allow at least chimpanzees, or dolphins, or domestic pets at least partial access onto the protected side. If that is thinkable—if we can begin to craft some sort of legal or moral recognition to some non-humans—why not for viruses, too? And isn't the claim for variola strengthened by the realization that we need not advocate here any very expansive or expensive formula for viral rights, just a claim to passive preservation of the last remnants of the species in secure, isolated facilities, and especially when there is such a light set of interests pushing from the other side in favor of extermination?

VII. CONCLUSIONS

As forecast, the preceding analyses have not provided legally binding guidance on the target question of whether to destroy the last known remaining samples of the smallpox virus. There simply is no authoritative precedent, no compulsory treaty, no applicable statute on point. The language snipped out from the most nearly apposite instruments, both international and domestic,

168. *See* MANN & PLUMMER, *supra* note 76, at 244; *see also* Erik Stokstad, *Rescue Planned for Seed Banks*, 297 SCI. 1625, 1625 (Sept. 6, 2002) (gene banks for food crops hold perhaps some two million varieties of plants, many of which are no longer sustained in nature).

does not exactly (and sometimes not nearly) embrace microorganisms. The original contexts, in both environmental protection and animal rights law, are simply too remote to stretch to cover this novel issue.

On the other hand, there is some value in analogy. The animating spirit underlying those fields of law can overflow the boundaries of the original disciplines. Environmental law teaches us the importance of preserving biodiversity, of treasuring each shard of genetic variability, even (or especially) when we do not comprehend a current use for it. The preservationist instinct commends itself here, too. The variola virus is a unique exemplar of a still-mysterious breed, and we should not cavalierly dispense with it. Likewise, the underlying concepts of animal rights law, including the increasing ethical and legal respect for non-human entities, resonate here. Extending those notions even to non-sentient creatures, including those that barely, if at all, fit inside the realm of living organisms, and furthermore including those whose only biological function is to cause horrible, incurable human disease, is another monumental step, but perhaps a step to which the logic of the field slowly drives us.

The WHO has repeatedly, if futilely, called for destruction of the CDC and Koltsovo variola inventories, a plea that has once again been deferred by the Bush Administration's strategy in response to September 11 and subsequent terrorism. The instinct to cleanse the world of the infectious agent, as a capstone to the heroic 1970s campaign against the disease, and as insurance against its return, was driven by the disciplines of virologists and immunologists, who unsentimentally sought to prevent their public health labors from unraveling. But there are other perspectives at work here, too, and other legacies to consider.

The unremitting clash between science and theology on smallpox has surfaced repeatedly throughout history. Just as the medical advances promulgated in earlier centuries by Mary Montague, Cotton Mather, and Edward Jenner were challenged by resistance to the "unnatural" procedures of variolation and vaccination, today's genetic engineering both enthrals and troubles us. As the hypertrophic development of biotechnology augurs the prospect of redesigning the variola genome, to steer it in an even more rapacious direction, as well as the ability to create functional new viral particles from scratch in the laboratory, we have to inquire about humanity's collective wisdom and ability at prudent self-restraint in the exercise of our newfound capacities.

Who are we, after all, to decide the permanent fate of other life forms? The Biblical warrant for humans to exercise dominion over all the creatures of the earth has its counterpoints: religious literature abounds equally with injunctions to live in harmony with nature; to sustain, as well as to exploit, other species; and to tend modestly and carefully all companion creatures, even

the least among them. Would a "good shepherd" easily destroy any of the flock, especially if it were so easy and safe to retain even the outliers? Doesn't our role as "trustees" for future generations require that we zealously safeguard the planet's most scarce relics, rather than expunge them from the legacy for our descendants?[169]

A. Precedential Impact

Although human beings have never before stared over the precipice of deliberate extinction of another species, this will hardly be the last occasion for the issue to arise. Other microbes of varying description, category, and pathogenicity are likely to follow variola into the WHO executioner's grasp, and our collective energies, intellect, moral sensitivity, and law will surely be engaged again. While it is difficult to predict which germs will be ripe for extermination on what precise timetable, it is entirely foreseeable that humans will be repeat players in the game of intentional species life or death.

One plausible candidate for imminent destruction is polio. This dread disease—for centuries a feared killer of millions around the world—is caused by a virus that is quite unlike variola in many respects, being much smaller and far simpler in genetic structure. But like variola, the polio virus infects only humans and has no viable reservoir in nature, so once person-to-person transmission is interrupted, the disease may be globally eradicated. Public health officials have made major progress toward that ultimate objective: this formerly global scourge has been reduced to only seven countries, and only 1500 or so polio cases were reported in 2002. The effort is far from over—millions of vaccinations are still required annually in endemic countries, the elusive virus seems determined to evade the grasp of WHO and associated hunters, and the originally planned deadline for complete eradication of the disease has already slipped several years.[170]

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169. WEISS, *supra* note 75, at 2 (asserting each generation is a trustee for the natural and cultural resource base, obligated to pass it unimpaired to next generation); J. Ronald Engel, *Environment and Religion*, *in* ENCYCLOPEDIA OF BIOETHICS, *supra* note 142, at 707; Holmes Rolston III, *God and Endangered Species*, *in* ETHICS, RELIGION AND BIODIVERSITY: RELATIONS BETWEEN CONSERVATION AND CULTURAL VALUES 40 (Lawrence S. Hamilton ed., 1993) [hereinafter ETHICS, RELIGION AND BIODIVERSITY] (discussing religious teachings on biodiversity, and humans' relationship to animals); Leslie E. Sponsel & Poranee Natadecha-Sponsel, *The Potential Contribution of Buddhism in Developing an Environmental Ethic for the Conservation of Biodiversity*, *in* ETHICS, RELIGION AND BIODIVERSITY, *supra*, at 75-97 (summarizing ethical arguments in favor of preserving biodiversity); John Copeland Nagle, *Playing Noah*, 82 MINN. L. REV. 1171 (1998) (asserting religious values underscore need to protect biodiversity; religious instinct to protect all of God's creatures underlies the Endangered Species Act); Callicott, *supra* note 139, at 138-72; White, *supra* note 162, at 99 (noting Christian scriptures warrant three distinct human attitudes toward nature).

170. World Health Org., *Polio News*, issue 17 (Dec. 2002); United Nations International Children's Emergency Fund, *A World Without Polio*, *at* http://www.unicef.org/polio/index.html (May 13, 2003); Polio Backgrounder, http://www.gatesfoundation.org/GlobalHealth/InfectiousDiseases/Polio/PolioBackground.htm (last visited Jan. 16, 2004); M.A.J. McKenna, *Polio Eradication Impossible, Doctors Told*, ATLANTA J.-

Still, WHO authorities can already anticipate the day when the polio virus, like variola, will be reduced to a few tightly-secured freezers, and they have already propounded international guidance for those last repositories to identify, safeguard, and consolidate the inventories.[171] The next question—undoubtedly building upon whatever consensus emerges from the current variola debates—will be whether to destroy, conduct further research upon, or retain indefinitely, those final polio virus exemplars.

After that, public health officials may concentrate on any of a variety of other tragic and preventable diseases. The viruses that cause measles and yellow fever would be suitable targets, although for a variety of technical reasons, global eradication of those agents seems more remote. Certain non-viral pathogens may sooner or later also be controlled, although true vanquishing of the bacteria that cause bubonic plague and tuberculosis is far from imminent. Parasitical diseases, such as dracunculiasis ("guinea worm fever"), onchocerciasis ("river blindness") and even malaria are stubborn, but so much progress has been registered in confining the formerly vast ranges of those creatures that perhaps eventual elimination is imaginable.[172]

Although the crystal ball gets cloudy when we try to predict which of these noxious creatures will arrive on WHO's chopping block at what time, it is clear that the case study presented by variola will not be unique; it is simply the first (and perhaps the first by only a few years) to test the collective strength and judgment of human beings.

CONST., Oct. 27, 2002, at A19.

171. World Health Org., *Proposed Global Action Plan and Timetable for Safe Handling and Maximum Laboratory Containment of Wild Polio-Viruses and Potentially Infectious Materials*, at 6 (June 1998) (on file with author) (discussing elimination of poliovirus). "The world now faces the formidable, but not insurmountable, challenge of locating the many laboratories that have wild poliovirus infectious, or potentially infectious, materials and ensuring that they are adequately contained in the laboratory, rendered non-infectious, or destroyed." *Id.* The first task is to hunt down and compile a list of facilities that house polio; after that, each laboratory will have to decide whether to transfer its polio virus materials to a maximum containment facility, or to inactivate or destroy them. Press Release WHO/48, World Health Org., As Polio Retreats, Viruses in Labs Pose Biggest Risk to World Population (June 26, 1998) (detailing steps for polio elimination); *Poliomyelitis Eradication*, Resol. 52.22, WORLD HEALTH ASSEMBLY (May 25, 1999) (urging member states "to begin, in collaboration with WHO, the process leading to the laboratory containment of wild poliovirus in maximum containment laboratories").

172. World Health Org., *Disease Eradication/Elimination Goals*, *at* http://www.who.int/infectious-disease-report/pages/ch6init.html (last visited Jan. 16, 2004) (identifying six diseases "WHO stands poised to eradicate or eliminate as a public health problem," including poliomyelitis, dracunculiasis, and leprosy); F. Fenner, *Candidate Viral Diseases for Elimination or Eradication*, http://www.cdc.gov/epo/mmwr/preview/mmwrhtml/su48a17.htm (on file with author) (survey about viral diseases possibly considered as leading candidates for eradication or elimination; listed measles first, by large margin, followed by hepatitis B, rubella, yellow fever, rabies, and mumps); World Health Organization, Dracunculiasis Eradication, Fact Sheet No. 98 (March 1998); World Health Org., Onchocerciasis (River Blindness), Fact Sheet No. 95, *at* http://www.cdc.gov/nip/publications/pink/meas.pdf (measles) (on file with author); David Brown, *The Long March Toward Stamping Out Infectious Diseases*, WASH. POST, June 2, 1997, at A3.

B. What Is, and Is Not, at Stake

Although the story of smallpox is long, erratic, and complicated, the current policy choices are in some respects much more tractable. That is, the ethical or moral question of deliberate extinction engages a rather sharply defined set of issues, somewhat simpler than those addressed in the typical controversies about environmental protection or animal rights.

First, this issue is not about utility. Those who would retain the variola virus for further research have argued, not without objection, that additional manipulation of its genome might yield secrets about viral infectivity, applicable to other diseases, as well; that it might generate improved anti-smallpox vaccines and even a cure for the disease; and that it might produce improved sensors to detect the presence of the dangerous microbe in the armaments of a rogue army or terrorist. Those contentions may well be valid; for if we are willing to throw enough money, scientific expertise, and time at the problem, who knows what additional insights and products might be generated to combat any revival of smallpox itself or to assist in other immunology inquiries? Certainly, if one projects further into the future, it is quite imaginable that future generations of researchers, armed with improved technology and enhanced models of cellular operations, might be able to discern lessons from, and about, variola, that are beyond current ken.

But from the ethical or philosophical point of view, variola's potential utility to human beings is far from the end of the inquiry. We cannot demand that other species on the planet "earn" their right to continued existence by demonstrating their usefulness to our technological advances. Even the most homocentric conceptions of earthly processes would admit a broader range of considerations in contemplating survival, even for the most deadly and abominable of creatures. Instead, we must also weigh the inherent "right" of a species—any species—to exist, and the companion obligation of humans not to destroy a life form, absent the most compelling requirements.[173]

Likewise, this particular controversy is not about money (since the cost of sustaining the existing variola inventories is minimal) or about safety (given the WHO guarantees that both CDC and Vector have instituted state-of-the-art security procedures). The competition over alternate uses of resources has

173. EHRLICH & EHRLICH, *supra* note 76, *passim*; ETHICS, RELIGION AND BIODIVERSITY, *supra* note 169, *passim*; EHRENFELD, *supra* note 137, *passim*; Bryan G. Norton, *On the Inherent Danger of Undervaluing Species*, *in* THE PRESERVATION OF SPECIES, *supra* note 77, at 110; Nagle, *supra* note 169, at 1171 (presenting and critiquing utilitarian arguments for preservation of biodiversity). *But see* FENNER ET AL., *supra* note 3, at 1339 (noting "only criterion by which to judge the necessity for the preservation of the virus, we believe, is whether it is necessary for scientific work."); Frank Fenner, *The WHO Global Smallpox Eradication Programme: Vaccine Supply and Variola Virus Stocks*, *in* CONTROL OF DUAL-THREAT AGENTS: THE VACCINES FOR PEACE PROGRAMME 185, 201 (Erhard Geissler & John P. Woodall eds., 1994) (affirming view that there is no legitimate moral question concerning preservation of variola).

dominated most Endangered Species Act cases (e.g., preserving the critical habitat for a breed of small fish vs. constructing a dam to generate hydroelectric power); other environmental law controversies have been roiled by uncertain risk analyses (e.g., calculating how much it is really worth to reduce further the tiny amounts of arsenic in drinking water). But regarding variola, the ethical issues are exquisitely teed up in isolation.

Instead, this controversy is about preserving a shred of viable DNA simply because it exists, and because it has existed, in parallel with humanity, for millennia. The story of variola is part of our own story, and destruction of it would impoverish us, too. The fact that we would be accomplishing that extinction deliberately (rather than ignorantly or negligently, as humans have usually caused other species to disappear) only compounds the mistake. Our planet sustains a marvelous kluge of biological possibilities; the harsh facts of evolution mean that some species will inevitably come and go, but intentional, readily avoidable species erasures are a different matter.

It is important, but difficult, to avoid anthropomorphizing here. We instinctively want to depict variola as a "killer," awaiting execution on WHO's "death row," unrepentant and irreformable. But this is not a plea for "mercy," still less for "pity" for an insentient creature. Instead, it is simply an argument that we express better our own humanity, and an appropriately humble appreciation for our place in nature's grand scheme, by backing away from its deliberate extinction.