OPERATOR: THORON EXTRACTION LOADING OPERATOR   1 men/shift; 1 shifts/day; 1 men/day

THORON

Operation or Operating Area	Time Per Opera. (min)	Opera. Per Shift	Time Per Shift (min)(T)	No. of Samples	Concentration d/m/m^3 Low	High	(C) Avg	Avg Con'c.* Times Total Time (T X C)
Unloading 190# Fibre Pak carton of THT in hopper	2	6	12	3	0	900	460	5,520
Loads up correct weight THT into 3 small cartons	2.3	6	14	3	0	2000	730	10,200
Dumps cartons containing THT into tank	1	6	6	2	0	300	150	900
G.A. Thorium extraction (Room 203)	-	-	418	8	60	365	175	73,200
Hallway (Corridor)	-	-	30	2	11	16	14	520
Lunch (Seminar Room)	-	-	60	2	24	31	28	1,680

* Adjusted to two significant figures.

ΣT 540 $\Sigma (T \times C)$ 92,000

$\Sigma \frac{(T \times C)}{\Sigma (T)}$ = 170 d/m/m^3 = 2.4 Times the Maximum Allowable Concentration.

Initial ~~Maximum~~ Thoron Daughter = 19,000 d/m/m^3 at actual time of survey

USA 012569

OPERATOR: CASTING OPERATOR   1 men/shift; 1 shifts/day; 1 men/day

THORON

SECRET

Operation or Operating Area	Time Per Opera. (min)	Opera. Per Shift	Time Per Shift (Min)(T)	No. of Samples	Concentration d/m/m³ Low	High	(C) Avg	Avg Con'c. * Times Total Time (T X C)
G.A. West Control Panel	-	-	450	2	0	14	7	3150
G.A. Th. Casting Area (Room 29)			30	6	0	45	16	480
Lunch (Seminar Room)			60	2	24	31	28	1,680

*Adjusted to two significant figures.

ΣT 540 $\Sigma (T \times C)$ 5,310

SECRET

$\Sigma \frac{(T \times C)}{\Sigma (T)}$ = 9.8 γ/m^3 = 0.14 Times the Maximum Allowable Concentration.

Unit, Thoron + Daughter = 1000 d/m/m³ at actual time of survey.

USA 012570

1

OPERATOR: Milling Operator 1 men/shift; 1 shifts/day; 1 men/day

THORON

Operation or Operating Area	Time Per Opera. (min)	[redacted] Per Shift	Time Per [redacted] (min) (T)	No. of Samples	Concentration d/m/m³ Low	High	(C) Avg	Avg Con'c.* Times Total Time (T X C)
Milling or Cropping Thorium pieces	-	-	420	1	69	-	61	25,600
G.A. Room 22	-	-	60	3	0	200	68	4,080
Lunch (Seminar Room)	-	-	60	2	24	31	28	1,680

* Adjusted to two significant figures.

ΣT 540 [redacted] $\Sigma (T \times C)$

$\Sigma \frac{(T \times C)}{\Sigma (T)}$ = 58 d/m/m³ = 0.83 Times the Maximum Allowable Concentration.

Thoron

Initial Thor. Daughter= 6400 d/m/m³ at actual time of survey

USA 012571

OPERATOR: Foreman Crude Dept. 1 men/shift; 1 shifts/day; 1 men/day

THORON:

Operation or Operating Area	Time Per Opera. (min)	Operations Per Shift	Time Per Shift (min)(T)	No. of Samples	Concentration d/m/m^3 Low	High	(C) Avg	Avg Con'c.* Times Total Time (T x C)
G.A. Thorium crude area- Room 33	-	-	480	11	0	90	36	17,300
Lunch Room	-	-	60	2	24	31	28	1,680

* Adjusted to two significant figures.

ΣT 540

$\Sigma (T \times C)$ 18,980

$\Sigma \frac{(T \times C)}{\Sigma (T)}$ = 35 d/m/m^3 = 0.5 Times the Maximum Allowable Concentration.

Initial Thoron Daughter- 3800 d/m/m^3 at actual time of survey

OPERATOR: Machining Operator   1 men/shift; 1 shifts/day; 1 men/day

THORON:

Operation or Operating Area	Time Per Opera. (min)	Opera. Per Shift	Time Per Shift (min) (T)	No. of Samples	Concentration $d/m/m^3$ Low	High	(C) Avg	Avg Con'c.* Times Total Time (T X C)
Sawing Thorium Billet	-	-	480	3	0	30	17	8160
Lunch (Seminar Room)	-	-	60	2	24	31	28	1680

* Adjusted to two significant figures.

Σ T 540 [redacted] Σ (T x C) 9840

$$\Sigma \frac{(T \times C)}{\Sigma (T)} = 18 \ d/m/m^3 = 0.26$$ Times the Maximum Allowable Concentration.

Initial Thoron Daughter = 2000 $d/m/m^3$ at actual time of survey

USA 012573

OPERATOR: **Casting and Desincing Operators** 3 men/shift; 1 shifts/day; 3 men/day

THORON

Operation or Operating Area	Time Per Opera. (min)	Opera. Per Shift	Time Per Shift (min)(T)	No. of Samples	Concentration d/m/m^3 Low	High	(C) Avg	Avg Con'c.* Times Total Time (T X C)
Unloading Desinced Billet								
Remove furnaces by cart to hoist, remove quartz cover tube and insulation bricks.	2.2	4	9	3	100	860	430	3,870
Remove 2 graphite pots containing 2 desinced billets, unloads by dump- by dumping on floor, weighs, removes to shipping area.	3.6	4	14.5	3	120	1690	800	11,600
Chips 2 billets and blows off dust with air hose.	3.3	4	13	3	0	-	0	0
Loading Desinced billets								
Inserts 2 desinced billets into Be crucible. Adds thorium scrap and places top on crucible.	7.5	4	30	3	111	200	103	3,090
Places quartz tube around Be crucible. Adds graphite between quartz tube and crucible. Places quartz cover tube on furnace. Air hoses unit.	9.5	4	38	3	60	290	170	6,450
Removes furnaces to remelt areas. Secures cover tube with sealer.	2	4	8	3	0	-	0	0

* Adjusted to two significant figures.

ΣT ______ SECRET $\Sigma (T \times C)$ ______

$\Sigma \frac{(T \times C)}{\Sigma (T)}$ = ______ /m^3 = ______ Times the Maximum Allowable Concentration.

USA 012574

OPERATOR: **Casting & Dezincing Operators (continued-2)** 3 men/shift; 1 shifts/day; 3 men/day

THORCH

Operation or Operating Area	Time Per Opera. (min)	Opera. Per Shift	Time Per Shift (min)(T)	No. of Samples	Concentration d/m/m³ Low	High	(C) Avg	Avg Con'c.* Times Total Time (T x C)
Unloading Casting								
Removes quartz furnace top, graphite top and vacuum furnace	3	4	12	2	0	70	35	420
Removes quartz inner tube graphite. Blows off furnace	2.7	4	11	2	0	60	30	330
Unloading Furnace Room 22								
Unloading furnace insulation and Thorium metal casting.	3.7	4	15	2	120	200	160	2,500
Clean off furnace parts, brick insulation	17.5	4	70	2	0	1530	765	53,600
Clean outside furnace cover tube with scrapper, brush and air.	5.2	4	21	3	0	35	20	420
Loading Crude Biscuit for Dezincing								
Cleaning graphite heater pots that holds crude biscuit	2.9	4	12	2	0	-	0	0
Loading 2 crude biscuits into pots, place insulation brick around pots, place quartz tubes on furnace unit. Air hoses.	9	4	36	2	144	200	172	6,190
Gen. Air Room 29 (Thorium Casting)	-	-	190	6	0	45	16	3,040

* Adjusted to two significant figures.

ΣT SECRET $\Sigma (T \times C)$

$\Sigma \frac{(T \times C)}{\Sigma (T)}$ = ________________ d/m/m³ = ____________ Times the Maximum Allowable Concentration.

USA 012575

OPERATOR: Casting & [illegible] Operators (continued-3) 3 men/shift; 1 shifts/day; 3 men/day

THORON

Operation or Operating Area	Time Per Opera. (min)	Opera. Per Shift	Time Per Shift (min)(T)	No. of Samples	Concentration d/m/m^3 Low	High	(C) Avg	Avg Con'c.* Times Total Time (T X C)
Lunch	-	-	60	2	24	31	28	1,680

* Adjusted to two significant figures.

Σ T 540 Σ (T x C) 93,800

SECRET

$\Sigma \frac{(T \times C)}{\Sigma (T)}$ = 173 d/m/m^3 = 1.5 Times the Maximum Allowable Concentration.

Initial Thoron Daughters 19,000 d/m/m^3 at actual time of survey

USA 012576

OPERATOR: HF OPERATORS 2 men/shift; 1 shifts/day; 2 men/day

THORON

Operation or Operating Area	Time Per Opera. (min)	Opera. Per Shift	Time Per Shift (min)(T)	No. of Samples	Concentration /m³ Low	High	(C) Avg	Avg Con'c.* Times Total Time (T X C)
Unloading calcining furnace- removing 4 trays ThO_2	1	9	9	2	900	1100	1000	9000
Loading calcining furnace- with 4 trays Thorium Oxylate	1	9	9	2	0	600	300	2700
Unloading 2 trays ThO_2 in hood (weigh trays and then dump in hood)	1	18	18	2	0	2500	1250	22,500
Unloading ThF_4 furnace opening 3 furnaces	4	1	4	1	0	330	330	1,320
Unloading 12 trays ThF_4 in sets of 4 onto buggy carts	3.5	3	10.5	3	10	425	190	1,900
Transporting 12 trays on 3 buggies from HF furnace room to calcining room for cooling. Unloads buggy	2.9	2	6	2	60	500	220	1,340
Sweeps off ThF_4 cooling tube with fox-tail	1.0	2	2	1	1500	2800	2150	4,300
Unloads 3 trays ThF_4 from cooling rack weighs and dumps into loading hood (hammers back of tray)	3.0	12	36	3	300	900	440	15,800
Load ThF_4 into 5 gal. lined drum, weigh and seals drum (hammers cover)	3.6	12	43	3	0	550	180	7,740
Unloads 1 drum of ThO_2 in large hood	1	3	3	2	0	1800	3600	10,800

* Adjusted to two significant figures.

ΣT $\Sigma (T \times C)$

SECRET

$\Sigma \frac{(T \times C)}{\Sigma (T)}$ = ____________ d/m/m³ = ____________ Times the Maximum Allowable Concentration.

USA 012577

OPERATOR: HF OPERATORS (continued) 2 men/shift; 1 shifts/day; 2 men/day

THORON

Operation or Operating Area	Time Per Opera. (min)	Opera. Per Shift	Time Per Shift (min)(T)	No. of Samples	Concentration /m³ Low	High	(C) Avg	Avg Con'c.* Times Total Time (T X C)
Loading 4 trays with ThO_2 in larger hood	1.33	9	12	3	200	2100	1170	14,000
Weighing 4 trays; making up weight and transporting to storage (open) area	3.6	9	33	3	10	500	270	8,900
Leveling off ThO_2 in 6 trays	6	6	36	2	400	2000	1200	43,200
Sweeps up ThO_2 and ThX	4.0	1	4.0	1	-	-	0	0
Removing 12 ThO_2 trays from cooling area (bench) and inserting trays in furnace. Seal furnace	5.7	3	17	3	70	130	94	1,600
Unloading 4 trays [illegible] ThO_2 into large hood. Weigh and dump	1.5	2	3.0	1	0	-	0	0
Gen. Air Room 307	-	-	69	5	0	-	0	0
Gen. Air Room 303	-	-	166	4	0	60	17	2,800
Lunch (Seminar Room)	-	-	60	2	24	31	28	1,680

* Adjusted to two significant figures.

ΣT [illegible] $\Sigma (T \times C)$ 240,000

SECRET

$\Sigma \frac{(T \times C)}{\Sigma (T)}$ = 600 d/m/m³ = 3.9 Times the Maximum Allowable Concentration.

Initial Thoron Daughter- 30,000 d/m/m³ at actual time of survey

USA 012578

OPERATOR: Half-time Dezincing Operators — 3 men/shift; 1 shifts/day; 3 men/day

THORUM

Operation or Operating Area	Time Per Opera. (min)	Opera. Per Shift	Time Per Shift (Min)(T)	No. of Samples	Concentration γ/m³ Low	High	(C) Avg	Avg Con'c. Times Total Time (T X C) *
Unloading dezinced billet								
Remove furnaces by cart to hoist, remove quartz cover tube and insulation bricks.	2.2	3	7.	3	100	860	430	3010
Remove 2 graphite pots containing 2 dezinced billets. Unloads by bumping on floor, weighs and removes to chopping area.	3.6	3	11	3	120	1690	800	8800
Chops 2 billets and blows off dust with air hose	3.3	3	10	3	0	-	0	0
Loading dezinced billets								
Inserts 2 dezinced billets into Be crucible. Adds [illegible] scrap and places top on crucible	7.5	3	22.5	3	111	200	103	2,320
[illegible] quartz tube around Be crucible. [illegible] graphite between quartz tube and crucible. Places quartz [illegible] tube on furnace [illegible] unit.	9.5	3	28.5	3	60	290	170	4,850

*Adjusted to two significant figures.

ΣT Σ(T x C)

SECRET

$\Sigma \frac{(T \times C)}{\Sigma(T)}$ = ______ γ/m³ = ______ Times the Maximum Allowable Concentration.

USA 012579

OPERATOR: **Half-time desincing Operators** 3 men/shift; 1 shifts/day; 3 men/day

THORON

Operation or Operating Area	Time Per Opera. (min)	Opera. Per Shift	Time Per Shift (Min)(T)	No. of Samp-les	Concentration d/m/m^3 Low	High	(C) Avg	Avg Con'c. * Times Total Time (T X C)
Removes furnaces to remelt areas. Secures cover tube with sealer	2	3	6	3	0	-	0	0
Unloading Casting								
Removes quartz furnace top, graphite top and vacuums furnace	3.0	3	9	2	0	70	35	315
Removes quartz inner tube graphite. Blows off furnace	2.7	3	8	2	0	60	30	240
Unloading Furnace in Room 22								
Unloading furnace insulation and Thorium Metal casting	3.7	3	11	2	120	200	160	1760
Clean off furnace parts, Brick insulation	17.5	3	52.5	2	0	1530	765	40,100
Loading Crude Biscuit for desincing								
Cleaning graphite heater pots that hold crude biscuit.	2.9	3	8.5	2	0	-	0	0
Load 2 crude biscuit into pots, place insulation brick around pots, place quartz cover tube on furnace, Air Hose	9	3	27	2	144	200	172	4,650

*Adjusted to two significant figures.

ΣT ______ $\Sigma (T \times C)$ ______

SECRET

$\Sigma \frac{(T \times C)}{\Sigma (T)}$ = ______ γ/m^3 = ______ Times the Maximum Allowable Concentration.

USA 012580

OPERATOR: Half-time Desincing operators (continued-3) 3 men/shift; 1 shifts/day; 3 men/day

THORON

Operation or Operating Area	Time Per Opera. (min)	Opera. Per Shift	Time Per Shift (Min)(T)	No. of Samples	Concentration d/m/m³ Low	High	(C) Avg	Avg Con'c. * Times Total Time (T X C)
Gen. Air Room 29 (Thorium Casting)	*	0	100	6	0	45	16	1600
GA. East Panel Board	-	-	180	2	0	6	6	1080
Lunch	-	-	60	2	24	31	28	1680

*Adjusted to two significant figures.

ΣT 540 SECRET $\Sigma (T \times C)$ 70,400

$\Sigma \frac{(T \times C)}{\Sigma (T)}$ = 130 γ/m^3 = 1.9 Times the Maximum Allowable Concentration.

Init. Thoron; Daughter= 14,000 d/m/m³ at actual time of survey

USA 012581

S[illegible]

OPERATOR: Be Technician   2 men/shift; 1 shifts/day; 2 men/day

Be Operations   **Room 28**

Operation or Operating Area	Time Per Opera. (min)	Opera. Per Shift	Time Per Shift (Min)(T)	No. of Samp-les	Concentration d/m/m³ Low	High	(C) Avg	Avg Con'c. * Times Total Time (T X C)
Loading Furnace Dumped BeO in Pan. Scoop loaded large Be pot; Jolt; set on floor; removed plug-pulled mandril	3¼	2	6½	1	-	-	0.4	26
Removing furnace from coil to cooling vent	0.5	2	1.0	1	-	-	2.9	3.0
Unloading Furnace	2.5	2	5.0	1	-	-	6.0	30
Unloading muffle furnace	2.5	1	2.5	1	-	-	1.7	4
Loading small mixer center of room with BeO and Ca	16	1/5	3	1	-	-	35	70
Weighting 2¼ charge BeO	6	1	6	1	-	-	150	900
Dumping 2¼ charge BeO and ¾# lime into large mixer	2	1	2	1	-	-	180	360
Unloading l rge mixer	1	3.5	3.5	1	-	-	4.0	14
G.A. Room 28 Be furnace and prepara-tion room	-	-	873	7	0.05	0.9	0.4	349

*Adjusted to two significant figures.

ΣT 960   SEC[illegible] $\Sigma(T \times C)$ 1800

$\Sigma \frac{(T \times C)}{\Sigma(T)}$ = 1.9 γ/m³ = 0.95 Times the Maximum Allowable Concentration.

USA 012582

The Ames Project: Administering classified research as a part of the Manhattan Project at Iowa State College, 1942-45

by

Carolyn Stilts Payne

A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of the
Requirements for the Degree of
DOCTOR OF PHILOSOPHY

Department: Professional Studies in Education
Major: Education (Historical, Philosophical, and Comparative Studies in Education)

Approved:

In Charge of Major Work

For the Major Department

For the Education Major

For the Graduate College

Iowa State University
Ames, Iowa

1992

TABLE OF CONTENTS

CHRONOLOGY OF IMPORTANT EVENTS

ca 400 B. C.	Democritus, a Greek, theorized that minute particles or atoms, which were unchangeable and indivisible, composed all material things.
1789	M. H. Klaproth from Germany isolated a metallic substance from pitchblende, naming it uranium after the recently-discovered planet Uranus.
1803	John Dalton proposed all elements were composed of like atoms and were distinguishable from each other by mass.
1841	Eugene Peligot, a French chemist, first prepared uranium as a metal after obtaining uranium chloride and reducing it with potassium.
1869	Dmitri Mendeleyev of the University of St. Petersburg found that all elements could be arranged in the order of atomic weights. He created the first periodic table of elements.
1893	Henri Moissan, a French chemist, obtained a metallic uranium ingot from uranium oxide and sodium chloride. This experiment was repeated in 1942 by many of the scientists on the atomic bomb project with better success.
1895	W. C. Roentgen discovered x-rays.
1896	A. H. Becquerel presented to the Paris Academy of Sciences his discovery of radioactive radiation from uranium.
1898	Marie and Pierre Curie announced the discovery of polonium in July and radium in December.
1905	Albert Einstein published his special theory of relativity including the equation for the equivalence of energy and mass ($E=MC^2$).
1910	F. Soddy suggested existence of atoms with different atomic masses but identical properties called isotopes.
1911	Ernest Rutherford proposed an atomic theory where a critical mass and a positive charge were located in nucleus of atom.

1913	Niels Bohr suggested the existence of a central nucleus with electrons moving in orbits around the outside.
1919	Discovery of protons by Ernest Rutherford.
1922	J. W. Marden from the Lamp Division of Westinghouse obtained a patent for reducing uranium halides with aluminum, publishing the first known example of uranium preparation in the United States.
1932	P. P. Alexander, a student at M. I. T., reported his thesis work on reduction of uranium oxide with calcium hydride.
1932	H. C. Urey discovered heavy hydrogen called deuterium, which was used in atom smashing experiments.
1932	Ernest Lawrence reported in the literature about his invention of the cyclotron, an instrument that accelerated and aimed protons and other nuclear particles at a target, using powerful magnets to control the action of those particles involved.
1932	James Chadwick announced the discovery of the neutron, a neutral-charged particle of about the same mass as a proton.
1932	L. S. Taylor developed an air ionization chamber to determine the value of a roentgen.
1934	F. Joilet and I. Joilet-Curie discovered artificial radioactivity by bombarding aluminum with alpha particles, noticing neutrons and positively charged particles were emitted.
December 1938	Nuclear fission discovered by Otto Han and Fritz Strassmann by bombarding uranium and noticing it broke into two fragments. Made public in *Die Naturwissenschaften*, January 1939.
December 1938	Lise Meitner and Otto Frisch confirm the experiment and inform Niels Bohr of their findings.
January 26, 1939	Niels Bohr reports the European discoveries at a meeting on theoretical physics in Washington, D.C.
August 2, 1939	Einstein letter to President Franklin D. Roosevelt detailing need for atomic bomb project.
September 1, 1939	Germany invaded Poland, setting off World War II.
October 11, 1939	President Roosevelt met with Alexander Sachs, a representative from Einstein and other immigrant

	scientists, convincing him to create a uranium study group.
October 21, 1939	First meeting of the Committee on Uranium with Lyman Briggs of the National Standards of Bureau serving as chairman.
1940	John R. Dunning and his research group at Columbia University discovered that fission is more readily produced in U_{235} than in U_{238}.
1940	Two new elements created from uranium bombardment: neptunium (atomic number 93) and plutonium (atomic number 94).
April 1940	American scientists propose voluntary censorship plan for scientific publications.
June 27, 1940	Organization of the National Defense Research Council (NDRC) organized under Vannevar Bush.
May 1941	Glenn Seaborg proved that plutonium was more fissionable than U_{235}.
May 17, 1941	A National Academy of Sciences committee headed by Arthur Compton released its first report encouraging further research in power applications of nuclear energy.
June 22, 1941	Germany invaded the Soviet Union.
June 28, 1941	Institution of the Office of Scientific Research and Development (OSRD).
July 2, 1941	The British MAUD report is released and concluded that an atomic bomb was feasible.
July 11, 1941	A second National Academy of Sciences report confirmed the first one in May.
October 9, 1941	Vannevar Bush convinced President Roosevelt to start an all-out study of uranium, but with strict secrecy controls.
November 9, 1941	The third and last National Academy of Sciences report like the MAUD report confirmed the feasibility of an atomic bomb.
December 7, 1941	Japan attacked Pearl Harbor.
December 8, 1941	U.S. declared war on Japan as result of previous day's bombing of Pearl Harbor.
December 10, 1941	Germany and Italy declared war on the United States.
December 16, 1941	The secret Top Policy Committee became responsible for policy decisions in uranium research.

December 18, 1941	The S-1 Executive Committee replaced the Uranium Committee and gave Ernest Lawrence $400,000 for research on electromagnetic research.
January 19, 1942	Roosevelt responded to Bush's report from the National Academy of Sciences and officially approved atomic bomb research.
January 1942	Metallurgical Laboratory established at the University of Chicago. Columbia and Princeton groups move to Chicago.
January/February 1942	Frank Howard Spedding invited by Arthur Compton to become leader of Chemistry Division in Chicago at the Metallurgical Laboratory.
February 21, 1942	Ames Project established to back up Chicago metallurgical studies, with Harley Wilhelm joining and signing oath on February 24.
February 1942	Iowa State College signed first sub-contract for $30,000 with Metallurgical Laboratory to conduct metallurgical and chemical studies in support of the Chicago group.
May 23, 1942	The S-1 Executive Committee recommended that the project move to the pilot stage and build one or two reactors or piles to produce plutonium and plants for the electromagnetic, centrifuge, and gaseous diffusion separation methods of uranium.
June 1942	Bush recommended that Roosevelt continue four methods of uranium separation. Also suggested that the Army be brought into the project.
June 1942	Designs for the pile developed at the Metallurgical Laboratory.
June 17, 1942	Roosevelt approved the commercial plants suggesting that the Army Corps of Engineers take over this construction stage.
June 18, 1942	Creation of a new district under the control of J. C. Marshall within the Army Corps of Engineers. Called the DSM Project (Development of Substitute Materials).
August 13, 1942	Manhattan District formally established in New York City under Colonel James C. Marshall.
August/September 1942	At Iowa State College, Wayne Keller, with help from Spedding, Wilhelm, and others successfully produced uranium metal from a reduction experiment with calcium and uranium tetrafluoride

	and then cast an 11-pound ingot of uranium, the largest single piece of uranium to that date.
September 15, 1942	Iowa State signed two contracts, one for production and one for research, both directly with OSRD rather than under Metallurgical Laboratory.
September 17, 1942	Brigadier General Leslie R. Groves appointed chief of the Manhattan Engineer District (MED).
September 19, 1942	General Groves resolved the priority rating problems by procuring an unheard of rating of AAA for the Atomic Bomb Project.
September 23, 1942	A Military Top Policy Committee named, consisting of Vannevar Bush, James Conant, General Styer of the Army, and Admiral Purcell of the Navy to direct Groves' activities within the Manhattan Project.
September 24, 1942	Clinton Engineer Works site chosen in the hills of eastern Tennessee near the city of Knoxville.
October 1942	DuPont chosen as commercial contractor for the chemical separation plant at the Clinton plant.
October 1942	The centrifuge method of separation of uranium is dropped.
October-November 1942	Upon recommendation from Arthur Compton and other scientists, Groves decided to separate building of the atomic bomb from the Chicago Metallurgical Laboratory and place it in more isolated site. Los Alamos, New Mexico, selected as site for bomb development, code-named Project Y with J. Robert Oppenheimer in charge.
November 1942	The Military Policy Committee endorsed recommendations from Groves and Conant that the project move from research stage directly to the development of industrial-scale plants using electromagnetic and gaseous diffusion of uranium and pile production of plutonium.
December 2, 1942	First self-sustaining chain reaction under the direction of Enrico Fermi at the West Stands, Stagg Field, University of Chicago. Iowa State provided two tons of uranium metal for the project.
December 1942	Hanford, Washington, selected as site for plutonium production rather than Clinton.
December 28, 1942	President Roosevelt officially approved all plans for the production of atomic bombs.

February 1943	Construction of the electromagnetic plant (Y-12) and the plutonium pilot plant (X-10) begun at Clinton.
April 1943	Bomb design work began at Los Alamos.
May 1943	Manhattan Engineer District took over all research and development contracts from OSRD.
June 1943	Construction for the gaseous diffusion plant (K-25) begun at Clinton.
Summer 1943	The headquarters of the Manhattan Engineer District was moved to Oak Ridge at the Clinton Engineer Works.
September 8, 1943	Surrender of Italy.
November 1943	Pile at Clinton (X-10) in operation. Iowa State supplied almost 90 percent of the uranium for this plant.
February 1944	Y-12 plant at Clinton sent first 200 grams of U235 to Los Alamos.
March 1944	Bomb models tested at Los Alamos.
June 6, 1944	Allied invasion of Normandy (D-day).
July 1944	The plutonium gun bomb (Thin Man) was abandoned, leaving only the Little Boy (uranium gun device) and Fat Man (plutonium implosion device) for possibilities.
September 1944	First pile at Hanford operating.
December 1944	Chemical separation plants at Hanford finished.
December 16-26, 1944	Battle of the Bulge.
February 1945	Los Alamos received first plutonium shipment.
February 4-9, 1945	Yalta Conference.
March 1945	Tokyo was firebombed, resulted in 100,000 deaths.
April 12, 1945	Roosevelt died and Truman became president.
April 25, 1945	Stimson and Groves brief Truman on the Manhattan Project activities.
May 7, 1945	Germany surrendered.
July 16, 1945	First successful test of atomic bomb at Almogordo, New Mexico.
May 1945	Tokyo firebombed again, resulting in 83,000 deaths.
June 1945	Scientists at the Metallurgical Laboratory issue the Franck Report asking for a demonstration drop of the atomic bomb before using it in a war effort.

June 21, 1945	The Franck Report's plan for a demonstration was rejected by the U. S. government.
June 16, 1945	Scientists successfully tested a plutonium implosion device in the desert near Almogordo, New Mexico, code-named Trinity.
July 17-August 2, 1945	Potsdam Conference.
August 6, 1945	Uranium bomb (Little Boy) dropped on Hiroshima.
August 8, 1945	Russia declared war on Japan and invaded Manchuria.
August 9, 1945	Plutonium bomb (Fat Man) dropped on Nagasaki.
August 12, 1945	The Smyth Report, containing the story of the secret Manhattan Project activities, was released
August 14, 1945	Japan offered allies terms of surrender.
September 2, 1945	Japan signed surrender articles on the U.S.S. Missouri.
September 9, 1945	Y-12 shut down at Clinton.
September 15, 1945	Army-Navy E Award with four stars conferred to Iowa State for production efficiency. Presented by Groves to the College in a public ceremony, October 12, 1945.
November 1, 1945	Institute for Atomic Energy established at Iowa State College.
August 1, 1946	U.S. Atomic Energy Act signed by President Truman.
January 1, 1947	In accordance with the Atomic Energy Act of 1946 all atomic energy activities were transferred to civilian control under the U. S. Atomic Energy Commission.
August 15, 1947	The Manhattan Engineer District was abolished.
December 31, 1947	The National Defense Research Committee (NDRC) and the Office of Scientific Research and Development (OSRD) were abolished and their functions that remained were transferred to the Department of Defense.

PARTICIPANTS IN ATOMIC RESEARCH

Bohr, Niels	(1885-1962) Danish physicist, Director of the Institute for Theoretical Physics in Copenhagen. Was one of early pioneers in fission experiments during the thirties. During World War II, he was a consultant for Los Alamos.
Briggs, Lyman J.	(1874-1963) Director of the National Bureau of Standards and the chairman of the first uranium committee.
Bush, Vannevar	(1890-1974) A former engineer, he was Director of the NDRC (1940-1941), OSRD (1941-1946), and member of the Top Military Policy to direct the Atomic Bomb Project.
Chadwick, Sir James	(1891-1974) British physicist and discoverer of the neutron in 1932.
Compton, Arthur H.	(1892-1962) Nobel prize-winning physicist (1927) who directed the Metallurgical Project at the University of Chicago.
Conant, James B	(1893-1978) Chemist, assistant to Vannevar Bush, Chairman of the NDRC, Deputy director of OSRD, president of Harvard.
Doan, Richard L.	(b. 1894) A manager in industrial research, he was appointed Director of the Metallurgical Laboratory in Chicago in January 1942.
Einstein, Albert	(1879-1955) Former German Nobel prize-winning physicist (1921) whose theories were proven with the successful splitting of uranium.
Fermi, Enrico	(1901-1954) Former Italian physicist, Nobel prize-winner (1938) who went to Columbia shortly before the war and then to the Metallurgical Laboratory. He successfully demonstrated the first sustaining nuclear chain reaction.
Franck, James	(1882-1964) Former German Nobel laureate who became head of Chemistry at the Metallurgical Laboratory after Frank Spedding.
Frisch, Otto R.	(1904-1979) Nephew and collaborator with his aunt Lise Meitner, he publicized the early fission work of the German scientists.

Groves, Leslie R.	(1898-1970) Brigadier General in the Army Corps of Engineers who was placed in command of the engineering and production side of the Atomic Bomb Project, called the Manhattan Engineer District.
Hahn. Otto	(1879-1968) Collaborator with Lise Meitner at the Kaiser Wilhelm Institute in Germany. Discovered fission with Fritz Strassmann for which he won the Nobel prize in 1944.
Hilberry, Norman	Originally from New York University, he became the right hand man of Compton at the Metallurgical Laboratory. His official title was Associate Project Director and his task was to see that the various groups worked effectively toward their goals.
Hopkins, Harry L.	(1890-1946) Long-time friend and advisor of President Roosevelt.
Joilet-Curie, Frederic	(1900-1958) French chemist who with his wife, Irene Joilet-Curie (1897-1957), worked on early experiments with transuranium elements, particularly in the area of induced radioactivity.
Lavender, Cpt. Robert	Career Naval officer who was called out of retirement to head up the patent office within OSRD in 1942.
Lawrence, Ernest O.	(1901-1958) Nobel prize-winning physicist (1939) for the invention of the cyclotron. He was director of the University of California at Berkeley Radiation Laboratory and worked on the electromagnetic separation of uranium.
McCoy, Herbert	(1870-1945) The foremost rare earth specialist in the country. He was invited to head up the chemistry division at Chicago's Metallurgical Laboratory, but since he was retired he suggested Frank H. Spedding as his substitute.
Meitner, Lise	(1878-1968) Head of the nuclear physics department at Kaiser Wilhelm Institute where she worked on radioactivity experiments with Otto Hahn. Shortly after she fled Germany, her former colleagues discovered fission.
Oppenheimer, J. Robert	(1904-1967) American physicist and director of Los Alamos.
Sachs, Alexander	(b. 1897) Russian-born economist crucial in convincing Roosevelt to create a committee on

	uranium. Took the famous Einstein Letter to President Roosevelt in 1939.
Seaborg, Glenn	(b. 1912) Chemist from University of California and co-discoverer of plutonium in 1943.
Smyth, Henry D.	(1898-1986) Employed by the Manhattan District to write the documentary history of the Atomic Bomb Project. The book was the first public disclosure of the secret project, although it was primarily aimed at the scientist and technician.
Irvin Stewart	(b. 1899) Business and contracting officer for OSRD, he developed the contract for research during World War II.
Spedding, Frank H.	(1902-1984) Head of the physical chemistry division at Iowa State College, he was the first head of the Chemistry Division for the Metallurgical Laboratory and eventually the Director of the Ames Project.
Stimson, Henry L.	(1867-1950) Secretary of War, 1940-1945.
Strassmann, Fritz	(b. 1902) With Otto Hahn discovered fission in 1939.
Styer, Wilhelm	(1893-1975) Lieutenant general who was Groves' first supervisor in the Construction Division of the Army Corps of Engineers and served as the Army representative on the Top Military Policy Committee.
Szilard, Leo	(1898-1964) Hungarian-born physicist who helped convince Einstein to write to President Roosevelt. Eventually in charge of materials procurement at Chicago's Metallurgical Laboratory.
Tolman, Richard	(1881-1948) Physical chemist, chairman of a Groves-appointed committee to investigate declassifying documents after World War II.
Wallace, Henry W.	(1888-1965) Vice President of the United States (1941-1945).
Wilhelm, Harley A.	(b. 1900) Metallurgist and professor of chemistry at Iowa State College who was Associate Director of the Ames Project.

ACKNOWLEDGMENTS

This project could not have been undertaken without the assistance of many individuals, almost too numerous to name. I must first thank my major professor, Charles R. Kniker, for interesting me in the whole field of qualitative research, and particularly in the area of oral histories. Had he not allowed me the latitude in a class to conduct an oral history, it is possible that this dissertation could never occurred. One of the interviews that I conducted introduced me to Little Ankeny and the secret war-time project that no one talked about. I must also thank him for his assistance and guidance in the development of this dissertation, and I look forward to future collaborations.

Thanks must also go to the other members of my committee. To Professors Owen and Kizer, thanks to both of them for introducing me to Plato, Rousseau, and the other philosophers of education. Their classes were most interesting and thought-provoking. To Professor Marcus, I thank for making me persevere in his challenging classes. He taught me that perhaps I could produce a dissertation; he certainly helped me improve my writing skills. I respect his scholarship as a teacher, and, just as importantly, his advice as a friend. To Dr. George Karas, I thank for his patience and guidance in teaching me first-hand about graduate education, because I think no one knows more about the field at Iowa State University than he. Thanks must also go to him for giving me some additional incentive to finish this project by hiring me in the Graduate College.

I must also thank the many librarians, archivists, and historians at the facilities I visited and telephoned to complete this research. I especially thank the staff at the Iowa State University Parks Library Special Collections Room and the Ames Laboratory. To Anne, Becky, and Betty, I thank for patiently and courteously finding me materials in the boxes in the archives and for sharing with me the enthusiasm of small discoveries. To Diane Borgen at the Ames Laboratory, I especially thank for allowing me access to the materials in the Ames Laboratory warehouse, to the photographic collection, and to the tape recordings in the vault. This courtesy was especially appreciated because I know she and her staff had other things on their minds, such as a federal inspection tour, but they patiently worked with me.

Thanks must also go to all those I interviewed. The men who worked on the project—Drs. Carlson, Voigt, Peterson, Daane, Svec, and Wilhelm—I thank for the interviews. Their enthusiasm and assistance in helping me discover the information I needed was most appreciated. And though I was not a scientist by training, they never withheld information, but patiently explained processes, experiments, and other matters in ways I could always understand. Their leads to other people to contact were also most helpful.

Special thanks must also go to Edith Landin and Elizabeth Calciano. Giving me access to these most important and personal documents was much appreciated. They made me feel the presence of the man who, though dead now, still leaves his mark on the Ames Laboratory—Dr. Frank Spedding. The interviews and the manuscript history were entertaining and most useful. I must especially thank Edith for allowing me in her home to do the necessary research on these papers while she was busily engaged in her own family activities. Her hospitality was most gracious.

Finally, I must thank the two important men in my life, my husband, Don and my son, Austin for their patience during this long period of time. I thank them for their encouragement and for never once pressuring me to hurry up and finish. To them go a special thanks for meals not prepared and for clothes not washed by me, so that I could finish this dissertation in a timely fashion.

INTRODUCTION

About 10:00 a.m. on Monday, August 6, 1945—a typical summer day on the Iowa State College campus—a radio bulletin broke into the placid daily activities. President Harry S. Truman announced suddenly:

> Sixteen hours ago an American airplane dropped one bomb on Hiroshima, an important Japanese Army base. That bomb had more power than 20,000 tons of TNT. It had more than two thousand times the blast power of the British "Grand Slam" which is the largest bomb ever yet used in the history of warfare.[1]

According to Harley A. Wilhelm, a young metallurgist and associate director of a secret laboratory at Iowa State College, the word spread quickly that a more detailed announcement would come that afternoon from Secretary of War Henry A. Stimson.[2] By 3:00 p.m. a small group of scientists, primarily chemists from a secret project headed by the soon-to-be-well-known Frank H. Spedding, had gathered in the Chemistry Building to listen to Henry Stimson's remarks. Those gathered in Room 113, drinking coffee and waiting for the announcement included the Fornefeldts, Jim Warf, Adrian Daane, Artie

---

[1]Quoted in *The Manhattan Project: Official History and Documents*, Book I, Volume 4, Chapter 8, Part I, No. 1, 1, Record Group 77, National Archives, Washington, DC (microfilm, Robert W. Parks and Ellen Sorge Parks Library). (hereafter cited as *MED History*). This statement and the one by Stimson were made available as press releases by General Leslie Groves and his office, the Manhattan Engineer District, which served as the administrator for production of the Atomic Bomb. They were published in entirety in the official history of the atomic bomb, commissioned by General Grove, referred to as the *Manhattan District History*, compiled by a staff member, Gavin Hadden. *The Manhattan District History*, which is located in the National Archives, was made available in a microfilmed version in 1977 called *The Manhattan Project: Official History and Documents*. That edition is the one cited in this paper throughout as *MED History*. The press releases were published in every major newspaper on August 7 after Truman and Stimson had initially broadcast them on the radio.

[2]Harley A. Wilhelm, interview with author, Ames, Iowa, August 1990.

Tevebaugh, Art Kant, and Charlie Banks, all young men and women who had for several years of their lives worked day and night in rooms behind a barricade in the Chemistry Building.[3] Soon Stimson's voice echoed throughout the room:

> The recent use of the atomic bomb over Japan, which was today made known by the President, is the culmination of years of Herculean effort on the part of science and industry working in cooperation with the military authorities.[4]

As the scientists listened to Stimson's recounting of the history of the Manhattan Project and about the importance of laboratories and facilities at places familiar to them but unknown to the public at large—Clinton Engineer Works,[5] Los Alamos, and Hanford—a somewhat pleasant announcement came over the airwaves:

> Certain other manufacturing plants much smaller in scale are located in the United States and Canada for essential production of needed materials. Laboratories at the Universities of Columbia, Chicago, and California, and Iowa State College and at other schools as well as certain industrial laboratories have contributed

---

[3]Harry A. Svec, interview with author, Ames, Iowa, February 1991; Adrian Daane, telephone interview with the author," March 18, 1992.

[4]Quoted from "Statement by the President of the United States," August 6, 1945, in *MED History* Book I, Vol. 4, Chapter 8, Part I, No. 2. press release 1. Also appeared in *New York Times*, August 7, 1945, 7.

[5]The Clinton Engineer Works was actually the laboratory facility and Oak Ridge was the town next to the plant The laboratory was never officially called Oak Ridge until after the war. In this dissertation all references to the laboratory will refer to the Clinton Engineer Works and references to the town will be Oak Ridge. (*New York Times*, August 7, 1945, 7; "Background Information on Development of Atomic Energy Under Manhattan Project," December 31, 1946, in *MED History*, Book I, Vol. 4, Chapter 8, Part I, No. 2, press release no. 99; F. G. Gosling, *The Manhattan Project: Science in the Second World War*, Energy History Series (Washington, D. C.: U.S. Department of Energy, Office of Administration and Human Resources Management, 1990), 20.

materially in carrying on research and in developing special equipment, materials, and processes for the project.[6]

At the mention of "Iowa State College," a cheer erupted from the small group gathered around the radio.[7] The secret was finally out—Iowa State College had been a major player with institutions like the University of California, Columbia University, and the University of Chicago in a substantial research effort for the war.

As the news spread, reporters came to the College, and for awhile the campus was a whirlwind of activity Reports in several local newspapers revealed that Iowa State College discovered a method for the production of uranium metal and then at its own pilot plant produced over 1,000 tons of the metal until industry took over the process.[8] On Friday, October 12, 1945, General Leslie R. Groves, the leader of the Manhattan Engineer District, came to Ames to present Iowa State College the Army/Navy Flag for Excellence in Production with Four Stars, demonstrating excellence in industrial production five times for over a period of two-and-one-half years, making the College the only educational institution to ever receive the honor.[9]

---

[6]Quoted from "Statement of the Secretary of War," August 6, 1945, in *MED History,* Book I, Vol. 4, Chapter 8, Part I, No. 2, press release no. 2 Also appeared in *New York Times,* August 7, 1945, 7.

[7]Wilhelm, interview with author, 1990.

[8]See "Atomic Bomb Opens New Era in Scientific History: Dr. Spedding Heads ISC Research on Atomic Bomb and Worries about Weeds in Victory Garden in Spare Time," *Ames Daily Tribune* (August 7, 1945): 1; "ISC Research Speeded Development of World's Most Destructive Weapon," *Ames Daily Tribune* (August 8, 1945): 1; "Intricate System of Passes for Bomb Project at College," *Ames Daily Tribune* (August 10, 1945): 8; "I. S. C. Experts Speeded Work on Atom Bomb," *The Des Moines Register* (August 8, 1945): 1; and "College Does Secret Atomic Power Work," *Iowa State Daily Student* (August 8, 1945): 1 for a sampling of area newspaper articles that appeared on the Ames Project.

[9]"The Ames Laboratory: How it Started," n.d., 1; "The United States Army-Navy Production Award for Excellence to Iowa State College Men and Women of Chemistry Annex 1

The Significance of the Ames Project

From 1942-1945, Iowa State College, like several other universities and colleges, conducted classified, war-related research, under the sponsorship of the National Defense Research Council (NDRC), the Office of Scientific Research and Development (OSRD), and the Manhattan Engineer District (MED), three federal government units each supervising research on the atomic bomb. Although some scientists participated in research during World War I, the United States entered that war at such a late date that research activity was minimal compared to that of World War II.[10]

At the beginning of World War II, few administrative structures existed within most academic institutions to carry on extensive weapons research. The federal government likewise had no single central organizational unit dedicated to weapons research. In general, government research funding agencies consisted primarily of specialized bureaus like the Census Bureau, the Bureau of Mines, and for awhile the Works Progress Administration, which supported applied research in narrow fields. The

---

and 2," (October 12, 1945), in the Ames Laboratory Papers Record Group 17/1, Robert W. Parks and Ellen Sorge Parks Library, Ames, Iowa (hereafter cited as Ames Laboratory Papers); "Schedule and Script", the Ames Laboratory Papers; Press Release about the Ceremony, the Ames Laboratory Papers. In 1906 the Navy instituted the Navy E Award for excellence, first awarding it in gunnery, later expanding it to include engineering and communications excellence in wartime activities. With the advent of World War I, the award recognized industrial plants that produced war machinery. In World War II, both the Army and Navy supported the award.

[10]Vannevar Bush, *Science the Endless Frontier: A Report to the President* (Washington: The Government Printing Office, 1945), 80. There are no really accurate estimates for government funded research in World War I, but the research budget of the government in 1923 was $15,000,000. By 1940, it had grown to $69,000,000 and by 1944 the total grew to over $720,000,000.

largest research funding unit supporting scientific research, the United States Department of Agriculture, worked primarily with land grant schools through state experiment stations to subsidize research in agriculture and related areas. There was no central organized science policy nor one group in the federal government that could finance research in broad academic disciplines. In addition, most government funding efforts in the early 1930s revolved around recovery from the depression and not support for science at all.[11]

World War II though demonstrated a successful marriage between government and science. But before this marriage could be consummated, both the federal government and universities and colleges had to inaugurate a new administrative system in order to oversee unique war-related research. That same structure, in many ways distinctive to classified research, became the foundation for post-war federal and university relationships to continue.

The new administrative structure also exhibited one of two administrative management styles or a combination of both in some cases: an academic system of committees, group research, and consensus-building indicative of academic institutions, or the hierarchical, control-based, command-laden military structure of management. Even though the military eventually controlled the atomic bomb project through classified research, this dissertation contends that the administrative apparatus

---

[11] A. Hunter Dupree, *Science in the Federal Government: A History of Policies and Activities to 1940* (Cambridge: The Belknap Press of Harvard University Press, 1957), 361.

which the federal agencies (NDRC, OSRD, and MED) adopted was, by and large, characterized by the academic style of management.

The Ames Project then serves as a case study of a wartime classified laboratory—a laboratory conducting and managing research in the name of national security. But just as importantly, it is typical of federally-funded research units appearing after the war because most of the rules and regulations that controlled research administration in the war laboratory evolved into the rules and regulations that governed university-wide relationships with the federal government after World War II.

An Explanation of the Format of the Dissertation

This dissertation will examine the Ames Project in that light—as a precursor for the post-war research apparatus of Iowa State College. Though the dissertation will discuss some aspects of science and technology, it will concentrate primarily upon the administrative aspects of the Ames Project during World War II, examining the history of the Ames Project in the life of Iowa State at the time and its contributions to the development of the college's research infrastructure after the war. The author uses newly-released archival materials, interviews from many of the actual participants in the war-related research project, and some heretofore private manuscripts and unreleased interviews related to the project and its participants to analyze the Ames Project in detail. Although Part 1 will chronicle the scientific role for the Ames Project, it will also concentrate on the organizational structures that were initiated and adapted to place a security-intensive laboratory on an academic campus. Part 2 will concentrate primarily upon administrative issues, defining the academic and military styles of management and revealing how security, governmental and military relationships, financial methods of operating a contract research facility, and health regulations contributed to the final research funding apparatus.

A Review of the Sources

The story of the Ames Project appeared for some time in bulletins from the College, in newspaper accounts as information was declassified, and in other local College reports. But the story of Frank H. Spedding and his contingent of graduate students and young Ph.D.s did not appear in any detail in the national printed accounts after the war.

The *Smyth Report*,[12] the first officially sanctioned report to surface after the war, traces the administrative and technical history of the Manhattan Project, the official name for the secret project that led to the development of the atomic bomb. This book-length report was published in three editions.[13] The first, called *A General Account of the Development of Methods of Using Atomic Energy for Military Purposes under the Auspices of the United States Government 1940-1945*, appeared only days after the atomic bombs were dropped on Japan. General Leslie Groves hired Henry DeWolf Smyth, chair of the physics

---

[12]Henry D. Smyth, *Atomic Energy for Military Purposes: The Official Report on the Development of the Atomic Bomb under the Auspices of the United States Government 1940-1945* (Princeton: Princeton University Press, 1948).

[13]There is a full account of the publishing activities of the *Smyth Report* in *MED History*, Book 1, General Volume 4: Auxiliary Activities, Chapter 13, 1-18. Also, the *Princeton University Library Chronicle* published in its Spring 1976 issue (vol. 37, 173-218) several articles on the publishing history of the Smyth Report. Smyth himself reprinted a report he had written on the history of the Smyth Report dated January 1947, a memorandum that had remained buried in his files until its publication in this journal.

department at Princeton, to write the report in April 1944. Smyth was given access to all security protected materials. He submitted the first draft to Conant and Groves in May 1945 at which time Groves appointed several scientists as reviewers and editors. A mimeographed version reached Conant, Groves, and Truman's inner circle of advisors for final review in July 1945. Because the group had to wait for Truman's return from overseas, the edition was not ready at the time of the bomb explosions. One thousand copies were printed though, kept by Groves' staff, and finally released after an announcement appeared in the Sunday newspapers on August 12, 1945. The first one thousand copies quickly sold; another press run of two thousand copies was ordered and printed. Other editions were released in September 1945. The report provided the literate or technical-oriented public an explanation of the activities that took place in the various laboratories, companies, and agencies within the government. Later, the report was published with pictures, an index, and some material added from Britain and Canada. Somewhat later, a government document version was published with the original title displayed. This official history of the project mentioned the Ames laboratory in less than ten lines of text in over 400 pages of material.

The release of the official manuscript history in the late 1970s, simply called *The Manhattan District History,* dispels the notion that the Manhattan Project did not produce a lengthy written record. General Leslie Groves, commander-in-chief of the project, commissioned the work, not so much a single book as it was a collection of reports, charts, pictures, memos, and other materials about the Manhattan Engineer District. The collection of materials, now housed in the National Archives, serves as the complete and definitive work about every aspect of the massive project. Iowa State rated one single chapter of approximately fifty pages in this massive document, a reprint of a post-war report that was published in an Ames Laboratory scientific series by E. I. Fulmer.[14] Compiled with summary accounts from the division heads and project leaders, this short work is the only published account of Iowa State's role in the Manhattan Project. It does provide a short summary of Iowa State's participation and is particularly useful as a scientific guide to the various projects undertaken in Ames' wartime laboratory.

Several other archival collections include documents about the Manhattan Project. Most of the old Argonne Laboratory[15] documents have been moved to the National Archives in Washington, D.C., and though they detail administrative, financial, and scientific information, Iowa State College information is very scant. The collections of archives that are scattered throughout the present U.S. Department of Energy files include scientific reports, fiscal information about the individual academic laboratories, and some general commercial contractor information. The Oak Ridge National Laboratory housed most of the information related to Iowa State since much of the Ames laboratory correspondence was sent to the Manhattan Engineer District, which moved its headquarters to Oak Ridge in 1943. Much of that documentation about the project is still classified and what information is housed there is also located at Iowa State or elsewhere.

---

[14]E. I. Fulmer, "History of the Ames Project Under the Manhattan District to December 31, 1946," ISC Report No. 10 (Ames: Iowa State College, 1947), typescript.

[15]Argonne Laboratory was the successor to the Metallurgical Laboratory of the University of Chicago.

Iowa State College fared no better in the secondary historical accounts because so many of them were taken from the "official" documents above. Shortly after the declassification of the countless documents on the atomic bomb project in the seventies, *The Secret History of the Atomic Bomb*[16] appeared The first book to be published that relied heavily on the *Manhattan District History*, this account filled in many of the gaps that to that date had been unavailable to researchers. The book emphasizes the scientific and technological development of the project and serves as a good summary of the more complete history located in the National Archives. This book contains only a few references to contributions by Iowa State College.

The best and probably most thoroughly researched scholarly document on the Manhattan Project is the Atomic Energy Commission's first volume of a series on the history of the commission by Hewlett and Anderson.[17] The authors cover the development of the atomic bomb in their first volume. Given unlimited access to the classified and unclassified documentary and archival materials under the auspices of the Commission, Hewlett and Anderson produced a non-partisan, independent history of the time period, with a particular emphasis on the scientific advancements within the Manhattan Project. The substantial notes section of the book is an especially invaluable scholarly aid. Iowa State's contributions are given several scattered references, and almost one-half page details the Ames process for reducing

---

[16]Anthony C. Brown and Charles B. MacDonald, eds., *The Secret History of the Atomic Bomb* (New York: Dial Press, 1977).

[17]Richard G. Hewlett, and Oscar E. Anderson, Jr., *The New World*, 1939-1946. Vol. 1 of *A History of the United States Atomic Energy Commission* (University Park: Pennsylvania State University Press, 1962).

uranium metal. A more recent, popularized Pulitzer Prize book by Richard Rhodes[18] updates the atomic bomb story, providing a novelistic type format for the reader. It is well-documented for the scholar but adds little information on the Iowa State story.

Vincent C. Jones,[19] with help from the Center for Military History, examines the Manhattan Project from the U.S. Army's viewpoint. His well-documented volume depends heavily on the *Manhattan District History* and summarizes in great detail the Army's role in the development of the atomic bomb. It includes topics such as the Army take-over of the project from the civilian Office of Scientific Research and Development (OSRD), the creation of the Manhattan District, the appointment of General Leslie Groves as head of the District, the administration of the production plants, laboratories, and other support facilities, the actual testing and employment of the bomb, and a chapter on the transition from the Army-controlled Manhattan Engineer District to the civilian-administered Atomic Energy Commission after the war. For the researcher, the bibliographical essay is invaluable for its detail, currency, and complete location information, but Iowa State is virtually ignored except in a chapter on laboratories that provided fuel feed materials.

Personal accounts proliferate in the atomic energy story, but none are more famous than the one by Groves.[20] Leslie R. Groves, the General in

---

[18]Richard Rhodes. *The Making of the Atomic Bomb* (New York: Simon and Schuster, 1986).

[19]Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II Special Studies (Washington, DC: Center of Military History, 1985).

[20]Leslie R. Groves, *Now It Can Be Told: The Story of the Manhattan Project* (New York: Harper & Row, 1962).

charge of the Manhattan Engineer District, wrote his memoirs in order to tell the story of the Army's role in the Manhattan Project from his own unique perspective. A man called tyrant, czar, and other more derogatory names by the scientists under him, Groves was an imposing figure in the development of the atomic bomb. The book is certainly a reflection of the General's personality. It also displays his support for military action in the development of sensitive, secret projects but gives no insight into Iowa State contributions.

Arthur H. Compton,[21] who headed the Metallurgical Project at University of Chicago, wrote *Atomic Quest*, a personal account of his involvement with the Manhattan Project. The book is important because the Ames Project constituted a part of Compton's laboratory. The value of a study like this is more in its personal accounting of impressions and perceptions, but its major disadvantages are the lack of referenced notes and bibliography to prove the validity of its text Even though Frank Spedding served under Compton as his chief chemistry officer for a time, Compton provides only scattered information about the Ames Project and Spedding.

Today, more than forty years after the events of World War II, no book-length history of the Ames Project exists. Only one public account of the work is available as a manuscript at the National Archives and also as an Ames Laboratory scientific report. Documents, papers, correspondence, research notebooks, and declassified materials remain in the Iowa State University Library, to date unpublished by scholars.

---

[21] Arthur H. Compton, *Atomic Quest: A Personal Narrative* (New York: Oxford University Press, 1956).

A large portion of this dissertation will rely on interviews with participants from the Ames Project. Because some of the material in this dissertation cannot be verified by the documentary history, every effort has been made to use several interviews as source materials rather than to rely upon one person's memory of events. However, there still may be errors. In some cases, for example, dates cannot be substantiated for personnel becoming a part of the project, the role of military personnel on the Ames campus during the time under Manhattan District authority cannot be substantiated from existing sources, and sometimes it is unclear about the organizational relationships between Ames and other laboratories. What these interviews do provide though is a complement to the official records, which consist most often of scattered correspondence, scientific and administrative reports, and documentary history for events at the national and regional levels of the Manhattan Project

PART 1. CREATION, ORGANIZATION, AND PURPOSES OF THE AMES PROJECT

THE GENESIS AND ORGANIZATION OF THE AMES PROJECT

Pre-1941 Uranium Research Activities

Niels Bohr, an imminent physicist in Copenhagen, remained late in his laboratory on January 3, 1939, finishing up work before he was to leave for an extended research visit at the Institute for Advanced Study in Princeton, New Jersey. Otto Frisch, another Danish physicist, rushed into the laboratory with incredible news from his aunt, Lise Meitner, a recently exiled Austrian physicist. Meitner had just received news from Germany that Otto Hahn, her former collaborator, and his new colleague Fritz Strassmann had bombarded uranium with neutrons and produced barium. "Had they split the atom?" Hahn asked in a letter to his former colleague, Meitner. After several long discussions with his aunt, Frisch contacted a biologist friend and asked him what term was used when a cell split. "Fission," was the term Frisch heard from his friend, and he was the first to apply it to what happened in the Hahn-Strassmann experiment.[22]

Hahn and Meitner had been collaborating on identifying mystery radioactivity materials, generally thought to be transuranic (beyond uranium) that Enrico Fermi, an Italian physicist, had first discovered in the mid-thirties when he bombarded uranium with neutrons. This problem was also being investigated in France by Irene and Frederic Joilet-Curie. In fact, Hahn and

---

[22]Ruth Moore, *Niels Bohr: The Man, His Science, & the World They Changed* (New York: Alfred A. Knopf, 1966), 222-223.

Meitner were replicating an experiment that the French scientists reported when Meitner decided to flee from the country because her homeland Austria had come under Nazi rule. Fritz Strassmann then teamed with Hahn, helping him precipitate the Joilet-Curie radioactive products with barium. Amazingly, the radioactive materials precipitated, leading the men to consider the impossible: they had split the atom. They repeated the experiment certain that the materials must be some form of radium (no. 88 on the periodic chart, not barium which was 56). The same result occurred. The men, believing that this was impossible, tried to separate the "radium" isotopes from the carrier barium. That failed proving again that they had indeed precipitated barium. Hahn immediately wrote to Meitner about their discovery. Shortly after this encounter, Bohr left for America and repeated the news of the experiment to the American scientific community.[23]

The famous paper by Hahn and Strassmann appeared in *Die Naturwissenschaften* January 6, 1939. However, many people did not hear about it until the Fifth Conference on Theoretical Physics held in Washington January 26-28, 1939, when Bohr and Fermi announced the news to the audience even before a single paper had been presented.[24] Papers by Frisch, Fermi, Szilard and Bohr followed rapidly in *Nature* and *The Physical Review*.[25]

---

[23] Moore, 222-223; Roger H. Stuewer, "Bringing the News of Fission to America," *Physics Today* (October 1985): 49-56; Otto R. Frisch, "How It All Began," *Physics Today* (November 1967): 272-277. See also Peter Wyden, *Day One: Before Hiroshima and After* (New York: Simon and Schuster, 1984), 22; Rhodes, 233-275; and Anderson and Hewlett, 10-11 for other accounts of bringing the news to America.

[24] Stuewer, 54.

[25] Louis A. Turner, who published an article in the January 1940 *Reviews of Modern Physics* summarizing the research appearing only after the Hahn and Strassmann work, found nearly 100 articles published to that date (p. 1).

The Einstein letter

Though the experiment was exciting for its energy applications, scientists had already predicted that a powerful weapon could be produced from such a release of energy. In the United States, several recently-arrived European immigrants were particularly concerned because the discovery had occurred in Germany and that added to the fear that Germany could first produce an atomic weapon. Enrico Fermi, a recent émigré from Italy, upon hearing the historic news in January 1939 "shaped his hands into a large-sized ball. A little bomb like that, he remarked, and it would all disappear."[26]

Leo Szilard, a brilliant physicist formerly of Hungary, and another former European physicist colleague, Eugene Wigner, met in the summer of 1939 to discuss the uranium research events, particularly the development of a uranium-graphite system to create a chain reaction, something Szilard had been working on as early as 1933.[27] Both men, worried about the world situation, wondered what would happen if Germany shut off uranium exportation by the Belgians, who were mining in the African Congo region.

---

[26]Quoted in Daniel J. Kevles, *The Physicists: The History of a Scientific Community in Modern America* (Cambridge, MA: Harvard University Press, 1971), 324.

[27]Spencer R. Weart and Gertrud Weiss Szilard, eds., *Leo Szilard: His Version of the Facts: Selected Recollections and Correspondence*, Vol. II (Cambridge, MA: MIT Press, 1978), 17-18; 80-82. As early as 1933, Szilard had the idea if an element could be found that emitted two neutrons and absorbed one, and if it could be obtained in large enough quantity, a self-sustaining chain reaction could be created. In 1934, he applied for a patent that described the laws governing a chain reaction. Because he did not want the patent to become public at that time, he assigned it to the British Admiralty and went on to other experiments. The chain reaction idea appeared again after the discovery of fission by Hahn and Strassmann. He teamed up with Fermi at Princeton trying to work out a uranium-water system that might be capable of sustaining a chain reaction. By the summer of 1939, Szilard had decided that because Fermi was lukewarm to his idea and because of the world political situation he would take matters into his own hands and approach the United States government directly to warn it of the dangers of world domination by Germany.

They wanted to warn Belgium of the dangers but had no idea of the state protocols involved. A friend, Albert Einstein, another émigré living in a summer house on Long Island knew the Queen of Belgium, so they decided to solicit his assistance. On July 16, 1939, Wigner and Szilard drove to Long Island to visit Einstein and inform him of recent discoveries. After a lengthy discussion, the group decided not to contact Belgium directly with a letter but to somehow get the U.S. government involved.[28]

Through a friend, Szilard found Alexander Sachs, an economist and investment banker, who had been an informal advisor of several government officials, including President Roosevelt himself. Szilard visited him in New York, and Sachs suggested that Einstein compose a letter to President Roosevelt on the concerns of the immigrants. Sachs volunteered to take the letter to Roosevelt personally and argue the scientists' case for increased research and the German dangers of world domination if, as they all guessed, German atomic research could deliver a bomb first.[29]

The letter was written, signed by Einstein on August 2, 1939, and given to Alexander Sachs for delivery to the President.[30] Sachs did not encounter President Roosevelt immediately because World War II broke out in September 1939.[31] On October 11, he finally got an audience to present the

---

[28]Rhodes, 303-305. This visit to Einstein is also recounted in detail in Weart and Szilard, 82-83; Anderson and Hewlett, 16-17; and Wyden, 32-34.

[29]Weart and Szilard. 84.

[30]There is some debate about who wrote the letter (see the letter in Appendix A). It appears to have been a collaborative effort between Szilard and Einstein. See Weart, 83-84 and Rhodes, 305-308 for details of the collaboration.

[31]Wyden, 35. Poland was invaded by Germany on September 1, 1939. On September 3, 1939, Britain and France retaliated by declaring war on Germany and on September 8

scientists' case. Knowing that Roosevelt was a busy man, Sachs prepared a reading file for the President containing the two letters, his own paraphrase of the letters, and a copy of a book of lectures by F. W. Aston of Cambridge, Oxford in honor of Lord Ernest Rutherford, an early British atomic physicist.[32] Interestingly, to open the meeting Sachs read his own paraphrase to Roosevelt rather than the Einstein Letter:

> Briefly, the experimentation that has been going on for half a dozen years on atomic disintegration has culminated this year (a) in the discovery by Dr. Leo Szilard and Professor Fermi that the element uranium could be split by neutrons and (b) in the opening up of the probability of chain reactions—that is that in this nuclear process uranium itself may emit neutrons. This new development in physics holds out the following prospects:
>
> 1. The creation of a new course of energy which might be utilized for purposes of power production—
> 2. The liberation from such chain reactions of new radio-active elements, so that tons rather than grams of radium could be made available in the medical field.
> 3. The construction, as an eventual probability, of bombs of hitherto unenvisaged potency and scope. . . .
>
> In connection, then, with the practical importance of this work—for power, healing, and national defense purposes—it needs to be borne in mind that our supplies of uranium are limited and poor in quality compared with the large sources of excellent uranium in the Belgian Congo, and, next in line, Canada and former Czechoslovakia.[33]

Roosevelt had proclaimed a National Emergency and was trying to get Congress to lift the arms embargo.

[32]Alexander Sachs, Testimony before the United States Senate, Special Committee in Atomic Energy on Senate Resolution 179, Tuesday, November 27, 1945, 7-8. Sachs revised his statement a bit and placed it as an appendix to the proceedings. He also deposited a copy for the *MED History* in the National Archives. An account of the meeting is also summarized in Rhodes, 313-315; Wyden, 35-38.

[33]Sachs, 7.