ADAM COUNCIL

AGENDA:

Deliberating Upon the Scientific, Political, and Ethical Ramifications of the Manhattan Project

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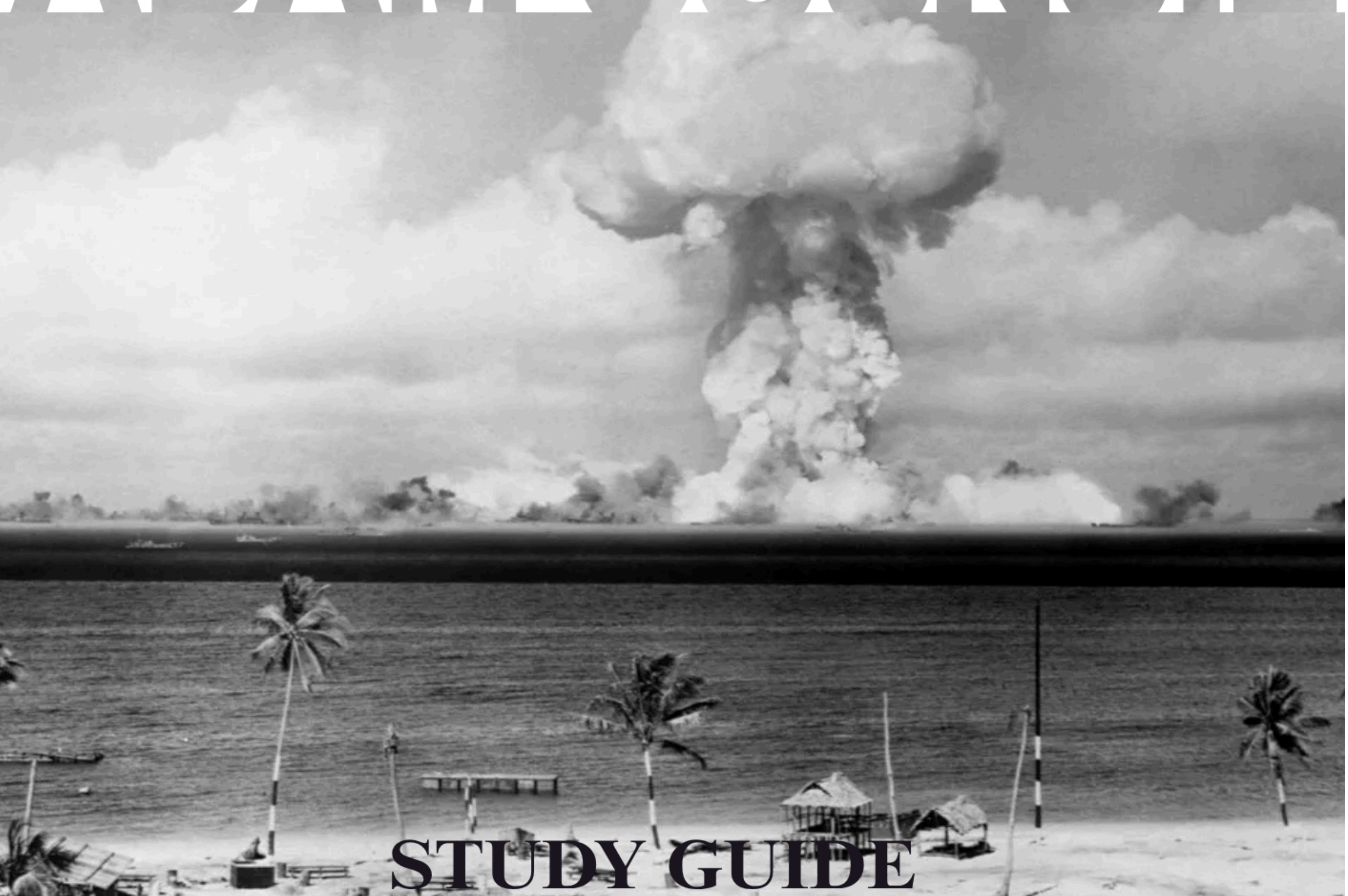


STUDY GUIDE

TABLE OF CONTENTS

LETTER FROM THE BUREAU

Greetings Delegates,

It is with great honour that we, the Bureau of the ADAM Council, welcome you all to the **Tenth Iteration of the Shishukunj Model United Nations**.

The ADAM Council, addressing the agenda: **"Deliberating Upon the Political, Scientific, and Ethical Ramifications of the Manhattan Project"**, explores a topic that revolutionised geopolitics and shook the world during the 20th century.

Set during the heat of the Second World War, the ADAM Council is a historic committee focusing on the development of the atomic bomb and its far-reaching consequences on warfare, scientific morality, and international diplomacy.

The Manhattan Project was one of the most secretive and consequential undertakings in human history. Surrounded by ethical dilemmas, scientific breakthroughs, and geopolitical stakes, it presents a unique platform for intense and multidimensional debate. You will be called upon to weigh national security against human cost, technological progress against ethical restraint, and urgency against accountability.

This is not merely a history lesson: it is a thought experiment in reimagining a moment that changed the world. You will confront difficult decisions, explore alternative scenarios, and consider what paths humanity could have taken. The future, in this committee, is not written in stone.

We expect all delegates to enter the committee with deep research, original ideas, and a commitment to high-level debate. The Bureau is here to guide you through what promises to be a dynamic, challenging, and deeply rewarding committee. While the background guide will serve as a foundation, it is your preparation and participation that will bring this committee to life.

"The power you are about to reveal will forever outlive the Nazis, and the world is not prepared."

See you at the conference!

Warm regards,
Aryav Shah, Chairperson
Raunak Kinger, Vice Chairperson
Himani Goyal, Rapporteur

INTRODUCTION TO THE COMMITTEE

The **ADAM Council** stands for the **A**pex **D**irectorate for **A**tomic **M**ilitarisation. This Committee, chaired by U.S. President Franklin D. Roosevelt, has been established in light of the significant advances in atomic technology and shall act as the highest-level body overseeing the Manhattan Project. This committee aims to deliver an efficient Manhattan Project that will bring the enemy, Germany and Japan, to their knees, thus ending the Second World War.

Being an emergency committee, our main goal will be to prepare an ideal Manhattan Project, which shall be officially referred to after the bombs have been completed, and the contributions of this committee shall lay down what is expected to be achieved just before the execution of the ultimate task. The ADAM Council is the primary committee of The Manhattan Project, whose decisions will influence all Operations and Agencies that are developing the bomb.

This committee consists of the major personalities of the Manhattan Project, who were politically, scientifically and ethically aware of what the U.S. was creating and what impact it would have on the rest of the world. The members of this committee have complete access to confidential data. They can order any site (eg, Los Alamos, Hanford, Oak Ridge, Chicago) to work on any demand or provide any information that this committee deems necessary.

This committee also has the power to align with or collaborate with agencies like the OSRD, any War Policy Committees and any Research Societies to effectively implement its decisions. The outcomes of this committee will be made highly confidential and will be made public only after the Manhattan Project has been declared to the world.

AGENDA DESCRIPTION

The ADAM Council, with the agenda "Deliberating Upon the Scientific, Ethical, and Political Ramifications of the Manhattan Project," meets to discuss one of the most substantial decisions: the development and use of nuclear power during World War II.
The agenda covers the Manhattan Project, the United States' covert wartime project to produce the world's first atomic weapon during World War II. The project brought together the brightest scientific minds and massive governmental resources to create a weapon capable of ending the war, but with unknown ethical, political, and strategic consequences.

The freeze date of the committee is June 7, 1944, a time when major decisions were just beginning to take shape, and there was still scope for improving the project to benefit both the nation and the world. To support this broader mission, the agenda is broken down into some major subtopics:

Tackling Scientific Complexities and Internal Inefficiencies - This subtopic covers both the scientific hurdles of the Manhattan Project and its internal administrative flaws. It examines research prioritisation, fissile material challenges, and bomb design while also addressing the misallocation of funds and poor coordination and leadership, revealing how technical progress was often shaped or hindered by structural shortcomings.

Maintaining the Global US Reputation - Here, we explore how the development of atomic weapons reshaped America’s international image. It considers diplomatic concerns with Allied powers, fears of initiating a global arms race, and other ethical perceptions, highlighting the pressure on the U.S. to balance scientific advancement with the responsibility of global leadership.

Post-War Control of Atomic Power - Focusing on the uncertain future of nuclear governance, this subtopic discusses military and scientific visions for control of atomic energy. It lays the groundwork for discussions on long-term oversight, responsibility, and containment of nuclear power beyond the war.

Discussing the Injustice to the Principle of Distinction - This subtopic debates the moral cost of the bombing and the implications of targeting civilians. Based on the international humanitarian principles, it discusses theories of deontology and utilitarianism, shedding light on how the Manhattan Project pushed the ethical boundaries of modern warfare.

With this agenda at hand, the ADAM Council stands amidst war, science, and morality, tasked with shaping a future where the legacy of atomic power is not defined by destruction, but by foresight.

KEY TERMS

1. **Authoritarian** – Rule favouring strict obedience to authority at the expense of personal freedom.
2. **Blitzkrieg** – A swift, sudden military offensive using speed and surprise, commonly associated with German tactics in WWII.
3. **Centrifugation** – A process that uses centrifugal force to separate substances of different densities, commonly used to enrich uranium.
4. **CIC (Counter-Intelligence Corps)** – The U.S. Army unit responsible for maintaining secrecy and security within the Manhattan Project.
5. **Critical Mass** – The minimum amount of fissile material needed to maintain a self-sustaining nuclear chain reaction.
6. **Debilitate** – To weaken or impair the strength of something.
7. **Embargo** – An official ban on trade or commercial activity with a specific country.
8. **Espionage** – The act of spying or secretly gathering information, especially for political or military purposes.
9. **Fascism** – A far-right, authoritarian ultranationalist ideology characterised by dictatorial power and suppression of opposition.
10. **Fertile** – Describes materials that can be converted into fissile material through nuclear reactions.
11. **Fission** – The splitting of a nucleus into smaller parts, releasing a large amount of energy.
12. **Fraught** – Filled with or likely to result in something undesirable (e.g., fraught with danger).
13. **Isotope** – Variants of a chemical element with the same number of protons but different numbers of neutrons (different mass numbers).
14. **Liaison** – Communication or cooperation that facilitates a close working relationship between people or organisations.
15. **Luftwaffe** – The aerial warfare branch of the German Wehrmacht during WWII.
16. **Militarism** – The belief or desire of a government or people that a country should maintain a strong military capability and be prepared to use it aggressively.
17. **Ordnance** – Military supplies, especially weapons, ammunition, and combat equipment.
18. **Projectile** – An object thrown or propelled through space, especially as a weapon.
19. **Punitive** – Inflicting or intended as punishment.
20. **Radioactive** – Emitting ionising radiation as a result of nuclear decay.
21. **Ramifications** – The often complex or unintended consequences of an action or decision.
22. **Totalitarianism** – A political system in which the state holds total authority over society and seeks to control all aspects of public and private life.
23. **Unprecedented** – Never done or known before; without a previous example.
24. **Yield** – The amount of product, especially energy or explosion force, produced by a nuclear reaction.

HISTORICAL BACKGROUND OF WWII

The world's most widespread and destructive concern started in 1939, involving 30 countries, and reshaping the entire globe. The causes lie with the consequences of the First World War: one-sided implications arising from the Treaty of Versailles, the worldwide depression of the 1930s, and the rise of dictatorships. The policies and measures adopted by these regimes on a very aggressive note tore the dismal peace that had prevailed in the interwar years. This section attempts to give a thorough review of developments in politics, in military matters, and even ideologies that led to the outbreak of the war.

Pre-War Developments

The Aftermath of the Great War and the Treaty of Versailles (1919-1929)

The First World War ended with the surrender of Germany on the 11th of November, 1918, leaving Europe shattered. The global economic power shifted toward the United States, while politically, new nations were born and nationalist feelings arose throughout Europe.

The Treaty of Versailles dispelled all doubts about the ending of the war on 28 June 1919; however, the terms dictated by the Allied Powers were designed to punish Germany in an attempt to ensure no further wars should take place. Germany was to pay enormous reparations under the "War Guilt Clause," which were later fixed at £6.6 billion ($5 billion). Germany also lost substantial territories to France and all of its overseas colonies. The military was curtailed beyond comprehension. The Rhineland was to remain demilitarised, whereas Anschluss was to be prohibited.

This created a lot of resentment in Germany. Many had expected leniency under Wilson's "14 Points," which stressed peace and reconstruction. The treaty was seen as a punishment instead. The new German government, the Weimar Republic, was blamed for signing the treaty and was labelled the “November Criminals.” All this, combined with economic problems, created instability and social unrest.

The Rise of Totalitarianism and Militarism (1929–1938)

The Great Depression of 1929 deepened many already shaky economies, causing great unemployment and social disorder. This suffering, however, formed a very fertile ground for the ascent of aggressive totalitarian regimes in Italy and Germany and militaristic government in Japan. The widespread suffering made the people more willing to go along with strong leaders who promised stability, national pride, and solutions to economic struggles.

After the Great War, Italy had economic struggles and developed frustration with the Treaty of Versailles, all leading to an increase in nationalist sentiments. It was during these turbulent times that the Fascist Party, led by Benito Mussolini, rose to prominence. In 1922, the famous "March on Rome" led the king to appoint Mussolini as Prime Minister, marking the beginning of a fascist dictatorship awash in nationalism, military power, and authoritarianism.

The Weimar Republic of Germany found itself unstable and full of conflicting political viewpoints. The worsening of the crisis by the Great Depression helped in building up the fulfilment of the Nazi Party. Hitler was chosen Chancellor in 1933 through political intrigue rather than an election in the true sense of the word. Hitler defied the Treaty of Versailles in his endeavours to rearm and suppress civil liberties. A majority of the Germans believed him to be the man destined to liberate them.

The European response was to let Hitler have the Sudetenland in 1938, through the Munich Agreement. However, Hitler soon reneged on his promises and seized control of all of Czechoslovakia. The failure to stop him resulted in the invasion of Poland and eventually the Second World War.

Escalating Allied–Axis Tension

The Outbreak of War and European Campaigns

The Second World War officially began on 1 September 1939, when Nazi Germany invaded Poland in a military tactic called Blitzkrieg or 'lightning war,' exploiting the speed of its tanks, motorised infantry, and air support to overwhelm the Polish forces suddenly. Britain and France, honouring their commitments to Poland, declared war on Germany two days later, marking the start of the conflict.

Following that invasion, Germany rapidly extended its control across Europe. Germany invaded Denmark and Norway in April 1940, intending to secure important ports and resources for their use. In May, a sudden strike in Belgium, the Netherlands, and Luxembourg allowed the Germans to circumvent the heavily fortified Maginot Line and force French and British forces into a retreat; by June 1940, France was divided into territories of occupied and Vichy control.

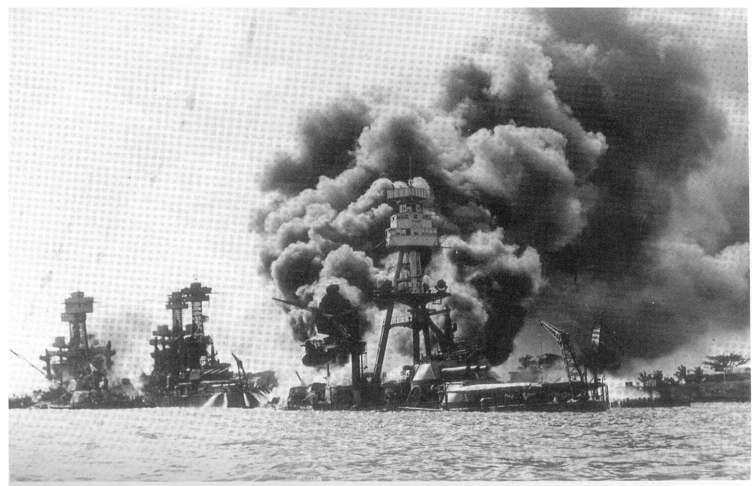
War expanded with Italy entering the war on the side of Germany in June 1940 and launching campaigns in North Africa and the Mediterranean. Meanwhile, the Battle of Britain, fought from July to October 1940, marked Germany's first defeat. The Royal Air Force held the United Kingdom safe from Luftwaffe bombing campaigns and prevented a potential German invasion.

With such campaigns unrolled in the west, terrorising effectiveness would have been their hallmark, and the Allies had to reconsider their strategies against an all-powerful foe. The rapid fall of Western Europe sent a shock wave across the world, leaving Britain as the major power holding firm against Axis forces in Europe, thus opening the windows for a long and brutal confrontation.

The Pacific and U.S. Entry

As World War I exploded in Europe, the Pacific contained turmoil between Japan and Western Powers, especially the United States. Japan sought to grow its empire to procure raw materials and dominate Asia and the Pacific. Thus, Japan's invasion of Manchuria in 1931 and the commencement of full-scale military operations against China in 1937 were aggressive steps for regional control. The expansion and breaking of agreements by Japan caused the United States to impose economic sanctions and embargoes on Japan, one such embargo forbidding exports of oil, most needed by Japan for the war effort.

The tensions finally burst on the morning of December 7, 1941, when Japan surprised the U.S. naval base at Pearl Harbour, in Hawaii. The attack nullified most of the Pacific Fleet, killed over 2,400 Americans, and shocked the whole nation. Then, on December 8, the United States declared war against Japan and thereby entered the Second World War officially. Soon after, Germany and Italy declared war on the United States, thus reinforcing the global conflict.


Battleship row at Pearl Harbor after the attack with capital ships settling on the bottom.

The entry of the United States into the war gave a new dimension to the war with her incomparable industrial and military might poured into the Allied cause. The Pacific theatre now registered as a main front with fierce engagements being fought over huge tracks of ocean from the campaigns in the Philippines, Midway, Guadalcanal, and Burma. The fighting between American and Japanese forces would be ferocious and would go a long way in deciding the eventual outcome of the war.

Scientific Race and Strategic Pressures

During the height of the Second World War, the race for newer and more formidable weapons became the game's strategic conundrums for the great powers of the world. The military value of atomic energy made an instant impression on governments and scientists, thereby engendering an intense and secret scientific competition mainly between the Allied and Axis powers.

Immediately, the United States along with Britain and Canada merged forces in an attempt to study nuclear chain reactions and the feasibility of an atomic bomb, bringing in practically all the greats in the scientific world, including those émigrés now depending on the Allied war effort for protection from the Nazi regime. The scientific problems were paramount, from uranium enrichment processes, chain reaction control, to how to design a bomb that would work, all requiring research in physics, chemistry, and engineering. It was slow-going at first, given the complexity of the technology, but then the growing Axis threat created a sense of urgency.

Having been born with great collaboration between the U.S., Britain, and Canada, the Manhattan Project quickly emerged as the central organisation entrusted with solving the problems involved in making a working atomic bomb.. The project had to confront unending logistical and organisational issues from how different laboratories were coordinated, how scarce materials like uranium and plutonium were to be allocated, and how to reconcile previously unfettered scientific endeavour with the necessities of wartime.

HISTORY AND STRUCTURE OF THE MANHATTAN PROJECT

The Origin

In 1938, German Scientists Otto Han and Fritz Strassmann discovered nuclear fission. In 1939, when Germany invaded Poland, it created fear that, considering the extremist regime of Hitler, Germany could easily create the atomic bomb, thus becoming a deadly threat to the entire world. By 1940, the United States had many suspicions that Germany had initiated its program to create an atomic bomb. Many scientists within the United States, most of them refugees from fascist regimes in Europe, took several steps to organise a project to harness the newly recognised nuclear fire for military purposes. In February 1940, $6000 was made available to initiate the research work under the supervision of the Advisory Committee on Uranium, headed by Lyman J. Briggs.

After the U.S. entered The Second World War, the War Department acquired joint responsibility of the project as by 1942, it was clear that a vast array of pilot plants, laboratories, and manufacturing facilities would have to be constructed by the U.S. Army Corps of Engineers to enable the assembled scientists to carry out their mission. By June 1942, the Corps of the Manhattan district was assembled to carry out the management work of the project and later, the project experienced involvement of the majority of the United States Army. 'Manhattan Project' became the code name for the research, construction and army work that stretched across the regions of the country under this common objective. So, international cooperation felt necessary to execute this task before Germany. By 1943, the Combined Policy Group was established with Britain and Canada, and most British and Canadian scientists came to the United States to continue this effort.

The Organisational Structure

Los Alamos, Project Y

Los Alamos, also called Project Y, is one of the most confidential sites working towards the atomic bomb. In 1943, James B. Conant recommended to Vannevar Bush that the OSRD and the Army form a committee to delve further into the bomb development. Considering this, Vannevar Bush sent this recommendation to the Top Policy Group. By 1943, sentiments grew among the scientists of the Manhattan Project to establish a better-controlled and coordinated facility. Then J. Robert Oppenheimer started advocating for a centralised facility where theoretical and experimental work could take place, abiding by the scientific protocol to ensure accuracy and speedy progress. Understanding the need for this facility, General Leslie Groves started searching for an apt site to meet such demands, and thus, Los Alamos was chosen with J. Robert Oppenheimer as its director. It was constructed on the Pajarito Plateau to inculcate firm security measures. Its sparse population, accessible water resources and the nearby Los Alamos Ranch

Institution make it ideal for effective research and scientific progress. The Los Alamos Site consists of The Theoretical Division led by Hans Bethe focussing on calculating critical masses, nuclear efficiency and explosive yields; The Experimental Physics Division led by Robert Bacher which is home to experimenting with the “Gun Type” and “Implosion Type” bombs; The Ordnance Division led by Captain William “Deak” Parsons and The Chemistry and Metallurgy Division led by Joseph Kennedy. The Los Alamos Site will be the official site where the bomb design is made.

Oak Ridge, Tennessee

In September 1942, two days after General Leslie Groves was appointed, he approved of an idyllic site location in East Tennessee, approximately twenty miles away from Knoxville. Surrounded by the Appalachian Mountains and the Cumberland Plateau, this sparsely located region was ideal for developing the Oak Ridge Site. Initially, the Oak Ridge Site was called Kingston Demolition Range and later the Clinton Engineer Works. This site, directed by General Leslie Groves, is home to the massive Uranium Enrichment facility of the Y-12 Electromagnetic Separation Plant. Due to slow construction, it is necessary to come up with an implementable solution for the faster development of the K-25 Gaseous Diffusion Plant. Recently, at The Y-12 Electromagnetic Separation Plant, the nine Alpha and four Beta racetracks are becoming significantly more reliable due to maintenance improvements and chemical refinements by The Tennessee Eastman, but they are still not producing up to design potential. By early 1944, the S-1 Committee encountered several issues in the Y-12 Electromagnetic Separation Plant and the slow construction of the K-25 Gaseous Diffusion Plant, so J. Robert Oppenheimer convinced General Leslie Groves that thermal diffusion should also be considered, as up till now, it had only been looked upon by the Navy. The responsibility of the Oak Ridge, Tennessee site is to provide the design needed for Uranium to the Los Alamos Site.


Alpha Racetrack, Y-12 Electromagnetic Plant, Oak Ridge

Hanford Engineer Works

Colonel Matthias was assigned to select the Hanford Site for Plutonium Production. The task was to make three water cooling reactors represented by the letters B, D and F near the Columbia River.DuPont is the official contractor of the Hanford Site and supervises the necessary construction for effective Plutonium Production. The four separation facilities were built in pairs and are the “pile” facilities of the Manhattan Project. They were made to produce slugs and perform tests on Plutonium, which was the decayed and separated material from Uranium-238. In 1943, Construction also began on two separation facilities, which were called the “200 area”. DuPont had to divert its attention from this “200 area” to the B-Reactor’s construction due to labour shortages and a lack of blueprints. The B-Reactor has separation and concentration facilities along with ventilation systems to eliminate radioactive and poisonous gases. By early 1944, the 120-foot windowless structure of the B- B-Reactor was completed, which had thermal and biological shields and the D-Reactor was halfway finished. Till then, the F-Reactor has witnessed growth, but not at a fast rate. The 200 area includes two sister facilities, out of which one has almost been completed and the other one is yet to be started. Though such massive improvements have taken place at Hanford, the actual testing for plutonium production remains.


Construction of B Reactor, Hanford

University of Chicago

The University of Chicago was set up in 1942 to explore the physics of The Nuclear Chain Reaction for efficient Plutonium Production. It is home to The Met Lab, which is its primary site and The Chicago Pile No. 1, where the first Nuclear Chain Reaction to produce Plutonium was achieved, making it crucial for the Manhattan Project. Stagg Field is the major site where the tests are conducted. Here, two major types of pile designs were considered by Arthur H. Compton. One included a water-cooled model with a cylinder of graphite with pipes of uranium extending from a water tank. Another one was suggested by Leo Szilard of using liquid metal when used with an electromagnetic pump, but obtaining the piles of bismuth, the metal he suggested, was not feasible, as bismuth is a rare metal.

General Leslie Groves complained about the delay and gave a deadline to Arthur H. Compton to decide soon whether to work with one method or pursue both. The Met Lab decided to give Leo Szilard time to find a way to gather supplies for the present and the future, while production was primarily expected from the first method. The 100 kilowatt design using helium as the coolant was set up at Oak Ridge and has been making 100 grams of plutonium a day. While the CP-1 was earlier tasked with producing an intermediate pile using an external coolant, and now the University of Chicago, specifically The Met Lab and CP-1, are the major producers of plutonium.

TIMELINE

December 1938- German scientists Otto Han and Fritz Strassmann discover Nuclear Fission

2 August 1939- President Franklin D. Roosevelt receives the "Einstein-Szilard Letter"

1 September 1939- World War II begins

21 October 1939- The first meeting of the Advisory Committee on Uranium is held in Washington, DC

27 June 1940- The National Defence Research Committee (NDRC) is created to manage the scientific resources of the U.S.

7 December 1941- Japan attacks on U.S. naval base of Pearl Harbour

8 December 1941- The U.S. declares war on Japan

19 January 1942- President Franklin D. Roosevelt approves the creation of the atomic bomb, and the Metallurgical Lab (Met Lab) is established at the University of Chicago

18 June 1942- The Manhattan Engineer District Is Formally Established

17 September 1942- Brigadier General Leslie R. Groves is appointed head of the Manhattan Project

19 September 1942- Oak Ridge, Tennessee, is declared the secret site for uranium enrichment

16 November 1942- The world's first nuclear reactor, the Chicago Pile No. 1 (CP-1), starts being constructed

25 November 1942- Los Alamos is declared the secret site for atomic bomb development and construction

16 January 1943- Hanford is declared the secret site for plutonium production

4 November 1943- Oak Ridge's X-10 Graphite Reactor achieves the world's first self-sustained Nuclear Chain Reaction

Tackling the Scientific Complexities in the Manhattan Project

Allocation of Resources and Research Prioritisation

During the early days of photo production, the Manhattan Project was devised for the broad adoption of a strategy that implemented multiple scientific and technical approaches at the same time. This step was taken because no one could doubt the fact that there were so many uncertainties about the feasibility of generating fissionable materials and the design of a functioning atomic bomb. The project leaders realized that, were they to depend on one unproven method alone, there would be the likelihood of the mission failing, and therefore they financed all uranium separation methods—in which they had not only centrifuge and gaseous diffusion methods but electromagnetic separation as well as liquid thermal diffusion—besides chain reaction that they carried alongside it. Such an "all-paths" way was aligned with the nature of the project as an experiment that allowed all the opportunities for success to be pursued despite numerous scientific unknowns.


S-1 Committee, Bohemian Grove, September 13, 1942.

Government support began cautiously in 1939 with the Advisory Committee on Uranium, evolving through several organisational shifts, including the Uranium Committee and the S-1 Section, before a more streamlined S-1 Executive Committee took charge in mid-1942. Throughout this period, resource allocation decisions were made amid intense national competition for labour, materials, and industrial capacity.

Recruiting and retaining a skilled workforce posed significant challenges. Remote locations of major sites— Los Alamos, Oak Ridge, Tennessee, Hanford and Chicago—offered limited housing and transportation, which hindered recruitment efforts and led to turnover rates well above the national average. The project demanded a vast range of workers, from scientists to glass blowers, all vital to its progress. Even as it became the highest-priority wartime program, these logistical difficulties persisted, highlighting that success required more than scientific breakthroughs; it demanded exceptional management of people and infrastructure under wartime conditions.

The large size of the project was extraordinary. In 1943, Oak Ridge alone used approximately 1% of the U.S. electric output. Over 50% of all the US Army construction labour and steel production went to Manhattan Project facilities. To meet the tight schedule, the program skipped conventional pilot plant steps, and experiments were conducted only in laboratories at full production. This determination exposed the project to danger when an untried bunch of industrial processes were put into service without standard intermediate testing, thus, latency in technical occurrences and delays in the processes increased.

The parallel development scheme was the reason for the existence of internal competition and the prioritisation of tasks. One of the instances was the liquid thermal diffusion method of Philip Abelson. When it was first deemed too slow, the project excluded it and used it elsewhere. However, by early 1944, the project, after facing major problems in the area of the primary uranium enrichment plants, reevaluated this method and included it as another way of reaching the same goal. This example was the demonstration of the project’s adaptability, while at the same time, it showed the uncertainty and the numerous daunting tasks that existed in the process of taming the wild technological field.

Uranium and Plutonium: Enrichment and Technical Barriers

One of the most formidable scientific and engineering problems that the Manhattan Project faced was to obtain sufficiently large quantities of fissionable uranium-235 and plutonium-239. Both the materials necessitated novel and intricate isolation and extraction methods.

Naturally occurring uranium is primarily uranium-238, with uranium-235, the fissile isotope needed for a chain reaction. Because these isotopes are chemically the same and differ in mass by less than 1%, physical separation was very tough and costly. This prominent feature had a decisive influence on the project’s technical strategy, which aimed at devising a multitude of highly complex separation methods instead of leveraging extant ones.

As of spring 1944, the Y-12 and K-25 uranium enrichment plants were plagued by serious problems, and this made the thermal diffusion method that was originally set aside necessary to be reconsidered. By January 1944, the centrifuge method was dropped as being unfeasible, although it had been known to hold promise. Such changes seen in the process indicate that experiments and the trial-and-error nature are dominant in the field, where theoretical prospects often conflict with the practical nature of the process.

By spring 1944, the uranium enrichment plants at Y-12 and K-25 were experiencing severe difficulties, prompting reconsideration of thermal diffusion methods initially set aside. The centrifuge method, once seen as promising, was abandoned by January 1944 due to practical limitations. This shifting landscape revealed the trial-and-error nature of the work, where theoretical promise often collided with engineering realities.

Challenges associated with plutonium are numerous. Specifically, plutonium is not available in large quantities in nature, and consequently, it should be obtained by producing it in nuclear reactors from the exposure to neutrons of uranium-238. Enrico Fermi's successful attempts to run a nuclear reactor in late 1942 showed that plutonium production was possible. However, by 1943, the knowledge of the material and nuclear properties of plutonium was still rather unclear.

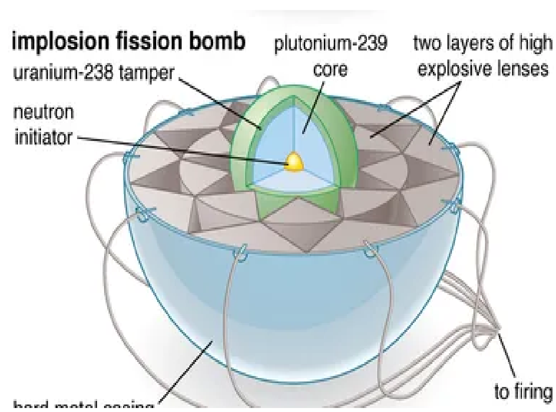
Very high purity that would prevent the premature triggering of the charge was necessary because plutonium emits alpha particles and consists of isotopes that undergo spontaneous fission, which can cause fast chain reactions.

The scarcity of plutonium restricted the initial research. In the beginning, only a few milligrams were obtainable in January 1944, and more grams were produced in February. During their work, the metallurgists encountered the problem of how to make the methods of treating the small samples suitable for large ones. In March 1944, the scientists succeeded in preparing the first sizeable quantities of metal plutonium through a variety of innovative methods, such as the temporary use of the centrifuge separation method.

Overall, the challenges of uranium and plutonium production reflected the enormous gap between laboratory science and full-scale industrial implementation, a gap the project had to bridge under immense time pressure and wartime constraints.

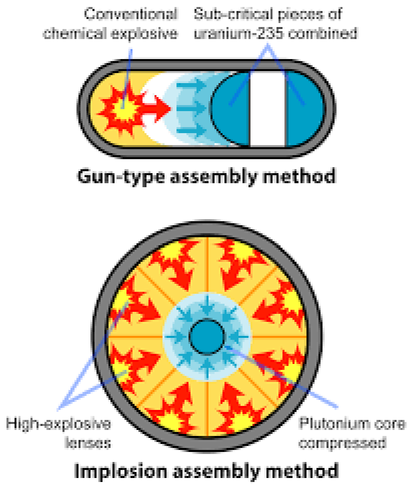
Designing and Assembling the Atomic Bomb

The primary goal of the Manhattan Project was to design and build a functional atomic bomb at Los Alamos Laboratory (Project Y). This task involved overcoming major scientific uncertainties about nuclear chain reactions and the behaviour of fissile materials under extreme conditions.

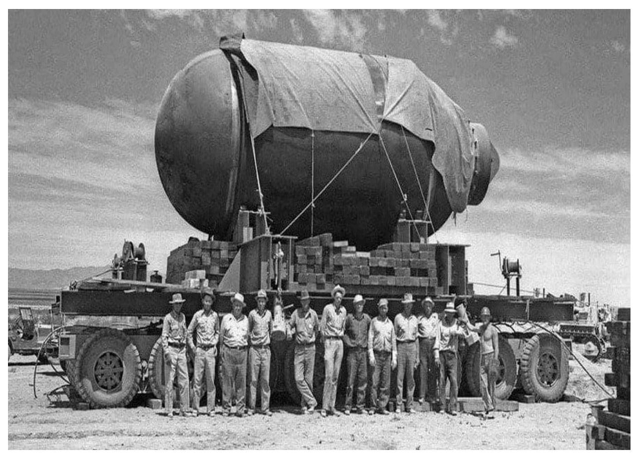


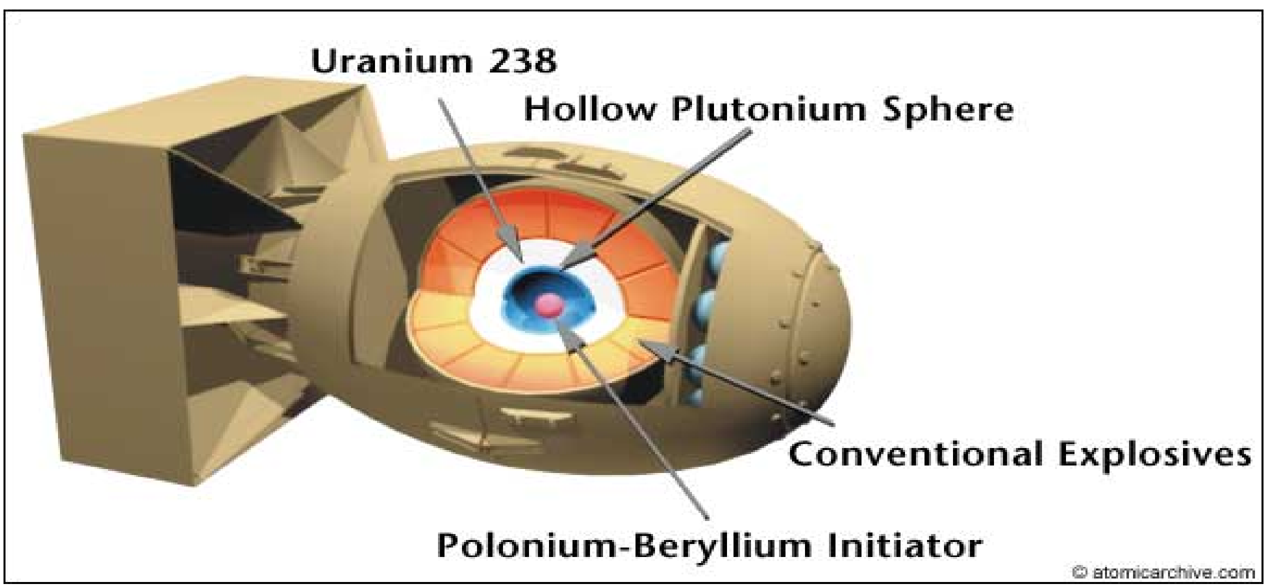
Established in 1943, Los Alamos brought together top scientists to develop bomb designs. Early on, the gun-type method was considered the most promising. This design involved firing one subcritical piece of fissile material into another to achieve a supercritical mass. Efforts in 1943 focused on building artillery capable of delivering the required projectile velocity, despite the device needing to fire only once. By March 1944, two plutonium gun assemblies were completed and tested, with uranium guns also ordered. A key challenge was predetonation—the risk that a premature chain reaction would cause a low-yield “fizzle.” This risk was especially high for plutonium, due to its alpha radiation and plutonium-240 impurities. Therefore, the gun-type method required plutonium of extremely high purity and projectile speeds near the limits of practical artillery.

However, the testing of the implosion method was something that could be said to be of more current experience and less widespread knowledge. Implosion, a process that implied the compression of a subcritical fissile core with precisely timed explosives of high detonating power to achieve critical mass, was what it was. The first trials of this technology were often the reason for uneven compression, and in February 1944, Oppenheimer stated that only large-scale experiments would answer the question. Still, the arrival of IBM computers in April 1944 helped researchers to calculate equations for implosion, but the practical problems with explosives and the choice of materials were still so big that they were practically insurmountable. What turned out to be a game-changing moment for the project was a discovery made in April 1944. The reactors produced plutonium that contained a substantial amount of plutonium-240, which has a high spontaneous fission rate. Thus, the gun-type design was almost sure to be a fiasco due to the predetonation. Implosion, therefore, becomes a necessary, though difficult, way out of the situation.



Material purity was the main condition. The purity of uranium-235 required a moderate level of purification, while plutonium had to be highly pure. Los Alamos's chemical and metallurgical teams by mid-1944 had been working on the job of visiting the materials and their form very well. Even so, the questions on the bomb yield and efficiency persisted. The theoretical forecasts of the implosion device were widely disparate and thus reflected only the lack of a complete understanding of the nuclear processes. The project had to deal with an overwhelming number of new scientific questions and consequently seek an ongoing adaptation.





MAINTAINING THE GLOBAL US REPUTATION

There is a very debatable topic known as the trolley problem. The trolley problem consists of two tracks that diverge from a single track. The fast-moving trolley is heading towards the two tracks, and the subject can pull the lever and divert the trolley onto one track. The first track has five people tied to it, all of them being criminals. The second track has one unknown person tied to it. The person has to decide whether to pull the lever and save five criminals or not pull the lever and thus kill five criminals and save one unknown person. Pulling the lever abides by the Utilitarianism method, where the action will amount to maximum profit. Not pulling the lever is Deontology, where getting involved in the action of killing even one person or five persons is not justified.

Ethical Perception Of The Atomic Bomb (Utilitarianism)

The atomic bomb was a necessity for the United States and the world. Germany, portraying its fascist nature, surely has its nuclear ambitions. If Germany somehow develops the atomic bomb first, the fascist regime would dominate the world, thus leading to a global massacre. The aspect of Time makes this method even more necessary. Every week, World War II kills millions of military personnel and civilians. The atomic bomb, if used, will drastically change the devastating impact that the other nations will have to suffer. The United States has the scientific potential and economic resources, and so, it has the moral obligation to swiftly end the war. The United States has also been developing fragile relations with the Soviet Union, this weapon can also prevent another war between the two major powers of the world.

The Opposing Ethical Dilemma (Deontology)

Even though the United States may find this action to be necessary and just, at the global level, it might face immense opposition, and so, the United States must be prepared to give viable justifications to save its reputation. The atomic bomb will introduce a new category of Weapon of Mass Destruction. Deploying such a weapon would violate the principles the Allied Powers are fighting for, namely democracy and world peace. It will also start another arms race as discussed below. Even proper ethical oversight is not guaranteed by the United States, considering that in an emergency, this weapon will be the primary resort. This weapon may also tarnish the image of the evolution science has brought to the world, from going to the wheel to a literal atomic bomb.

Diplomacy with the Allied Powers

For the Manhattan Project to move forward in 1943, diplomatic cooperation between the US, UK, and Canada was crucial. Through the Quebec Agreement, these countries committed to sharing resources, expertise, and security protocols and formally partnered in nuclear research.

During the war, this solidarity strengthened their military partnership and accelerated scientific discoveries. At the same time, many other nations, including some Allied powers, were kept in the dark about the project entirely. Most significantly, despite fighting alongside the United States against Germany, the Soviet Union was not made aware of the project. Since some Allies started to feel left out of important wartime decisions and future planning, this led to quiet tensions.

Only a select few leaders are fully aware of the Manhattan Project due to its extreme secrecy. As a result, others found it challenging to openly discuss the use of the atomic bomb. Understanding the ethical, military, and political ramifications of employing such a potent weapon required careful thought. By 1943, many leaders realised that atomic energy would alter international relations and the way wars are waged. They started considering how nuclear weapons should be regulated to avoid future abuse or risky competition. These early debates demonstrated that international cooperation and responsibility would be necessary for the management of atomic energy. It was hoped that nations would cooperate to maintain peace and prevent the devastation that such weapons could cause after the war.

POST-WAR CONTROL OF ATOMIC POWER

Scientific Vs Military Governance

The Manhattan Project's atomic weapons undeniably played a crucial role in swiftly ending WWII, highlighting the pivotal contributions of both scientists and political-military leaders.. However, the project's legacy necessitates a broader discussion about the future of atomic power and demands that the management, improvement and use of this power be supervised by a responsible agency. The project was born out of scientific concern when Albert Einstein, with the support of Leo Szilard and Edward Teller, wrote a letter to Franklin D. Roosevelt about the potential dangers of harnessing atomic power. Scientists are instrumental in coming up with the "Gun Type" and "Implosion Type" design, purifying Uranium 235 for weapon fuel, calculating the critical mass for the nuclear chain reaction and synthesising Plutonium- 239 for alternative weapon fuel.

But without political and military supervision, this project could well be considered just a scientific discovery. The Army, especially with its Corps of Engineers, has made this project possible and implementable. Site selection, the MED's Counterintelligence Corps ensure secrecy, material procurement, allocates the required budget, and the significant contributions of the Military Police emphasise the political aspect of The Manhattan Project. Despite scientific initiation, the Top Policy Group remains the father of The Manhattan Project, which was led by Franklin D. Roosevelt, the primary political head. Realising the vital contributions of both sides, who shall look after the Atomic agency after WWII. If it is scientists, then how will future weapons be created? If it is the military, then what will be the future of nuclear science?

Building The Basis For an Oversight Agency

Whether the oversight agency is governed by civilian, scientific or military authority, defining its core principles is mandatory for the efficient use of future atomic power. Enlisting a detailed and implementable directive for such an agency that it shall adhere to and abide by while performing its actions and implementing its decisions. Some aspects of the directive are such as, but are not limited to:

1. President or Chairman, who shall preside over its proceedings.
    a. His position as appointed or elected; if appointed, then by whom and according to which criteria; if such an agency is public, then who shall elect him and the process; his term as the Presiding Official.
2. The powers of the agency, whether they shall be restricted to Atomic Energy or shall also include the development of atomic weaponry.
    a. Collaboration of this agency with other bodies like The U.S. Senate and the United Nations; it's position as independent or subordinate of The Congress; It's

Control over the Navy, Army and AirForce if it is tasked with Atomic Weaponry as well; it's control over contractors like DuPont and Sites like Los Alamos.

b. To what extent will the powers of this agency be in overruling Congressional decisions, despite knowing its primary funding might come from Congress, and the powers of this committee to overrule military decisions?

3. The strength of this agency, along with the criteria for selecting its members, is how they differ from the Chairman.
4. The Presiding location of this agency, its site and establishment date.

Discussing The Injustice To The Principle Of Distinction

Introduction To The Principle of Distinction

The Principle of Distinction is the foundational law of International Humanitarian Law. One must know who and what may be assaulted and who and what may not. The initial rule bolstering the IHL is that even in armed struggle, the only respectable action is to debilitate the military capability of the adversary, which implies that there is a clear distinction between who may be attacked and who may engage in fortified conflict. Under the Principle of Distinction, all involved in conflict must differentiate between therefore defined as combatants and civilians. Civilians are considered as all persons excluding the combatants, do not take direct part in hostilities and do not have the right to take part in hostilities, may be direct or indirect and may be penalised for their mere participation in hostilities and are defended by transnational law until they get involved in hostilities. Combatants are considered as fortified members of hostilities that have the right to take direct part in hostilities but are obligated to observe the IHL, may not be penalised for their mere participation in hostilities and are defended by transnational law when they no longer take part in hostilities.

Prospectives of Armament Race and the Threat to the U.S.

It has been widely suggested that the proliferation of nuclear weapons can be prevented by keeping the world devoid of the knowledge that the U.S. possesses about atomic weapons and nuclear power. Although it can be undoubtedly stated that the U.S. is presently much ahead of the world, as far as the fundamental facts about atomic power are concerned, but it shouldn't be ignored that German scientists, because of whom the development of this field has originated might not have made significant advancements as compared to the U.S., the U.S. has to this date been living in constant apprehension as to their possible achievements. Even in the Soviet Union, there is basic knowledge of the implications of nuclear power, and the involvement of Russian scientists in nuclear facilities will make them capable enough to retrace the steps taken by the U.S., even if we try to conceal them. Many emerging institutions will delve further into this field, and even if secrecy is maintained, it would be foolish to assume that the U.S. can protect itself from nucleonics and atomic weapons for many years.

It is also viable to discuss whether achieving a monopoly in raw materials will sustain the proliferation of nuclear weapons. Though the largest known uranium deposits are present in the West, the older deposits of Germany and the radium territories of Russia can also be potentially dangerous. It is also not reasonable to assume that large uranium deposits will not be found in a country that covers almost one-fifth of the Earth’s surface.

If it is assumed that the U.S. will not have to face any threats in the future if it acquires the position of leader or dictator due to its overwhelming industrial and scientific advancement, then it should be made clear that such a quantitative advantage will not secure the U.S. from a sudden attack. Just because a potential enemy is afraid of being 'outnumbered and outgunned', it may be too tempting for him to attempt a sudden unprovoked blow, particularly if he suspects the U.S. of harbouring aggressive intentions against his security. In no type of warfare can the aggressor expect to have such a heavy advantage. The enemy can place all his "infernal machines' in advance and explode more than half of the metropolitan cities existing in the U.S.

It can be expected that in almost ten years into the future, most nations will have the capability to assign more than ten to fifteen bombs with 20 kg of active material and detonate them at 6 percent efficiency, which will deal damage of almost 20,000 tons of TNT. This initiative will be capable enough to easily wipe out almost five hundred square miles of the U.S. The population and industries that are most likely to be targeted will be eradicated, leaving a staggering blow to the entire nation. Unless the country can plan out its six million square miles in such a way that no five hundred square miles will be important enough to massively stagger the nation, proper safety of the U.S. cannot be ensured.

Discarding the idea of assumptions, an Armaments race is inevitable to begin after the first exposure of such nucleonics has been made to the world and a new way of gaining monopoly over the world will certainly arise and it will be fatal for the western countries, even if this position is not won by the U.S. or any Allied country.

CASE STUDIES

The OSRD

Dr. Vannevar Bush, who headed the Office of Scientific Research and Development (OSRD), was in charge of the United States' war research and especially of the Atomic Bomb development. Created in 1941, the OSRD has the main purpose of gathering the brightest minds of the country and leading the nation's scientific and industrial innovative potential to manufacture the most advanced military equipment.

Instead of providing research itself, the OSRD performs central management and finance roles, and it supports the projects in several academic institutions, private labs, and Army bases. Under Bush's administration, the OSRD got rid of the bureaucratic delays, accelerated the financial support of science, and ensured the easy flow of information from the scientists to the military. Bush's permitting of the White House and military command to be in direct communication with the scientists allowed science to play a key role in national strategy—a very uncommon occurrence which prevailed at the time.

One of their first and certainly most important activities was the creation of the S-1 Committee to explore whether nuclear fission could take place and whether it was possible to make nuclear weapons. The OSRD chipped in by giving their support to early trials in isotope separation, plutonium production, and bomb construction, thus laying the groundwork for the Manhattan Project. Even after the project was handed over to the U. S. Army's Manhattan Engineer District and was under military control, the OSRD still wielded its influence over science-related priorities and policies.

The OSRD plays a major part in giving evaluations, and the endorsements for various uranium enrichment methods (electromagnetic separation, gaseous diffusion, and thermal diffusion) and it has the handling of the major contracts with the private sectors, such as DuPont and Westinghouse, to convert theoretical models into scalable engineering.

It also acts as the intermediary between the government and the academic institutions, ensuring that the advanced scientific work turns the tools of war into practical ones. The OSRD stands for the efficient compartmentalisation of knowledge, the implementation of internal security controls, the protection of sensitive research and the stimulation of collaboration where it is imperative.

Even though the OSRD is not a moral authority, it is the place where discussions on the long-term implications of atomic power often develop. However, its major concern is still speed, feasibility, and coordination. It is the backbone of the scientific enterprise, quietly organising, funding and directing high-level research that without this control would be misplaced and inefficient.

During the Bush administration, the OSRD became essential for the Manhattan Project, and it transforms disorderly ends of scientific creativity into a coherent program that has goals and is easily measurable by progress.

The Ordnance Division

The Ordnance Division, led by Captain William "Deak' Parsons is the primary body that deals with the weaponization of The Manhattan Project so that the scientific innovations, fabrication materials etc is be shaped into a deliverable and impactful atomic bomb with the help of proper delivery mechanisms, bomb casings, fusing mechanisms and deployment mediums.

It works upon deciphering and the shape of the bomb, which can't be just arbitrarily decided, the shape has to be aerodynamically stable, it has to be endurable enough to house the heavy amount of explosives and withstand handling, transportation and delivery and the shape has to have proper amount of space for fitting explosives and the fissile core. The Ordnance Division is also responsible for ensuring safety to prevent accidental detonation and pre-detonation.

One of the primary works of the Ordnance Division is to collaborate with the Air Force to ensure proper execution of the task. With the help of the United States Army Air Forces (USAAF), the Ordnance Division has successfully developed some initial prototype Boeing-29 SuperFortresses. These are strategic long-range bombers with pressurised cabins, remote-controlled turrets and can be expected to carry 20,000 pounds of conventional bombs.

The Ordnance Division and the United States Army Air Forces have initiated the Project Silverplate. This Project has and aims to make modifications in the B-29 Bombers to reduce the weight of the bombers to ensure agility and to avoid entering the heavy conflict zones, to carry radar and trigger systems to know when the B-29 Bombers will be at the optimum height and electrical firing systems to enable precise detonation. Under this Project, the Ordnance Division also plays a key role in testing of ideal height and crew training.

Top Policy Group

The Top Policy Group was the first high- level body governing body of the Manhattan Project. It can be considered the precursor of the ADAM Council. The Top Policy Group was established by U.S. President Franklin D. Roosevelt, involving Secretary of War Henry L. Stimson, Director of the OSRD Vannevar Bush, Army Chief of Staff General George C. Marshall, Brigadier General Leslie Groves, Dr. James B. Conant and Naval Representative Rear Admiral William R. Purnell. `

The Top Policy Group was the major authority for transforming the Manhattan Project from Research work to Production. It also directed isotope separation and directed formation of the S-1 Committee. The Top Policy Group also provided emergency funding and approved the changing budget of The Manhattan Project. It also ensures that The Top Policy Group is accountable to the United States President and is the primary oversight authority after the ADAM Council. It also endorsed international collaboration with Britain with the establishment of the Quebec Agreement and has expressed concerns about Soviet espionage.

Advisory Committee on Uranium

The United States government established the Advisory Committee on Uranium in October 1939 to look into the possible military applications of uranium, especially in the creation of potent new weapons. This committee was among the first official actions the United States took in the course of the Manhattan Project, which produced the first atomic bombs during World War II.

Recent scientific discoveries in Europe gave rise to the concept of uranium as a weapon. German researchers discovered nuclear fission in 1938. This process releases a significant amount of energy when the nucleus of a uranium atom splits. Global physicists were alarmed by this discovery, particularly in light of Nazi Germany's growing aggression.

Physicists Eugene Wigner and Leo Szilard wrote a letter alerting U.S. President Franklin D. Roosevelt to the possibility that Germany would be the first to develop a nuclear weapon. The letter was sent to the president in August 1939 and was signed by renowned scientist Albert Einstein.

Roosevelt responded by establishing the committee, which was headed by National Bureau of Standards Director Lyman J. Briggs. The committee, which was composed of scientists and military advisors, was tasked with evaluating uranium's use in weapon development, researching its potential for a chain reaction, and suggesting additional government action.

Early advancement came slowly. To test uranium, the committee gave researchers like Fermi and Szilard small grants. Although their results were encouraging, at first, funding and urgency were limited. But the U.S. realised the strategic value of nuclear research as World War II grew more intense.

The Advisory Committee's efforts by 1940 resulted in the founding of bigger, better-funded groups concentrated on nuclear development. This road finally brought one to the Manhattan Project, which effectively created the first nuclear weapons. Though it did not create a bomb, the Advisory Committee on Uranium was instrumental in starting America's nuclear programme.

Operation Alsos

The operation aims to gather information and capture Italian, French and German Scientists to prevent them from making the atomic bomb before the U.S. By far, it has cleared Italy and aims to infiltrate France; it has most of the information on the whereabouts of German Scientists and Uranium ores. The United States must know about the atomic advancements of the Axis Powers and prevent them from overcoming the U.S.'s atomic capability. The establishment of such an operation was suggested by General George C. Marshall under the auspices of the Manhattan Engineer District. The Operation's primary objective is to prevent German monopoly of atomic power, and so, it also targets Italian and French Scientists to know about Germany's atomic capability. This is directed by General Leslie Groves and is being conducted in three phases, with its headquarters in London. It is commanded by Lt. Col. Boris T. Pash. In 1943, the London Office was established to act as the liaison between the Manhattan Project and other intelligence agencies. This was established by Major Robert Furman and was later commanded by Captain Horace K. Calvert. The purpose of this office has been to gather and allow the Alsos Mission to locate the major German Scientists and has been successful in locating the whereabouts of the workplace and home addresses of these Scientists.

Operation Alsos I- Italy

The Italian Mission was first assembled in Algiers in 1943 and included Lt. Col. Boris Pash, executive officer, four CIC agents, and some Scientists from the OSRD. The Operation Alsos Italy interrogated two Italian scientists, Edoardo Amaldi and Gian Carlo Wick. They were able to gather that Italy hadn't worked for Germany in the development of atomic power.

Operation Alsos II- France

Operation Alsos France hasn't infiltrated France yet, it aims to land in the city of Rennes and interrogate Scientist Joliot- Curie. It aims to gather names of some other German Scientists that are not the present targets of Operation Alsos, Germany and establish headquarters there after Allied forces have taken control.

Operation Alsos III- Germany

The goal of Operation Alsos Germany will be to capture German Scientists, take the available records and destroy the rest of the facilities. It also has to ensure that no German Scientists fall into Soviet hands and that the whereabouts of Soviet occupied German facilities are obtained so that they can be destroyed. It plans to enter Germany through Hechingen and the main task is to obtain the whereabouts of three major scientists, Werner Heisenberg, Otto Han and Carl Von Weizsäcker.

Maud Committee

The MAUD Committee came into existence in April 1940 under British auspices to explore, during World War II, the possibility of manufacturing an atomic bomb in the early years. Formed as a result of this discovery of nuclear fission in 1938 and with fears that Nazi Germany might get there first with such a weapon, the committee's mandate was to study uranium as a possible source for a very powerful bomb and to give impetus to this work in Britain.

Prompted by the famous Frisch-Peierls Memorandum, made by Rudolf Peierls and Otto Frisch in March 1940, which postulated that only a small quantity of uranium-235 would be required to make a bomb, the committee went almost immediately from theoretical considerations to practical work. G. P. Thomson and Sir Henry Tizard were prominent figures in the leadership; the committee itself had in its membership James Chadwick and Mark Oliphant. Its principal activities were isotope separation and chain reactions using uranium. The name "MAUD," however, came about because of Niels Bohr's physicist misinterpreting a message.

In 1940–1941, it was agreed that gaseous diffusion would be the best way to separate uranium-235. The committee then came up with a rough figure for the size of the actual bomb: 8 to 12 kilograms was considered a critical mass, which of course, would be a very small explosion. The committee also looked at plutonium but gave priority to uranium-235 because it seemed closer to realisation.

The MAUD Report was put forward before Prime Minister Churchill in July 1941 and concluded that a uranium bomb was feasible and able to cause an explosion equivalent to 1,800 tons of TNT. The report called for the urgent development of uranium enrichment plants, so the bomb material could have been ready by late 1943. It emphasised strategic importance and the possibility of ending the war at once.

Further, the MAUD Report deeply influenced the U.S. atomic effort, stimulating increased uranium research in the States and also Anglo-American cooperation, despite initial secretiveness and nationalistic apprehensions. This cooperation became defined and formalised with the signing of the Quebec Agreement in 1943.

Therefore, by mid-1944, the work of the MAUD Committee had already directly influenced the Manhattan Project, contributing to the accelerated Allied atomic bomb program and setting the stage for a nuclear era with the vast geopolitical ramifications.

QUESTIONS A RESOLUTION MUST ANSWER (QARMA)

1. Detailed postulates of the Oversight Agency that shall be established (Scientist-Civilian directed agency or a military-directed agency) to ensure proper usage of atomic power and Nuclear Science. Clear provisions of another agency must be enlisted that will look after the Development of atomic weaponry if it is not overseen by this Agency.
2. The Organisational Structure of this Oversight Agency, its composition, presiding official, powers, collaboration and all the other aspects that the ADAM Council deems necessary for the establishment and functioning of this Oversight Agency.
3. Establishment of a clear definition of Combatant concerning the Manhattan Project to foster accountability at the international level in the post-war scenario.
4. Provisions for limiting an armament race in the future, and how it can be ensured that the U.S. maintains control over this global atomic power after the Manhattan Project.
5. How can the construction of the K-25 Gaseous Diffusion Plant be made faster, modifications in the Y-12 Electromagnetic Separation Plant to produce design potential Uranium and deciding which facilities might be required to explore the Thermal Diffusion process, along with where its plant would be set up.
6. How can the implosion design be given more attention so that the plutonium issue is dealt with more efficiently?
7. How can better secrecy of the Manhattan Project be better ensured, considering Soviet spy rings might still be operating within the Manhattan Project?
8. How can the organisational structure be more branched to ensure an evolving Manhattan Project as per the dynamic war?
9. Devising an effective argument to justify the necessity and urgency of the atomic bomb.

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