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PROMETHEUS UNLEASHED: SCIENCE AS A DIPLOMATIC WEAPON IN THE LYNDON B. JOHNSON ADMINISTRATION

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ABSTRACT

Scholars who have examined science policy within the Johnson Administration have generally argued that the President's Science Advisory Commission (PSAC) reached its zenith of influence late in the Eisenhower Administration, declining through the Kennedy and Johnson years until President Richard Nixon abolished it in 1973. These accounts, however, have overlooked Johnson's determination to employ science and technology as tools in foreign policy, and the rapid growth of the State Department's international science office early in his Administration. They also overlook the

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singular importance that Johnson era officials placed on the physical environmental sciences—especially oceanography and meteorology—as tools of foreign policy. This article, based on archival sources, examines how Johnson Administration officials embraced science in diplomatic policy from 1964 through 1968, when rising tensions over Vietnam limited these efforts. Our study includes a detailed examination of one such instance: a secret Administration effort to employ weather modification in India and Pakistan as a technological fix to mitigate the Bihar drought and famine of 1966-67, and to achieve U.S. policy goals in this strategically important region.

INTRODUCTION

Science and technology have long been used as tools of the state. Their use intensified in the second half of the twentieth century—particularly after the launch of Sputnik in 1957—when scientific and technological achievements came to symbolize the strength and vitality of nations.[1] In 1960 Paul Nitze, the noted nuclear arms negotiator, declared "the most important tool of foreign policy is prestige."[2] "Our scientific 'prestige' is an increasingly important component in our international bargaining power, perhaps even more important with those who know little of science than with those who do," a high-

[1] Ronald E. Doel and Zuoyue Wang, "Science and Technology in American Foreign Policy," in *Encyclopedia of American Foreign Policy*, rev. ed., eds. Alexander DeConde, Richard Dean Burns, and Fredrik Logevall (New York, 2001), 443-459.

[2] Quoted in Eugene B. Skolnikoff, *Science, Technology, and American Foreign Policy* (Cambridge, Mass., 1967), 209.

level report on U.S. science declared the following year.[3] White House leaders determinedly sought new ways to promote its foreign policy goals through scientific achievements and technological applications.

Until recently, most studies of the role of science as an element of U.S. foreign policy have largely focused on physics. The atomic bomb created a dramatic new role for science in foreign policy in August 1945, and physicists became visible figures in efforts to negotiate treaties, shape world opinion, and articulate models of international governance.[4] In the United States, the Eisenhower Administration—seeking a peaceful application of nuclear weapons—advocated "Atoms for Peace," while the Atomic Energy Commission (AEC) emphasized through Project Plowshare the applications of atomic

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[3] Joseph Pratt, *Science in UNESCO: United States Interest in Science Abroad,* 16 Aug. 1961, Box 9, Frank Press papers, MIT archives.

[4] Relevant literature is voluminous; see for instance Lawrence Badash, *Scientists and the Development of Nuclear Weapons: From Fission to the Limited Test Ban Treaty, 1939-1963* (Atlantic Highlands, NJ, 1995); Gregg Herken, *Cardinal Choices: Presidential Science Advising From the Atomic Bomb to SDI* (New York, 1992); Daniel J. Kevles, "Cold War and Hot Physics: Science, Security, and the American State, 1945- 56," *Historical Studies in the Physical and Biological Sciences* 20 (1990): 239-64; Melvyn P. Leffler, *A Preponderance of Power: National Security, The Truman Administration, And the Cold War* (Stanford, Cal., 1992); Spencer R. Weart, *Scientists in Power* (Cambridge, Mass., 1979).

energy towards civil engineering problems.[5] Post-Sputnik, the U.S. space program also served to demonstrate the importance of American science and technology as symbols of the West's vitality, and to persuade newly independent non-aligned nations to follow the West's lead.[6]

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[5] On Atoms for Peace, see Bruce W. Hevly and John M. Findlay, *The Atomic West* (Seattle: 1998); Richard G. Hewlett and Jack M. Holl, *Atoms for Peace and War, 1953-1961: Eisenhower and the Atomic Energy Commission* (Berkeley, 1989); and Martin J. Medhurst, "Eisenhower's `Atoms for Peace' Speech: A Case Study in the Strategic Use of Language," *Communication Monographs* 54 (1987): 204-220; on Project Plowshare see for instance Barton C. Hacker, *Elements of Controversy: The Atomic Energy Commission and Radiation Safety in Nuclear Weapons Testing, 1947-1974* (Berkeley, 1994) and Peter Coates, "Project Chariot: Alaskan Roots of Environmentalism," *Alaska History Magazine* 4, no. 2 (fall 1989): 1-31.

[6] Rip Bulkeley, *The Sputnik Crisis and Early United States Space Policy: A Critique* (Bloomington, 1991); Robert A. Divine, *The Sputnik Challenge* (New York, 1993); W. Henry Lambright, *Powering Apollo: James E. Webb of NASA* (Baltimore, 1995); Roger D. Launius, *NASA, A History of the U.S. Civil Space Program* (Malabar, Fla., 1994); Roger D. Launius, John M. Logsdon, and Robert W. Smith, *Reconsidering Sputnik: Forty Years Since the Soviet Satellite* (Amsterdam, 2000); John M. Logsdon, *The Decision to Go to the Moon: Project Apollo and the National Interest* (Cambridge, Mass., 1970); Walter A. McDougall, *The Heavens and the Earth: A Political History of the Space Age* (New York, 1985).

Largely missing from these accounts, however, are the roles played by members of the geophysical sciences—the realm of the earth sciences that might best be termed the "physical environmental sciences" to distinguish them from the biological environmental sciences.[7] Their fields were among the most militarily strategic, since advanced weapon systems critical to U.S. defense depended on geophysical knowledge. As field scientists, dependent upon globally collected data, geophysicists were also internationally minded, active players in national security and foreign policy networks. Finally, some geophysicists held out the promise of controlling nature—including tools for exploiting the oceans and deliberately modifying the weather—that tempted state leaders. Assessing the contributions of the physical environmental sciences is thus an important step in reassessing the interplay between science and foreign policy in mid-twentieth century America.

Lyndon Johnson's fascination with the physical environmental sciences—particularly his faith in weather modification and the control of nature—is thus especially revealing. For Johnson, the physical environmental sciences were more than national security tools: he sought to apply these sciences to alleviate the suffering and raise the standard of living of the domestic population and U.S. allies, finding them a political tool of the utmost importance. Yet until now his secret use of science and technology to "fix" emerging environmental problems while bolstering foreign regimes nevertheless has

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[7] Ronald E. Doel, "Constituting the Postwar Earth Sciences: The Military's Influence on the Environmental Sciences in the USA after 1945," *Social Studies of Science* 33 (2003): 635-666.

remained hidden.[8] Johnson's attempt to control the weather in India to aid food production challenges existing historical accounts that emphasize extraordinarily tense relations between the United States and India created by Johnson's food policy, which left India begging for grain as monsoon rains failed.[9] But while he very publicly withheld grain shipments, behind the scenes Johnson was deploying a secret diplomatic weapon: a highly classified method for augmenting rainfall. By taming nature, Johnson hoped to tame the world.

NATIONAL SECURITY, U.S. FOREIGN POLICY, AND THE ENVIRONMENTAL SCIENCES

From the start of the Cold War the physical environmental sciences began gaining influence within U.S. foreign policy as the result of two distinct, yet overlapping, developments. The first was the growing importance of issues at the intersection of natural resource policy, international law, and U.S. foreign relations. The spread of nuclear fallout made environmental pollution an international concern, stimulating efforts

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[8] Modern presidential historians have not found science and technology compelling themes. For instance, Robert Dallek's massive LBJ biography contains just one reference to Johnson's science advisor; see Robert Dallek, *Flawed Giant: Lyndon Johnson and his Times, 1961-1973* (Oxford, 1998), on 424.

[9] See, for example, Francine R. Frankel, *India's Political Economy 1947-1977: The Gradual Revolution* (Princeton, NJ, 1978); H. W. Brands, *India and the United States: The Cold Peace* (Boston, 1990); Lloyd I. Rudolph and Susanne Hoeber Rudolph, *The Regional Imperative: The Administration of U.S. Foreign Policy Towards South Asian States under Presidents Johnson and Nixon* (Atlantic Highlands, NJ, 1980).

to forge a nuclear test ban treaty.[10] Finding a political solution to competing claims for the Antarctic continent—a key issue for U.S. diplomacy since the end of World War II—came to hinge on making Antarctica a "continent for science." The International Geophysical Year of 1957-58, involving extensive Antarctic studies, cemented this thrust and helped form the framework of the Antarctic Treaty, signed in 1959.[11] Oceanography played a role as intensified fishing practices—including the development of factory trawlers capable of operating at unprecedented distances from their homeports—and growing interest in sea floor mining helped spawn the first U.N. Conference on the Law of the Sea in 1958. Debates over the extent of international waters, nuclear waste disposal, and deep sea mining claims all highlighted the increasing relevance of the environmental sciences for U.S. foreign policy.[12] As a time of intense geographical

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[10] Robert A. Divine, *Blowing in the Wind: The Nuclear Test Ban Debate, 1954-1960* (Oxford, 1978); Kai-Henrik Barth, "The Politics of Seismology: Nuclear Testing, Arms Control, and the Transformation

of a Discipline," *Social Studies of Science* 33 (2003): 743-781.

[11] Aant Elzinga, "Antarctica: The Construction of a Continent by and for Science", in *Denationalizing Science: The Contexts of International Scientific Practice*, eds. E. Crawford et al. (London and Dordrecht, 1992), 73-106.

[12] Ann L. Hollick, *U.S. Foreign Policy and Law of the Sea* (Princeton, 1981), 144-159; Jacob Darwin Hamblin, "Environmental Diplomacy in the Cold War: The Disposal of Radioactive Waste at Sea during the 1960s," *International History Review* 24 (2002): 348-375.

exploration, it is hardly surprising that the physical environmental sciences were resurgent.[13] All emerged as significant issues for the White House.

The second development—less visible at the time because of secrecy and national security concerns—was the importance of the physical environmental sciences for national defense and military operations. By the mid-1950s almost all fields of the earth sciences, including meteorology, upper atmospheric research, ionospheric studies, solar-terrestrial relations, geodesy, terrestrial magnetism, and oceanography, were specifically identified as critical to the National Military Establishment—particularly the development of ballistic missile systems and anti-submarine warfare.[14] Understanding the operating environment became one of the most pressing areas of military research. This need drove an expansion of geophysical research and the creation of new geophysical and oceanographic research institutions. [15] International atomic issues predominated in public and classified discussions, but the physical environmental sciences were a close second in funding and influence on foreign policy. When Washington Senators Henry [Scoop] Jackson and Warren Magnuson protested the U.S. position at the second U.N. Law of the

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[13] On geography's relationship to the state see Steven J. Harris, "Long-Distance Corporations, Big Sciences, and the Geography of Knowledge," *Configurations* 6 (1998): 269-304.

[14] For overviews see John Cloud, "Introduction," 629-634, and Michael A. Dennis, "Postscript: Earthly Matters," 809-819, both in *Social Studies of Science* 33 (2003).

[15] Ronald E. Doel, "Constituting the Postwar Environmental Sciences," 635-666, and Naomi Oreskes, "A Context of Motivation," 697-742, both in *Social Studies of Science* 33 (2003).

Sea conference in 1960, arguing that it harmed fishing interests, they learned that submarine nuclear defenses trumped fishing interests.[16]

For many geophysicists, international policy concerns and military applications were integral parts of a unified, seamless continuity. Unlike their laboratory-based colleagues, their work in many cases depended upon the immediate, global sharing of data. Seeking global programs, these scientists sought to highlight their contributions to national security: meteorologists developing increasingly sophisticated numerical weather prediction models (to meet both military and domestic civilian needs) pointed out that they were totally dependent upon surface and upper air weather observations shared by all nations—no matter what their ideology.[17] As a result, many geophysicists became active in efforts to expand the role that earth scientists could play in international affairs. They began intensive political outreach efforts to persuade the White House and

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[16] Secretary of State Christian Herter to Sen. Henry Jackson, 10 Mar. 1960, Jackson 3560-3, Box 58, Folder 18a, Henry Jackson papers, Special Collections, University of Washington.

[17] Data requirements for successful numerical weather prediction are discussed in Kristine C. Harper, "Boundaries of Research: Civilian Leadership, Military Funding and the International Network Surrounding the Development of Numerical Weather Prediction in the United States" (Ph.D. diss., Oregon State University, 2003); see also Harper, "Research from the Boundary Layer: Civilian Leadership, Military Funding and the Development of Numerical Weather Prediction (1946-55)," *Social Studies of Science* 33 (2003): 667-696.

Congress of the strategic value of developing cooperative international earth sciences programs.[18]

The launch of the IGY-connected Sputnik in October 1957 earned the physical environmental sciences additional stature and authority within the White House and State Department. The election of John F. Kennedy as President in 1960 further served to spotlight these fields. More than Eisenhower, Kennedy made the nuclear test ban treaty negotiations a national priority.[19] He supported large increases in the public-enthralling space program. In oceanography, the so-called 'wet' space program, Kennedy recognized the growing dilemma of looking to the oceans for food while also using it to dump radioactive wastes. He also supported plans for the large-scale Indian Ocean expedition to gather detailed information about the biology, meteorology, and physical oceanography of this politically sensitive region, allowing researchers to "show the flag" while promoting international cooperation.[20]

The Kennedy Administration became interested in the environmental sciences for yet another reason: the potential of large-scale physics-based experiments to tarnish the U.S. reputation abroad. Kennedy seemed quite gratified by the Limited Nuclear Test Ban

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[18] See for instance Joseph Kaplan to Lloyd Berkner, 25 Sep. 1953, Box 1, USNC/IGY, International Geophysical Year collection, National Academy of Sciences Archive.

[19] Zuoyue Wang, "American Science and the Cold War: The Rise of the U.S. President's Science Advisory Committee" (Ph.D. diss., University of Santa Barbara, 1994), 250-254.

[20] Oceanography concerns were reported in H.K. Bourne, "Biological Implications of Radioactive Isotopes in the Sea," FV 7 / 52, Public Record Office, Kew; the Indian Ocean Expedition is discussed briefly in Skolnikoff, *Science* (cit. n. 2), 62.

Treaty's eventual passage in 1963, since it indicated the nation's commitment to limiting radioactive fallout. Yet the United States had been embarrassed in October 1962 when the *New York Times* leaked that it had tested a nuclear bomb in space more than a hundred miles above Hawaii. Aware too that the Atomic Energy Commission's (AEC) plan to detonate several nuclear weapons in Alaska to create an artificial harbor was sparking intense controversy, Kennedy sought to limit governmental programs with environmental impacts.[21] On April 17, 1963, Kennedy issued a secret directive from the National Security Council, National Security Action Memorandum 235, to all members of his cabinet, insisting that any large-scale scientific or technological experiments with possible adverse environmental effects (either physical or biological) be reviewed in advance for their potential harm.[22] Seeking to reassure the American scientific community, Kennedy addressed the National Academy of Sciences one month before his death, acknowledging concern about deliberate environmental modification. While in the past such modification had mainly been inadvertent, Kennedy noted, for the first time

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[21] Divine, *Blowing in the Wind* (cit. n. 10); on Alaska's Project Chariot, see Dan O'Neill, *The Firecracker Boys* (New York, 1995).

[22] National Security Action Memorandum No. 235/1, April 17, 1963, Foreign Relations of the United States (FRUS), *Organization of Foreign Policy; Information Policy; United Nations; Scientific Matters*, Vol. XXV (2001), item #352. This memorandum directed the CIA and the Department of State (among other agencies) to undertake advance reviews of potentially controversial programs in the environmental sciences; it emerged from discussions within PSAC, reported in "Notes on International Cooperation in Science," Box 16, Detlev Bronk papers, Rockefeller Archive Center.

science "could undertake experiments with premeditation which can irrevocably alter our physical and biological environment on a global scale."[23]

Kennedy's speech touched on the principal environmental sciences concerns that had come into focus since the late 1950s, including conservation policy as well as understanding and exploiting the sea and atmosphere. One final issue that Kennedy raised —much in the news at that time—was deliberate weather modification. In his October Academy speech, Kennedy noted that the state needed to work to ensure that the potential benefits of weather control were not outweighed by their risks— "against the hazards of protracted droughts or storms."[24] Just one month before his speech, the *New York Times* had editorialized on "Controlling the Weather," declaring that ambitious schemes to "improve the weather in one area" might well come "at the expense of that in another area. When control of the weather actually becomes possible, argument about who should gain and who should lose could become significant sources of international tension."[25]

Thus when President Johnson later began thinking seriously about weather modification as a tool of the state, he was engaged not in marginal scientific undertakings but in issues that, like the broader environmental sciences themselves, had become central to U.S. foreign policy and to the practice of international law.

LYNDON JOHNSON'S AIMS FOR U.S. SCIENCE AND TECHNOLOGY POLICY

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[23] See 'Text of Kennedy's Address to Academy of Sciences," *New York Times*, Oct. 23, 1963, 24.

[24] Ibid.

[25] "Controlling the Weather," (editorial), *New York Times,* 25 Sep. 1963, 42.

As President, Lyndon Johnson had a clear idea of how he wished to utilize science policy. On one of his first days as Science Advisor to the President, Donald Hornig, a Harvard-trained chemist, listened as Johnson spelled out his aims for science and technology policy. Two points stayed with him. He later recalled Johnson's emphasis on the *applications* of science: "for $18 billion a year," Johnson told him, referring to the total federal R&D budget, "there ought to be something to say at least once a week." Johnson, Hornig also quickly grasped, "saw everything in political terms."[26]

Johnson's attitude towards science and technology had its origins—indeed was deeply shaped—by experiences in his childhood.[27] Applications of technology became key issues in his earliest political campaigns. Born in the arid Hill Country of central Texas in 1908, Johnson came of age as radio, movies, and electricity rapidly spread across the nation. In this poor and sparsely populated region, however, neither electricity, radios, nor paved roads existed through the 1930s. After his election to the House of Representatives in 1937, Johnson successfully brought the New Deal to central Texas by securing federal funds to dam the Colorado River for local power production.[28] Celebrating his victory, Johnson had declared that Texans could now "turn the vicious Colorado which for centuries had gone whooping and snorting down the valleys on its

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[26] Donald Hornig, "The President's Need for Science Advice: Past and Future," in William T. Golden, ed., *Science Advice to the President* (New York, 1980), 42-52, on 47, 50; Wang, "American Science in the Cold War" (cit. n. 19), 258.

[27] "For all the patterns of his life have their roots in this land;" see Robert A. Caro, *The Years of Lyndon Johnson: The Path to Power* (New York, 1982), xxiii.

[28] Ibid.

sprees of destruction, into the quiet ways of work and peace."[29] A dedicated New Dealer, Johnson embraced the early twentieth century ethos that technology could improve the material lives of ordinary citizens.

Another closely related and equally characteristic attitude—Johnson's drive to use technology to modify and improve the natural environment—also stemmed from his childhood experiences. While growing up, Johnson never forgot the anxiety of worrying whether vital rain would come. His faith in technological progress was linked to a perception that water policy was fundamental to domestic politics, an issue he later came to see as global. Journalist Hugh Sidey, visiting the President at his family homestead in the mid-1960s, wrote that Johnson was "quite convinced that adequate water in the areas of shortage and control of the water in the areas of surplus could do more for peace that just about any technological breakthrough."[30]

Science and technology policy retained a fascination for Johnson as he rose politically. As Senate Majority Leader, Johnson championed legislation that established the National Aeronautics and Space Administration. Initially seeing space as a matter of national defense, Johnson quickly grasped its potential for showcasing U.S. science and technology around the world. He similarly encouraged an applied role for science and technology when he backed the proposed East-West Center in Hawaii, arguing that the

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[29] Jordan A. Schwarz, *The New Dealers: Power Politics in the Age of Roosevelt* (New York, 1994), quoted on 274.

[30] Hugh Sidey, *A Very Personal Presidency: Lyndon Johnson in the White House* (New York, 1968), quoted on 16; see also 137.

U.S. needed to step up efforts to train young Asian intellectuals and researchers.[31] As Vice President, he became Kennedy's point man for the space program.[32] These commitments foreshadowed two themes of Johnson's future Presidency: a deep-rooted New Deal enthusiasm that state-backed technological systems could be used to improve the living standards of all Americans (indeed, of individuals around the globe) and a faith that technological centers, including the military-industrial complex, were critical for promoting the economic growth of disadvantaged citizens as well as advancing U.S. military strength.[33]

Until now, most scholars have argued that Johnson primarily sought to use science and technology to further domestic aims.[34] For instance, in his history of the President's Science Advisory Committee (PSAC), founded after the 1957 launch of Sputnik, Zuoyue Wang argued that compared to Eisenhower and Kennedy, Johnson "liked to focus on domestic and not international affairs."[35] Environmental historians

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[31] Office of the President, University of Hawaii, Memo for the files Laurence H. Snyder, Aug. 13, 1959, Chancellor's Records, Univ. of Hawaii Coll. 1991:003, University of Hawaii Archives.

[32] Dallek, *Flawed Giant* (cit. n. 8), 22-23; for a less positive view see Robert A. Caro, *The Years of Lyndon Johnson: Master of the Senate* (New York, 2002), 1028-30.

[33] Schwarz, *New Dealers* (cit. n. 29), 266, 270, 283.

[34] For instance, Dupree, "Historian's View" and William G. Wells, Jr., "Science Advice and the Presidency: An Overview from Roosevelt to Ford," in Golden, *Science Advice* (cit. n. 25), 191-220, on 206.

[35] Wang, "American Science" (cit. n. 19), 258.

such as Samuel P. Hays have emphasized Johnson's commitment to addressing environmental pollution and improving the environment—perhaps because Johnson wished to extend Kennedy's environmental interests (illustrated by his public embrace of Rachel Carson's *Silent Spring* and making natural resources conservation a high administration priority).[36] There is no doubt that Johnson did care deeply about natural resource and environmental issues. PSAC's 1965 report on environmental pollution—largely confirming Carson's concerns about the overuse of pesticides—was one of the Johnson Administration's most influential science reports.[37]

Nevertheless, other scholars have begun to notice that Johnson was no less interested in employing technology and science to aid U.S. foreign policy.[38] Certainly like his immediate predecessors, Johnson was concerned with ballistic missile development, basic research and graduate education, assessments of Soviet science, scientific exchanges with the Soviet Union, and the problems of international science.[39] But Johnson's interests ranged considerably beyond these points. For instance, Johnson demanded that Hornig find ways to provide technical assistance to developing countries

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[36] Samuel P. Hays, *Beauty, Health, and Permanence: Environmental Politics in the United States, 1955-1985* (New York, 1985); Dallek, *Flawed Giant* (cit. n. 8), 83.

[37] Wang, "American Science" (cit. n. 19), 260; Dallek, *Flawed Giant* (cit. n. 8), 229-30.

[38] W. Henry Lambright, *Presidential Management of Science and Technology: The Johnson Presidency* (Austin, 1985).

[39] On PSAC's assessment of key national security concerns, see Hornig memo to President, 17 Feb. 1964, Box 1, Hornig papers, Lyndon Baines Johnson Presidential Library [hereafter Hornig-LBJ].

he visited on formal state visits. Working with State's science experts, Hornig crafted cooperative programs in space technology, typhoon damage control, and oceanography to offer Philippine President Ferdinand Marcos when Johnson visited Southeast Asia in 1966; on that same trip, in South Korea, Johnson announced U.S. support for a new Korean Institute for Industrial Technology and Applied Science.[40] Johnson also demanded that his science advisors work to ameliorate the perceived "Technological Gap" involving Western Europe. Growing fears of Western European nations that they were losing the battle to regain their prewar technological footing made the technological gap a potent, but short-lived flash point in U.S. foreign policy.[41] Johnson ordered his White House scientists to address the 'gap' issue, determine its accuracy, and to take appropriate steps as necessary. Later, State's science officials remembered it as one of the most time-consuming challenges of the Johnson Presidency.[42]

Johnson's fascination with the physical environmental sciences—and their implications for foreign policy—is less well known. In part this had to do with secrecy: Johnson's most incisive use of environmental sciences applications in India and Pakistan,

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[40] The Korean Institute idea had first been broached during a 1965 state visit by the South Korean president to the U.S.; see Hornig, memo for the files, 7 Oct. 1965, Box 3, Hornig-LBJ.

[41] Jean-Jacques Servan-Schreiber, *Le Defi Americain* (Paris, 1967); Johnson to Department Secretaries, 25 Nov. 1966, Confidential File Container 85 SC Sciences, LBJ; Eugene V. Kovach oral interview (Ronald E. Doel, interviewer), 28 Jun. 2001, American Institute of Physics, in process.

[42] Kovach OHI (cit. n. 41).

and later in Vietnam, as the Vietnam War escalated, was carried out entirely in secret. But another critical factor was the tendency of contemporary outside observers to not recognize the significance of the environmental sciences as a cohesive field, even if key Johnson advisors did.[43] (Hornig referred to "environmental sciences" as shorthand for "aeronomy, geology, geodesy, seismology, hydrology, meteorology, oceanography, and cartography," placing biological environmental sciences in a separate mental category.)[44] One of the first initiatives that Johnson sought to promote—not surprising, given his upbringing—was international water policy. In 1964 Johnson sought to focus efforts on nuclear-powered desalination. He launched a major international program—Water for Peace—and lobbied Congress hard to adequately fund the project.[45] Two years later

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[43] In 1965 the Environmental Science Services Administration (ESSA) was created under the Department of Commerce, a step urged by geophysicist Lloyd V. Berkner to make the environmental sciences as visible as physics. It is not clear however what role Johnson played in this consolidation; see Hornig to Lucke, 17 Sep. 1965, Box 2, Hornig-LBJ; see also Luther J. Carter, "Earthquake Prediction: ESSA and USGS Vie for Leadership," *Science* 151 (1966): 181-183.

[44] Hornig, memo to Joseph Califano, 25 Jan.1966; see also Hornig, memo to Schultze, Director, Bureau of the Budget, 10 Jan.1966, both Box 3, Hornig-LBJ.

[45] On desalination, see Hornig, memo for the record of conversation with President, 9 Jul.1964, Box 1; on Water for Peace, see Hornig, memo to Hon. Joseph J. Sisco, Dept. of State, 25 Oct. 1965, Box 3, both Hornig-LBJ; and memo, Bernard J. Rotklein to Mr. Shaver, 12 Oct.1966, RG 59, Bureau of International Scientific and Technological

Johnson also accepted a proposal to speak at the dedication of a new research vessel (R.V. *Oceanographer*) from his White House advisors, who saw this as a chance for Johnson to "talk not only about the resources of the sea but in broader terms about worldwide peace, higher standards of living throughout the world, feeding a rapidly growing population, etc."[46] Also in 1966 Johnson gave strong backing to World Weather Watch, a World Meteorological Organization cooperative program first proposed and vetted in the early 1960s, that promised the U.S. critical data while allowing the state to proclaim its commitment to international scientific cooperation and nation-building.[47]

Affairs, Box 17, National Archives and Records Administration II, College Park, MD [hereafter NARA II].

[46] Robert E. Kintner, memo to Will Sparks and Bob Hardesty, 6 Jul.1966, Confidential Files RA, Container 85, Oceanography, LBJ. In this same year the Johnson Administration decided to give India the oceanographic research ship *Anton Bruun*; see Hornig, memo for President, 11 Mar. 1966, Box 3, Hornig-LBJ. At the conclusion of a dry dock period prior to transfer to India, however, *Anton Bruun* sank, sustaining damage beyond economical repair.

[47] See Charles E. Johnson to Bromley Smith, memo accompanying Draft Press Release on World Weather Watch, 22 Sep.1966, NSF Subject File, Container 52, Folder: 'World Weather Watch,' LBJ. In 1962, under the Kennedy Administration, meteorological projects involving data exchanges had been vetted by the Pentagon, the CIA, and key members of Congress and found "quite safe," worth promoting because they aided U.S. foreign policy goals while strengthening international cooperation; see FRUS (cit. n. 22) #387, cover note dated 13 Jul. 1962.

None of these individual efforts was individually surprising, but as a whole they formed a pattern: Johnson devoted more effort to practical environmental sciences initiatives than to those in any other scientific fields, showing little inclination to promote pure science efforts with less certain practical benefits.[48] If anything, Hornig wanted Johnson to broaden his efforts in environmental sciences research, urging him to pay more attention to marine policy and to deep ocean operations, particularly following the U.S. inability to recover its sunken nuclear submarine *Thresher* in 1963 and its embarrassing loss of an atomic bomb off Spain.[49]

Each of these presidential activities—Johnson's public speeches and presidential initiatives—represented typical ways that White House occupants sought to push their policy and views. What is extraordinary was the extent to which Johnson sought to use science and technology, particularly the environmental sciences, to micromanage U.S. foreign policy and the internal affairs of other nations. Seeking results—aware that he had inherited from Kennedy a world that was increasingly unresponsive to U.S. leadership—Johnson also undertook actions that bypassed and ignored the views of his

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[48] While Johnson certainly spent considerable energy promoting space exploration and space flight, here too he especially emphasized such developments as meteorological satellites, which overlapped directly with the environmental sciences.

[49] See especially Hornig, memo for President, 1 Apr. 1966, Box 3, Hornig-LBJ; on these incidents see Oreskes, "Context of Motivation" (cit. n. 15). He reiterated this point several months later, writing Johnson that "National Security poses the most urgent requirement for effective use of the sea;" Hornig, memo to President, 7 Jun. 1966, Box 3, Hornig-LBJ.

science advisors in his pursuit of desired political outcomes.[50] He particularly did so in two countries where the United States was already promoting more traditional forms of science and technology support, including reactor design, science education programs, and advanced cardiac clinics: India and Pakistan.

JOHNSON, SCIENCE AND FOREIGN POLICY IN THE INDIAN SUBCONTINENT

The primary objective of Cold War U.S.-India foreign policy was to pull non-aligned India—the world's most populous democracy and a vital linchpin in U.S. Asia policy—into the western sphere, as a bulwark against the Soviet Union and Communist China. And it was in South Asia that the environmental sciences and U.S. foreign policy came to intersect, when Johnson decided to use environmental sciences applications as a foreign policy tool in India and Pakistan in early 1967. The science was meteorology. The tool was weather control.

Weather control fulfilled two disparate foreign policy goals toward this objective. First, State wanted to dissuade India from becoming a nuclear nation. Sporadic border disputes with neighboring Pakistan (Rann of Kutch and Kashmir—1965) and China (Aksai Chin plateau—1962), from which India emerged politically diminished, had threatened to escalate into major destabilizing conflicts. However, it was the 1964 explosion of China's first nuclear device that had most seriously damaged India's self-esteem. By joining the nuclear nations, China had usurped India's claim to a prestigious

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[50] See Warren Cohen, "Introduction," in Warren I. Cohen and Nancy Bernkopf Tucker, editors, *Lyndon Johnson Confronts the World: American Foreign Policy, 1963-1968* (New York, 1994), 1-8, on 1.

position in science and technology—a position that needed to be reclaimed if India were to maintain influence with Asian and African nations. With a hostile nuclear neighbor, pressure began to build within India to start its own nuclear weapons program.[51]

During the Cold War, in India, as in other developing countries, industrialization and weapons programs primarily served a political purpose: to reach equity with more powerful nations. As political scientist Hans J. Morgenthau noted, these powerful symbols of modernity and power were and remain crucial to the self-image of emerging nations. Similarly, as the historian George Perkovich has argued, too often U.S. policy makers in the 1960s tended to see these issues through a security framework, when in fact they were efforts to achieve increased national prestige and status (and the economic benefits that accrue from them). Nevertheless, most western policy makers did assume that all nations wanted to improve their lot through the application of advanced science and technology.[52]

Certainly that was foremost in the minds of State Department officials in mid-1966 as they grappled with India's perceived motivations for "going nuclear." State ultimately recommended to Johnson that the India desk make a special examination of "more specific steps that might be taken to enhance India's political prestige, including

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[51] Itty Abraham, *The Making of the Indian Atomic Bomb: Science, Secrecy and the Postcolonial State* (London and New York, 1998), 124-125; George Perkovich, *India's Nuclear* Bomb (Berkeley, 1999), 6-7.

[52] Hans J. Morgenthau, *A New Foreign Policy for the United States* (New York, 1969), 93. See also Perkovich, *Nuclear Bomb* (cit. n. 51), 8-13.

scientific and technical projects…." Johnson approved this approach.[53] Of particular value would be "dramatic uses of modern technology to attack India's basic problems of food, population, health and education..."[54] Hornig, together with State's science office, sought to identify ways that U.S. scientific programs could both aid India and bolster U.S. foreign policy.[55] India's strong history of outstanding achievement in meteorology, for example, might make a cooperative effort to place a geo-synchronous satellite in orbit over the Indian Ocean a viable possibility.[56]

It was against this backdrop of military aggression that India suffered a serious crop failure in 1965 when the summer monsoon—India's rainy season—failed. Hardest hit was the state of Bihar, with a population of over 51 million and a primary grain crop heavily dependent upon water: rice. Without water, the paddies dried up and the rice shriveled and died. Although crops can be saved with irrigation, Bihar was almost exclusively dependent upon rainfall. During a good monsoon season, the rice crop was good. When the monsoon failed, the rice crop failed with it.[57] India had depended upon U.S. grain shipments since the mid-fifties, using imports to provide cheap food to the

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[53] W. E. Gathright to Garthoff, Schneider, Coon, and Weiler, 1 Jul. 1966, Box 15, Folder: Def 18-2, State 5255-NARA II.

[54] Raymond A. Hare to Pollack, 7 Sep. 1966, Box 15, Folder: Def 18-1, State 5255-NARA II.

[55] Hornig, memo to President, 11 March 1966, Box 3, Hornig-LBJ.

[56] J. Wallace Joyce to Hare, 10 Oct. 1966, Box 17, State 3008D-NARA II.

[57] Paul R. Brass, "The Political Uses of Crisis: The Bihar Famine of 1966-1967," *The Journal of Asian Studies* 45 (1986): 250.

masses while its capital was invested in heavy industry instead of a strong agricultural base. India's attempts to reform its inefficient agriculture program through the use of increased amounts of chemical fertilizer, high-yield seeds and privatization, had largely failed because low government-imposed prices eliminated the financial incentive to incur the costs associated in producing higher yield harvests.[58] However, even fertilizer and high-yield seeds are of no use when there is no water. In 1965, India was without water and without grain.

Already by 1964, Johnson had taken the extraordinary step of wresting control of food aid from the U.S. Agency for International Development (USAID)—which he did not trust— and became the *de facto* "desk officer" controlling PL-480 food aid to India and ten other countries under the auspices of the more easily managed U.S. Department of Agriculture.[59] In 1965, the Bihar drought compounded pre-existing food problems. So while State continued to address nuclear weapons issues, Johnson personally took the reins of the second foreign policy goal: to make India self-sufficient in food. Indeed, as historian Paul Hammond has argued, Johnson's role in the Bihar famine was an extreme

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[58] James Warner Bjorkman, "Public Law 480 and the Policies of Self-Help and Short-Tether: Indo-American Relations, 1965-68 in Lloyd I. Rudolph and Susanne Hoeber Rudolph, *The Regional Imperative: The Administration of U.S. Foreign Policy Towards South Asian States Under Presidents Johnson and Nixon* (Atlantic Highlands, NJ: 1980), 229; Francine Frankel, *India's Political Economy 1947-1977: The Gradual Revolution* (Princeton: 1978), 280.

[59] Dennis Kux, *India and the United States: Estranged Democracies* (Washington, D.C., 1993), 243.

example of exercising presidential influence on another government.[60] Although Johnson publicly argued that the "first obligation of the community of man is to provide food for all its members,"[61] his political instincts told him that drought and impending famine in India was a situation to be exploited in forcing the government to reform its agricultural program by making it a higher economic priority. And that is exactly what he did.

In June 1965, Johnson put his "short tether" policy into place, releasing just enough grain to India to arrive "just in time." Monthly, he personally evaluated the situation, and then, and only then, permitted grain shipments. Otherwise, the supply line was closed. "Short tether" made the Indian government very nervous—and extremely resentful of what they considered a heavy-handed and demeaning tactic. It also spurred heavy investment in agriculture, coming at the same time that a strong supporter of radical agricultural reforms—Chidambaram Subramaniam—was finally making headway as Indian Agriculture Minister.[62]

As India's grain harvest plummeted due to lack of rain in early 1966, U.S. Agriculture Secretary Orville Freeman told Johnson that India's food situation would be desperate by fall. To alleviate catastrophe, Freeman wanted more fertilizer shipped to

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[60] Paul Y. Hammond, *LBJ and the Presidential Management of Foreign Relations* (Austin: 1992), 226.

[61] Lyndon Baines Johnson recommending to Congress steps in an international effort in the War against Hunger, 2 Feb. 1967 quoted in James MacGregor Burns, ed., *To Heal and to Build: The Programs of Lyndon B.* Johnson (New York, 1968), 32.

[62] Carleton S. Coon, Jr. to Carol Laise, 2 Mar. 1966, Box 15, Folder: Unlabeled, State 5255-NARA II; H. W. Brands, *Cold Peace* (cit. n. 9), 118.

India. "The weather for next year's crop cannot be controlled," Freeman wrote, "but the amount of fertilizer to be used can be."[63] Freeman was right about the fertilizer. He was wrong about the extent to which the U.S. government, under Johnson, was about to go in an attempt to control nature—and the weather.

Throughout 1966 Johnson was keeping his finger on India's agricultural, and weather, pulse. He pored over the detailed weekly rainfall maps,[64] later recalling that he knew "exactly where the rain fell and where it failed to fall in India."[65] Meanwhile, Secretary of State Dean Rusk was reading a point paper outlining the foreign policy implications of weather modification. Although no nation could as yet threaten the economy or security of another by controlling the weather, it was only a matter of time before it would be possible. The State Department needed to develop a policy on weather control. As the scale of weather modification research increased, the effects would stray outside national borders. The paper's author, Bureau of Intelligence and Research staffer Howard Wiedemann, continued, "Further research may lead to opportunities for using weather modification techniques for common benefit, including technical assistance to less developed countries" or it could be used to inflict "massive" damage on enemies. Some small-scale programs, including those that resulted in modest rain enhancement, could be a "meaningful way" to render assistance to less developed countries. In fact,

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[63] Orville Freeman to Lyndon B. Johnson, 22 March 1966, WHCF CO 113, Box 38, CO 121 India 3/19/66-3/29/66, LBJ.

[64] Kux, *Estranged Democracies* (cit. n. 59), 255.

[65] Lyndon Baines Johnson, *The Vantage Point: Perspectives of the Presidency, 1963-1969* (New York, 1971), 226.

Weidemann argued that "in attempting to assist less developed countries, it may be essential to stress the limits of weather modification in order keep their hopes within reasonable bounds; in collaborating with other countries on international projects, it may be difficult to strike a neat balance between healthy skepticism and an imaginative approach."[66]

In late 1966, stubbornly determined to make India self-sufficient in food, Johnson turned off the U.S. grain spigot to India. Public outrage both within and outside of the U.S. at the specter of the potential starvation of millions of people made this an extremely unpopular decision. Despite the criticism, Johnson continued his stranglehold on grain shipments.[67]

However, the continued drought was standing in Johnson's way of forcing India to complete the job of overhauling its agricultural system. The State Department was still looking for that illusive scientific project that would fill its foreign policy requirements for meeting India's development needs while enhancing its national scientific and technological prestige. Weather control, with its promise of rainfall to break the drought and provide a cushion against future weather vagaries (and its promise of increasing scientific prestige), was seen as the solution.

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[66] Thomas L. Hughes to the Secretary of State, 14 Apr. 1966, State Department Records, Entry 3008D, Box 21, NARA II (hereafter State 3008D-NARA II). The Bureau of Intelligence and Research is part of the U.S. intelligence community, providing analysis to State's policy makers on issues of importance to foreign policy.

[67] Hammond, *Presidential Management* (cit. n. 60), 227.

PROJECT GROMET

In the cloudless, dark early morning of Monday, 23 January 1967, a large unmarked U.S. military transport plane, several small disassembled aircraft resting in its belly, landed just outside of New Delhi at 5 A.M. On board were atmospheric scientist Dr. Pierre St. Amand and his associates from the Naval Ordnance Test Station (NOTS), China Lake, California. They were in India to undertake a secret mission: the breaking of the crop damaging Bihar drought, one of the greatest humanitarian crises of that time, by classified, military-developed weather modification techniques.[68]

NOTS researchers had spent several years perfecting weather control techniques. An unclassified version involved seeding Caribbean hurricane systems with aircraft-dispensed silver iodide (Project STORMFURY). Its classified counterpart involved testing an advanced pyrotechnic dispensing technique (codenamed POPEYE).[69] POPEYE's purpose was to test the feasibility of artificially lengthening the naturally occurring monsoon season in Laos and Vietnam, thus disrupting North Vietnam's extensive supply routes. This new technique targeted large, high altitude, cold clouds (tops below 25°F) with specially formulated silver iodide. Seeded clouds would "blow

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[68] AMEMBASSY New Delhi to US Naval Ordnance Test Station, China Lake, California (Code 50), 270425Z JAN 67, NSF Country File India, Box 131, India Memos and Misc. 1 of 2, Vol. VIII, 9/66-2/67, Lyndon Baines Johnson Presidential Library (hereafter India/Memos-LBJ).

[69] John K. Rouleau to Pollack via Joyce, 16 Dec. 1966, Box 21, State 3008D-NARA II.

up" distinctively and drop large amounts of rain.[70] The Pentagon proposed using this advanced, classified method in India. Its unclassified code name: GROMET.

In late 1966, Defense Secretary Robert McNamara broached the possibility of a "Joint U.S.-India Precipitation Experiment" to U.S. Ambassador to India Chester Bowles. Cautioning Bowles that the new techniques had only been tested in limited geographic areas and under special conditions, McNamara stressed the need to avoid raising the level of expectation with the Indian government until the method proved efficacious in the target states: Bihar and Uttar Pradesh. Despite the limited winter monsoon cloud cover, DoD was willing to begin the project in January 1967 in hopes of improving India's spring harvest. Seeding would be most advantageous between May and October—the cloudy summer monsoon season. McNamara asked Bowles to immediately explore the possibility with Prime Minister Indira Gandhi. If she concurred, a technical team would meet with Indian scientists to develop a plan.[71]

Pentagon officials were enthusiastic. State Department personnel were extremely wary. They had just been discussing the necessity of conducting a preliminary study of weather modification's legal issues. However, they did not have time for a study. The decision needed to be made now.[72] Concerned that offering rainmaking to India without

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[70] Hornig to LBJ, 20 Feb. 1967, NSF Country File Vietnam, Box 41, Vietnam Memos (B), Vol. 66, 2/17 – 28/67, LBJ [hereafter Vietnam/Memos-LBJ].

[71] McNamara to Bowles, 091624Z Dec. 1966, India/Memos-LBJ. The estimated resources: three contract seeding aircraft, one weather reconnaissance aircraft provided by the Navy, and seventeen people for a total cost of $300,000.

[72] Rouleau to Joyce, 14 Dec. 1966, Box 21, State 3008D-NARA II.

making the same offer to West Pakistan could lead to diplomatic problems, State Department officials queried DoD about that possibility. Defense's representative was pessimistic—not because they were unwilling, but because cloud cover would be meager. However, he would check into it.[73] In mid-December, State's Science Office advised Bowles of its concerns: the project was classified and associated with the U.S. military, they were facing the possibility of raising false hopes in an adverse climatological environment, and there could be legal problems if the effects of seeding crossed an international border. Despite these issues, DoD remained positive. State's Science Office—aware that Hornig had requested an environmental impact review of STORMFURY in accordance with Kennedy's National Security Action Memorandum 235 directive of 1963—hoped they were right.[74]

Less than a week later, Hornig informed Johnson's National Security Adviser Walt Rostow that POPEYE testing had been successfully concluded. DoD was ready to go operational and needed the President's approval.[75] As 1966 drew to a close, Rostow advised Johnson that the rainmaking experiment in India was going forward on a "highly classified basis." If it worked, the additional rain would "materially improve the chances that [the] spring's crop will produce something in the worst affected areas." Participants would fly in commercially marked planes and all occupants would wear civilian clothes. In case there were questions from the media, a contingency press release had already

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[73] Rouleau to Pollack via Joyce, 16 Dec. 1966, Box 21, State 3008D-NARA II.

[74] Pollack to Bowles, 17 Dec. 1966, India/Memos-LBJ; Hornig to U. Alexis Johnson, 13 June 1966, Hornig chronological files, Box 4, LBJ.

[75] Hornig to Rostow, 22 Dec. 1966, Box 41, Vietnam/Memos-LBJ.

been prepared explaining that this was an "agro-meteorological survey." Rostow finished with a flourish: "May the rain makers succeed!"[76]

A joint State/Defense communiqué advised Bowles that GROMET was proceeding. The memo of understanding stressed the project's classification. There would be no publicity. The Indian government was fully responsible for any resulting claims for personal injury or property damage. There would be no public release of information without the mutual consent of both countries.[77]

Bowles quietly made arrangements in India. The project had to remain secret. The Indians, long suspicious of U.S. military and diplomatic intentions based on previous U.S.-Pakistan military aid, did not want it known that the U.S. military was involved, nor did project participants want their activities known.[78] They were concerned that local residents might conclude that the Americans were trying out this technique in India because it was illegal in the U.S. Indeed, the Defense Department *was* the only U.S. government agency not required to notify Congress before undertaking weather modification experiments.[79] However, the mutually agreed-upon reason for keeping GROMET secret was to avoid raising false hopes for rain.[80] Some members of the Indian government urged abandoning secrecy. The potential for political damage, in their

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[76] Rostow to Johnson, 29 Dec. 1966, India/Memos-LBJ.

[77] State and Defense to Bowles, 29 Dec. 1966, India/Memos-LBJ.

[78] Bowles to State, 240512Z Jan. 1966, India/Memos-LBJ; Perkovich, *Nuclear Bomb*, 25.

[79] Rouleau to Pollack via Joyce, 16 Dec. 1966, Box 21, State 30008D-NARA II. Reporting requirements were addressed by Senate Bill 2916 of October 13, 1966.

[80] Bowles to State, 240521Z Jan. 1967, India/Memos-LBJ.

opinion, would be greater if information leaked out requiring "defensive action." However, Bowles and others in the Indian government wanted firm results first.[81] Their agreed upon statement:

> Scientists from the United States and India are cooperating in a joint agro-meteorological research project, localized in the Eastern Uttar Pradesh and Bihar to study the cloud physics and rain producing mechanism over these areas of India which have incurred several droughts during the last few years.[82]

The Indian government insisted that any comments on this project connect it to agriculture, not military objectives.[83] Thus, India and the United States were playing a high-stakes game of diplomacy with GROMET. If the rains came, and the crops were saved, India would be able to claim a scientific and agricultural breakthrough. If the project failed, and it later came out that the U.S. had been using classified military techniques under the cover of an "agro-meteorological survey," both governments could be severely embarrassed.

The weather did not cooperate; skies were clear. Clouds were, however, starting to appear in the northern Punjab. State was hesitant to extend the operational area due the recent shoot-down of a Pakistani aircraft near the border.[84] Bowles was fully aware of the

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[81] Bowles to State, 071255Z Feb. 1967, India/Memos-LBJ.

[82] Ibid.

[83] AMEMBASSY New Delhi to State, 301340Z Jan. 1967, India/Memos-LBJ.

[84] State to AMEMBASSY New Delhi, 8 Feb. 1967, India/Memos-LBJ.

risks. When the primary target areas remained cloudless, the Indian government identified additional areas in Uttar Pradesh.[85] State Department personnel remained uneasy. They wanted to retain control over the seeding areas due to the "sensitivity of the GROMET team activity." Any alternate sites had to be cleared with them first.[86] Bowles argued, and L. K. Jha, Secretary to Prime Minister Gandhi, agreed, that they needed the flexibility to take advantage of every cloud formation that did not run the risk of provoking an international incident. It was of the utmost importance to prove the efficacy of the rain-making technique. "Both we and the Indians want to demonstrate that if we can [make rain] that India's food and agriculture need not be entirely at the mercy of weather vagaries," Bowles wrote. The Bihar-UP area had been chosen because it needed rain and there was an outside chance that the cloudless conditions would break. However, the skies had remained cloudless, and it was important to move the seeding effort to an area where there were clouds.[87] State finally relented, but insisted seeding had to have "some legitimate agricultural use beyond demonstration of the GROMET technique."[88] Furthermore, there would be no publicity until the military was out of the picture and civilian agencies were firmly in control.[89]

Seedable clouds finally appeared in mid-February. The outcome was mixed. Some clouds produced heavy rain, others light-to-moderate rain. Large clouds responded

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[85] AMEMBASSY New Delhi to State, 091256Z Feb. 1967, India/Memos-LBJ.

[86] State to AMEMBASSY New Delhi, 10 Feb. 1967, India/Memos-LBJ.

[87] Bowles to Rusk, 131300Z Feb. 1967, India/Memos-LBJ.

[88] State to AMEMBASSY New Delhi, 14 Feb. 1967, India/Memos-LBJ.

[89] Ibid.

better than small clouds. Team members believed that "economically valuable amounts of rain" could be produced over much of India during and after the monsoon season when non-raining cloud cover was more abundant. The embassy reported that agencies throughout India were now aware of the project and were extremely enthusiastic.[90] Interestingly, the GROMET team did not report how much rain hit the ground—an important measure of the project's success. The dry air evaporated the falling rain. Clearly, rain that failed to land on the parched earth would not aid plants. It would be difficult to call the project "successful."[91] Reporting these events to Johnson, Rostow concluded, "State and the scientists are sorting out what kind of statement to issue—if any."[92] It is unclear if any public statement was made. But absence of GROMET's mention in later books on weather control by Indian authors casts doubt that it was discussed outside of government circles.[93]

Despite this lack of success, the State still wanted to include Pakistan within GROMET. Desiring to ensure regional stability, the U.S. needed to take an even-handed approach to aid for these two South Asian adversaries, while assuring both India and

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[90] AMEMBASSY New Delhi to State, 201254Z Feb. 1967; AMEMBASSY New Delhi to State, 270916Z Feb. 1967, India/Memos-LBJ.

[91] AMEMBASSY New Delhi to State, 281256Z Feb. 1967, India/Memos-LBJ.

[92] Rostow to Johnson, 28 Feb. 1967, India/Memos-LBJ.

[93] Neither P. Koteswaram, *Water from Weather* (Waltair, India, 1976) nor N. Seshagiri, *The Weather Weapon* (New Delhi, 1977) mentions governmental rainmaking efforts in India in 1967. Kux, *Estranged Democracies* (cit. n. 59) discusses grain shipments to India during the 1966-1967 drought years, but not rainmaking efforts.

Pakistan that neither was being given an advantage. As the summer monsoons approached, the wind would blow from east to west. The effect of seeding could carry over into Pakistan. The biggest fear: that rain would fall in India, robbing Pakistan of water. With Pakistan's "almost psychotic fear of India," it would not be a good idea for Pakistani leaders to become convinced that India was trying to steal its water.[94] It was now March, and May, the arrival of the summer monsoon, would bring good "cloud hunting." Time was growing short and arrangements needed to be made.[95]

While overtures were being made to both governments, this plan hit a snag.[96] By mid-May, a frantic Bowles had still received no "green light" from State, or the White House, to continue GROMET. He thought his agreement with McNamara was to continue seeding as the monsoon clouds streamed in. Indeed, he had thus sold Mrs. Gandhi on the project. Bowles had invested considerable time serving as the go-between for State, the Pentagon, and the Indian government while arranging GROMET and creating a suitable cover story. Always committed to finding new ways to reinforce a stable India, for Bowles, "the hour for Indian democracy" was late. If the crops failed for a third year in a row, the "fragile Indian democracy" could be in jeopardy, as its large

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[94] Walter P. McConaughy, U.S. Ambassador to Pakistan, quoted in McMahon, "Toward Disillusionment and Disengagement in South Asia," in Cohen and Tucker, eds., *Confronts* (cit. n. 50), 140.

[95] State to AMEMBASSIES New Delhi, Rawalpindi, 8 Mar. 1967, NSF Country File India Box 31 India Cables Vol. IX, 3/67-7/67, LBJ (hereafter cited as India/Cables-LBJ).

[96] State to AMEMBASSIES New Delhi, Rawalpindi, 15 Mar. 1967, India/Cables-LBJ.

restive population scrambled for food. The clouds were starting to move in. Bowles asked Hornig for help.[97]

Bowles's difficulty in extending seeding to India's rainy season had less to do with U.S.-India foreign policy than it did with the deployment of the "weather weapon" in Laos. Apparently having new doubts about the rainmaking project in South Asia, Rostow spelled out for Johnson the potential problems of launching the weather weapon. Security was a serious issue. Although a "leak" was unlikely, if GROMET continued in a public venue people would soon make the unwanted connection between enhanced monsoon rainfall in India and the increased rainfall in Laos.[98]

There were also ethical and moral issues at stake. Rostow wrote Johnson, "The fact that we are going ahead with the Indian program on the basis of apparently flimsy back-up evidence has led to speculation that we 'know something' which has not yet appeared." Furthermore, he warned, the administration should not underestimate the "degree of revulsion to be expected in the domestic and international meteorological circles."[99]

Indeed, domestic "meteorological circles" had made it abundantly clear that using cloud seeding for military purposes was unacceptable. University of Washington meteorologist Robert G. Fleagle recalled his service on the National Academy of

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[97] Bowles to Hornig, 11 May 1967, India/Cables-LBJ.

[98] Rostow to Johnson, 22 May 1967, Box 88, Vietnam-LBJ.

[99] Ibid. For reactions within the scientific community to the possibility that weather had been used as a weapon in Vietnam, see Deborah Shapley, "Rainmaking: Rumored Use Over Laos Alarms Arms Experts, Scientists," *Science* 176 (1972): 1216-1220.

Sciences' Committee on Atmospheric Sciences during the 1960s. Committee members had rejected a March 1963 recommendation by atomic bomb physicist Edward Teller that they should propose a NATO study of weather control because it would jeopardize international cooperation in the atmospheric sciences, and a scientific basis for making such a study was lacking. Despite this rebuff, a few years later Teller recommended that cloud seeding be used for military purposes during the Vietnam War—relating that NOTS personnel claimed that they could muddy up the Ho Chi Minh trail. Several of the committee members opposed Teller, and numerical weather prediction pioneer Jule Charney of MIT spoke out strongly against it. According to Fleagle, Teller "knew when he could not win and [withdrew] his proposal."[100] However, cloud seeding *was* used as a weapon despite opposition—moral, ethical, and scientific—from the National Academy.

Two weeks later in early June 1967, Hornig informed Johnson that a team sponsored by USAID was heading to India to set up a permanent weather modification program despite potential legal and international complications.[101] However, the rest of the files related to India, Pakistan, and the office of the president's science advisor contain no further references to GROMET or weather modification in South Asia. The arrival of abundant monsoon rains ended the drought in the summer of 1967. Combined with more fertilizer and improved seeds, the result was a bumper grain crop. The specter

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[100] Robert G. Fleagle, *Eyewitness: Evolution of the Atmospheric Sciences* (Boston, 2001), 76.

[101] Hornig to Johnson, 5 Jun. 1967, CF Box 85, Folder: SC Sciences, LBJ. In this memo Hornig warned Johnson that the international implications were severe—adding that the state of Maryland had declared any form of weather modification to be a crime.

of famine faded away. State did not need GROMET to keep India's hopes for a better harvest alive, and Defense did not need their cover blown in Laos. GROMET quietly died.

In the end, the lack of a positive outcome combined with the risk of exposing its use as a weapon doomed the secret "agro-meteorological survey." However, despite its failure to produce rain during a normally dry season, the attempt to solve India's water problems, and hence its food problem, with advanced weather control methods was in keeping with Johnson's desire to use environmental sciences to make the world a better place to live for all people, apart from its benefit to U.S. foreign policy. As Walt Rostow remembered, "The India food question went right to where he lived. It was part of Johnson's fundamental concern for human beings and his hatred of poverty."[102]

CONCLUSION

Science is not usually the first word one associates with Lyndon Johnson or with his presidential administration, despite his early championing of the space program and his efforts on behalf of the outer space treaty. Indeed, the Johnson administration is more likely to bring to mind the failed Great Society and the disastrous Vietnam War. But what drove his campaign for the Great Society and the Vietnam War, despite their undesirable outcomes, was essentially the same desire: to improve the quality of life for all people and to bring peace and stability to the world while winning the Cold War for the West. Johnson saw science—science *applied* for the good of mankind—as the means to see that desire come to fruition.

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[102] Walt Rostow quoted in Kux, *Estranged Democracies* (cit. n. 59), 243.

Unlike his post-war predecessors, for whom physics was the scientific tool of choice as the Cold War heated up, Johnson looked particularly to the physical environmental sciences to achieve his aims. He saw advantages in supporting geophysicists: while they successfully gathered global data and strengthened international scientific exchanges, Johnson gained the opportunity to show the flag, increase U.S.prestige, and make diplomatic overtures around the globe. Furthermore, he was able to do all those things while meeting national security needs for improved weather forecasts, oceanographic knowledge in support of anti-submarine warfare, and geodetic data in support of ballistic missile programs. Most importantly, Johnson saw the opportunity to apply these sciences to controlling nature: providing water where there was little, preventing flooding where there was too much, and exploiting the oceans and their "unlimited" supply of food for the world's hungry. The physical environmental sciences were not just about understanding the earth and its atmosphere—or about strengthening national security during the Vietnam War era—but also about improving the quality of life. From the taming of the Colorado River in his congressional district in the thirties to modifying weather in the sixties, controlling nature through the application of science and technology was central to his programs. Yet by 1968 an embittered Johnson put his science advisors at arm's length along with other elites, feeling that they had betrayed him by not fully supporting his efforts in Vietnam.[103]

The abortive effort to control the weather in India and Pakistan also provides new insight into U.S. international relations in the 1960s. Scholars critical of Johnson's South Asia foreign policy have argued that his "real" reason for interrupting the routine flow of

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[103] Bruce L.R. Smith, *The Advisors: Scientists in the Policy Process (Washington, D.C.*, 1992), 168.

grain to India was his anger with Indira Gandhi over her public criticism of U.S. involvement in Vietnam. Since India was already reforming its agriculture, Johnson's attempts to justify his actions as forcing such a reform were disingenuous and a cover for punishing Mrs. Gandhi's opposition to the war.[104] However, that GROMET was proposed at all supports Hammond's conclusion that these critics were wrong. While India had been a fairly low priority for U.S. diplomacy, Johnson nevertheless raised it to a critical level. Instead of staying above such mundane matters as scheduling food shipments, Johnson made a conscious decision to actively intervene. Unlike his subordinates, he recognized that the ruling Indian Congress Party held power in impoverished rural India because of inefficient agriculture that made wheat patronage an effective political strategy: no substantive agricultural reform in India would occur without intense outside pressure. The 40% of India's population living in abject poverty written off by the government otherwise would never see an improvement in their way of life. Seeking to maintain India within the Western orbit, Johnson intervened to improve their way of life in advance of the Green Revolution. In this task, he was largely successful.[105]

Finally, this account provides new insight into the relationship of modern American presidents and the scientists who serve them. In a poignant lament on the

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[104] Hammond, *Presidential Management* (cit. n. 60), 66. See also Bjorkman, "Public Law 480," (cit. n. 58), 229, 234.

[105] Hammond, *Presidential Management* (cit. n. 60), 67, 98,106, 225-226; see also John H. Perkins, *Geopolitics and the Green Revolution: Wheat, Genes, and the Cold War* (New York, 1997).

trajectory of U.S. science policy, A. Hunter Dupree expressed his frustration that in 1983 President Ronald Reagan informed only six people (including physicist Edward Teller) about his decision to proceed with "Star Wars," the Strategic Defense Initiative, one of the most significant and costly science-technology initiatives of his administration.[106] For Dupree, Reagan by this act had failed to honor the traditional pattern of science advising in the United States, and brazenly bypassed talented experts available to him. Yet it is now clear that this was not the first time that a strong president in the imperial presidency had conducted a science-based operation with just a few highest-level confidents, against the wishes of a research community that did not believe the tool worked. Lyndon Johnson was willing to experiment with the bold new power over nature that Pentagon scientists (and powerful outsiders, like Teller) sought to put at his disposal for both humanitarian and war-fighting purposes. His actions need to be further explored in the frame of the 20th century fascination with the control of nature.

[106] A. Hunter Dupree, "Science Policy in the United States: The Legacy of John Quincy Adams," *Minerva* 28 (1990): 259-271, on 267-28.