for use on the telephone. Spedding recalled several farm terms developed by the Ames group. "Eggs" were 2" diameters of uranium and often the caller would indicate "2-dozen eggs shipped." Later, when Clinton wanted a 1" x 4" length of uranium shipped, these were called frankfurters or hot dogs; billets 4" in diameter and 2-3-feet long weighing 250 pounds were called "cheeses." Iowa State shipped uranium scrap turnings as "hay." Boron, a dangerous poison and contaminant, was called Vitamin B. Reports referring to a percent of Vitamin B content contained in the metal or tube alloy meant that the uranium contained a certain percent of boron [241]

Code names were also used for the heads of laboratories and other prominent scientists. Dr. Enrico Fermi, for example, was called Mr. Farmer, Dr. Eugene Wigner was known as Mr. Warner, and Dr. Arthur Compton answered to Mr. Comas.[242] Sometimes, though the code name system backfired. In his manuscript history, Spedding explained well what could happen to even a Manhattan District person who made a mistake in realizing the importance of security as far as codes were concerned. As noted earlier, documents of specified classifications were delivered in certain ways. By 1943 and 1944, secret documents were usually sent by registered mail, and top secret

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[241]R. S. Apple, "Letter to C. M. Cooper on Proposed Codes at the Metallurgical Laboratory," October 30, 1942 Spedding Papers; Spedding, interview 5 with Calciano, 10-11; Frank H. Spedding, "A Security Scare—Boy Saying Uranium," 1-2. Humorous names also appeared. At some point later in the project, when Iowa State began shipping thorium billets, some people in the Chicago Metallurgical lab called thorium "mernalloy" after the actress, Myrna Loy. (Spedding, "A Security Scare," 2.) See also Frank H. Spedding, "Interview with George Tressel for film on anniversary of CP-1," July 12, 1967, Transcipt in Ames Laboratory Papers, 10-11.

[242]Frank H. Spedding, "Top Secret Incident," Spedding Manuscript, 1; Compton, *Atomic Quest*, 141

ones were sent to Ames by a courier. For delivery of top secret documents, usually the courier was a lieutenant who would come to Ames by train or plane. He would contact the director, Spedding, personally and get his signature on the document before he left. To protect the identity of the directors, each courier used code names to hide their true identity One time, a man carrying a British top secret document on turning rhodium into platinum arrived in Ames looking for Spedding. Spedding related the rest of the tale in his history:

> [He] went to the telephone booth at the Sheldon Munn Hotel and got out his little black book which informed what my true name was instead of my code name, and what my telephone number was. He called me and I made arrangements to meet him at my office. When he arrived, he suddenly became very concerned, because he had left his little black book with the code names for all prominent scientists in the phone booth. We immediately sent him down with a car, but the little black book was gone. He was a very concerned young lieutenant, with some justification, because he had to report the loss! I never saw the young lieutenant again, but I did hear from Washington gossip that he had been transferred to a company which was stationed on the outermost Aleutian Islands.[243]

Whether or not all of the story is true is probably not so important, but it does point to the fact that the Manhattan Engineer District considered adherence to its security policies a serious matter indeed

Sometimes secrecy and protection of documents led to unusual applications. At Iowa State, all books on atomic energy and related topics were removed from the College library and placed in a room behind a barricade that was built across the east and north halls of the first and ground floors in the

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[243]Frank H. Spedding, "Top Secret Incident," Spedding Manuscript, 2.

Chemistry Building. According to one scientist on the project, since Spedding had been given almost carte blanche from President Friley to obtain whatever he needed, when several scientists needed access to books on radio-chemistry, the library was instructed to let him have any books he wished on indefinite loan. To explain the loan to the Ames Project, the entry in the check-out records in the library told users the books were at the bindery. Scientists thus had their own private library behind the wall of secrecy, probably a great convenience as well as a security measure to let no one know what was being used, but any student who wanted information on a field of atomic energy found books that had once appeared in the library suddenly and inexplicably missing.[244]

Evidently, newspapers in Ames and the surrounding towns obeyed the censorship orders prohibiting any news about the secret project. From January 1942 until August 5, 1945, there were only passing references to the project in the *Iowa State Daily Student*, the College newspaper. It was not because the project was so secret that no one knew about it. In fact, there was no attempt to hide the fact that war research was being conducted on campus; no one though questioned just what kind of research was undertaken In the student

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[244]Svec, interview with author, 1991, 3. See also Daane, telephone interview with the author. The books were still behind the barricade in 1946, when an auditor from the Project noted that: "Library books are numbered with yellow paint and charged out by a librarian on a loan basis." (E. Stimpson, Auditor's Report, November 12, 1946, OSRD Files, Finance, National Archives, Washington, DC). These same books after the war became the nucleus of the Physical Sciences Reading Room which Spedding had built from funds left from overhead recovery. (Margaret Mae Gross, "Interview with the Author," January, 1992, Ames, Iowa; Charles H. Brown to Charles Friley, "Memorandum on the Future Organization of the College Library," November 10, 1944, Library Dean's Office Subject File, Record Group 25/1/1, William Robert Parks and Ellen Sorge Parks Library, Iowa State University, Ames Iowa, 1-2 (hereafter called Library Papers); "Physical Sciences Reading Room," *The Library at Iowa State* 2, no. 3 (November 19, 1947): 33.

newspaper, censorship rules were first referred to even before the Manhattan Project took over. In an editorial on May 22, 1942, the newspaper editor hinted that tough measures would come to those who were caught either intentionally or unintentionally revealing secret information.[245]

Direct references to the project during the time period totaled four articles and one editorial. A blaze that damaged the chemistry roof was reported in July 1942. The Ames Fire Department was called, but about thirty members of the chemistry staff had almost extinguished the fire before the fire trucks arrived. The explanation for the fire, given by W. F. Coover, was: "an experiment using highly inflammable materials and a continuously running motor was being conducted for defense work."[246] This article was the only time the project, even in an indirect way, made the front page of a paper before the official announcement in August 1945 about the role of the College in war work. Later that year, Coover reported in the paper that "26 members of the Chemistry Department are engaged in vital war projects of a confidential nature."[247] His reference was never explained in any follow-up article. Earlier that same month, B. H. Platt, the head of the building and grounds department at the College, indicated "considerable remodeling on the inside of the [Chemistry Building] where storerooms and classrooms were rearranged."[248]

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[245]Lyle Abbott, "Be Patriotically Quiet," *The Iowa State Daily Student*, May 22, 1942, 3.

[246]"Chemistry Roof Blaze Brings Out Firemen," *The Iowa State Daily Student*, July 7, 1942, 1.

[247]"Chemists Needed for War Work," *The Iowa State Daily Student*, September 23, 1942, 4.

[248]"Building and Grounds Men Kept Busy," *The Iowa State Daily Student*, 6.

No mention was made that this extensive remodeling included erecting barricades across the halls of the building. A more direct reference to secret research was made in January 1943 when a report appeared about the building of a gas main for the new research laboratory east of the Dairy Industry Building. "What the gas will be used for was not revealed since the activities within the laboratory are defense secrets."[249] This article was the last to appear and only a small letter to the editor in 1943 complaining about the lack of fire exits in the Chemistry Building followed. In that letter, a reference was made by the student to new construction that " closed off the hallway."[250] The voluntary censorship plan must have worked because no more mention was made of the project at all. This search of the papers probably proved that Groves' method to allow casual references in every day matters did work at least at Iowa State College. The secret was never that there was secret work going on; it was just that the details of the involvement with atomic research and any mention of the Manhattan Project was prohibited.[251]

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[249]"New Research Laboratory Connected to Gas Main," *The Iowa State Daily Student*, 7.

[250]Louise Jaggars, "Believes Chemistry Building Need More Fire Exits," *The Iowa State Daily Student*, March 30, 1943, 3.

[251]There is some evidence that even town's people knew that secret work was on campus. For example, Margaret Mae Gross, a young secretary in the library at the time remembered taking her father's farm milk to the Dairy Industries Building for testing and knowing that secret work was going on next door (Gross, interview with author, January 1992). Also Bess Ferguson, a longtime Ames resident remembered walking by on the cinder path that ran near the present day Physical Plant and knowing that secret work was progressing in what later became known as Little Ankeny (Mrs. Fred Ferguson, "Interview with author," April 21, 1986, Ames, IA, 10). The attitude in both cases seemed to be that even if you knew, you just did not talk about it; after all a war was in progress.

Materials Shipping Security Regulations

Federal rules and regulations for shipping materials

The OSRD and NDRC developed no specific requirements for shipping hazardous materials, so the general regulations of the War Department regarding all military information served as the guide.[252] However, by the time the Manhattan District took over, shipments were becoming more numerous, so the District instituted a survey in November 1943, followed by specific regulations on handling shipments. Guard pools were created at specified sites around the country, including over twenty guards who were stationed at Chicago to guard rail and truck shipments of critical materials to Hanford from sites in the East and shipments of recovery materials from Hanford to sites in the Midwest and East (including Iowa State College). The courier system was also enlarged with pools established at various sites, including Chicago, especially after the institution of the Top Secret classification scheme, to carry small items, often radioactive, in personal luggage from site to site. Finally, a scheme of eight forms of transportation methods ranging from Railway Express to Courier in descending order was standardized to prescribe shipment of the critical materials by the most appropriate and secure means.[253]

Materials shipping security at Iowa State College

Harley A. Wilhelm received the honor of taking the first "shipment" of uranium to Chicago when he made the historic trip with an 11-pound ingot

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[252]*MED History*, Book I General, Volume 14 Intelligence and Security, 5.1.

[253]*MED History*, Book I General, Volume 14 Intelligence and Security, 5.1-5.9.

carried in the old suitcase some students had earlier given him.[254] Frank Spedding continued that tradition for a short while when he transported metal on his weekly trips into Chicago. Soon the quantity and weight of shipments grew too great to hand carry, so the project began to use railway express and then freight. Shortly before moving to the Physical Chemistry Annex, the small 4" x 4" x 3' boxes would be trucked down to the depot to catch a Railway Express car, but when the production plant was set up at the Annex, a train box car would be called to come to the railroad sidetrack that ran by the power plant close to the Annex. Men from the plant would load the train, lock it, and give instructions for shipping the materials. On the other end, quite often Chicago, someone from the laboratory would meet the train and unload it. The railroad personnel had no reason to suspect what was in the little wooden boxes. The trains appeared to come into Ames empty and leave empty because usually one layer of 4" by 4" boxes was all that was necessary to come close to exceeding the weight limits. Most freight cars at that time held approximately 40,000 pounds, so quite often less than 400 boxes would meet the weight limits. Most trains left Ames with what looked like a higher floor, but if anyone had examined the train closely, they would have seen axles straining or even bending under the extreme weight.[255]

Early under the jurisdiction of the Manhattan District, there were no special guard details. After the Manhattan District required shipments of this type to carry guards from the Chicago pool, two men in civilian clothes,

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[254]Wilhelm, interview with author, 11-12.

[255]Peterson, interview with author, 7.

usually overalls and sweaters, came and left with the shipments. Spedding recalled that people in town soon spread stories that empty train cars were coming into the College with two hobos in the car and were leaving empty with those same two hobos aboard. Those who saw the trains probably thought that the scientists or the College had so much power that they could order and send out empty trains when farmers throughout the state could not get a train to ship out their corn.[256] But security remained intact and no one reported in the newspapers the incidents of the empty trains.[257]

Plant Security

Governmental plant security regulations

In the case of academic institutions, the NDRC and OSRD required no special integrity checks or loyalty signatures for the institution as it did for individuals within the organization. Unlike the educational institutions, companies and other private contractors were checked for violations of laws, fraud, and any poor performance with government contracts. OSRD and NDRC made no physical inspections of the majority of plant operations, since it did not have a separate staff from the committee or organization to perform

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[256]Spedding, Interview 5 with Calciano, 10; Peterson, interview with author, 1990, 6-7; Wilhelm, Interview with author, 1990, 16-17; Spedding, Wilhelm, Daane, Interview, 1967, 12; Frank H. Spedding, "Freight Car Boondoggle," Spedding Manuscript, 1.

[257]There was only one small breach, or what was initially believed to be a breach, in security during the shipping days. A young boy of about twelve, watching some of the men loading the Railway Express car, noticed that they were having trouble lifting the boxes. He shouted, "What are you loading there, uranium? When military security got wind of the incident, they were sure a breach of security had occurred. Upon investigation though, it seemed that the boy had been studying chemistry and the elements on the periodic table. He had made the assumption that the highest numbered element (uranium) was also the heaviest. He just used that as a reference to the heaviness of the boxes. No one from the Project had talked. (Frank H. Spedding, "A Security Scare--Boy Saying Uranium," Spedding Manuscript, 1-2.)

them. All of that activity was left to individual contractors. There were twenty-five plants, however, plants that were contributing a major portion of research expertise, whose operations were checked for any violations of government security measures. The violations though were reported only to OSRD and it was left to the committee to bring about compliance with the recommendations. The national headquarters adopted minimal security measures: staff wore photographic badges like those used by the Army and Navy, the Federal Works Agency provided guards for duty around the building, and OSRD installed electrical burglar alarms in sensitive areas to be turned on after the offices closed.[258]

The Manhattan District instituted a much more thorough program of plant security when it launched its Plant Protection Program in August 1943. The program required a survey of all installations engaged in important work to discover if conditions existed to delay and hamper production or to violate security, particularly checking to see if a loss or comprise of sensitive information occurred. Reports and recommendations were forwarded to the Area Engineer or an officer assigned to that facility as security officer. The District compiled a list of important facilities and revised it bi-monthly starting in June 1944. Each facility was rated *A* (where interruptions would seriously delay the project work). *B* (infractions would cause minor delay), and *C* (where violations would cause no delay). Each report contained a composite rating of *Excellent, Good, Fair,* or *Poor*. All A and B facilities had to maintain at least

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[258]Stewart, 253-254.

Good and Fair ratings respectively, and it was up to the area engineers to bring them into compliance.[259]

Protection against sabotage was another concern of plants, so erecting barriers like fences and screens as well as locking entrances and providing guard details was common practice. Usually workers wore an identification badge to gain entrance to restricted areas that were normally set aside or protected in some way. The Manhattan District also instituted a rigorous program of visitor access in order to protect the plant from the unwanted, the undesirable, or the curious. For a visitor to gain access, written permission had to be obtained from the District Engineer Office. Since most visits were personnel employed elsewhere on the project, background checks had already been completed. Those completely outside the jurisdiction of the Manhattan Project facilities at first had to undergo a background check before gaining admittance to a site facility. Later, the Area Engineer's Office initiated a standard pass and completed checks, which speeded up the process of visitor access. When visits were considered urgent by the contractor, as was quite often the case later in the war, teletype and telephone clearances substituted for written requests.[260]

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[259]*MED History*, Book I General, Volume 14 Intelligence and Security, 54-55, 4.1-4.9.

[260]*MED History*, Book I General, Volume 14 Intelligence and Security, 4.9-4.11. See also The War Department, "Plant Protection for Manufacturers," Pamphlet No. 32-1, May 1, 1943, revised from the February 1942 pamphlet of the same name for more information on every aspect of plant security from sabotage to fire protection.

Plant security at Iowa State College

At the start of the project, Iowa State developed its own security system. After clearances were received, all employees were informed that the Ames Project's purpose was to obtain pure materials used in the construction of an atomic bomb and that the work was highly classified. No one was to discuss the work with another person except others on the project. Papers and notebooks were always to be locked up and no non-project person who was in the area at the time should see handwriting on paper or on the blackboard By summer, the Chemistry Building had two wooden partitions or barricades erected, one at each end of the area in which the project people were working, and a guard was posted at each barricade at all times to check identification badges of workers and passes from visitors. That guard kept a log of visitors with names, time of arrival, and time of departure. There were no special barriers erected at the production plant, but it was guarded at all times and spotlights were placed outside and fluorescent lighting inside for extra protection. Since three shifts ran 24-hours per day, it was probably thought that guards and the spotlights were sufficient. The Manhattan District added some guards to the local force and also required extensive logs to be kept. Work was compartmentalized and only the top men in each project were briefed on work elsewhere.[261]

John W. Moore, personnel director of the Ames Project, in an interview with a local Ames paper in 1945, explained a bit more about the local personnel

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[261]Frank H. Spedding, "Problems Encountered with Setting and Maintaining a Security System," Spedding Manuscript, 1-2; Frank H. Spedding, "Security," Spedding Manuscript, 1-2; "Building and Grounds Men Kept Busy," 6; "'Little Ankeny' Plays Part in Victory," *Iowa State Student*, August 15, 1945, 6.

situation at Ames, especially the hiring and maintaining of guards. Moore conducted the personnel checks for many of the Ames workers hired on the project. He was also responsible for hiring guards. These men, usually local residents, were equipped with revolvers and controlled passage in and out of buildings. Moore went on to explain the tight security:

> A system of pass identification (if you didn't have one, you didn't get in period, and if you had left it home you went home after it period) was worked out for employees. The guards were tough, too. On one occasion, even Moore was refused admittance because he had left his pass at home, although he remedied that situation by writing one out.[262]

Several scientists found out that the guards were just as strict about notebooks or research materials left about. If someone left a notebook unlocked, he or she was telephoned at home and told to come back immediately to put it in the safe. Needless to say, coming back late at night to put away secret materials soon cured the forgetful scientists about carelessness.[263]

Few documents remain recording the results of plant inspections,[264] but in one recorded instance, the security inspection team proposed some unusual measures to correct a perceived security problem. Iowa State disposed of the slag material from the reduction experiments at the College dump. The material included calcium fluoride, lime, and probably a little uranium that might be left in the slag. The calcium chloride, according to Spedding, served

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[262]Bernie Kooser, "Intricate System of Passes for Bomb Project at College," *Ames Daily Tribune*, August 10, 1945, 8.

[263]Peterson, interview with author, 2.

[264]See, for example, John L. Ferry, "Letter to F. H. Spedding about Visit to Project to take Radioactivity Tests," August 18, 1943, Ames Laboratory Papers.

as a good rat poison, but the security officials for the Manhattan District were concerned about the uranium pieces as a security risk. The project employees were instructed to dig up material that had been deposited in the dump and ship it to New Jersey for storage as well as any future waste. Security inspectors also noticed that small amounts of the uranium tetrafluoride were sometimes deposited in the soil at the Chemistry Annex building. The Ames Project personnel dug up six inches of soil in a strip twenty inches wide all around the Annex to ship to New Jersey also. Filters were installed on the exhaust fans to eliminate the deposition of uranium outside the annex.

The project administration searched in vain for containers to ship this material in until Wayne Keller suggested that in his Kentucky hometown, whiskey barrels were quite often left over from the distillation process and could make suitable containers. Spedding approved the suggestion and asked him to order 1,000 whiskey barrels. By mistake, Keller's secretary typed on the purchase order, "one thousand barrels Hiram Walker Whiskey." The purchasing agent of the college, Mr. Potts, had been told early in the project that for security reasons he was to approve anything Dr. Spedding ordered, and the government would pay for it. Despite the security requirements, Potts called Spedding at 6 o'clock one morning and questioned why he was ordering whiskey through the College in Iowa, a dry state. Needless to say, Spedding straightened out the agent and assured him that it was just a typographical error; he only needed the barrels.[265]

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[265]Spedding, interview with Hacker, 37-38; Frank H. Spedding, "Security Involving Scrap," Spedding Manuscript, 1-3. This story also appeared in varying forms in several publications including many Ames Laboratory publications after the war.

That was not the only trouble the project had with those whiskey barrels. When the barrels arrived, a group of men who did the heavy lifting around the project called the "Bull Gang," were instructed to dig up the dump material. Suddenly, Dr. Wilhelm had too many men volunteering for this dirty and strenuous duty. He suspected something was amiss, and when he went to the dump, he found that the men were propping the whiskey barrels on the edge of a hill and draining about a cup of whiskey from each barrel before filling them with the dump material. Despite the happy workers, the slag was eventually crated and shipped to New Jersey as the instructions provided. What New Jersey finally did with the fine Iowa black dirt and slag is not mentioned in any records, and evidently no one to this day knows.[266]

Occasionally, more than plant security was threatened by secrecy. Because the chemicals were volatile, frequent fires errupted. Since the Ames fire department could not come into the buildings that housed the production plant or the research activities because of secrecy requirements, the College allowed the firemen and equipment to come, but remain outside in the event a fire went out of control. Luckily, the workman were always able to use the lime and powdered graphite around the production building to squelch any flames. Some days that was quite a chore; there were at least six explosions in one day because some wet raw lime being mixed in the bomb retort containers adversely affected the reduction experiment.[267]

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[266]Frank H. Spedding, "Security Involving Scrap," Spedding Manuscript, 1; Frank H. Spedding "Interview with Dorothy Kehlenbeck," July 5, 1961, Transcript in Spedding Papers, 5-6; Tressel, 10-11; Daane, Spedding, Wilhelm Interview, 1967, 13-14.

[267]Kooser, 8; Frank H. Spedding. "Explosions," Spedding Manuscript, 4-5; Daane, Spedding, Wilhelm Interview, 1967, 25.

Incidentally, that was the day that several secretaries threatened to resign and one Army officer received a rather suspicious wound. Secretaries, who were at an office attached to the production plant, had to pass through the firing pit area in order to get outside the building. After that series of explosions, they were wary of staying any longer in a potentially dangerous work environment. Spedding, however, convinced all but two of them to stay after he promised to strengthen the wall between the office and the operations area and to cut a door to the outside directly from their office. That same day Major H. A. Savigny, an Army officer who also happened to be the Area Engineer, came to investigate the problem after the third explosion. While he was there, another explosion occurred, and, of course, he immediately ran for the door. As he was talking to someone a few moments later, he suddenly grabbed his leg, and a small piece of metal fell from a burned hole in the seat of his pants. Since he sustained a minor burn, he was kidded that he was probably entitled to a purple heart that could be used as a patch to cover that hole in his pants. Others, however, thought it might be somewhat hard to justify his "bravery" since it was apparent what he was doing when he was injured.[268]

When there were breaches of plant security, Spedding could often depend upon his own personnel to let him know about potential problems. Only one letter existed in the documentary files about a potential lack of security, and that was from a night shift manager at the Physical Chemistry

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[268]Frank H. Spedding, "Explosions," Spedding Manuscript, 5-6; Daane, Spedding Wilhelm Interview, 1967, 11-12, 25-26.

Annex I. During a blackout one night that foreman, testing the project security, found that he could move freely around the building without being challenged since only one roving guard was posted. He noticed that there was no guard in the back room where locked files were located, so he suggested that guards be posted in each room. The three regular guards then could be placed at the front door, the back door, and roving.[269]

Compartmentalization of Information

Federal rules for compartmentalization

Compartmentalization of information as conceptualized by the NDRC and OSRD meant that no person contracting a project from the government needed more information than what was necessary to complete a contract. As a result, no one except the members of the committee or some central staff members knew the entire operation of NDRC or OSRD. The purpose of this restrictive policy was to minimize the amount of damage if any individual, either intentionally or inadvertently, divulged secrets.[270] The policy was highly criticized by the scientists throughout the war as a detriment to efficiency. The principle, as it operated under NDRC and OSRD, was probably as much a concession to the armed forces to allow them to entrust the agency with classified information as it was to protect indiscretion since there were no known cases of the latter.

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[269]Jack Boyt, "Letter to Frank H. Spedding, on Security," July 30, 1943, Spedding Paper.

[270]Stewart, 28-29.

The guiding principle for the Manhattan Engineer District was also compartmentalization, interpreted in the most stringent of terms. Groves took his rules from an intelligence bulletin that stated:

> Two cardinal rules govern the right to possess classified information:
>
> (1) The person must be authorized to have the information (i.e., known to require the information in connection with official duties and in performance of his work.)
>
> (2) If the person is authorized to have the information, then he is entitled to only so much as is necessary for him to execute his function.[271]

Groves applied this policy much more literally than the guidelines used under the NDRC or OSRD. For example, blueprints for plant construction project had to be broken into parts to conceal total project designs; orders for raw materials were supposed to come from a number of suppliers because a large quantity coming from one supplier could betray the project's purpose; and functions like assembly of certain equipment and its manufacture were to take place in separate locations. The Army took a much stricter view of information and personnel exchange between laboratories and even within each laboratory. As a result, written agreements such as one developed between Los Alamos and Chicago Metallurgical Laboratory were spelled out in such minute detail that the only practical channel open for exchange of information was for Oppenheimer or his representative from Los Alamos to visit the Chicago laboratory in person when information was needed.[272] The

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[271] *MED History*, "Safeguarding Military Information," 4.

[272] *MED History*, Book I General, Volume 14 Intelligence and Security, 6.3-6.4; Jones, 268-270; Hewlett and Anderson, 238-239.

case of holding a colloquium at Los Alamos, for example, created such a stir within the project that the Military Policy Committee sent Bush to Roosevelt for a letter that could be sent to Oppenheimer and project directors emphasizing the need for strict compartmentalization. Finally, a compromise was reached with Los Alamos where they were allowed to continue weekly colloquiums for exchange of information; these meetings were restricted as to who was given access, a concession to Groves' extreme interpretation of compartmentalization.[273]

Compartmentalization at Iowa State College

There was some compartmentalization at Iowa State, especially after the Manhattan District took over. Only the top research directors had access to what transpired at other sites and travel between sites became more restrictive. But the seminars started under Spedding in 1942 continued throughout the war. The Manhattan District seemed to be much more interested in the products that came out of the Ames Project itself, and since production was not interrupted, the Manhattan District did little to interfere with the internal workings of the scientific side of the laboratory.

Just like at other institutions, the Manhattan District did provide its own separate staff to Iowa State College. An area manager, security agents, safety engineers, and auditors were placed on campus to run the project administratively. These agents could not interfere with the scientific progress,

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[273]Franklin Roosevelt, "Letter to Leslie R. Groves, on Security in Manhattan Project," June 29, 1943 in *MED History*, Book I General, Volume 14 Intelligence and Security, Appendix A-1; Hewlett and Anderson, 238-239; Wyden, 99-100.

but they reported production progress, checked security measures, and audited travel and other expense accounts. Spedding revealed in his manuscript history that these people were rarely scientists, or were they even security agents by training. They were often businessmen or lawyers, so they had little experience with either how science worked or how to make a plant secure. They used compartmentalization techniques that were handed down from headquarters, but often they did not understand what they were implementing.[274] So often this level of organization seemed to the scientists more of a nuisance than actually facilitating the project's goals.

The District Area Manager himself was Spedding's counterpart on the Army side. Usually, he was a major in training for a higher management position in the Army and because Ames was such a small installation, the area managers changed as often as every six months. It became almost a joke that Ames was breaking in so many new managers constantly. Spedding said the Army told him (in jest he assumed) that they would send someone to Ames, and, if he could get along with Spedding, he was ready for a larger assignment, such as a project that employed 5,000-30,000.[275]

Compartmentalization affected many sites much more than Iowa State. Because Iowa State, by the time the Manhattan District arrived, had already completed much of its original research under freer conditions, it was not as hampered. From 1943 onward, Iowa State was primarily serving as a

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[274]Frank H. Spedding, "Security of Scientific Information, 1941-1954," Spedding Manuscript, 3.

[275]Frank H. Spedding, "My Personal Contacts with General Groves," Spedding Manuscript, 2-3.

production facility and also doing specific research at the request of other contractors. Its purification program may have benefited from access to others' files, but most of that was done on demand from another contractor with whom conversation was allowed. The Manhattan District's strict rules and regulations were more a nuisance than probably anything else.

Effect of Security on the Academic Laboratory, 1942-1945

Despite the requirements and regulations imposed by added security when the Manhattan District acquired the atomic bomb project, the Ames Project remained an academically-managed unit. The security requirements were added along side the academic structure, and even the military employed academic management techniques when time and expediency required it. For example, compartmentalization often broke down when a laboratory wanted information to continue its project. Los Alamos was a perfect example when Groves allowed the weekly seminars to continue. Groves never set foot on the Iowa State College campus during the war, and Spedding recounted several instances when security was compromised to accommodate other concerns. For example, once a security officer asked that bars be placed on the windows in the Chemistry Building to prohibit entry by some saboteur. There were no bars placed on the windows because the design of the building required that ventilation go through those windows when experiments were in process. Another time, a Manhattan District officer told Spedding to darken some windows in the Chemistry Building. They were never darkened because Spedding thought that would make the working area for the scientists too dark. It was also a well-known fact that the Manhattan District officers were

required to go through channels, but if a research director had an urgent problem, he could even directly approach Groves if he wished.[276]

Security did prevent publication of the results of research, and on the surface that was a military victory. But that requirement was imposed long before the military took over, and the scientists found a substitute for publication that served the project just as well in secrecy—the report. In the beginning of the project, weekly reports were required, then bi-weekly, and eventually monthly reports of progress in each laboratory. Each project leader was responsible for his own group's report and those were summarized by Spedding and submitted to the Metallurgical Laboratory.[277] An elaborate process of coding, numbering, and distributing these reports was instituted, and the only way added security from the military affected this system was to require that only laboratory or project directors request reports from another facility. Written agreements had to be formulated with each facility as to what it could provide to others. But by the time this took effect in 1943 and 1944, most scientists already knew, in a general way, who was working on the project and what each laboratory might discover. It was a matter of getting around the paperwork to obtain information.

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[276]Spedding, interview with Hacker, 1980, 25-26.

[277]Numerous memos and letters abound in the files relating to the receipt of reports, weekly, bi-monthly, and then monthly. For a sampling, see A. H. Compton, "Letter to S. K. Allison, Encouraging Widespread Use of the Reports for Dissemination of Information," June 5, 1942; J. A. Wheeler, "Memo to Research Associates on the Change in Plans for Weekly Reports to a Monthly System," August 13, 1942; Warren C. Jones, "Memo to Boyd, Burton, Coryell, Seaborg, Spedding, Eastman, and Latimer Discussing the Receipt of Reports to Provide Summaries for Dr. Compton," August 4, 1943; "Request for Assistance in Indexing Your Reports," n.d.; A. H. Compton, "Letter to F. H. Spedding Requesting a Report for the Transfer of OSRD Contracts to Manhattan District," April 19, 1943; and Canfield Hadlock, "Letter to F. H. Spedding on the Consolidation of Monthly Reports and Letters into Semi-monthly Reports," September 6, 1943, all located in the Ames Laboratory Papers.

Visits to other facilities were still allowed under the Manhattan Engineer District though more paperwork accompanied each visit. There is some discrepancy in how much time the military security requirements actually delayed the project. In a Senate Hearing after the war, Leo Szilard complained that he thought compartmentalization delayed the atomic bomb deployment by up to eighteen months.[278] When one considers that in the National Academy Report in 1941, Compton predicted a device by January 1945, compartmentalization and other security measures delayed the achievement of the final goal only until August. Other problems were just as important in the delay as the nuisance of security measures: innovative procedures had to be developed; shortage of raw materials delayed the development of processes; and the experimentation and calculation and recalculation in a new field certainly caused as much delay as security. Groves even hinted in his book that perhaps the Manhattan Project speeded up the process because scientists were not allowed to discuss every alternative and spend a great amount of detail in the discussion process. When a method worked, it was immediately used and usually became the preferred method; action on all others was stopped.[279] Perhaps, in some strange way, that was the case. The military did not change the existing academic structure set in place by Bush; it merely added procedures and requirements along side the other

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[278]"Hearings Before the Senate Committee on Atomic Energy, U.S. Senate Resolution 179: A Resolution Creating a Special Committee to Investigate Problems Relating to the Development, Use, and Control of Atomic Energy," November 27, 1945-February 15, 1946, 294.

[279]Groves, 140; Hewlett and Anderson, 239. See also Richard G. Hewlett, "Beginnings of Development in Nuclear Technology." *Technology and Culture* 17, no. 3 (July 1976): 469.

structure. In most cases when security was lifted, what was left was an academically-styled unit or laboratory.

However, there was one area in which security continued to exert a detrimental influence and that was in the declassifying process of documents used in the creation of the atomic bomb and the many processes developed for atomic energy applications. As early as 1944, there was a movement under way to discuss ways to notify the public about atomic energy. Henry Smyth was hired to begin the history of the project and release certain kinds of information at the end of the war. The process of declassification of information though became ensnared in procedure after procedure. The Tolman Committee (Spedding served on the committee) was commissioned in early 1946 to implement a declassification scheme, designating which information could be released to the public and when it could be released. Information to be released immediately included that of "a broad scientific or general technical nature."[280] Information to be held secret included the "design and availability of atomic weapons. On these we believe that release of information must be made a matter of general policy to be determined by the Congress and the President."[281]

The major complication after World War II was the developing Cold War, with the Soviet Union as the target of continued secrecy. The Tolman Committee recommendations were not implemented quickly by the new civilian agency overseeing atomic research. By 1948, three of four research

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[280]"Statement of Recommendations on Release of Atom Bomb Project Information," Spedding Papers, 2.

[281]"Statement of Recommendations on Release of Atom Bomb Project," 3.

papers from the laboratories of that civilian body, the Atomic Energy Commission, were still classified "Secret." Also after the war, academic theses on atomic energy remained classified until information could be later released, and academic journals could publish nothing about atomic processes. It was not until 1955 after the Geneva Conference on the Peaceful Uses of Atomic Energy that many of the previously held secrets were released. This conference was also coupled with a directive from President Eisenhower that all atomic energy information be released so that industry could use the information to build nuclear reactors.[282]

[282]Kevles, 378; Greenburg, 216. Also see Richard G. Hewlett and Francis Duncan, *Atomic Shield, 1947/1952* (A History of the United States Atomic Energy Commission, Vol. II; College Park, Pennsylvania State University Press, 1969). At Iowa State theses also remained classified. By 1951, Robert Orr, the Director of the Library, reported that at that point a total of 26 theses were still classified and 5 were restricted. Of the 31 total, 11 were from Physical Chemistry (Robert Orr, "Record of Classified Theses Written at ISC," Library Papers).

CONTRACTING—FINANCIAL CONTROL OF THE AMES PROJECT

Introduction

Just as security challenged the administration of research, financial control also became an important issue in research administration. Financial controls were placed on the Ames Project by the NDRC, the OSRD, and the Manhattan Engineer District. Each of those wartime national organizations adopted a financial management device known as a *contract*, a mechanism that essentially redefined the relationship between government and the academic world. Unlike security, which was by and large a temporary measure that affected primarily the administration of a wartime laboratory, contract administration actually changed the nature of research administration forever.

Early University/Governmental Research Relationships

Contractual arrangements actually developed out of a long-time and somewhat ambivalent relationship between scientists and the federal government.[283] The academic scientist, particularly in the non-agricultural disciplines, generally taught courses while completing research and

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[283]For detailed reports on early governmental and academic relationships, see A. Hunter Dupree, *Science in the Federal Government*, who traces what he calls a split between the government that values primarily applied research and the universities that conduct what he calls basic research. Though this argument doesn't take into consideration all of the complexities governing the developing relations, it does portray the fact that the two entities did in many ways feel suspicious of each other. Also see Daniel S. Greenburg, *The Politics of Pure Science* (New York: New American Library, 1967), 51-67 for a discussion of pre-World War attitudes in academia and government towards scientific research.

scholarship at his/her own expense as a part of the teaching appointment. Little governmental support of academic science developed before World War II, except some attempts at supporting application-oriented research that would have short-term benefits to a particular segment of society (i.e., that provided by agricultural support or public health research). A report commissioned by Franklin Roosevelt in 1938, for example, reported that universities spent $50 million on research in 1935-36; of that $6 million came from the federal government, mostly supporting agricultural research.[284]

By the 1930s, some of the barriers to government funding changed by a complicated set of circumstances. The financial situation, caused in large part by the Depression, eroded many university endowments as well as those of private foundations that had supported scientific research through the 1920s. By the beginning of World War II, coupled with the advent of more sophisticated and expensive research equipment, the transition to large group research, and the need for large infusions of money to make new scientific discoveries in fields like nuclear physics, scientists had begun to make overtures to interest the government in funding scientific research.[285]

However, the eroding world situation was probably as much a contributor to the changing attitude as anything. Most documentary sources do not give enough credit to this dangerous condition, but physicists and other scientists were most often, as the majority of professionals and non-professionals alike, patriotic people. This situation more than anything else

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[284]*Research—A National Resource: I. Relation of the Federal Government to Research.* National Resources Committee, December 1938, 189.

[285]Greenburg, 65-66; Dupree, 367.

probably made the difference in the relationship between government and science—they needed each other to win a war which was to be fought with advancing technology as well as human resources.[286] The split between academic scientists, if indeed there was an actual split, and the government establishment dissolved when scientists and federal money were both needed to win the war against Germany.

Cementing the Relationship—Bush's NDRC and OSRD

When the National Defense Research Council (NDRC) and the Office of Scientific Research and Development (OSRD) were established, they did not create their own laboratories to support scientific efforts, but they decided to support research through existing laboratories, mostly in educational institutions. The idea was certainly novel, since during the last war scientists had most often worked in uniform at makeshift laboratories away from their home institutions. This new approach though necessitated some way to register the government/academic relationship, thus the NDRC looked at the contract as a device to cement that relationship with academic laboratories.

Interpreted in its broadest sense as an agreement between two or more parties to conduct work for the benefit of those involved, the contract had long existed as a device to control relations between the government and others. For example, the government had been known to contract for surveys of coastal or geographic areas of importance, to fund expeditions across the

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[286]Arnold Frutkin, *International Cooperation in Space* (New York: Prentice Hall, 1965), 10-17, argues that scientists in war time have generally reacted to the national needs of the country.

country, or to support some project of national importance throughout its history, but these were not by and large scientific ventures.[287] By the early twentieth century, the primary support for science funding was still located within the university structure. Government support of scientific research efforts in World War I became temporarily necessary for national defense. Scientists were recruited into the military forces and given problems, especially those of a chemical nature, to solve. The National Research Council was set up as an agency to oversee this cooperative research, but after the war when the emergency was lifted, most scientists returned to their individual institutional efforts.[288]

The agricultural research movement

That is not to say there were no cooperative ventures between the government and the academics. Federal money provided through semi-independent research institutes called experiment stations had supported agricultural research at land-grant colleges since the passage of the Hatch Act in 1887. The Adams Act in 1906, the Purnell Act of 1925, and the Bankhead-Jones Act in 1935 further codified and structured the rules for agricultural research. The experiment station was organized as essentially a separate, but cooperating organized research unit (ORU) or research institute, or center within a

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[287]For the most definitive work on government and science relations see Dupree, *Science in the Federal Government*. See also books like Alice M. Rivlin, *The Role of the Federal Government in Financing Higher Education* (Washington, DC: Brookings Institution, 1961), Chapters 2 and 3; and Homer D. Babbidge and Robert M. Rosenzweig, *The Federal Interest in Higher Education* (New York: McGraw-Hill, 1962), Chapter 1 for general historical surveys on governmental and academic relations.

[288]John C. Burnham, ed., *Science in America: Historical Selections* (New York: Holt, Rinehart and Winston, 1971), 257.

university or college. The Hatch Act was not explicit about the particular structure to be employed in the organization of experiment stations, except that the stations act somewhat like departments in colleges or universities:

> in order to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agriculture, and to promote scientific investigation and experiment respecting the principles and applications of agricultural science, there shall be established, under direction of the college or colleges or agricultural departments of colleges in each State or Territory . . . a department to be known and designated as an "agricultural experiment station" . . .[289]

Since the research crossed several departments, for all practical purposes, most stations were separately administered by their own staff, quite often run by governing boards from various disciplines in universities or colleges Early on, some university presidents even served as station directors, but by 1905 only four states remained in this situation. A more common practice saw the dean of agriculture serving as the station director.[290] This administrative structure, akin to a quasi-departmental structure, surfaced again in the twentieth century as a standard model for interdisciplinary research in physics and chemistry during and after World War II.[291] The passage of the Hatch Act

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[289]"Act of 1887 Establishing Agricultural Experiment Stations," in H. C. Knoblauch et al., *State Agricultural Experiment Stations: A History of Research Policy and Procedure*, U. S. Department of Agriculture Miscellaneous Publication No. 904 (Washington, D. C.: U. S. Government Printing Office, 1962), 219.

[290]Alfred Charles True, *A History of Agricultural Experimentation and Research in the United States 1607-1925*, U.S. Department of Agriculture Miscellaneous Publication, No. 251 (Washington, DC: U.S. Government Printing Office, 1937), 134-136

[291]Several works have been written detailing the passage and effects of the Hatch Act and subsequent legislation. See H. C. Knoblauch et al., 1962 for a summary discussion of the Hatch Act and its subsequent implementation; Alfred Charles True, 1937 for one of the first surveys of agricultural research and its relationship with the government; and Alan I Marcus, *Agricultural Science and the Quest for Legitimacy: Farmers, Agricultural Colleges, and*

and its subsequent legislation affecting agricultural research, certainly set the stage for certain notions of contract research to be implemented later in the twentieth century.

The National Advisory Committee for Aeronautics

However, the National Advisory Committee for Aeronautics (NACA) came closest to the actual model for contract research as interpreted and put into place by Bush. NACA employed a contract type arrangement to fund research in both its own laboratory and in those instances it went outside to the university. Created in 1915, NACA consisted of a committee of twelve unpaid people, including two from the War Department, two from the Navy Department, one each from the Smithsonian, the Weather Bureau, the Bureau of Standards, and five more at-large members commissioned to solve problems in the aeronautics field.[292] After splitting into thirty-two subcommittees during World War I, the Committee reorganized after the war

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Experiment Stations, 1870-1890 (Ames, IA.: Iowa State University Press, 1985) for an examination of the complicated relationships between the various peoples and associations involved in establishing and maintaining the experiment stations in the late nineteenth century. Robert S. Friedman and Renee C. Friedman, *The Role of University Organized Research Units in Academic Science*, National Science Foundation Report, NTIS PB 82-253394 (Washington, DC: National Science Foundation, 1982), 35-36 point to these agricultural units being separate from academic departments and foreshadowing a trend for research institutes in the twentieth centuries as separate, sponsored-driven and funded, task-oriented, and problem-focused entities. Agricultural research received the lion's share of federal funding from the federal government up until World War II. For example, from the time of the enactment of the Hatch Act through 1933-34, experiment stations had received almost $74 million. (Malcolm M. Willey, *Depression, Recovery and Higher Education: A Report by Committee Y of the American Association of University Professors* (New York: McGraw-Hill, 1937), 360.

[292]Roger Bilstein, *Orders of Magnitude: A History of the NACA and NASA, 1915-1990* (Washington, D. C.: National Aeronautics and Space Administration, 1989), 4.

into six technical committees and a research director who handled most administrative matters.

By the late 1920s, the committee was enlarged to fifteen members with its own national laboratory conducting most of the research work. The committee received suggestions for research from three sources: the government (most often the military), the NACA staff, and outside sources like aircraft manufacturers. The projects from outside sources were assigned to a subcommittee in the area for evaluation on technical merit and then sent to the executive committee for final approval. The suggestions from the military services and other government bureaus were sent directly to the executive committee and approved unless they duplicated work already in process. Once a project was approved, it generally ended up at the Langley Laboratory where a research authorization was written with a scientist who was allowed great latitude in the conduct of the research Review of the research was guaranteed at the beginning of the project and at intervals along the way, but researchers were essentially left to conduct the research by their own devices.[293] Prior to building the laboratory at Langley, NACA had also contracted research on aeronautics to individuals within universities. The earliest contracts were for studies on propellers with William F. Durand at Stanford, who coincidentally was a member of the main committee.[294] Even after establishing the laboratory, NACA continued to contract with universities for scientific

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[293]Alex, Roland, *Model Research: The National Advisory Committee for Aeronautics, 1915-1958* (Washington, D. C.: National Aeronautics and Space Administration, 1985): 103-106.

[294]Roland, 33.

research work. By 1939, NACA had contracts for twelve investigations at ten universities.[295] This flexible contract style of research management attracted Vannevar Bush when he became the committee's chairman in 1938.

The Contract As Developed By NDRC and OSRD

When Bush looked around for a structure to administer NDRC research, contracts were fairly common. However, those developed outside the USDA and NACA were most often military procurement devices so fraught with requirements and special safeguards that they would not work with universities that already suspected government control. When Bush originally developed the plan for the NDRC organizational structure, he made a decision to split the actual research areas from the business side of the agency under the assumption that once work started, the scientist need not worry about financial regulations with the Bureau of the Budget or the Patent Office or the other bureaucratic agencies that were concerned with the administration of research. He chose Irvin Stewart, a lawyer who had been a member of the Federal Communications Commission, to oversee the business side, or the administration of contracts.[296]

In Stewart's mind as well as Bush's, the development of a special contract with universities must "combine a maximum of freedom for the exercise of scientific imagination on NDRC problems with those safeguards

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[295]Dupree, 366.

[296]Stewart, 191; Bush, *Pieces of the Action*, 37-38. Conant, *My Several Lives*, 241.

necessary for the expenditure of public funds."[297] Upon first hearing of this new way of mobilizing science, James Conant, Bush's colleague, remembered:

> I recall saying something to the effect that, of course, we would have to build laboratories and staff them with government employees. "Not at all," Bush replied. "We will write contracts with universities, research institutes and industrial laboratories." He pointed out that such a procedure had already been used by the National Advisory Committee on Aeronautics of which he was then chairman. . . . Scientists were to be mobilized for the defense effort in their own laboratories. A man who we of the committee thought could do a job was going to be asked to be the chief investigator; he would assemble a staff in his own laboratory if possible; he would make progress reports to our committee through a small organization of part-time advisors and full-time staff.[298]

The actual contract form adopted on August 29, 1940, contained two characteristics: work at the home laboratory and complete flexibility in the research plan of attack. The performance clause, the key to the new contract, was an exercise in simplicity: the contractor would conduct studies on a given topic and make a final report on a specified date; no details were provided as to how the work must be performed.[299]

Another departure from past contracting procedures required contract negotiation with the investigator's institution, not the individual. This legal precedent freed the researcher to do the work but did not leave the institution holding the bag if additional costs were incurred. To provide further safeguards, the contract was written on a no-cost basis to the institution, plus an overhead recovery, or administrative charge, of fifty percent of the wages

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[297]Stewart, 191.

[298]Conant, *My Several Lives*, 236.

[299]Stewart, 191.

and salaries to cover the institution's cost in providing research facilities.[300] As Bush later reported:

> We proposed to contract with the university itself, thus placing on it the responsibility for all such matters, and also giving it the authority necessary for proper performance. In return we proposed to pay its overhead costs, the portion of its general expenses properly attributable to the added operation.[301]

OSRD also adopted the contract device as developed by NDRC, and by January 1943, it created what became known as Standard Form 1001 to use for all contracts (See Appendix E for a copy of this form). When procurement became a necessary part of the project as it scaled into its engineering stage, another contract form, the Standard Form 1002, was created allowing for work on a fixed price, plus a reasonable profit for the contractor. Educational institutions, however, never benefited from this form since by charter they could not make a profit.[302]

Establishing research administration at the institutional level also involved splitting the functions of business and research. NDRC and then OSRD assigned each institution receiving a contract both a research officer and a business or contracting officer. Likewise, the institution receiving a contract was expected to assign someone to handle business affairs for the institution, in addition to the principal investigator already chosen by OSRD to handle research. This important division into two functions became a characteristic of

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[300]Stewart, 191; Irvin Stewart, "Memo on Explanation of Overhead and Survey Report on Possible Changes," August 5, 1942, in OSRD Papers, Record Group No 227, National Archives, Washington, D. C.

[301]Bush, *Pieces of the Action*, 38.

[302]Stewart, 19192-198.

the wartime research, but it also continued as government relations with universities continued to grow after the war. It is still a common characteristic of academic research administration.[303]

This type of research organization succeeded then, partly because of the novel form of the contract, and partly because scientists were more than willing to support the defense efforts. By 1942, work on between 400 and 500 contracts with about seventy-five educational institutions had commenced.[304]

The Manhattan District followed the policies of OSRD and NDRC in the contracting area. It used the cost plus overhead basis for all its academic research program contracts. Payment for work completed continued by a reimbursement system just as it had under OSRD However, the Manhattan Engineer District required each contractor to submit a voucher to its assigned area office first where a preliminary audit would be conducted before the request for reimbursement would be forwarded to the District headquarters.[305]

Contracting at Iowa State College

The University of Chicago's Metallurgical Laboratory negotiated the first contract with Iowa State College, actually a subcontract from its own OSRD Contract No. OEMsr-410 in February 1942 for $30,000, to last until July 1942 to conduct experimental studies on the chemical and metallurgical aspects of

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[303]Milton Lomask, *A Minor Miracle: An Informal History of the National Science Foundation* (Washington, D. C.: National Science Foundation, 1975), 38-39.

[304]Karl Compton, "Scientists Face the World of 1942," in *Scientists Face the World of 1942: Essays by Karl T. Compton, Robert W. Trullinger, and Vannevar Bush* (New Brunswick, N. J.: Rutgers University Press, 1942), 20-21.

[305]*MED History*, Book IV Pile Project, Volume 2 Research, Part 1 Metallurgical Laboratory, Appendix D-1.

uranium and related materials.[306] Most early contracts were actually letters-of-intent with specific details to be worked out later in a formal written document. In the summer of 1942, the OSRD negotiated directly a separate contract (No. OEMsr-433) with Iowa State College for experimental studies of tube alloy and for experimental chemical and metallurgical studies in building a power plant.[307] (For examples of versions of these two contracts, see Appendix E.) In late November 1942, the Manhattan Engineer District took over OEMsr-410, changing its status to a production or supply contract and continuing it as Contract No. W-7405-eng-7 until termination on December 31, 1945.[308] OEMsr-433 transferred to the Manhattan District as Contract No. W-7405-eng-82 on May 1, 1943, when most other OSRD contracts were placed under district control. That contract with some modifications is the present contract with which the Ames Laboratory continues its work through the U. S. Department of Energy.[309] (See Appendix E for extracts of those under the Manhattan District, and the full contract with the U. S. Atomic Energy Commission is included for 1948.)

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[306]*MED History*, Book IV File Project, Volume 2 Research, Part 1 Metallurgical Laboratory, 2.1. E. I. Fulmer, "History of the Ames Project under the Manhattan District to December 31, 1946, 7 also published as *MED History*, Book I General, Chapter 11 Ames Project (Iowa State College).

[307]Vannevar Bush, "Letter to F. H. Spedding Appointing Him as Official Investigator for Contract OEMsr-433," July 20, 1942. 'Contract OEMsr-433, Supplement No. 2," December 26, 1942, 1, both located in Ames Laboratory Papers, Parks Library.

[308]Manhattan Engineer District, "History of Account," attached to an Audit by E. J. Stimpson, May 6, 1947, in Manhattan Engineer District Files, Record Group No. 77, National Archives, Washington, DC. Also see *MED History*, Book IV File Project, Volume 2 Research, Part 1 Metallurgical Laboratory, 2.9

[309]Manhattan Engineer District, "Listing of Accounts," attached to an Audit by E. J. Stimpson, May 6, 1947, in Manhattan Engineer District Files, Record Group No. 77, National Archives, Washington, DC.

As seen in the appendix, the early contracts with the University of Chicago and OSRD were quite flexible. When the Manhattan District took charge, the production contract underwent several modifications. Because all contracts were on a cost plus overhead basis, there could be no profit to an educational institution like Iowa State. Particular problems arose when the Manhattan Engineering District wanted to negotiate the contracts on a price-per-pound delivery of uranium and also on certain purity and quantities produced. However, there was no adequate way to predict the costs of these requirements. Price per pound started at about $22 when the district took control, but Spedding thought that he could make uranium for around $8.50 per pound. It was actually produced at a cost less than that, so with each contract supplement, the price was negotiated downward as quantity and purity scaled upward. Renegotiating supplements demanded by the no profit clause created a constant problem, and during the war it was never solved because Iowa State, an educational institution, was the only full-fledged industrial plant operating under no-profit requirements. Eventually, the Manhattan Project had to reimburse Iowa State for actual costs because the project could not get extra money from the College or anywhere else if the costs of materials suddenly changed or delays were encountered in the processing.[310]

By December 31, 1946, the face value of the Ames contracts amounted to approximately $7 million. However, the work, including research, production, and service had been carried out for $4 million with the laboratory producing

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[310]Frank H. Spedding, "Contracts," Spedding Manuscript, 1-2; Manhattan Engineer District, "Listing of Accounts." See the appendix for the history of costs reductions.

over two million tons of uranium billets with smaller amounts of thorium and other rare earths. Uranium production costs fell from around $22 per pound to $1 per pound before the end of the war, in most part, because of the Ames process of uranium production. All in all, the government received quite a bargain working on a no profit basis with the College.[311]

The issue of overhead cost recovery was a particular thorny issue for Iowa State because of the difference in the face value of the contracts and the actual costs incurred. After the war, that charge was negotiated and renegotiated until Iowa State finally received approximately $1.2 million in administrative charges for research and development work for the war work.[312] Some of the federal overhead money paid for a new building that linked the chemistry and physics departments physically as well as symbolically. President Friley, as controller of the overhead money, spent $10,000 for journals and books to start a Physical Sciences Reading Room on the second floor of the new administration building; some of the funds even went to assist the new commercial television station on the campus.[313] These

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[311]Fulmer, 7.

[312]Iowa State Board of Education, *Minutes of the Iowa State Board of Education*, December 9, 1947, 97. To understand the enormous value of that figure one needs only note that the entire operating budget of the College for 1944-45 was $4.5 million (*Biennial Report of the State Board of Education Ending June 30, 1946, 476*). The total value of business transacted by Iowa State during the 1944-45 fiscal year was $8 million, a 50 percent increase over the last peace time year 1941-42. Most of that increase was due to increased activity in military training and war-related research (*Biennial Report of the State Board of Education Ending June 30, 1946*, 394).

[313]Frank H. Spedding, "1946-55," Spedding Manuscript, 3; Spedding, Wilhelm, Daane Interview, 1967, 35-36. Actually Gaskill and Friley could sign for Iowa State according to a resolution adopted at the February 8, 1944 Board of Education meeting: "WHEREAS, President Friley has reported the negotiation of contracts with governmental agencies for war research, BE IT THEREFORE RESOLVED that the President of Iowa State College, the Business Manager of Iowa State College, and Harold V. Gaskill, Dean of the Division of Science be authorized to sign, either separately or jointly, contracts with U.S. Governmental

funds were spent essentially at the discretion of the President, and it was not until 1950 that a policy was created to handle this administrative money differently (see Appendix F). That policy again established the two tier system: both a science officer and a business officer for the College needed to negotiate contracts The policy for handling administrative costs was also established: that all overhead funds should go into the General Fund instead of the President's Office to compensate the College for the costs of doing research.[314]

Shortly after the war's end, Spedding approached the state of Iowa to take some of the overhead money and invest in the initiation of an Institute for Atomic Research at Iowa State College to run atomic research projects of interest to the state. The Ames Laboratory was also established in 1947 funded from the federal government, and continued under the newly formed U.S. Atomic Energy Commission the same research and development contract held by the old Manhattan Engineer District. The contract declared that Iowa State as a national laboratory should continue atomic research, particularly specializing in materials preparation research. The newly-formed Institute for

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Agencies for War Research, and to accept grants for such research programs, subject to the approval of the Building and Business Committee" (*Minutes of the Board of Education*, February 8, 1944, 273). A separate account was created to receive the funds from the government for war research, but Friley reported each of the payments to the Board of Education during the war. (See *Minutes of the Board of Education*, June 22, 1943, 181 for a report of the receipt of $300,000; *Minutes of the Board of Education*, March 28, 1944, 298 for a report of a $500,000 amount on a research supplement as well as the report of the inspection of an addition to the Physical Chemistry Annex on February 14 paid for by government funding; *Minutes of the Board of Education*, September 19, 1944 for receipt of $1,314,000 for continued research. Subsequent reports follow in June 1945.)

[314]Iowa State Board of Education, "Statement of Principles Relating to the Negotiation and Acceptance of Research Contracts," *Minutes of the Iowa State Board of Education, 1949/50*, March 15-16, 1950, 269-272.

Atomic Research would contractually administer the federal laboratory for the College.[315]

Patents and the Contracting Process

The use of the contracting mechanism by universities had one requirement that greatly affected research administration during the war as well as set a precedent after the war: all patents belonged to the United States government when research work was completed on federal contracts. This policy developed out of lengthy discussions during the time both NDRC and OSRD controlled atomic research As can be seen in the Standard Contract 1001 there are two forms for patents. The first patent arrangements, worked out with companies, essentially stated that the government received a royalty-free license from any invention developed from war research. This policy helped break the bottleneck that developed when companies refused to sign contracts that did not give them title to patents. However, all atomic research eventually came under jurisdiction of the short form which stated that the government had the sole right to determine who had title to the patents. In the beginning, the long form patent policy was used, but as the project grew, in the summer of 1942, President Roosevelt instructed Bush to make sure that the government obtain assignment of the patent titles for all research done under

[315]Note the similarities between this unit and the agricultural research units described above. Spedding went to the state legislature also hoping to receive state funding for his research unit, much like an experiment station. It was separately administered by a research institute outside any one department; it was focused upon research in both chemistry and physics as they related to atomic research; and it was sponsored by the federal government through a contract-like appropriation.

the government-sponsored programs.[316] Bush succeeded in convincing all OSRD contractors to move toward that goal.

> It was agreed that no monetary consideration would be given by the Government for the patent rights that already had been vested in the contractors through operation of the original provision, but instead that the necessary legal consideration would be supplied by the signing of supplemental agreements to continue the work, as each of the contracts involved required renewal.[317]

Bush wanted someone familiar with Army and Navy patent practices to administer patents for OSRD, so the Navy assigned Captain Robert A. Lavender (retired) the task of handling the patenting process for the OSRD.[318] When the Manhattan District took over the project, it continued the practices set up by the OSRD and even allowed Lavender to handle all patents for them as well, since he was already familiar with the rules and regulations that governed military and defense interests.[319] Bush as director of the OSRD continued to receive "on behalf of the Government, assignments of rights to inventions made under the Manhattan District contracts."[320] Bush, in turn, assigned the patents to the public, thus keeping individuals after the war from profiting from research completed by the contractors during the war.

The practice of issuing patents followed very specific instructions, and all projects upon termination had to clear up and file patents according to

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[316]Stewart, 229-230, Bush, *Pieces of the Action*, 83-84; *MED History* Book I General, Volume 13 Patents, S2, 2.1-2.4 See also Office for Emergency Management of the Office of Scientific Research and Development, "Inventions and Discoveries," Administrative Circular 10.06, *MED History*, General, Volume 13 Patents, Appendix A3.

[317]Stewart, 230.

[318]Stewart, 226; Bush, *Pieces of the Action*, 83.

[319]Stewart, 226-227; *MED History*, Book I General, Volume 13 Patents, 6.1.

[320]Stewart, 231.

those specifications. For example, research notebooks could be used as proof and evidence for both assigning the patent to the government and crediting a patent to the named contractor. This evidence was followed with statements and certifications from the prime contractor head.[321] As of December 31, 1946, over 5,600 inventions had been docketed by the Patent Advisor Lavender's office from over 2,400 prime and subcontracts.[322]

After the project was discontinued, this kind of paperwork created additional headaches for men like Spedding who not only had to worry about the disposal of property for the projects under them, but they also had to clarify what was patentable and then go through the lengthy processes of determining who should be credited for the inventions. Spedding, for example, spent countless hours and several letters clarifying the varying potential patentable processes under his control at Chicago and Ames during the war.[323]

The Impact of the Contract on Research Management Styles

The contract encouraged universities to participate in defense work because of the benefits incurred doing government research without many of the administrative problems that had previously plagued agency-supported

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[321] Army Services Forces, Manhattan District, "District Circular Letter," Legal 44-5, June 12, 1944, *MED History* Book I General, Volume 13 Patents, Appendix A10.

[322] *MED History* Book I General, Volume 13 Patents, 5.1.

[323] For just a sampling of the various cases that required Spedding's attention, see the following letters all in the Ames Laboratory Papers: Frank H. Spedding, "Letter to Col. H. E. Metcalf Regarding Case S-520, Patent for a Uranium Hydride Method Under Newton and Johnson," February 27, 1945; Frank H. Spedding, "Letter to Col. H. E. Metcalf Regarding Case S-524, Reduction of Uranium Tetrafluoride with Magnesium," May 4, 1945, Frank H. Spedding, "Letter to Col. H. E. Metcalf Regarding Cases S-4035 and S-4036, Purifying Uranium Materials," May 11, 1945.

research. At first, the contract was flexible, open-ended, and did not prescribe the work needed. Those principles laid down by NDRC and OSRD were in line with basic goals and principles of academic management techniques. The contract also allowed administration of research to be split from the actual work of research and that appeased the scientists involved. It satisfied the educational institutions because they were to be reimbursed at cost, plus an administrative fee for providing facilities and other necessities to enable the scientists to undertake the necessary work without jeopardizing the financial situation of the institution. The patent clause became an additional control device over the project because no one person could benefit financially from the work undertaken though due credit for effort and innovation was promised. The Manhattan District did not do away with the contract or patent principles laid down by OSRD, even though it made the contract somewhat more prescriptive, particularly under those regulations that controlled production.

But the contract did more than enhance the academic style of management; it allowed the relations between government and universities to continue in much the same fashion after the war was over. Unlike World War I, the scientists did not retreat from seeking research funding from the government, because Bush had brought that research support along with its administration to the researcher in his own laboratory, and in order to continue work with necessary support, the scientist had a stake in seeing that the relationship with government continue to grow after the war. The contract helped cement that relationship between the academic world and government in ways that heretofore had been unknown. The contract

remained the primary way of doing business with the government until the National Science Foundation was created in 1950. At that time, the non-military agencies like the National Science Foundation began to develop what they called a new mechanism to control scientific research. However, if one looks closely at the *grant*, it was first and foremost a flexible contract. It had all the characteristics of Bush's earlier device: non-limiting in its geographical applications, supporting project research with no prescribed formula except the demand of a report at project's end, the award of the funds to the institution rather than the individual, and fiscal as well as research responsibility demanded from the institution. The contract then—first a wartime fiscal device—grew to be the controlling device for most research administration after the war. It was the foundation upon which the academic world and the government built a long-term relationship, a relationship that appeared to mutually benefit both parties.

WORKER HEALTH AND SAFETY

Introduction

> Mr. Premo Chiotti was working with Dr. Wilhelm and me on the reduction of thorium fluoride to thorium metal. Mr. Chiotti was adding a booster to the reaction in a room a few doors down the hall from my office. Suddenly there was a terrific explosion which blew out several of the windows in the front of the chemistry building. When I came out of my office to see what had happened, the corridor was filled with dust about six feet above the floor to the ceiling. I was relieved to see that Mr. Chiotti had not been injured, but he looked very dazed and was pacing up and down the corridor. As I passed him, I heard him muttering, "I must have misplaced that decimal point, I must have misplaced that decimal point."[324]

The story above was probably embellished in the retelling, because health and safety of workers were serious matters on the Ames Project. As long as the atomic bomb project remained a research project, worker health protection schemes concentrated on protecting scientists, who by training were careful experimenting with potentially hazardous materials, from the dangers of known radioactive and toxic materials that would be used in the wartime laboratories. Little was known though about the risks with new materials like plutonium, thorium, and other potentially harmful daughter products created as a result of splitting uranium. Since the scientific literature contained information about the harmful effects of radioactivity, it was natural to start a protection program upon that established knowledge base. However, when

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[324]Frank Spedding, "Humorous Story Concerning Explosions and Education," Spedding Manuscript, 2.