Public Health Chronicles

The massive expansion of the chemical industry following World War II promised virtually unlimited improvements in everyday life. “Better Living Through Chemistry” was a marketing slogan that went virtually unchallenged throughout the 1950s and early 1960s. Yet, by the end of the 1960s, the perceptions of the synthetic world that our massive chemical industry had created had fundamentally changed. By the first Earth Day in the spring of 1970, the use of Dow’s chemical defoliants and napalm, the experience with thalidomide, and, of course, the publication of Rachel Carson’s *Silent Spring* profoundly undermined scientists’ and the public’s belief in the unchecked benefits of scores of chemicals.

This brief but startling article by Conis provides us with insight into the rapidly evolving and transformative debates regarding the safety of synthetic materials, environmentalism, chronic disease, genetic damage, and low-level exposures during the 1960s and early 1970s. It also gives us an understanding of the current debates regarding the precautionary principle, low-level exposures and their relationships to human health, the concept of the threshold level, and the uncertainty involved in environmental research. As this article illustrates, perhaps the most critical and paradigmatic arguments occurred—and are still occurring—over the unbridled use of pesticides, particularly dichlorodiphenyltrichloroethane.

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DEBATING THE HEALTH EFFECTS OF DDT: THOMAS JUKES, CHARLES WURSTER, AND THE FATE OF AN ENVIRONMENTAL POLLUTANT

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In the late 1960s, two chemists began to argue head to head in newspapers, journals, and courtrooms about a pressing question inspired by Rachel Carson’s *Silent Spring*:¹ namely, should the pesticide dichlorodiphenyltrichloroethane (DDT) be banned in the U.S.? The protracted debate between Stony Brook University professor Charles Wurster and University of California at Berkeley professor Thomas Jukes initially concerned the pesticide’s effects on nontarget wildlife, including robins, hawks, salmon, and crabs. As the debate gained momentum and visibility, however, it became clear that it concerned DDT’s effects on another species as well: humans. Jukes argued that few technological breakthroughs had done as much as DDT to save human lives, by protecting millions from malaria, typhus, and starvation. Wurster, on the other hand, maintained that DDT threatened the lives of millions more by destroying the ecosystems on which humanity depended for its well-being. Wurster argued that DDT’s effects on wildlife were a harbinger of what was to come

for humankind. Significantly, he also denounced the chemical as a pervasive likely carcinogen.

In recent years, a growing number of public health historians have begun to bridge the history of health and disease to the history of the environment. The public debate regarding DDT that began in the 1960s—and of which the heated disagreement between Wurster and Jukes is emblematic—represents a historical moment in which human health concerns played a key role in an episode of environmental politics in the U.S. Focusing in on the exchange between Wurster and Jukes reveals that human health arguments were, in fact, intrinsic to what has widely and enduringly been perceived as an environmental debate. Close analysis of the two scientists’ dispute also reveals that their disagreement was not fundamentally about the validity of scientific claims; more accurately, the subtext of their disagreement concerned differing values, social interests, and world views, and the effect that these values and interests had on the selection and interpretation of scientific findings the two scientists employed to support their respective positions on DDT.

A HEALTH CONCERN EMERGES

In his examination of American environmentalism, *Beauty, Health, and Permanence*, historian Samuel Hays dates to the early 1970s a phase of environmental

politics characterized by concern with toxic chemicals, which he says was linked to new ideas about personal health and preventive medicine. Hays cited the evolving case against DDT as proof: "Whereas proceedings against DDT in the late 1960s had centered on adverse ecological consequences, similar proceedings in the 1970s focused primarily on human health."² On the surface, this is true. What Hays overlooked, however, is that the legal proceedings against DDT that took place in the 1960s and 1970s were part of one continuous struggle against the chemical on the part of environmentalists, with no sharp break in between. The reason that Hays was able to delineate a distinction between the 1960s and 1970s proceedings is in part due to the changing nature of the evidence that environmentalists had at hand; it's also due to their strategic use of that evidence. In fact, health arguments were an important factor in the debate from early on, and remained largely consistent during the course of the ardent campaign against DDT.

One of the key figures in that campaign was Wurster, a young, Stanford-trained chemist who had studied the effects of DDT on robins during his postdoctoral work, publishing evidence of the chemical's harms in *Science*.³ As a new professor of biology at Stony Brook University on Long Island in 1965, Wurster began attending the meetings of a community environmental group and, at the group's urging, wrote a letter to the local newspaper on the hazards of DDT. In 1966, with the help of a local lawyer, the group succeeded in convincing a judge to halt their county's use of the chemical. The following year, the group incorporated as the Environmental Defense Fund (EDF) and went on to help communities seeking similar bans in Michigan and Wisconsin.

Human health did not constitute part of the legal proceedings that the community groups instigated against DDT in New York or Michigan—a fact that incensed Jukes, who often wrote that he had been first roused to the chemical's defense by Carson's *Silent Spring*. A tireless letter writer, Jukes (a California resident at the time) wrote to a Michigan newspaper in response to the DDT hearings in that state: "I was primarily concerned with the omission of any mention of the importance of DDT to public health, and the same omission was made in the hearings on DDT in Wisconsin. . . . A generation is growing up which hears of DDT only as a toxic chemical that has 'deleterious effects on wildlife.' . . . We need . . . insecticides . . . and every other possible aid from science in the struggle for survival of our species."⁴ In countless letters to newspapers and scientific journals, Jukes argued that DDT had proven its merit by killing typhus-carrying lice

and malaria-carrying mosquitoes throughout southern Europe during and after World War II (WWII). Not only was the chemical saving lives threatened by infectious disease, he argued, it was also preventing mass starvation by protecting crop yields from pest damage around the world. "Insects would eat up the food supply of mankind if they had the chance," he wrote in an editorial for the *Washington Post*.⁵ In Jukes's view, human health—indeed, human survival—formed the crux of DDT's defense.

Jukes would be somewhat vindicated when hearings on DDT began in Madison, Wisconsin. Human health was not mentioned in the petition that environmental groups, including EDF, filed to have the state classify DDT as a water pollutant. But as the highly publicized hearings continued, stretching from the fall of 1968 through the spring of 1969, DDT's impact on human health became central to the debate, starting with the testimony of Vanderbilt University professor Wayland J. Hayes, former Chief Toxicologist for the U.S. Public Health Service (PHS). Hayes, a witness for the state, declared DDT safe on the grounds that soldiers sprayed with it in the 1940s and prisoners who swallowed it in studies performed in the 1950s had suffered no adverse effects. Lawyers and witnesses for the petitioners dismantled Hayes' testimony by focusing on the human health questions left unanswered by such studies: DDT's long-term toxicity; its effects on the endocrine system and liver; and its effects on newborns, children, and women.

The health-focused testimony that garnered the most attention outside the courtroom, however, came from Goran Lofroth, a scientist from Sweden. Sweden had just issued a two-year moratorium on DDT, based on findings that DDT levels in human breast milk across the globe were twice the maximum intake level set by the World Health Organization, and equal to a level that caused biochemical changes in laboratory rats.^{6,7} The testimony made headlines across the country, from Madison to Modesto, California. EDF's decisions to discredit the PHS studies and call Lofroth as a witness were initially a response to the health-oriented arguments of the defense, but they quickly began to form the basis for the group's strategy to have DDT banned nationally. The group seized on the breast-milk contamination's resonance with the public, making it the focus of fundraising and membership pleas they began to run in newspapers across the U.S. "Is mother's milk fit for human consumption?" the ads queried. "Nobody knows . . . But if it were on the market, it could be confiscated by the Food and Drug Administration. Why? Too much DDT."⁸

Such health arguments were particularly resonant in

1969 because they tapped into public fears of chemical contamination of the food supply and human bodies, stemming from a series of scares dating to the 1950s, involving radioactive fallout, lead, and other pesticides, to name a few. By the late 1960s, such experiences had gradually eroded the public's faith in the steps that industry, government, and institutions were purportedly taking to protect them from chemical hazards. Such concerns were heightened by the fact that by mid-century, infectious diseases had given way to chronic illnesses, especially cancer, as the primary causes of death and illness. Fears of cancer spread as doctors, scientists, and politicians struggled to respond to the growing epidemic.

FEARS OF ENVIRONMENTAL CARCINOGENS

Concerns about the role that chemicals might be playing in the growing cancer epidemic prompted the passage in the 1950s of several laws to protect the food supply from contamination. One of these, the Delaney Clause, a 1958 amendment to the Food, Drug and Cosmetic Act, established a zero-tolerance limit for any food additive found to cause cancer in humans or animals.⁹ As historians Gerald Markowitz and David Rosner have described, the clause was commonly invoked in the 1960s by environmental and health advocates looking to secure bans on chemicals they perceived as harmful.¹⁰ DDT was no exception, as Wurster, who was named EDF's scientific director, demonstrated in several court statements. "There is no evidence to support the existence of a safe tolerance for a carcinogen, above which it causes cancer and below which it does not," he asserted in one affidavit. "The frequency or incidence of cancer induction becomes zero only at zero concentration of the chemical."¹¹

In the course of the widely reported-on Wisconsin hearings, EDF had swiftly become a national organization and had set its sights on a national ban. Following victory in Wisconsin, in the summer of 1969 the group petitioned the secretary of Health, Education and Welfare to set the tolerance level for DDT in foods at zero, citing the Delaney Clause. In addition to more than two dozen studies documenting the presence of DDT in breast milk and human tissues, the petition cited three studies, published in 1968 and 1969, linking DDT to cancer. In one, DDT had been found to cause as many tumors in mice as did the known carcinogen aminotriazole.¹² In the second study, successive generations of mice fed high doses of DDT showed increasing rates of leukemia and tumors.¹³ The last study, a human study, found that DDT levels were twice as high in people who had died of cancer compared with those who had

suffered sudden or accidental deaths.¹⁴ The studies, the petitioners concluded, provided "clear evidence that DDT causes cancer in animals and provides very strong indications that it produces cancer in man."¹⁵

EDF strategically framed DDT as a carcinogen because of the new evidence at hand, but also because carcinogenicity had stirred public concern and government action over other commonly encountered commodities, such as cigarettes. Historian Allan Brandt has described how in the 1950s and 1960s, medical professionals and political officials faced a controversy sustained by the tobacco industry regarding the causal relationship between cigarettes and smoking, drawing out confirmation of that relationship for more than a decade. As Brandt and others have described, the report on smoking and health produced by the Surgeon General's Advisory Committee in 1964 represented one of the first uses of a then-novel set of standards for scientific establishment of causality between exposure and disease.¹⁶ Taking inspiration from the fate of cigarettes, Wurster led EDF in the development of a strategy that would likewise condemn DDT as a carcinogen. In letters to fellow EDF executives and other scientists, Wurster referred to the effort it took to establish the carcinogenicity of cigarettes, as well as these new standards of causality, as indications that DDT could also be condemned as a cause of cancer. Wurster argued that people's concomitant, lifelong exposure to multiple carcinogens made the identification of carcinogens in general enormously difficult and time-consuming. DDT's persistence, ubiquity, and mobility, he argued, meant its own identification as a carcinogen could prove impossible to establish with the kind of population studies it took to link cigarettes to lung cancer.¹⁷

In light of this, Wurster pleaded for a united front demanding precautionary steps from the federal government, based on the "reasonable likelihood" that DDT caused cancer.¹⁸ Though cigarettes were his favored analogy for DDT, Wurster invoked other carcinogens as well. In court briefs, press releases, and media interviews, Wurster and EDF argued that a ban on DDT was consistent with other recent actions the government had taken to protect the public from possible carcinogens, including seizing a crop of aminotriazole-tainted cranberries in 1959, prohibiting administration of a diethylstilbestrol-containing drug to poultry in 1966, and banning the artificial sweetener cyclamates in 1969. "The overwhelming majority of chemicals are not carcinogens, but when laboratory tests give clear warning, we must prevent human exposure to such agents," Wurster wrote in a letter to the editor. "There is hope for preventing many future

cancers if we are prudent and place human lives ahead of some chemicals.”¹⁹

A DEBATE OVER VALUES

The value Wurster placed on human life was precisely one of the points Jukes took issue with in the scientists’ ongoing debate. In a pair of editorials commissioned by the *Washington Post* in 1969, Wurster described a chemical that persisted in the environment, traveled great distances, collected in tissue, and whose toxicity was broad but only partially understood, while Jukes described a chemical that was demonstrably safe and had saved millions of lives to boot.^{5,20} Jukes often argued that a DDT ban in the U.S. would mean the chemical’s use against insect-borne diseases would be curtailed across the globe, translating into death and decreased life expectancy for millions of the innocent poor. Of the proceedings in Wisconsin, Jukes wrote to the editor of *Science*, “It is... noteworthy that the World Health Organization was not represented at the hearings. Also unrepresented were 30 million Africans with onchocerciasis, which produces blindness. The issue of banning DDT is unquestionably a genocidal one.”²¹

The controversy regarding DDT’s continued use in the U.S. was one that pitted the chemical’s risks against its benefits. On the surface, this was also the subject of the debate between Wurster and Jukes. To Jukes, few technologies had done as much as DDT to promote human health. To Wurster, few were as insidious and subtle in their effects on the ecosystem, of which both humans and wildlife were a part. On another level, the debate also pitted the values of a conservationist (Jukes) against that of a “new” environmentalist (Wurster). A generation apart, Jukes had completed his biochemistry doctorate and was working for the chemical industry on the eve of WWII, just as DDT and other chemical pesticides were about to make a glorious and unprecedented technological debut; Wurster completed his advanced degree the year *Silent Spring* was published.^{22,23} The two fit the pattern of an inverse relationship between age and new environmental values described by Hays.

In their dispute over DDT, they also played out one of the “many clashes between older commodity and newer environmental values [that] occurred in the Environmental Era” described by Hays.² Jukes’s environmentalism indeed tended to view nature as a resource to be managed scientifically. Wurster’s own letters suggest a view that held nature as something to be preserved untouched, in a state whose purity was viewed as conducive to a better—indeed, more health-promoting—existence. Jukes, meanwhile, considered

such demands profoundly impractical. In an editorial in *Nature*, he railed that an environmentalist was “a person who insists that the 40 billion gallons of raw sewage that are dumped annually into Lake Erie contain absolutely no DDT.”²⁴ He likewise found the concern over trace amounts of DDT in human bodies and breast milk misguided, pointing out that even cholesterol could cause tumors when injected in laboratory animals under the right conditions. Though he had never studied DDT (as a professor of medical physics, his diverse research interests covered nutritional deficiencies, the role of vitamins and nutrients in cancer treatment, and molecular evolution), beginning in 1968 Jukes wrote several review articles defending research that had found the chemical safe, and repeatedly offered himself as a witness for DDT’s defense.

In their 1987 volume on the nature of scientific controversies, philosopher of science H. Tristram Engelhardt and bioethicist Arthur Caplan concluded that such controversies are rarely confined to empirical facts; rather, they often have heavy political and ethical overlays and, thus, constitute multiple controversies at once.²⁵ Jukes’s and Wurster’s drastically different perceptions of DDT revealed the gulf between their social interests and values. To the older environmentalist, DDT was, first and foremost, a product of the modern world’s technological prowess, an unprecedented tool in humankind’s war on disease and starvation. Moreover, as his comment on genocide suggests, his scientific position was couched in a political view that remained faithful to a vision of the U.S. as the superpower and global protector it became in the years after WWII. To the new environmentalist, DDT was instead a symptom of technology progressing unchecked, heedless of the growing body of scientific knowledge suggesting the delicate interconnectedness and interdependence of all living things. Wurster carefully defended the chemical’s use against malaria in poor countries, but did not believe that justified the chemical’s continued use in the U.S.

Engelhardt and Caplan have also argued that controversies involving disputes over risk-benefit assessments are often characterized by disagreements over the merits of the science used to assess risk and the ranking of possible benefits and harms.²⁵ Wurster’s and Jukes’s dispute took precisely this form. As two chemists, Wurster and Jukes could agree on one consistently observable truth: that a DDT dose of more than 5 grams or so, received all at once, was neurotoxic. Beyond this, their agreement ended. To Jukes, the chemical was safe and highly beneficial below this dose. In his view, any ill effects that might be documented in exposed wildlife were no worse than the harms wrought by

highways or cars, and any harms that might someday turn up in humans were outweighed by DDT's ability to save lives in the present.²⁶ To Wurster, meanwhile, the totality of the chemical's effects—both good and bad—could be assessed only through the newly popular lens of ecology.

Not infrequently, the disagreement between Jukes and Wurster devolved into personal attacks, as each called the other emotional, hysterical, and unscientific. "Jukes's is an example of the kind of thinking that concludes all is well with pesticides as long as there is food on our tables and robins on the lawn," Wurster wrote in a letter to *Science*.²⁷ In a letter to the BBC, Jukes wrote that "Wurster's achievement in the field . . . had been to collect a handful of dead robins . . . [and] in a flight of fancy . . . extrapolated these few dead members . . . into a nation-wide slaughter of millions."²⁸ Their insults only thinly concealed a deeper dispute. Jukes's letters defended a scientific and environmental tradition that he saw as uniquely empiricist, and that valued the expertise of its leaders. Wurster, meanwhile, defended a tradition he viewed as more "sophisticated" and "advanced" than one that had relied solely on acute toxicity research.²⁹ The newly prominent tradition of ecological thinking to which he subscribed maintained that there was an unknowable number of consequences to the utilization of new technologies that science had yet to observe—and that this uncertainty should guide government action to protect the population and the ecosystems it inhabited.

A HISTORY OF UNCERTAINTY

The centrality of uncertainty in the debate over DDT links this narrative to others that have begun to bridge the history of health to the history of the environment. In a 2004 essay, historians Greg Mittman, Michele Murphy, and Christopher Sellers pointed out that often, "The history of environment and health is about what we don't, or don't quite, know;" it's also a history of "invisibility, imperceptibility, and doubt."³⁰ As historian Thomas Dunlap has shown, trace levels of DDT were only recently made visible in the 1960s by the new technology of gas chromatography, which effectively helped make controversy possible—by making trace levels of DDT detectable (before this, there was little for the public at large to dispute).⁶ In the context of repeated health scares tied to chemical exposures, as well as a national epidemic (cancer) marked by long latency periods, the growing number of DDT foes that emerged in the 1960s argued that although DDT's ill effects had been imperceptible to

date, there was no way of knowing that they would remain so indefinitely.

Wurster and other advocates for a ban took advantage of scientific challenges concerning cancer causality to argue that DDT—like radiation and tobacco—could still turn out to be proven carcinogenic. Indeed, doubt formed the longstanding basis of the ultimately successful attack that environmentalists waged against DDT. The chemical's use was a "biological experiment of truly colossal proportions," Wurster wrote in the *Washington Post*.²⁰ With this, he echoed the Swedish scientist Lofroth, who had told a packed Wisconsin courtroom that "the whole earth is a large test tube" for studying DDT's effects.³¹ And he echoed Carson, who had warned a decade earlier in *Silent Spring* that "it is simply impossible to predict the effects of lifetime exposure to chemical and physical agents that are not part of the biological experience of man."³¹ Wurster and the EDF took advantage of that uncertainty, effectively constructing it into the large and terrifying specter of an unknown number of all-too-possible future cancers.

In 1972, following his review of seven months and more than 9,000 pages of federal testimony, William Ruckelshaus, head of the newly formed Environmental Protection Agency, canceled DDT's registration in the U.S. The ban answered the policy question of whether DDT should be used in the U.S.; it did not, however, answer the scientific question of whether DDT was safe for humans or the environment.²⁸ Ruckelshaus's written opinion on the rule stated that DDT's potential carcinogenicity figured prominently in his final decision to ban the chemical.³² But DDT's potential to harm human health remained just that: a possibility. EDF celebrated the rule as a victory. However, for the next 10 years, Wurster and Jukes continued to write heated letters and articles debating the risks and benefits of DDT. The scientific debate, replete with its social and ethical overlays, was anything but resolved—as it remains unto the present day.

The research for this article was supported by a fellowship from the Department of Anthropology, History and Social Medicine at the University of California, San Francisco, in San Francisco, California. The author thanks Elizabeth Watkins and Justin Remais for comments on earlier drafts of this article.

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REFERENCES

1. Carson R. *Silent spring*. Boston: Houghton Mifflin; 1962.
2. Hays SP. *Beauty, health, and permanence: environmental politics in the United States, 1955–1985*. New York: Cambridge University Press; 1987.
3. Wurster CF Jr, Wurster DH, Strickland WN. Bird mortality after spraying for Dutch Elm Disease with DDT. *Science* 1965;148:90-1.
4. Jukes T. Letter to the editor of the *Independent*. Thomas Jukes Papers, box 1, folder 15. Berkeley (CA): Bancroft Archives, University of California, Berkeley; 1969.
5. Jukes T. Its use saves untold lives. *The Washington Post* 1969 May 4:B1.
6. Dunlap TR. *DDT: scientists, citizens, and public policy*. Princeton (NJ): Princeton University Press; 1981.
7. Wurster CF. The charge is biocide: DDT stands trial. *Audubon* 1969;71:128-35.
8. Environmental Defense Fund. Advertisement: Is mother's milk fit for human consumption? *New York Times* 1970 Mar 29; p. 148.
9. Food Additives Amendment of 1958. Public Law No. 85-929, Sec 409, 72 Stat. 1784.
10. Markowitz G, Rosner D. *Deceit and denial: the deadly politics of industrial pollution*. Berkeley (CA): University of California Press; 2002.
11. Wurster CF. Affidavit, *EDF v. EPA*, 1971 Jan 22. Environmental Defense Fund Archives, Stony Brook University Special Collections and Archives, series 7, sub-series 1, box 4.
12. Innes JR, Ulland BM, Valerio MG, Petrucelli L, Fishbein L, Hart ER, et al. Bioassay of pesticides and industrial chemicals for tumorigenicity in mice: a preliminary note. *J Natl Cancer Inst* 1969;42: 1101-14.
13. Kemeny T, Tarian R. Investigations on the effects of chronically administered small amounts of DDT in mice. *Cellular and Molecular Life Sciences* 1966;22:748-9.
14. Radomski JL, Deichmann WB, Clizer EE. Pesticide concentrations in the liver, brain and adipose tissue of terminal hospital patients. *Food Cosmet Toxicol* 1968;6:209-20.
15. Environmental Defense Fund. Petition filed with Health, Education and Welfare by Environmental Defense Fund on behalf of Irene Lopez, Elvira Garduno, Kathe Radke, Marilyn Vittor, Leigh Roycroft, Juan Zamora, and EDF, September 1969. Environmental Defense Fund Archives, Stony Brook University Special Collections and Archives, series 7, sub-series 1, box 3.
16. Brandt AM. *The cigarette century: the rise, fall, and deadly persistence of the product that defined America*. New York: Basic Books; 2007.
17. Wurster CF. Correspondence, 1967–1970. Environmental Defense Fund Archives, Stony Brook University Special Collections and Archives, series 7, sub-series 1, box 1.
18. Wurster CF. Letter to scientists, 1969 Aug 4. Environmental Defense Fund Archives, Stony Brook University Special Collections and Archives, series 1, box 1.
19. Wurster CF. Notes for a letter to the editor, 1969. Environmental Defense Fund Archives, Stony Brook University Special Collections and Archives, series 2, box 3.
20. Wurster C. It's polluting all the world. *The Washington Post* 1969 May 4:B1.
21. Jukes T. Letter to Philip Abelson, editor of *Science*, 1969 Jul 11. Thomas Jukes Papers, box 1, folder 33. Berkeley (CA): Bancroft Archives, University of California, Berkeley; 1969.
22. Haron N. Interview with Thomas H. Jukes. Berkeley (CA): Bancroft Archives, University of California, Berkeley; 1981.
23. Deposition statement, December 1970. Environmental Defense Fund Archives, Stony Brook University Special Collections and Archives, series 7, sub-series 1, box 3.
24. Jukes T. *Alarums and excursions*. *Nature* 1970;225:301.
25. Engelhardt HT Jr, Caplan AL, editors. *Scientific controversies: case studies in the resolution and closure of disputes in science and technology*. New York: Cambridge University Press; 1987.
26. Jukes T. Letter to California state speaker Robert T. Monagan, 1969 Aug 19. Thomas Jukes Papers, box 1, folder 22. Berkeley (CA): Bancroft Archives, University of California, Berkeley; 1969.
27. Wurster CF. DDT and robins. *Science* 1968;159:1413-4.
28. Jukes T. Letter to Alec Nisbett, BBC-TV, 1975 Jun 25. Thomas Jukes Papers, box 1, folder 24. Berkeley (CA): Bancroft Archives, University of California, Berkeley; 1975.
29. Wurster CF. DDT makes matters worse. *New York Times* 1971 Aug 12; p. 33.
30. Mitman G, Murphy M, Sellers C. Introduction: a cloud over history. *Osiris* 2004;19:1-17.
31. Swede says intake of DDT by infants is twice daily limit. *New York Times* 1969 May 6; p. 49.
32. Ruckelshaus W. Opinion of the administrator in re: Stevens Industries et al. Consolidated DDT hearings, Environmental Protection Agency. Environmental Defense Fund Archives, Stony Brook University Special Collections and Archives, series 7, sub-series 1, box 5.