Secret Scientific Communities: Classification and Scientific Communication in the DOE and DoD

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Introduction

Science and secrecy have an ancient lineage, dating back to the Egyptians and Babylonians who developed number systems, geometry, as well as secret codes, and evolving through the hermetic laboratories of the high Middle Ages, where alchemy, in particular, protected knowledge of the elixir of life and the transformation of base materials into gold. Historians like Maurice Crosland (1962) who seek to decipher many of these codes are still frustrated, as are Cold War historians, in their attempts to break through the barriers of classification and security to learn about the activity of modern alchemists.

The Rosetta Stone of secret science is a security clearance and a need to know that permits access to classified information and facilities. Twenty years ago the teams of historians that prepared histories of the Lawrence Radiation Laboratory, the Los Alamos Scientific Laboratory, and Sandia Laboratories obtained such clearances and posed questions that opened drawers. Their products, still forthcoming, represent an attempt to apply a traditional approach to history—the acquisition of the requisite language with which to investigate a source—here, the new language of classification and security (Heilbron & Seidel, 1989; Furman, 1990; Hoddeson et al., 1993).

Like learning hieroglyphics or cuneiform, acquiring an understanding of classification and security is useful for historians who investigate such topics, including academic historians as well as agency historians. In the latter case, however, the final product must be checked by a "native speaker," usually a civil servant authorized to declassify information whose provenance is classified documents or research. The potential restriction of the researcher's free expression prevents most historians from applying this technique. Instead, they seek to declassify information through the Freedom of Information Act. This translation process is more difficult because it requires a knowledge of the existence of the source, seldom results in a translation that is complete, and often requires years to be completed. Nevertheless, hope springs eternal among these historians that at the stroke of a legislative pen or the bang of a judicial gavel, the walls of national security will crumble into dust, and they will be able to examine the original documents without need for translation. Their latest champion, Senator Daniel Patrick Moynihan, has proposed legislation to dismantle government secrecy and has written about it (1998). The pitfalls put in the path of this legislation have been formidable ("Update," 1998; "Administration Underscores," 1998; "President Critical," 1998).

However, millions of declassified documents would be unintelligible without a working knowledge of the original language, in which there are many false cognates. These result because information systems incorporate different levels of information: One finds not only "facts" but also structural information related to provenance and program, a wealth of acronyms for which there is no single Rosetta Stone, and many other clues that require an intimate understanding of the uses of such information.

Historians of Department of Defense (DoD) and Department of Energy (DOE) laboratories have provided a context for understanding information used within them. These "secret scientific communities" balance an interest in the dissemination of fundamental and applied scientific work and a concern about protection of information that might, if released, damage national security. Therefore, a historical understanding of the reconciliation between science and secrecy in these institutions provides a means of examining the dynamic relationship between the ideally open and the nearly closed.

Secret military research was unusual prior to World War I, although it occurred even in ancient times, Greek fire being a very early example (Long & Roland, 1994). Meanwhile, scientific information systems created in the seventeenth century have also been greatly ramified in this century (Price, 1963). This essay focuses on the last half century, not only because it saw the creation of secret scientific communities but also because it has seen the production of massive quantities of secret science, unprecedented in the history of science, as well as the evolution of new information systems to replace those of the early modern period.

In 1940 Leo Szilard feared that the discovery of fission by Otto Hahn and Fritz Strassmann at the Max Planck Institute for Chemical Research in Berlin would lead to the development of nuclear weapons. He urged his colleagues in the United States, Britain, and France to refrain from publishing research on the chain reaction in uranium. When Frédéric Joliot-Curie and his colleagues published nevertheless, this preliminary attempt at scientific self-censorship collapsed, and a flood of articles on fission chain reactions filled the scientific journals (Lanoette, 1992; Weart, 1979).

It required a higher power than Szilard's to stem the scientific passion for priority during the "phony war" of 1939–1940. The National Defense Research Committee (NDRC), which Vannevar Bush organized, supplied it (Meigs, 1982; Zachary, 1997; Stewart, 1948; Baxter, 1946). Bush had served as the vice president of MIT, president of the Carnegie Institute of Washington, and chairman of the National Advisory Committee on Aeronautics (NACA), one of the few scientific advisory boards remaining from the mobilization of World War I. He persuaded President Franklin D. Roosevelt to authorize the NDRC and its successor, the Office of Scientific Research and Development (OSRD), to oversee academic and industrial research supported by the federal government.

Bush took NACA as a model in many ways for the mobilization of science, in particular, in organizing science and technology information. NACA had institutionalized the technical report as its preferred form of scientific communication (Wooster, 1987). Industrial laboratories had developed analogous forms of internal technical communication (Hounshel & Smith, 1988; Reich, 1985). The advantages of the technical report for rapid communication as opposed to more conventional forms of scientific information are obvious. Because it is not intended for publication, it requires neither elaborate documentation nor peer review. Distribution is often limited to those who are directly concerned with the work reported, and, when classified, a technical report is accessible only to those who have the appropriate security clearances and a certified need to know its contents.

As information science pioneer Harold Wooster pointed out, "For some reason, technical documentary reports are regarded as second class citizens, which is a pity. Reports have a long and honorable history going back to 1915 and the old National Advisory Committee for Aeronautics" (Burton & Green, 1961, pp. 35–37). Bush incorporated them into the standard NDRC and OSRD contract. It called for contractors to report "the progress of such studies and investigations from time to time as requested by the Scientific Officer, and . . . furnish a complete final report of such findings and conclusions." Moreover, it laid out stringent security provisions, prohibiting the disclosure of any information concerning the contract or the results of the work to anyone except employees assigned to it during the course of the war. Failure to safeguard the information subjected "employees and contractors to criminal liability." Aliens and individuals determined by the contracting officer to be undesirable were prohibited access to contractor facilities and work (Stewart, 1948, Appendix 2).

Simultaneously, Bush continued a decade-old effort to harness microfilm as a means of information storage and retrieval. He won NDRC support for these efforts at the beginning of the war, but his efforts were frustrated by design and mechanical problems. By the end of the war he could still only project his vision of their potential (1945). He also sought to automate cryptography (Burke, 1994).

Military Security

Security classification of technical information was a relatively new process at the beginning of World War II. In 1936 Congress unanimously passed Senate Bill 1485, which authorized the president to define "vital military and naval installations or equipment as requiring protection against the general dissemination of information." Roosevelt's Executive Order 8381 gave him control of the army's and navy's classification system. The system assigned a "Secret" classification to information that could "endanger national security," or cause "serious injury to the interests or prestige of the nation, or any governmental activity thereof, and would be of great advantage to a foreign nation." A lower level of security applied to "Confidential" documents that would not endanger the national security but met the other criteria, and "Restricted" documents, which should not be published or communicated except for official purposes. The system of classification became more elaborate and restrictive during the war. The classification "Top Secret" came into use in 1944 "to cover secret documents, information, and material, the security aspect of which was paramount, and whose unauthorized disclosure would cause exceptionally grave damage to the nation." This classification severely retarded the communication of information to which it applied, according to Stewart (1948, pp. 250–251).

Bush and his deputy, Harvard President James Bryant Conant, had only had brief experience with military research in World War I. Consequently, "Secrecy as an institutional procedure also possessed for Bush and Conant none of the coercive symbolism with which it is associated today" (Meigs, 1982, p. 18; Shils, 1956, pp. 176–191). Others were more concerned. Theoretical physicist E. U. Condon, whom J. Robert Oppenheimer selected as his assistant director at Los Alamos, preferred to resign rather than administer the army's system there (Jones, 1985). Moreover, although Oppenheimer was willing to don a military uniform to get the job done, a number of the scientists whom he tried to recruit refused khaki; and so the laboratory was originally staffed with civilian scientists, with an intent—never fulfilled—of militarizing it when research reached the development phase (Bush & Conant, 1983).

Los Alamos was organized to overcome the disadvantages of classification and compartmentalization by concentrating various theoretical and experimental studies associated with the design of nuclear weapons in one place to enhance communication and increase the pace of the work. As Oppenheimer's experimental coordinator, physicist John Manley of the University of Chicago recalled,

> I had to chase around the country because there were . . . nine separate contracts with universities that had accelerators which could be used as neutron sources. . . . The problem of liaison among all the groups was a fantastically difficult one. We couldn't of course, use long distance telephone; our work was classified. Teletype connections that *could* carry classified messages were limited and next to hopeless for trying to unsnarl experimental difficulties. . . . We were so upset about the situation that shortly after General Groves was appointed . . . we approached him about establishing a new laboratory where one could bring all these separate groups, have an interchange of ideas on the experimental and theoretical difficulties instead of all this running around the country between groups of theorists and experimentalists. This consolidation was the main reason for Los Alamos. (1980)

Once together at the remote site, scientists were able to compare notes and set forward a working program of research. Manley, E. M. McMillan, and Hugh Bradner planned the experimental equipment and layout of the laboratory. The theoretical situation was set out by Robert Serber in a series of lectures in 1943 and published as LA-1, the first technical report of the laboratory (Cf. R. Serber, 1993). A review committee composed of senior scientists in the project then recommended appropriate courses of action to take.

In both MED (Manhattan Engineering District) and OSRD laboratories scientists recorded their work in technical reports. They also set up technical libraries to provide both access and security. For example, Oppenheimer recruited Robert Serber's wife, Charlotte, to run the library at Los Alamos. She was not a trained librarian, but he believed a professional librarian would be too meticulous to keep pace with the project. To assist in the work, they arranged for the loan of a number of books from the physics library at the University of California, Berkeley, and subscribed to physics journals through the university's business office, which surreptitiously transferred them to the site.

Security measures were primitive at first. Project secret reports and confidential mail were originally filed with platinum and gold foils, and scientists' cash was deposited in Oppenheimer's safe: "It had a unique combination, for although it was a three-tumbler affair, it required a swift kick at one point or it refused to open" (C. Serber, 1988, p. 65). David Hawkins, Oppenheimer's administrative director, instituted a nightly search for secret documents left unsecured. The punishments meted out were stiff fines or responsibility for a week of these security inspections. "These inspectors turned out to be the most efficient," Charlotte Serber recalled. "They seemed to get a vicious delight in discovering another offender." However, when Emilio Segrè was confronted for having left a secret document on his desk and ordered to make the rounds, he argued, "That paper, it was all wrong. I would only have confused the enemy!"(R. Serber, 1998, p. 80).

By the end of the war "the library was an odd place," Serber recounted. "It was the center for all gossip. It was a hangout. It had a document room and vault. It was the production center for all secret reports written on the Project. It was the sole owner of a ditto machine on which was run off everything from scientific reports to notices of ski club meetings, but it really was a library, too" (C. Serber, 1988, p. 70).

At the MIT Radiation Laboratory, Samuel Goudsmit organized a document room. Beginning with British reports that accompanied the transfer of radar magnetron technology in 1941, he recorded, indexed, and advertised these and other incoming reports in laboratory publications, and printed and distributed the Radiation Laboratory's own reports. It was, in the words of Henry Guerlac, "a combined reference library, editorial room, printing concern, security office, distribution center, and general information bureau" (1987, p. 677). Technical report libraries formed the neurons of the nervous system of secret scientific communities during World War II, and the Army Command Administrative Network provided secure communications between neurons, using enciphered teletypewriter messages. Bell Telephone Laboratory work on encryption provided the necessary equipment. It may also have inspired Claude Shannon's work on the theory of secret communication (Jones, 1985; Fagen, 1978; Shannon, 1993).

Postwar Secrets

The war came to an end thanks to the crucial role of radar and the definitive closure brought by the deployment of nuclear weapons to Japan. After the war, scientists hoped to return to the *status quo ante bellum* by publishing the scientific results of their work, returning to their academic and industrial laboratories, and resuming the studies that had been interrupted by OSRD and MED mobilization. To reap the scientific harvest of the war, they had to declassify wartime reports or write up their research in an unclassified form. Some scientists, like Edwin M. McMillan, who had discovered the principle of synchronous acceleration of subatomic particles while at Los Alamos, went so far as to smuggle papers out to avoid this delay (Wilson, 1993). Luis Alvarez, another missionary to Los Alamos from Lawrence's Radiation Laboratory, flew back from Hiroshima full of thoughts about a linear accelerator that he had conceived while at MIT and published without benefit of review (Goldman, 1986).

The effort to write up and declassify the wartime accomplishments was extensive. The Smyth Report led to the National Nuclear Energy Series. The Radiation Laboratory produced its own series of reports. These reports were shepherded to publication by scores of scientists, and the dispersion of scientists and engineers to universities and industry accelerated the informal dissemination of information. Like Samuel Slater, they carried in their heads the detailed plans for another industrial revolution in America.

Conant and Groves had anticipated the demand for information about the Manhattan Project. They commissioned physicist Henry Smyth of Princeton to write his famous report to provide as much information as possible, without disclosing "military secrets." Richard Tolman and his OSRD staff censored it. "Many changes in the original draft became necessary as our security criteria were applied to it," Groves (1983, pp. 348–349) remembered. "Copies of pertinent sections were given a final review by scientists in the various parts of the project, both for factual content and for security considerations. In order to speed up the process, officer couriers delivered the copies, and generally waited until the review was committed." Groves recognized the scientific and personal need that "everyone be accorded the recognition he deserved. This, we felt, would lessen the chances of future security breaks."

Groves found that scientists were not content with the Smyth Report and that they wanted to publish their work in traditional scientific journals. He appointed a Committee on Declassification, composed of the leaders of the wartime projects under his command, to advise him on the scope of declassification and the distribution of classified materials to cleared organizations and individuals. Groves ordered the study in a letter to R. C. Tolman on 2 November 1945 and appointed himself as chair and E. O. Lawrence, A. H. Compton, Harold Urey, Frank H. Spedding, R. F. Bacher, and J. Robert Oppenheimer to the committee (First report, 1945). The committee concluded that national welfare would best be served by almost total declassification, and national security would not benefit in the long term from concealing scientific information. While there were "probably good reasons for keeping close control of much scientific information if it is believed that there is a likelihood of war within the next five or ten years . . . this would weaken us disastrously for the future—perhaps twenty years hence." The committee recommended release of information that was either substantially known outside the project, was readily obtainable by theoretical or experimental work, or that would enhance American scientific or technological leadership. Information that could weaken the American military or international position would remain classified until there was "a real reduction in the threat of atomic warfare," as determined by the president of the United States and by Congress.

This recommendation left classification authority in the hands of the government and prey to the winds and rumors of war. The failure of the United Nations to internationalize nuclear power in the postwar period and the Soviet Union's development of its atomic bomb meant that complete declassification was never undertaken. There were, however, substantial amounts of material declassified in the first years after the war.

By April 1946 a Declassification Guide and Manual of Procedures had been completed and distributed throughout the MED laboratories. Groves set up a "Committee of Senior Responsible Reviewers" made up of scientists from various compartments of the project, who supervised the work of one hundred and fifteen responsible reviewers and "a considerable number of declassification officers, clerks, and typists working in the interest of the flow of scientific and technical information from restricted areas into normal channels to the maximum extent consistent with national policy and interest" (Manley, 1950, pp. 17–18). This consistency was the hobgoblin of great minds. It is impossible to estimate how much was lost to science because of the need to review and release work months, if not years, after it had been written. To be sure, the pages of the *Physical Review* swelled with articles repressed during the war, and new journals, like *Nucleonics*, provided an outlet for an outpouring of information. *Nucleonics* was the outgrowth of plans initiated in 1945 with publication of several issues each of three slim mimeographed "magazines," *Atomic Power*, *Atomic Engineering*, and *Nucleonics*. McGraw-Hill attempted to publish a periodical called *Atomic Power* in 1946, but apparently it was premature and ceased publication after three issues.

After the army proposed to continue military control of nuclear research, rank-and-file nuclear scientists lobbied Congress to create a civilian authority instead (Smith, 1971). Their efforts led to establishment of the Atomic Energy Commission (AEC) in 1946. The commission took the reins of one of the largest industrial and engineering complexes in the world. The AEC inherited the MED security and classification system, and a number of enhancements by Congress, which undertook to embargo export of all nuclear information, despite wartime agreements with the British for postwar cooperation. Congress also classified all information developed in working with nuclear fission and the fissile elements, until it could be reviewed (Hewlett, 1981). This congressionally mandated extension of the cloak of secrecy automatically classified as restricted data even information developed outside the secret scientific community. It required that creators of restricted data acquire security clearances if they were to continue to have access to it (Green, 1981; Groves to Tolman, 1945; Tolman to Groves, 1946).

H. Manley, the first secretary of the AEC's General Advisory Committee, recognized the expansion of the realm of classification in 1949. In a manuscript intended for publication in the *Bulletin of the Atomic Scientists*, he wrote:

> Science . . . especially portions of biology, chemistry, mathematics, medicine, metallurgy, and physics, is developing in this country and also abroad along two paths, restricted and open, classified and unclassified. The situation in which scientific work was, in general, freely published no longer exists and at least three nations have laws which restrict the freedom of interchange of certain types of scientific information. Undoubtedy [sic] in terms of numbers of scientific workers affected . . . the United States stands foremost." (1950, p. 1)

Congress, in its extension of secrecy in science, went far beyond Groves's efforts. It also created a precedent for other Cold War efforts to protect America's technological superiority through classification and compartmentalization, which had traditionally been restricted to wartime situations. Long and Roland (1994) surveyed the early history of secrecy and found little evidence for its use in peacetime before the nineteenth century. So strict was this imposition that when the Atomic Energy Act was revised in 1954, the Department of Defense lobbied for loosening it. Relations between the AEC and DoD with respect to nuclear weapons were unsettled after the Soviet atomic bomb explosion in August 1949, and the DoD sought a greater voice in nuclear weapons policy. Since its personnel did not have access to "Restricted Data," the DoD unsuccessfully sought to remove this classification, although it did gain access to "Formerly Restricted Data" (Maus, 1996).

New custodians had to be charged with safeguarding restricted data from the military and other unauthorized parties. The AEC's Technical Information Division (TID), created in the fall of 1947, enjoyed the luxury of a plant located in Oak Ridge for printing classified and unclassified technical reports and the burden of a declassification branch that supervised the activities of the scientists and engineers responsible for advising on declassification. "Senior responsible reviewers" included W. D. Johnson for the plutonium project, Robert L. Thornton for electromagnetic separation, Walter F. Libby for the diffusion process, Manley for weapons, and Harold A. Fidler as secretary. "Standing ad-hoc subcommittees" on chemistry and metallurgy, theoretical nuclear physics, and reactors were responsible to assist the committee, which met eleven times between July 1946, when Groves appointed it, and June 1949. Fidler later became the AEC's Chief of Declassification (Manley, 1950).

Despite their efforts, at the beginning of 1948, the first chairman of the AEC, David Lilienthal, felt the need "to get us in a position where we will really do something about this secrecy incubus. Now when we are being criticized . . . for keeping secrets . . . we are in a position for the first time to . . . junk a lot of this monkey-business" (Lilienthal, 1964, p. 442; U.S. Atomic Energy Commission, 1947–1948). Lilienthal felt that secrecy was abused by those in the military and elsewhere who used it to prevent honest debate on atomic energy issues.

The first test of a Soviet nuclear weapon in August 1949, suggested that the secret design of the atomic bomb had been stolen, despite efforts to prevent the transfer of vital defense information. A secret debate about whether to pursue development of the hydrogen bomb ensued, pitting Oppenheimer and the AEC against Ernest O. Lawrence, Edward Teller, and the defense establishment. In January 1950 Klaus Fuchs confessed his extensive espionage at Los Alamos during and after World War II, helping to resolve the debate in favor of the advocates of a "super" bomb (Williams, 1987; Moss, 1987). After the collapse of the Soviet Union the existence of another physicist-spy was disclosed by the KGB, which identified him only as "Perseus," and who was subsequently disclosed to be Ted Hall by Joseph Albright and Marcia Kunstel (1997). The classic account of the debate is by Herbert York (1976) (see also Bernstein, 1988; Bernstein & Galison, 1989; Hershberg, 1988).

At the same time Executive Order 10104, issued by President Truman on 1 February 1950, officially added the classification level of "top secret" to the existing three levels of secret, confidential, and restricted, and placed the classification system under presidential, rather than congressional, discretion. Congress reacted in a number of ways to the threat, ranging from the witch-hunting crusade of Joseph McCarthy to the requirement of a security clearance for AEC fellowship holders, even when they never used restricted data (Schrenker, 1998; Reeves, 1997; Rovere, 1996).

Spoils of War

The army and the navy, meanwhile, attempted to accommodate vast numbers of German documents captured in 1945. The Department of Commerce, as well as the armed services, participated in the plunder of people and documents well into 1947. Jackson (1992) describes documentation activities by the Air Documents Division, a precursor of the Defense Technical Information Center, involving captured German technical reports related to aeronautical science and technology following World War II (Cf. Lasby, 1971; Bower, 1987; Hunt, 1991; Gimbel, 1990a and 1990b). (For an insightful and comprehensive analysis of U.S. science policy in postwar Germany, see Cassidy, 1994 & 1996. For British activities, see Agar & Blamer, 1998, pp. 224–225.)

Thomas Pynchon's *Gravity's Rainbow* dramatizes the desperate competition between Allied intelligence agencies in occupied Europe at the end of World War II: ". . . the Faithful: the scavengers now following industriously the fallback routes of A4 batteries from the Hook of Holland all across Lower Saxony. Pilgrims along the roads of miracle, every bit and piece a sacred relic, every scrap of manual of verse of scripture" (1995, p. 391). But if Mark Twain in *The Innocents Abroad* found several tons of the True Cross, these visitors found hundreds of times that in "scripture." The documentation gathered in Germany at the end of World War II overwhelmed Allied information and intelligence services.

The information-gathering effort was initiated in 1944 when the Allied Combined Chiefs of Staff ordered a search for war secrets in occupied German territory. Many groups were involved, including several air technical intelligence teams from the navy and army air force. The head of the army air force effort, Caltech aeronautical engineer Theodore von Kàrmàn, gained support from Army Air Force Commander H. H. Arnold for a highly secret project to screen, organize, and catalog 186 tons of documents. The recovered documents were collected in a six-story building at 59 Weymouth Street in London. This "index project" was supervised by twenty-five prominent American scientists and aeronautical engineers under the auspices of the U.S. Navy, U.S. Army Air Force, and British Air Ministry (von Kàrmàn, 1967; Goldman, 1950; Jackson, 1949.)

The personnel of the Air Documents Research Office (ADRC) separated technical from nontechnical documents, sorted technical documents according to source libraries, and constructed “possibly the most rapidly compiled subject heading list in existence” (Jackson, 1949, p. 779). The catalog cards created in this preliminary processing and microfilms of the documents were sent to two hundred agencies. As many as 650 documents were processed daily, and over four tons of documents were screened by the ADRC staff. The ADRC was subsequently transferred to Wright-Patterson Air Force Base in Dayton, Ohio, along with 800,000 documents, and reconstituted as the Air Documents Division (ADD), Air Material Command.

> A more fortunate situation now as to space, personnel, and equipment enabled ADD more closely to approach the ideal “industrial pipeline” make-up. . . . all jobs connected with document processing were analyzed into their elements and lesser skilled persons would be utilized to perform those elements. (One group just established the author entry, another group merely the imprint, another the collation, another the subject headings, etc.) Professional librarians were hired for the document processing procedure to oversee establishment of new subject headings. (Jackson, 1949, p. 780)

Over 55,000 technical reports were eventually processed and combined with the resources of the technical library at Wright-Patterson Air Force Base to form one of the streams that fed a river of military technical reports in the late 1940s and early 1950s. In 1949 the Department of Defense chartered this organization as the Central Air Documents Office (CADO). It was to receive, organize, and distribute those documents of interest to aviation for all three services and to industrial, educational, and research institutions participating in federal aeronautical research and development programs (Goldman, 1950; Jackson, 1949; Jackson 1992).

Captured documents relating to the German atomic bomb project showed only that they had accomplished little, as interrogations and covert recordings of German nuclear scientists confirmed (Goudsmit, 1947; Operation Epsilon, 1993). It was, therefore, more plausible to American politicians that the atomic bomb might remain an American monopoly, and, as Gregg Herken (1980) has shown, they placed their diplomacy and national security on that foundation. Although Dean Acheson, then Undersecretary of State; David Lilienthal, Truman’s choice to head the Atomic Energy Commission; and Oppenheimer tried to open up channels for international cooperation with the Soviet Union, they were unsuccessful in averting the nuclear arms race.

Lewis Strauss, one of the first AEC commissioners, “did not share the prevailing state of euphoria as to Stalin’s amicable intentions.” Strauss sought to resist such pressures for scientific openness, which were based on the Atomic Energy Act’s call for “the dissemination of scientific and technical information relating to atomic energy . . . to provide that free interchange of ideas and criticism which is essential to scientific progress.” Instead, he supported his position on the basis of the act’s prohibition of “exchange of information with other nations with respect to the use of atomic energy for industrial purposes.” This stance divided him from the other commissioners: “As I adhered to the letter of the law, the brand of ‘security obsession’ was early burned upon me, and I still wear it” (Strauss, 1962, p. 256).

Strauss’s involvement with the navy’s wartime program to develop the proximity fuse convinced him that such weapons could be developed in secrecy. His connection with the Naval Technical Mission persuaded him that the Germans had done so, as well. It

> turned up an astonishingly large and heterogeneous variety of scientific information, material, and people[,] . . . located cunningly concealed laboratories and manufacturing installations (by the ingeniously simple expedient of tracking power lines); [and] found refugee scientists hidden in mines and caves, camouflaged wind tunnels, and rocket plants. It took possession of tons of documents and reports. (Strauss, 1962, p. 149)

Strauss recognized the advantages of a technological lead in nuclear weaponry, and he sought to “preserve that advantage as long as possible by locking up information on atomic energy” (Pfau, 1994, p. 97). He even sought to restrict foreign distribution of radioisotopes, which Strauss believed contained information that might be of use in producing weapons. Oppenheimer ridiculed Strauss’s position on radioisotopes during the 1949 “incredible mismanagement” hearings of the Joint Committee on Atomic Energy. He compared their importance to shovels and beer in the creation of atomic energy and ranked them somewhere between electronic devices and vitamins (Pfau, 1994, pp. 108–109). The hearings resulted from revelations that a Communist had received an AEC fellowship, which ballooned into a full-scale investigation of the commission. As a result AEC fellowship holders were required to take a loyalty oath and sign an affidavit that they were not Communists (Marks, 1949; see also Joint Committee on Atomic Energy, 1949).

Strauss launched a campaign within the government to build a super bomb in the wake of the Soviet detonation of their first atomic bomb in the summer of 1949. Aided by Edward Teller and Ernest Lawrence, the Department of Defense, and the Joint Chiefs of Staff, he prevailed over his fellow commissioners and the General Advisory Committee of the AEC in the secret debate over the H-bomb.

Strauss was able to forge a formidable security apparatus within the AEC, of which he became chairman in 1953. The elaboration of the system of classification was accompanied by a tightening of the personnel security system. Everyone involved with atomic energy was subjected to greater scrutiny, and most notoriously in the case of Oppenheimer, many people were deprived of their security clearances. As Eisenhower's choice for chairman of the AEC, Strauss presided over the inquisition of his old enemy. Many other scientists fell prey to the security apparatus of the military and the AEC and lost jobs in industry, academia, and federal laboratories (Pike, 1947; see also Martin, 1946; Engel, 1948; Miller & Brown, 1948; Davies, 1948; Committee on Secrecy and Clearance, 1948; "AEC Criteria," 1947).

Access and Security

Custodians of classified documents had to devise new systems to make scientific and technical information available to those who had a legitimate and legal need to use them. The problems of handling large amounts of classified and unclassified information led CADO to convene a conference in 1949 on the problems of centralized documentation at Wright Patterson. At this time the Air Technical Index, which had been set up in 1947, provided for an automatic, selective exchange of classified information through the Standard Aeronautical Indexing System. It was devised under contract by the Institute of Aeronautical Sciences, which consulted three thousand of its members and two thousand users of CADO in formulating 48 categories and 385 subcategories of technical information, in order to provide guidance to over 15,000 subject headings.

Eugene Jackson of CADO noted that the difficulty of finding information was complicated by military security, which he believed had been developed to protect tactical, strategic, and diplomatic messages. "However," he remarked, "it is coming to the attention of personnel concerned with the military documentation program that scientific materials are being unduly shackled by the imposition of classifications intended for another kind of material" (1950, p. 4). In particular, the dissemination of information was blocked by reserving the authority to declassify documents to the originating agency or individual, both ephemeral in the course of time, rather than allotting it to others conversant with the state of the field:

> CADO has literally hundreds of documents in its collection that it believes are over-classified but which cannot be downgraded now because that agency which prepared the report is no longer in existence . . . the existing military classification directives impose a tremendous obstacle to . . . disseminating technical information." (Jackson, 1950, p. 9)

The Special Committee on Technical Information of the DoD Research and Development Board concurred that technical information should be disseminated promptly to every one, assimilated and correlated with similar material, and made available to all who needed it in their work. Moreover, the committee held that research and development outside DoD needed to be integrated with this database. To avoid duplication of effort, it recommended that "a significant portion of money being spent on research and development be allocated to the specific purpose of creating better methods of insuring that information is recorded and is organized in such a way as to be readily available" (Jackson, 1950, p. 10).

Faced with approximately 4,000 cubic feet of reports, CADO sought to save space through miniaturization. As one military overseer remarked, "Many persons have looked hopefully to the future when all documentation will be done by electronic or other revolutionary methods," but microfilm was still the most convenient means. Not only did it reduce the volume of reports by a factor of ten or more, it also made distribution of multiple copies simpler. Most researchers found this format unobjectionable, and some contractors made full-sized copies from microfilm for internal distribution. The AEC, on the other hand, distributed its reports by printing them after establishing a minimum level for automatic distribution. "The AEC is controlled by the needs of the users, and . . . the user does not desire micro-reproduction" (Warheit, 1950, p. 31). Microfiche was not yet a feasible replacement.

Both CADO and the AEC agreed that IBM

punched-card equipment was a promising tool for cataloging and retrieval of reports. The AEC made particular use of such machines to process classified documents requiring hand receipts. IBM reported that it was investigating the major problems in centralized indexing and searching.

Although CADO was capable of handling approximately 70,000 documents a year, estimates of the total number of reports of interest to military researchers—370,000—drove the DoD to standardize its report formats through interservice agreements, style manuals, and contractual language.

Growth of the AEC Secret Scientific Community

The growth of the AEC following the decision by President Truman to accelerate development of the hydrogen bomb vastly increased the realm of secret scientific communities within its laboratories and production facilities. Livermore was founded as a branch of the University of California Radiation Laboratory at Berkeley in order to serve as a second weapons design laboratory. Production reactors were built at Savannah River to produce more fissile materials. Components of nuclear weapons were produced at Monsanto, General Electric, Pantex, and other new industrial laboratories (Anders, 1987). Although still small compared with the DoD—as were all other government agencies—the AEC was large compared with almost all other public or private enterprises in the United States.

The AEC's security system was very costly. In 1953 the University of California Radiation Laboratory reported security operating costs of $509,079, while Los Alamos Scientific Laboratory spent $383,000 (Reynolds, 1953; Hoyt, 1953). The total did not include "Inefficient Labor Cost while Awaiting Security Clearance," document handling ($42,600), classification and declassification effort ($10,100), overhead, special procurement for security purposes ($23,000), or depreciation of security equipment ($10,000), which brought the total cost to $963,479, a figure Reynolds anticipated would increase as Livermore grew. The total estimated costs for security classification of both federal agencies and federal contractors—which includes personnel, information, and physical security as well as training and management cost—totaled $5.26 billion in 1996. The cost estimates for the CIA were not included because they are classified. Of the agencies reporting, the two accounting for the largest amounts were the Department of Defense at $2.4 billion and the Department of Energy at $92.7 million. This $5.2 billion estimate includes only direct costs and does not include the loss—which many conclude is enormous—that is incurred by the government because of the lack of adequate oversight and open debate of programs that are classified (Garfinkel, 1996; see also Powers,1999).

Many scientists refused to take positions in the laboratories, and a number of scientists within them were discharged. Laboratory contractors complained that the commission reported derogatory information on others who did apply for jobs, "without making a definite recommendation. I judge that the [University of] Chicago's practice is that as soon as the Commission says some one is undesirable, they simply drop them off the payroll and are not inclined to fight back with the Commission as much as Brookhaven has done" (Knox, 1949).

The waning of the "Red Scare," the end of fighting in Korea, and the advent of a president with the prestige and military credibility sufficient to make hard decisions about nuclear weapons relieved the pressure. Over thirty thousand classified documents were in the AEC system when the 1954 Atomic Energy Act and Eisenhower's Atoms for Peace program dictated a revision of the AEC classification guide to make information available for industrial development of nuclear energy. The result was the declassification of eleven thousand and downgrading of eight thousand documents in 1956 and an additional nine thousand in 1957. The AEC also provided 1,404 access permits clearing 22,352 individuals for access to classified documents in order to build nuclear reactors, use isotopes, and mine uranium (Atomic Energy Commission, 1955).

The act also resulted in a stampede to the private sector by entrepreneurial scientists like Frederic de Hoffmann, an important participant in the development of the hydrogen bomb, who left federal service to create the General Atomics Division of General Dynamics (Seidel, 1995). This diaspora exacerbated the problem of classification for the AEC and was, in part, resolved by declassification of subject areas like controlled thermonuclear research, which Strauss made the subject of international display at the Geneva Conference of 1958. Ironically, publication of formerly classified fusion research tempered the interest of industrial concerns in the new technology by revealing how little progress had been made (Bromberg, 1982).

The opening of the closed world of fusion research suggests some of the limits of secret science: among others, lack of peer review, exclusion of politically unacceptable scientists, and lack of international exchanges.

To overcome these problems, secret scientific communities undertook a number of initiatives. Classified meetings, already common at Los Alamos during World War II, became a normal counterpart to the open meetings attended by uncleared scientists. In addition, classified technical journals were established to share information within the secret scientific community of the Atomic Energy Commission weapons laboratories. In this way a simulacrum of the larger world of science was created.

In addition, as the number of classified military technical reports grew, CADO became the Armed Services Technical Information Agency (ASTIA) and undertook to solve the problems of centralized distribution through automation. The result was the Defense Documentation Center (DDC), now known as the Defense Technical Information Center (DTIC), which provided technical report abstracts, work-unit information summaries, research and development planning reports, and independent R&D reports within the closed community of military laboratories and contractors (Defense Documentation Center, 1960).

The history of the development of the Defense Technical Information Center is beyond the scope of this essay (Wallace, 1996; Molholm et al., 1988). To indicate the usefulness of the DOE and DoD secret information systems to historians, however, I reflect below on my own experiences and those of my co-authors using these systems to write the histories of national laboratories and of military laser research and development.

Historian in Classified Worlds

To write a history of the Lawrence Berkeley Laboratory, which included the Livermore branch now known as the Lawrence Livermore National Laboratory, I wanted to see still-classified AEC documents at Livermore, Los Alamos National Laboratory, and DOE headquarters and field offices. The University of California president's office secured an appropriate clearance (of the sort granted to members of the Regents of the University of California whose purview includes both Livermore and Los Alamos). The official historians of the AEC, whose works not only provided a comprehensive guide to the history of the commission but also references to documents used in their research, led me to both classified and unclassified documents important to our study (Hewlett & Anderson, 1962; Hewlett & Duncan, 1962; Hewlett & Holl, 1989). Jack Holl and his staff at the DOE history office assisted us in our studies of Atomic Energy Commission records then held in Germantown, Maryland, and we were also assisted in our research by archivists and technical librarians at Brookhaven National Laboratory, Oak Ridge National Laboratory, and Argonne National Laboratory, as well as those at Berkeley and Livermore. We were also the beneficiaries of the work of Allan Needell and Jane Wolff for the American Institute of Physics, which had produced a number of reports on the DOE laboratory archives (Wolff, 1985; Warnow et al., 1985; Warnow et al., 1982).

The access to classified documents helped fill in many gaps in our understanding of the history of the Lawrence Berkeley Laboratory. The minutes of the Atomic Energy Commission and of its General Advisory Committee provided a national policy context within which we could situate the research and development efforts in the DOE laboratories. However, the materials that were made available in unclassified form deleted much that was still considered secret. Since we had seen the original documents, this was not a problem for our understanding and interpretation of the history, but the admixture of unclassified material with still classified information meant that we could not have had access to the former without the latter. Thus, much of what we learned was not secret but could not have been obtained without a clearance, for, once the text was removed from its classified context, it was often meaningless. Once identified and removed from that context, however, it could be used with an understanding of its significance without revealing information that might harm national security.

The need for access to classified information in writing history related to the AEC and its successors is an artifact of the very broad classification authority given to them by the Atomic Energy Act. This information is "born classified" and, except for historical investigations, is not declassified. The historian cannot investigate it without a clearance, and the efforts of the DOE to declassify large amounts of information, as was done in the 1970s, have been fraught with peril. Wholesale declassification has led to mistakes that have embarrassed, if not compromised, the nuclear weapons community, and consequently, declassifying documents one at a time remains the mode of choice. It remains to be seen if the recent "openness" initiative of the Department of Energy will alter this situation.

I discovered the secret world of DoD information via the Institute for Defense Analysis (IDA) guide, *How to Get It* (Defense Technical Information Center, 1992). I was surprised to find that a whole corpus of scientific literature existed that had not even been mentioned in my courses in the history of science and technology, not to mention the historical literature. When I had an unclassified search of DTIC done by the staff of the University of California Lawrence Berkeley Laboratory, I found what I thought was a bonanza: abstracts of hundreds of technical reports relating to military laser R&D. On a subsequent visit to the Naval Weapons Center (NWC) at China Lake, another outpost of the DoD's secret scientific community, I displayed this treasure and was told that it represented but a fraction of the technical reports available on the subject. The DTIC searcher there, F. Fisher, offered to conduct a more thorough search, which resulted in some 50 cubic feet of material, a large fraction of which was classified. (I had, however, to negotiate with Office of Naval Research [ONR] Security to see these results. It seems that after making the DTIC search, NWC personnel learned I was not a government employee but, rather, a consultant with clearance and left it to ONR to make the decision. The ONR security officer in Washington decided to take the risk without reviewing the material, which was in San Francisco.)

This material served as the basis for my research in the Laser History Project. In the course of that effort I found technical reports in libraries at AEC national laboratories; in air force, army, and navy laboratories; and in the archives of a few defense contractors who granted access to outsiders. A number of military historians offered hospitality. However, when the originating agency had been reorganized or dispersed, and none of its successors was willing to take the responsibility for granting me clearance, I was stymied.

I was able to overcome these difficulties with the aid of the Laser History Project's advisers, who enjoyed sufficient status within the defense community that their intervention and correspondence authorized my access to any document relating to the history of lasers. As one explained to military security officers, "He's a spy, but he's our spy." These letters opened doors from California to Boston.

One Special Access Program report was initially refused despite this comprehensive need to know, until I telephoned one of the authors whom I had recently interviewed and was added to the distribution list. The ONR arranged for a special review of the products of my research to avoid site reviews at every laboratory I visited. The ONR Patent Counsel's Office on Treasure Island provided space for storing and an office for consulting classified reports and interview transcripts. The Patent Counsel, Chuck Currey, was a congenial host for my work for a year and a half. His staff assisted me in the transcription of interviews and made security cabinets available for my work. William Condell of the Laser History Project Advisory Board was responsible for these arrangements, as well as for arranging the initial funding of the project.

The difficulty of transporting the classified tapes of my interviews was largely overcome by ONR's conferral of courier status. (I was told that I must destroy these tapes if my conveyance were hijacked by terrorists, and I debated whether I should eat the tapes or carry a large magnet to degauss them. Both seemed equally conspicuous and potentially lethal remedies, and so I was glad that the occasion did not arise.)

It is obvious that without these efforts on the part of my military patrons to make access and funding available, I would not have been admitted to the secret scientific community of military laser research and development. Once access was granted, however, I also had to assume responsibility for securing classified materials and for making sure that they were reviewed appropriately. This seems to many historians a burden that they should not bear, although scientists and engineers in these communities are accustomed to them. Although tedious and time consuming, these efforts were legitimate and effective, in my view, because of the broad and comprehensive research I undertook.

In addition to technical reports I found many other indications of the creation of secret scientific communities in my research. There are proceedings of classified conferences organized by the Office of Naval Research, the Air Force Office of Scientific Research, and other military sponsors of fundamental research. The weapons laboratories also publish classified journals. Although there are no formal professional societies of secret research to my knowledge, these vehicles perform the same functions for scientists and engineers working in the defense community that meetings and journals do for academic scientists. They permit an exchange of ideas, updates on progress of research, and opportunities for cooperative research.

Viewed from the outside, this community seems to threaten the traditional norms and values of science (see also Foerstel, 1993). From the belly of the beast, however, secret science is merely a different subdiscipline, with its own literature, meetings, laboratories, and concentrations of effort. Journalistic accounts of the community as well as biographies of some of its leaders have appeared, and many scientists who span the boundaries between the worlds of secret and academic science publish in both arenas.

The information systems developed by the Atomic

Energy Commission and the DoD should be seen as part of these communities. Like their patrons, technical libraries partake of both secret and open science and face the problems reconciling the desire to know with the need to know. The formal and informal systems that certify the need to know and the level of classification accessible to a patron are additional procedures that they must observe, but they do not differ substantially from other forms of controlled circulation. For the catalogers, indexers, and abstracters of this information, classified information presents a challenge because their product must be customized for different sets of users, but this, too, is not vastly different from the activities of open information science, as represented by such agencies as the National Technical Information Service (NTIS). Indeed, historian Colin Burke argues that the Cold War transformed the scientific and technical documentation aspirations of the American Documentation Institute into a highly profitable industry (Burke, 1994, p. 211, n. 13).

Profitable, if not perfect. Any number of studies of information systems have pointed out the fragmentation, difficulties, and limits of federal information systems (Committee of DDC Users 1969, pp. 5, 14; Coordination of information, 1961; Auerbach Associates, 1976; "Contract Status Report," 1975). Some of these problems were particularly acute for classified information. One study for the DDC by Auerbach Associates identified the problem in the defense department:

> DDC must be even more concerned than other information transfer organizations (such as NTIS) with the rapid delivery of current information, especially if it is classified. This conclusion is based upon the finding that users with Top Secret classifications found the currency of the information they received less satisfactory than did those with Secret or lower level classifications. DDC is one of the few S&TI [scientific and technical information] and RDT&E [research, development, testing and evaluation] management information services that provide classified information. (1976, p. 34)

The trade-off between speed and security was compounded by the compartmentalization of information such that even the abstracting and indexing services were insular. Indeed, by 1975, one study found that the Advanced Research Projects Agency (ARPA); the Energy Research and Development Administration (ERDA, the successor to the AEC and predecessor of the DOE); the National Aeronautics and Space Administration (NASA); the National Agricultural Laboratory; the National Bureau of Standards (NBS); the National Library of Medicine; the National Oceanic and Atmospheric Association (NOAA); NTIS; the Wright-Patterson Air Force Base Foreign Technology Division; the Air Force System Command's information center; MASIS; the Army Library and Modernized Army Research and Development Information System (MARDIS), and the Naval Material Command's Navy Technical Information (NTII) all provided similar information, used state-of-the-art techniques for information handling, reflected the broad range of information-handling activities of interest to DDC, and processed scientific and technical information, research, development, and testing and evaluation of management information.

Compartmentalization, classification, confusion, and information (C^3I) characterized these systems: "Each major information system has evolved at different points in time to meet different objectives," one study concluded, and added that

> the technologies these systems employ are not readily transferable to other system environments. Previously the diversity among systems resulted in progressive improvements. Today, however, the sheer number of diverse methods of system operations has resulted in difficulties of information exchange [and] in adverse effects among users. (Auerbach, 1975)

Here again, classified information was identified as a culprit in hindering interagency cooperation.

These straws in the wind suggest that the handling of scientific information by many agencies of the secret scientific community continued to frustrate efforts at centralization of scientific information throughout the Cold War. It is perhaps significant that such new agencies as NASA, the Air Force Systems Command, and ARPA all developed their own information agencies, notwithstanding the concern within the Office of the Secretary of Defense to reduce interservice rivalries, duplication of effort, and other dysfunctional aspects of its lack of integration. The continuing bifurcation between DOE and DoD information systems suggests that the centripetal forces of agency growth and differentiation are not easily overcome.

At the dawn of information science T. S. Eliot asked, "Where is the wisdom we have lost in knowledge? Where is the knowledge we have lost in information?" To answer this question literally would seem to be a reasonable objective for the field of science information. The coordination of classification and secrecy with this goal has presented a particularly challenging problem. Secrecy clogs the arteries of our scientific and technical information systems. Radical surgery to relieve this condition in the Soviet Union resulted in the death of the patient. Glasnost has yet to come to the United States.

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