

“Scientific Ammunition to Fire at Congress:” Intelligence, Reparations, and the U.S. Army Air Forces, 1944-1947

"Secrets by the Thousands!" "Nazi Science Secrets!" "A Technological Treasure Hunt!" "All the war secrets, as released, are completely in the public domain." Military intelligence was not quite as accessible as it seemed to journalists in late 1946 and early 1947. This particular bounty of intelligence derived from extensive exploitation strategies hatched by American and British forces in the closing months of World War II (WWII). These efforts anticipated the Potsdam Conference and Agreement of July and August 1945, where Germany and the Nazi economy were carved up for postwar occupation and reparations. The largest was Operation LUSTY (LUftwaffe Secret TechnologY), launched by the United States (US) Army Air Forces (AAF) in 1944. LUSTY was a small army of engineers, scientists, AAF officers, and troops, numbering 3,000 at its peak in the summer of 1945. The task was no mystery, teams scoured the German countryside and cities, crating up over three million documents from Braunschweig targets alone. About 16,280 items and 6,200 tons of miscellaneous materiel and documents were shipped through London and Paris and back to Wright Field and Freeman Field in Ohio and Indiana in the first three of LUSTY's sixteen months of existence. Jets such as the Me-262 and Ju-290 were flown; He-162s, Ho-229s, Me-163s, V-2 rockets, and Ötztal's wind tunnels were shipped.¹

For General Henry H. "Hap" Arnold, Operation LUSTY was a key element in the case for Air Force independence from the Army. Intelligence issuing from the Luftwaffe and its architects were just the materiel the AAF needed. "Arnold wants scientific ammunition to fire at Congress," a close advisor asserted, to fortify requests for adequate appropriations to finance the AAF's research program and procurement. Maintaining careful control of the situation, Arnold dispatched a group of thirty-two elite civilian engineers, scientists, and officers to assess and interrogate German targets. The AAF's Scientific Advisory Group (SAG), with responsibility for interrogation and reparations, constituted about one-third of Operation LUSTY. The SAG eventually produced the intelligence Arnold wanted: *Toward New Horizons*, a top-secret report delivered in 1945 with forecasts to 1965. Not surprisingly, the SAG positioned air power as the single most important component of national security. Do not see air power as "merely a collection of airplanes," Arnold had advised his colleagues before the war. "It is broad and far reaching. It combines manufacture, schools, transportation, airdrome, building and management, air munitions and armaments, metallurgy, mills and mines, finance and banking, and finally, public security— national defense."²

A general revision of intelligence and military histories along with increased access to WWII files declassified during the 1980s and 1990s and the collapse of communism in East Germany introduced a wealth of new insights into the machinations of the US defense

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establishment.³ For example, historians documented the transfer of German engineers, scientists, and their "secret" technologies to allied countries during and immediately following the war. The transfer of key personnel and materiel from the Peenemünde missile program to White Sands Proving Ground is one of the better instances of this transfer of Nazi-sponsored science and technology to the US.⁴ While the Manhattan Project absorbed German engineers and scientists who moved prior to the war, postwar projects were dependent on shrewd exploitation, interrogation, and reparation techniques in the war's latter stages.⁵ Indeed, the Army secured advanced weaponry and personnel from Peenemünde-Ost and Mittelwerk— 341 railcars of rocket technologies, 100 V-2s and 120 German engineers and scientists shipped to Fort Bliss and White Sands. Project OVERCAST (renamed PAPERCLIP in March 1946) enabled War Department officials to doctor the dossiers of hundreds of Nazis, including Peenemünde's Wernher von Braun and Walter Dornberger, to evade denazification. Nazi technologies were transferred to the US without congressional approval; entire military research facilities were established without "lengthy legislative procedures." Operation LUSTY and Project PAPERCLIP enabled the relocation of research facilities to Fort Bliss, White Sands, and eventually the Redstone Arsenal in Huntsville; from the Hermann Göring Aeronautical Research Institute near Braunschweig to Wright Field and the Arnold Engineering Development Center (AEDC) in Tullahoma, Tennessee. Although primarily a European project, the SAG also traveled through the Pacific, exploiting institutions in Tokyo, Yokohama, and Yokosuka.⁶

Project PAPERCLIP and the mobilization of Peenemünders for Army Ordnance are well documented. But historians have yet to fully explain the place of intelligence and reparations in AAF and USAF policies for postwar research and development (R&D). For example, the majority of historians of LUSTY and the SAG (notes 1-2) fail to acknowledge the role of the SAG in OVERCAST, PAPERCLIP (note 6), or intelligence and reparations. Similarly, histories of LUSTY and the SAG fail to follow the trail of intelligence into congressional hearings after the war. Histories of LUSTY are too general to provide details about the SAG, while histories of the SAG are too narrow to have connections with PAPERCLIP. As is evident here, the independence of the AAF from the Army was hinged on R&D. The AAF's intelligence and reparations practices provide an avenue for historians into this contingency.⁷

This article synthesizes histories of LUSTY, the SAG, and PAPERCLIP, and follows the SAG into Germany's R&D installations, the concentration camp Dora at Mittelwerk, allied interrogation facilities, Japan and the atom bomb, and finally into Congress, 1945. The history of the SAG's efforts from 1944 to 1947 reveals the intensity with which the AAF and its consultants in the aeronautical sciences pursued Nazi R&D. The fact that an exploitation of this R&D configured into the postwar policies of the AAF and USAF is accepted by historians. This article explains *how* this was done by describing the coordination of LUSTY, OVERCAST, PAPERCLIP, and the SAG in the AAF's exploitation of intelligence and reparations for postwar policies and politics.

Operation LUSTY and the Scientific Advisory Group

In October 1943, American, British and Soviet politicians began planning for the eventual defeat and occupation of Germany. At the Malta and Yalta meetings in January and February 1945, principles of occupation were focused in terms of denazification and “war indemnities” or reparations. The *Report of the Crimea Conference* at Yalta established a prime directive “to destroy German militarism and Nazism,” “wipe out the Nazi Party,” and remove Nazi influence from “the cultural and economic life of the German people.” Importantly, this entailed reparations ranging from restitution for wartime losses incurred by the allied countries to dismantling Germany's economic and military infrastructure. Investments (i.e., property), reparations (i.e., economic resources, capital and commodities, intellectual property), and “war booty” or “war trophies” (i.e., military supplies and capital) were nonetheless indistinguishable for field detachments. At Yalta, the Soviet Union proposed that \$10 billion be immediately removed from Germany, and another \$10 billion be removed in the ten years following the war. The Soviet Union wanted to recoup 50% of this, and proposed that Great Britain and the US get \$4 billion each, and the balance be divided among remaining allied countries. The Potsdam Conference, held July 16th to August 1st, 1945, crystallized denazification policies and ratified American, British, French, and Soviet zones of occupation (i.e, southwestern, northwestern, western, eastern). Although they accepted the four zones, politicians at Potsdam were noncommittal towards Soviet proposals for reparations. The agreements formed at Potsdam later shifted according to changes in interests and opportunities. The key US policy document for *Research in the "Secret Weapon" Field*, directing field detachments to confiscate armaments, remove research facilities, take into custody research personnel, and impound records, was released on 10 July 1945, by which time exploitation was well under way.⁸

Allied forces crossed their zones of occupation when opportunities arose and rarely differentiated economic 'property' from military capital, or 'restitution' from the destruction of military potential. In official documents, zones of occupation and reparations were well-defined and tidy, and the discipline exhibited by US soldiers was supposed to impress upon the Germans that “their conquerors are superior to them not only in military prowess but in their moral standards” as well. On the ground, however, it was another story. US troops were not transformed into “guardians of German culture;” looting and pillaging property or intimidating prisoners in the name of military custom, reparations, and war trophies were rampant.⁹ Military planners divided their attention in the war's latter stages between demobilization and maneuvering for postwar plans and status. For the AAF, reparations meant the spoils of war and trophies, or capture of Luftwaffe engineers, scientists, and technologies. US agents competed with allied countries intent on securing materiel and personnel for their own use. American teams often arrived at targets only to find a British, French or Soviet team already there. At times, US Navy crates were discovered, placed in larger crates, and relabeled “US Army” or “AAF.” Once shipped, heated, high level negotiations determined whether coveted wind tunnels, rockets, engineers, and scientists went to one or another military branch. As it turned out, air power at home and postwar plans were dependent on exploiting German technologies abroad.¹⁰

In July 1944, a month after the Normandy invasion and as Germany's Vengeance Weapon 1 (V-1) campaign began, the Army created Task-Forces (T-Forces), military units of intelligence specialists, interrogators, bomb squads, and combat troops assigned to secure, guard, and exploit German military targets. During August, the Joint Chiefs of Staff's (JCS) Joint Intelligence Committee (JIC) created the inter-Allied Combined Intelligence Objectives Subcommittee (CIOS) to select and recommend targets to the T-Forces. By the end of August, CIOS objectives encompassed industrial targets, a move pursued by the Director of the Office of Scientific Research and Development (OSRD), Vannevar Bush. For this expanded mission, the OSRD, War Department, and War Production Board created the Technical Industrial Intelligence Committee (TIIC). CIOS and TIIC were charged with pooling thirty-two industrial, military, and political intelligence groups, and operated under the Director of Intelligence, Supreme Headquarters Allied Expeditionary Forces (SHAEF) and Army Intelligence (G-2). From twenty-two officers in 1939, G-2 had by mid 1944 an international force of 1,260 counter-intelligence and exploitation officers and clerks. For the next year, at least eight US intelligence groups could be found operating in Europe, with as many as thirty-seven T-Forces on the ground in any given month. Lucrative targets often had six intelligence teams operating in tandem. Only somewhat facetiously were CIOS intelligence teams referred to as CHAOS.¹¹

In July 1941, President Roosevelt created a Coordinator of Information (COI) to manage intelligence and sort through the volumes of information amassed since the spring of 1940. The COI's initial reports on Germany's economic and military positions, completed after Pearl Harbor in December 1941 were enlightening, but inadequate. The Axis powers' declaration of war on the US prompted a restructuring of the entire military in February 1942. The Joint Army-Navy Board was reorganized into the JCS, providing a seat for Arnold. The JIC was created as an arm of the JCS to centralize military intelligence. The Office of Strategic Services (OSS) was formed from the COI and subordinated to the JCS for covert operations and psychological warfare. The result was a bureaucracy of secrecy. Military brass were ambivalent towards centralized intelligence and the OSS, dismissing it as too little, too late.¹²

The AAF's intelligence efforts prior to the war were, according to Arnold, "not only weak but [also] unimaginative." In 1939, he claimed to learn more about the Luftwaffe from a meeting with Charles Lindbergh than from his own air intelligence staff. He remained dissatisfied with his Assistant Chief of Air Staff, Intelligence (A-2) through March 1943, when he divided this office into operational, informational and counter-intelligence. He also created a Committee of Operations Analysts (COA) to coordinate and determine target priorities. When compiling target folders for bombing operations and exploitation during and immediately after the war, rather than turning to A-2, he relied on the COA, bankers, and engineers with contracts in Germany and Japan. Although the AAF was coordinating photo-reconnaissance missions and intercepting some Luftwaffe communications and movements, it was not until March 1943 that G-2 decryption efforts were combined with those of British Project ULTRA. When the Army entered Normandy in 1944 (OVERLORD: 6 June) and North Africa in 1942 (TORCH: 8 November), the AAF attached intelligence "crash teams" to ground units for 'on the spot' assessments of captured

or damaged aircraft, equipment and documents. Most air intelligence was carried by the Royal Air Force (RAF) up to 1942, while the AAF's A-2, COA or Air Technical Intelligence Section (ATI) acted somewhat independently.¹³

From the autumn of 1943, inter-agency projects, such as the War Department's ALSOS mission, were operational. ALSOS was the first intelligence operation to put groups of civilian engineers and scientists on the ground. Since it was initially a nuclear weapons mission, military branches doubted that it would satisfy their technical needs. Arnold declined invitations to include the AAF in ALSOS, opting instead for an independent intelligence operation. There was also considerable distrust after the war; Arnold said that "the G-2 men could not see over the hill," let alone foresee his intelligence needs. CIOS objectives were nonetheless general enough to allow individual agencies to manage collection targets with little, if any, War Department oversight. Operation LUSTY and other covert projects, such as Project OVERCAST, were conceived during the autumn of 1944 under A-2, G-2 and CIOS objectives with a growing, if not desperate, appetite for intelligence.¹⁴

Operation LUSTY, similar to CIOS, pooled thirty intelligence operations already exploiting German science and technology. LUSTY was officially initiated on 22 April 1945, after disarmament and tactical intelligence needs had declined, and "pure exploitation" was the primary objective. In their first six weeks, LUSTY's intelligence teams exploited over 500 targets and interrogated about 2,500 German engineers, scientists and technicians. LUSTY employed the COA and an Exploitation Division of ATI at Wright Field (later in France) to prioritize enemy targets; two-hundred T-Forces to secure Luftwaffe and industrial targets and intern German personnel; materiel retrieval units to procure and ship or fly equipment home; and R&D exploitation and interrogation groups such as the SAG. Collection points were set up at Meersburg, Munich, Nuremberg, and Stuttgart airfields. In addition to nearly 2,000 AAF personnel, LUSTY involved over 1,000 civilian specialists from industry and universities. Companies such as Allis-Chalmers, Bell Aircraft, Bendix, Boeing, General Electric (GE), Lockheed, Northrop, Packard, Standard Oil, and Remington Rand sent engineers and scientists. While one objective of Operation LUSTY was delivering materiel and personnel to the AAF and its contractors, the prime objective, to be filled by the SAG, was to deliver intelligence and a future for air power to square with the General's vision.¹⁵

The SAG was put into motion on or about 7 August 1944 *via* a discreet encounter between Arnold and California Institute of Technology (Caltech) aerodynamicist Theodore von Kármán, in an automobile parked on a runway at La Guardia airfield in New York. According to von Kármán, Arnold confided that, "we have won this war, and I am no longer interested in it.... Only one thing should concern us," he continued. "What is the future of air power and aerial warfare? What is the bearing of the new inventions, such as jet propulsion, rockets, radar, and the other electronic devices? I want you to... gather a group of scientists who will work out a blueprint for air research for the next twenty, thirty, perhaps fifty years." Arnold already had the AAF's postwar blueprint more or less outlined. With Caltech President Robert Millikan, he

prearranged for von Kármán's release to the AAF for Operation LUSTY. Millikan and von Kármán agreed that this was in Caltech's interest.¹⁶

Two months after the La Guardia meeting, Arnold forwarded a memo to von Kármán to explain his intentions. Basically, he wanted a guide for the next ten to twenty years to serve as a "basis for adequate Congressional appropriations." Military R&D was now oriented toward "total war," the object of which "is to destroy the enemy's will to resist, thereby enabling us to force our will on him." In total war, he continued, "political action is directed against the enemy's governing power, strategic action against his economic resources, and tactical action against his armed forces. Strategic and tactical actions are our main concern and are governed by the principles of objective, surprise, simplicity, mass, offensive, movement, economy of forces, cooperation, and security." Such were the values that civilian scientists and technologists had to appreciate. Kármán later recalled that Arnold seemed like a "fanatic" when it came to total war. His officers acknowledged his near "messianic faith in the potential of air power." Arnold's request fitted his wartime pattern of drawing on science and industry, mainly in the form of the National Advisory Committee for Aeronautics (NACA), for information on strategic targets. This time, however, to maintain control, he circumvented the NACA by creating the SAG.¹⁷

With thirty-eight years of military and AAF experience, Arnold was anxious to harness the momentum generated by the war. In 1944, his agency received 43% of War Department appropriations and, by his own account, he had overseen the development of the most powerful military arm in history. Since his appointment as Commanding General in 1938, AAF personnel had increased from 22,000 to 2.4 million; the number of aircraft increased from a few thousand to 70,000; total bomb tonnage increased from 10,200 in 1942 to 1.9 million in 1944; and bomb accuracy doubled. He ushered in the "Jet Age" with his order in 1941 of the XP-59A, built by Bell Aircraft and equipped with GE's copy of the Whittle engine. Arnold directed this momentum by suppressing any open agitation for independence, establishing the groundwork with his *Command and Employment of Air Power*, and controlling intelligence reports and reparations. Working behind the scenes, however, he maintained close, personal ties with the captains of the aviation industry, which became the US's largest economic sector during the war.¹⁸

This was also the way he preferred to deal with industry-driven universities such as Caltech. Arnold had befriended Millikan during World War I and maintained close connections throughout the 1920s and 1930s. In 1929, Millikan enticed von Kármán from Germany's Aachen Institute to direct the Guggenheim Aeronautical Laboratory (GALCIT). In 1939 and 1940, as a Major General, Chief of The Army Air Corps (AAF in June 1941), Arnold was a guarantor of GALCIT, with \$39,000 of contracts for von Kármán's Jet-Assisted Takeoff (JATO) project. In 1943, with a \$3 million Army contract, the JATO project effectively became the Jet Propulsion Laboratory (JPL). Two years earlier, von Kármán's Aerojet Engineering Corporation won a \$3 million contract from the Navy. It was primarily von Kármán's entrepreneurialism with the JPL that linked GALCIT tightly to the AAF. Under War Department policy, von Kármán resigned as

Aerojet's Chairman of the Board but retained his stock holdings. Aerojet's military contracts totaled \$5.2 million by the time of his employment in the AAF in late October 1944. By the end of the war, Caltech was the second largest nonindustrial defense contractor, with \$83.4 million in contracts.¹⁹

Kármán drafted Hugh Dryden (Director of the Bureau of Standards) as his Scientific Deputy and Frederick Glantzberg as Military Deputy about a month before the Pentagon officially established the SAG on 1 December 1944. He recruited another eleven civilian engineers and scientists for the first SAG meeting on 9 January 1945, and fourteen more were added by late spring. Generally, the first meeting involved an inventory of current intelligence reports on Germany's guided missiles and unexploded warheads from V-1 and V-2 rockets. Arnold and his officers briefed the SAG on special AAF problems including acoustic homing, flying in zero visibility, supersonic interception, and the ranges of German rockets. Arnold and von Kármán outlined the intelligence assignment, plans for the monthly meetings and an itinerary for SAG's trip to Europe in late April. Arnold cautioned his officers and the SAG to think about "aircraft and air weapons of the future" by avoiding the "innumerable petty details of current operations." "For the last twenty years," he reminded them, "we have built and run the Air Force on pilots— numbers of pilots.... But we can't do that anymore." "He spoke of 'manless' robots and said that it might be entirely possible that the next war would be opened by an attack on our cities by guided missiles or pilotless aircraft, and the defense against such attacks might only be through interception by similar pilotless weapons directed by radar and using homing devices. He said that all the pilots in the world couldn't help us then— that the Air Force would have to have 'longhaired' scientists... and all the other technical specialists." These were the conclusions for intelligence to support.²⁰

On 22 April 1945, ten days after the death of President Roosevelt, intelligence groups began to arrive in Europe under Operation LUSTY, which by this time had been given high priority. With Berlin's surrender on 2 May, and victory in Europe on 8 May, LUSTY followed literally on the heels of American divisions rolling into Germany. On April 25th, a group of twenty-nine representatives from the aircraft industry arrived in London and on the 28th, nine members of the SAG arrived. Intelligence on German aircraft industries, R&D, the Luftwaffe, and its weapons was sketchy at best. The AAF estimated that 90% of their existing intelligence covered only 10% of German priority technologies. After two months of Operation LUSTY, this changed. By 22 July, LUSTY's 300 officers and 65 engineers and scientists, including the SAG, had exploited 86% of 1,422 priority targets. Priority I targets were those that would help shorten the war in the Pacific. Priority II and III targets were those that had long-term security implications, such as factories for the Luftwaffe and communication networks. Of the priority targets exploited by 22 July, 76 were in armaments and ordnance, 65 were guided missiles, 119 were general electronics targets, 430 were in general aerodynamics, 179 were propulsion targets, 28 pieces of photo equipment, and 525 were miscellaneous technologies. A G-2 SHAEF

directive ordered allied troops to immobilize all personnel connected with the German aviation and aeronautics industry for interrogation by the SAG.²¹

Priority I personnel, such as von Braun, Dornberger and Wernher Osenberg, were captured and evacuated to Bad Kissengen, Munich or G-2 SHAEF's new headquarters in Luftwaffe offices near Frankfurt. Osenberg, Chief of the Planning Office (Planungsamt) of the Reichsforschungsrat (RFR), or Reich Research Council, directly subordinate to the Luftwaffe's Commander Göring, was seized on 25 April in Lindau-Göttingen, with 150 staff members and four tons of documents. He was initially interrogated by ALSOS and G-2 SHAEF agents; on 3 and 4 May 1945, von Kármán, Dryden and Wattendorf zeroed in on differences between research and development in German practice. Research (*Forschung*), according to Osenberg, "included the development of the new weapons and equipment up to and including the production of the first prototype." Development (*Entwicklung*) meant adapting "the prototype in accordance with tactical needs and the requirements of large-scale production." Osenberg had established the Planungsamt in the spring of 1944 to concentrate research on military matters, but then attempted to isolate research from Hitler's Minister of Armaments and War Production, Albert Speer. Speer wanted to concentrate research under his Development Commission, so as to break the campaign of Luftterror (Allied air raids). A major discovery for G-2 SHAEF and the SAG was that the RFR, in obtaining draft deferments for scientists and procurements for research materials, had generated extensive card files on 15,000 German scientists and 1,400 R&D establishments, in cities such as Braunschweig-Völkenrode.²²

When the SAG rolled into the Luftfahrtforschungsanstalt Hermann Göring (LFA) (German Research Establishment of Aerodynamics) in Völkenrode on May 6th, they anticipated neither the value nor volume of R&D materiel and personnel they found in fifty-six buildings on the 4,000 acre complex. Established in 1935 and made operational in 1938, the LFA had remained completely unknown to Allied intelligence until Ninth Army troops moved in on 22 April. The message wired to the SAG indicated that "Germany's ultimate secret weapons were developed" and ballistics designed for the Luftwaffe within the buildings housing some 1,200 people, dozens of labs, and five wind tunnels. The AAF's Colonel Don Putt, head of Operation LUSTY, had the area zoned off and thirty-five intelligence officers ready to assist. A battery of 129 questions pertaining to aircraft and aerodynamics was prepared to focus interrogations. A fifty kilometer perimeter was drawn around the complex and searched to pick up scientists and hidden documents. "The whole thing was incredible," von Kármán remarked. The SAG immediately interrogated the institute's Director of Aeronautics, Theodor Zobel, and Adolf Busemann, theoretician of the swept-back wing. Kármán said he tricked Zobel into leading him to a dry well, where wind tunnel data on the swept-back wing were hidden, by suggesting that the Soviets would follow-up with interrogations if the AAF failed. Caltech graduate and Wright Field engineer Wattendorf recollected that "for the first time, we saw the recent German advances in aeronautics, such as the swept-wing, which opened up a new flight regime; and the whole potential impact of gas turbine propulsion, rocket and missile development. We realized

that Frank Whittle's jet engine had been paralleled by German progress developing out of Hans von Ohain's first turbo-jet."²³

Following a week of interrogations and unearthing of records, von Kármán claimed that "seventy-five to ninety per cent of the technical aeronautical information in Germany was available at this establishment and that information on R&D which had not previously been investigated in the US would require approximately two years to develop with the facilities available there." Arnold's second-in-command, Major General Carl Spaatz, wired the promising news to the US: Völkenrode was the "most lucrative air force target yet... Tremendous volume of documents and test data there include DVL Berlin, Peenemünde, Aachen, Göttingen and Munich records. For example, fundamental wind tunnel data available on jet airplanes which Dr. von Kármán estimated will advance the AAF jet bomber program by eight to ten months if fully exploited and translated.... Five microfilm teams will have approximately 50,000 feet exposed of film by 1 July. Dozens of tons of other documents from all sources." Between early May and the end of June, the SAG returned to Völkenrode twice for short periods to complete reports and oversee reparations. By the end of June, Operation LUSTY had generated 719 intelligence reports, with 120 of these compiled at the LFA. Four wind tunnels ranging from subsonic to supersonic speeds (up to Mach 3), along with a four stage turbine engine and test stand, were crated and shipped back to Wright Field by the end of July. After Völkenrode, the SAG's priority targets encompassed Germany's famed R&D institutions and several recently discovered complexes: at Aachen, Göttingen, Munich, Ottobrunn, Ötztal and Kochel, Ilfeld-Nordhausen (Mittelwerk), Peenumünde, Sonthofen, and Heidelberg.²⁴

Following visits to Aachen and the Aerodynamische Versuchsanstalt (AVA) (Aerodynamic Test Establishment) (est. 1906, renamed in 1941) in Göttingen, Dryden, Tsien, Wattendorf, and Zwicky traveled south to the new facilities at the Luftfahrtforschungsanstalt München (LFM) (Aeronautical Research Establishment) (est. 1940) in Munich and in the Bavarian Alps near Innsbruck. They located two wind tunnels and test documents at the Oberwiesenfeld in Munich, and shipped loads of jet engine equipment from the Bayerische Motoren Werk (BMW) factory. On 15 May, American troops marched into the Wasserbau Versuchsanstalt (WVA) at the base of the Kochelsee and captured 190 researchers within the installation. The WVA's Director, Rudolf Hermann, and two high-ranking assistants were interrogated and evacuated to Garmisch. Others remained close to the WVA, hoping to make good on rumors of transfer to the US. The WVA and its wind tunnels were transferred from the Heeresversuchsanstalt Peenemünde (HVA) (Institute of Aerodynamics) (est. 1936) to Kochel in October 1943 after rocket testing facilities were damaged in Allied air raids (Operation CROSSBOW). When the SAG arrived on 10 June 1945, they found fully operational supersonic wind tunnels for testing A-4 (V-2), Taifun, and Wasserfall missiles. A hypersonic wind tunnel capable of Mach 7-10 speeds was near completion. Zwicky took charge of exploitation, moving German scientists to dig up documents and reports. The quality and scale of the German facilities were unmatched, according to Wattendorf. They marveled at the sheer ambition of the Reich

when they ventured into the world's largest wind tunnel complex on June 13th. At the confluence of the Inn and Ötz rivers was an eight meter sonic wind tunnel requiring 100,000 horse power; this was furnished by Pelton turbines below a 500 meter drop of water. The massive wind tunnel, about 80% complete, was operated by the Munich Institute for testing aircraft models and component parts. The Director, Fritz Schwaiger of the Reich Research Council, was interrogated and divulged details of Germany's entire wind tunnel program. Wattendorf placed a \$15 million price tag on the hypersonic Kochel tunnel, a \$30 million estimate on the Ötztal wind tunnel and a \$75 million tag on the Ötztal project. In October, a dozen freight cars carried the Ötztal facility to Bremerhaven for shipment to the AAF reparations storage base in Wilmington, Ohio.²⁵

"In the Interest of Science..."

LUSTY and the SAG transferred documents and technologies to the AAF while OVERCAST relocated the expertise for reassembling and using them. This articulated transfer of intelligence, materiel, and personnel is one of the more important insights of this article. Detail-oriented AAF brass and the SAG anticipated that Reich R&D could be denazified in the US and redirected toward postwar plans for independence from the Army and new weaponry.

The SAG returned to Washington in early July 1945 and convened a second trip to Europe beginning on 23 September, with primary destinations being Cuxhaven, Peenemünde, and Mittelwerk, the rocket production (and aircraft engine) facilities near Nordhausen. Joint US-British efforts to locate V-2s for an eventual launching with German prisoners of war were initiated back in September 1944 and codenamed Operation BACKFIRE. The British Army was given control of the final stage of the operation for the V-2 launchings in October 1945. The first launching was on 1 October at the Krupp Armament Proving Grounds near Cuxhaven on the Baltic coast; the SAG was invited in for the October 15th demonstration. After witnessing a successful flight, the AAF contingent remained somewhat reserved, concluding that at best "an invaluable amount of knowledge and experience" was gained. Operation BACKFIRE took a force of 1,000 to track down parts, reassemble and prepare the V-2 rockets, and in the process, the competition for intelligence and reparations among American, British, French, and Soviet forces grew fierce. Cuxhaven and Peenemünde were in Soviet zones of occupation; the Soviets also occupied Mittelwerk.²⁶

Following air raids over 16-18 August 1943, which left 732 dead but test stations generally intact, Speer ordered the move of Peenemünde's facilities into a mining tunnel system in the Harz Mountains. The name used for the complex was derived from the Reich-operated company (Mittelwerk GmbH) assigned to moving the facilities and overseeing production. On 28 August, a group of Buchenwald prisoners were trucked in to expand the tunnels and install machinery, effectively creating an underground Schutzstaffel (SS) concentration camp (Dora). Six thousand died of hard labor under dreadful conditions during the first six months. Nearly 20,000 SS camp (Mittelbau-Dora) workers died from numerous causes, mainly annihilation by work— assembly line production and mining.²⁷

By the time the US Army arrived at Mittelwerk on 11 April 1945, about 2,000 V-1s and 5,947 V-2s had been built. When the SAG arrived, the majority of exploitation and reparations was over; US troops quickly shipped out hundreds of missile parts and about one hundred V-2s. Soviet teams arrived in early July, and exported the remaining parts and missiles. The SAG was silent about Mittelwerk, choosing to contrast the lavish facilities of Peenemünde and Kochel with inadequate aerodynamics funding in the US. Writing his memoirs in 1963, von Kármán was sympathetic but ambivalent, remembering that the visit to Mittelwerk "was one of the most ghastly experiences I ever had.... a monstrous place... a perversion of science beyond anyone's nightmarish imagination." The SAG was more impressed by the network of science and technology finessed by Peenemünde's leaders than depressed by the conditions of Mittelwerk. "Dornberger found a good ally in von Braun," von Kármán said, "whose imposing appearance and dramatic flair were helpful in selling [the V-2]... von Braun could impress a man like Hitler."²⁸

In fact, prior to the SAG's journey to Mittelwerk, the SS Officer and V-2 technical director von Braun took advantage of a combination of Allied interrogation practices (e.g., ALSOS, LUSTY), elaborate strategies for importing German engineers and scientists to the US and denazification policies. In early April 1945, made anxious over news of approaching Allied troops, SS General Hans Kammler, who directed Peenemünde and its subsequent move to Mittelwerk, evacuated von Braun, Dornberger, and five hundred key personnel to Oberammergau in the Bavarian Alps. On 2 May, von Braun and Dornberger handed themselves over to Allied forces in Reutte, and by the time the Reich surrendered on 2 May, T-Forces were rounding up engineers and scientists for interrogations at Bad Kissengen and Garmisch. Dryden and Zwicky reported from their interrogations that the V-2 and other rockets and guided missiles were developments of the air forces. Hence the keen interest in Dornberger, von Braun, and the V-2s. After he interrogated the Peenemünders with Wattendorf, Zwicky commented that von Braun and Dornberger "watched the unexpected and disorderly procedures of the British and American teams with discerning eyes and it became apparent that they considered our missions pretty much of a farce." Another AAF interrogator reported that the captured Germans "seem to regard the initial stages of the occupation as a temporary and regrettable interruption of their work, and are interested only in continuing their activity under any auspices.... At Göttingen, some asked if they could not get grants of money from American institutions, such as the Carnegie Institute, for resuming their work.... There is no evidence that the war has changed moral values; but rather evidence to the effect that the loss of the war is regarded merely as an unpleasant and passing material incident."²⁹

From the beginnings of CIOS in 1944, exploitation, intelligence, and reparations involved a transfer of know-how along with technology. By the end of May in 1945, about 2,400 German engineers and scientists were tracked down and placed in internment camps within US zones of occupation and arrangements were underway to either employ them in Germany or re-deploy them in the US. G2 SHAEF and advisors, such as the SAG, were anxious over these new assets,

noting that "involuntary idleness" for researchers is "devastating." "This is particularly true of the German scientists who, if kept busy for the right employer, can be very useful," one intelligence officer suggested. R&D facilities were transported from Sonthofen, the WVA, and the Deutsche Versuchsanstalt für Luftfahrt (DVL) (German Test Establishment of Aviation) (est. 1912) outside Berlin to universities at Aachen and Heidelberg. Two thousand engineers and scientists were employed at the DVL during the war and a number were retained to complete reports on projects in progress prior to Allied occupation. Plans progressed for evacuating and contracting them to the US military at a rate not to exceed \$10.00 per day under Project OVERCAST, effective 19 July 1945. The SAG tried to temper the raid on the Reich's infrastructure by suggesting that long term employment for US experts was valued over importing Nazi engineers and scientists to "design weapons in a hurry." From the "few very outstanding Germans suitable for permanent settling in the U.S.," von Kármán recommended, only those "fit and willing to become good Americans" should be selected. Favoring long-term over short-term deployment, he cautioned that "the only justification for evacuation to the U.S. is need for advice in installation and use of evacuated equipment." Osenberg and his records were essential to the task of selecting whom to transport to the US, although some were suspicious that the Planungsamt intentionally doctored files for just such an occasion. In many cases, transfer was straightforward. With the V-2 missiles and data would come von Braun, and eventually Dornberger; Busemann came with his reports and sweptback wings, Hermann with the Kochel wind tunnels and measurements, Lippisch with his plans and Me-163 rocket-powered plane (Komet) and P-13 flying wings, Zobel with his calculations and interferometers, and so forth (fig. 1).³⁰



Fig. 1. Zobel with his instruments at Wright Field. Source: *The American Magazine* 145, March 1948, 25.

On 14 September 1945, the first group of nineteen Nazi engineers and scientists were on a plane to Boston. Six were destined for Wright Field and the AAF. When Zobel arrived, he

claimed he was dealt a bad hand. He was promised a one-way trip to the US in May, and ordered to sell his home and effects in mid June; but he did not leave Germany until mid-September. Zobel criticized Putt, who was directing the AAF's project, for promising more than he delivered, and complained that "beginning with the extended enforced waiting period in Germany prior to arrival here, [OVERCAST] has been badly planned and carried out." Putt merely noted that promises were verbal, not written. Being in charge, he had fewer reservations about the project than other AAF officers. One officer questioned Dornberger's inclusion on the list for evacuation, arguing that Dornberger's conversations monitored in Garmisch "leave no doubt as to his untrustworthy attitude in constantly seeking to turn ally against ally.... he cannot be trusted and would be a source of irritation and future unrest... in fact, we may trade him to the Russians for a dish of caviar" (within a year, the Soviet military would transfer 2,000 engineers and scientists to the Soviet Union). Hermann was accused of SS activities, and Zobel was accused of experimenting on prisoners to determine the upper registers of human resistance to high wind speeds in his tunnel tests. While some appeared more trustworthy than others, all were suspected Nazis.³¹

The top ranks of the military tallied up Nazi labor as fair payment for the price of war, while politicians began to question whether there was a way of avoiding "labor reparations, labor slavery." If German engineers and scientists were greeted at Wright Field with a contradictory mixture of resentment and respect, they were met with equally confusing instructions: "This project is classified as 'SECRET'... and I am sure you know what that means." "You are not POWs but are more in the category of employees of the USA... you are here in the interest of Science."³²

Scientific Ammunition to Fire at Congress

In August 1945, Arnold and the SAG decided that one party would return to Europe, and a second would tour Japan. The devastation from the bombing of Hiroshima and Nagasaki on the 6th and 9th of August entailed "delicate involvements," according to Arnold. After the war, von Kármán was asked "if you had been one of the dead, would it have made any difference to you if you were incinerated in Hamburg or in Hiroshima?": he was indifferent. Arnold recalled high level meetings in the months leading up to August 6th where military brass strategized "the killing of women and children [and] the destruction of surrounding communities," while choosing targets for strikes on Hiroshima, Kokura, Kyoto, Nagasaki, Niigata, Tokyo, and Yokohama. Similar to Arnold and Spaatz, who were more concerned with bombing efficiencies than civilian deaths, the SAG was concerned with the efficiencies necessary to coordinate R&D on scales as large as the Manhattan Project. In a new era of atomic weapons, AAF brass were suddenly confronted with suggestions that air power was less relevant than was apparent.³³

At Potsdam, according to Arnold, he reported, to the dismay of Truman, that it was not necessary to use the bomb to end the war. However, after its use, the SAG reported, "a strange change of opinion took place." Many now "seem to believe that destruction by means of a few

airplanes or missiles carrying atomic bombs is the only method of future warfare, making a strong air force superfluous." "The atomic bomb renders obsolete a number of tactics and weapons newly developed during the war," the SAG acknowledged in a report prior to the October trip. Japan's surrender the day after the AAF's "big finale" of 1,014 sorties on August 14th allowed General Douglas MacArthur's forces to proceed to Tokyo, and occupy Japanese targets for G2 teams under the direction of Army General E. L. Thorpe and the OSRD's Karl Compton. When the SAG arrived during the third week of October, intelligence and reparations similar to Europe were well underway, albeit on a much smaller scale.³⁴

Operation LUSTY officially concluded in August, but exploitation continued in occupied Germany for another year. In the meantime, Arnold suffered a heart attack and von Kármán went to Paris to accelerate the General's order for a final report of intelligence and secret technology. In September, the Office of Technical Services (OTS) in the Department of Commerce established the Field Information Agency, Technical (FIAT) to oversee commercial exploitation. The JCS and JIC collapsed CIOS and TIIC into the Joint Intelligence Objectives Agency (JIOA) to coordinate interrogations and reparations under OVERCAST. Some 2,000 reports were compiled on Nazi war secrets— 120 on the LFA in Völkenrode alone— with 80% destined for the AAF. On 22 August 1945, von Kármán submitted *Where We Stand*, a fifty-four page report of exploitation, and a comparison of US and German R&D for air power. This provided a background for *Toward New Horizons*, submitted to Arnold on December 15th. The SAG's final report detailed German and Japanese technologies and forecast air power to 1965— 1,400 pages with a policy overview, thirty-three monographs divided into five volumes, and an intelligence supplement with five reports (fig. 2).



Fig. 2. Cover of *Toward New Horizons*, depicting an Air Force long range rocket, seemingly launched in 1965 from the US to Japan (i.e., 6,000 mi.) and reaching supersonic speed. Source: Box 1.72, Carl Spaatz Papers. Courtesy of the Library of Congress.

This was intelligence made to order; the SAG confirmed Arnold's vision of new weapons as threats to peace, and reoriented R&D toward the AAF's new frontiers: "Supersonic flight, pilotless aircraft, all-weather flying, perfected navigation and communication, remote-controlled and automatic fighter and bomber forces, and aerial transportation of entire armies." Pilotless aircraft was intelligence code for 'missiles'; "aircraft" meant "Air Force" in the minds of politicians and the public. The AAF brass appreciated the conclusion that R&D can produce a "war machine in the proper sense of the word, consisting of technical devices only, and yet directed in all details by the mind and staff of some master strategist of air power." *Toward New Horizons* conflated Arnold's and the SAG's two fundamental axioms: "(1) Air power now constitutes the first line of national defense; (2) Air power is primarily dependent upon preeminence in research."³⁵

The SAG's first volume, *Science, the Key to Air Supremacy*, was its response to Bush's *Science, the Endless Frontier*, released in July 1945. Bush recommended a demobilization of the OSRD's civilian specialists, and a reconstitution of the Research Board for National Security (RBNS), which had been established in June as a joint Army-Navy research arm. Kármán and Arnold agreed that the government should sponsor research but deplored Bush's desires to centralize control. The SAG wanted control distributed among competing Federal agencies, one of which would be the AAF. "If free enterprise and initiative are essential for maintaining a sound economy," the SAG reasoned, "certainly they are more necessary in scientific life."

Challenging Bush's recommendations in *Science, the Endless Frontier*, they argued that "centralization can be detrimental to American science, if it means exclusion of independent individuals and small groups" of researchers. The AAF, they continued, should "have the freedom to call on institutions and individuals whose assistance they deem to be of greatest benefit for their program." Decentralized (read military branch) control of R&D was the core of the AAF's air power doctrine and the SAG's postwar report. The SAG wanted the military to mobilize and sponsor (i.e., maintain control of) "basic research" in industry and the universities, rather than create internal agencies for this part of the process.³⁶

These issues gathered momentum with Bush's proposal to create a permanent National Research Foundation (NRF). The AAF's initial response to his testimony in congressional hearings during January and February of 1945 decried the lack of air force representation on NRF's proposed Executive Committee and Board. However, the AAF calculated that Bush could "materially aid" them in obtaining postwar funds, and so publicly supported the proposal. Privately suspicious of Bush and his postwar NRF, Arnold recommended that SAG reports emphasize decentralized control and permanent R&D advisory groups. With eroded confidence in the NACA, this was timely advice. In *Science, the Key to Air Supremacy*, the SAG also recommended that "a permanent SAG, consisting of qualified officers and eminent civilian scientists, be available to the Commanding General to guide the AAF's R&D program" through peacetime.³⁷

While exploitation strategies were similar, postwar R&D plans differed among the NACA, OSRD, SAG, War Department, Army, Navy, and the AAF. Demobilization and insecurity threatened the military-industrial-academic complex. In June 1940, Bush had persuaded President Roosevelt to create a National Defense Research Committee (NDRC) to mobilize R&D. The NDRC was elevated to the OSRD in 1941 and by the war's end some 15,000 engineers and scientists were working on R&D projects that numbered in the thousands, with a \$155 million annual budget. The OSRD primarily drew from physics, chemistry and electrical engineering while the NACA retained control over most of the AAF's R&D in aeronautics. About 10,000 R&D personnel were mobilized for the AAF in 1945, with a \$150 million R&D budget, compared to \$3.6 million in 1939. The SAG envisioned comparable levels of personnel and significant increases of funds in postwar scenarios. Given that prewar (i.e., 1935) R&D was 0.5% of expenditures and wartime R&D between 1942 and 1945 averaged 1.8%, the SAG's recommendation of 25%-33% of annual expenditures for R&D was unrealistic (Table 1). Reparations, especially the \$30 million and \$75 million wind tunnels, were sure bets. As Wattendorf reasoned, special dispensations for the military branches allowed them to "re-erect useful German equipment without requirements of specific Congressional legislative authority." Similarly, exemptions made for deployment of German scientists helped the military get around the Civil Service Commission to pay for R&D at rates one-half to one-third of salaries paid to American personnel. Engineers and scientists, such as von Kármán and Bush, may have loathed political control over R&D but, along with their military bosses, anticipated the politics at hand. Intelligence, reparations, and *Toward New Horizons* were produced, as the SAG understood Arnold's objective at this point, to "obtain money from Congress for postwar AAF research."³⁸

Table 1. AAF and USAF R&D Budget, 1939-1949

Fiscal Year	R&D Budget	% of Expenditures
1935*	\$111,670	0.5%
1939	\$3,574,290	4.3%
1940	\$10,000,000	9.2%
1941	\$102,231,275	16.9%
1942	\$95,576,000	3.7%
1943	\$98,967,000	1.0%
1944	\$118,412,000	0.9%
1945	\$136,198,000	1.1%
1946	\$120,662,000	4.7%
1947	\$112,700,000	13.1%
1948	\$92,928,000	14.2%
1949	\$99,149,000	9.4%

*Estimate for 1935 based on actual expenditures and Navy R&D percentage.

Throughout the war, the AAF brass generally found Congress to be a soft target. When they went into hearings in August 1944, the Chairman of the House Select Committee on Postwar Military Policy, Clifton Woodrum, was agreeable but not entirely committed. "Congress has not" Woodrum lectured, "in any instance turned down any requests of the Army, the Navy, the NACA, or the OSRD for funds for research. You will find a very sympathetic attitude here on that. We have put the funds out about as fast as they could be used." Nonetheless, the politicians had to be coddled. "We have had all that we could use since 1939," the AAF brass responded. However, "you do not gain much if jet airplanes and robot equipment and modern radar equipment comes along and you don't have it." Arnold entered into the Woodrum hearings in November. "Today we have the greatest Air Force in the world," he testified. "But within 2-3 years every piece of equipment will be obsolete.... It is recommended as policy for the next five years after the war, that R&D for the Air Force be continued at the present scale, and that one-fourth of the equipment of the Air Force be newly acquired each year."³⁹

By the beginning of 1945, Arnold had convinced his boss, General George C. Marshall, to endorse an independent Air Force. But demobilization was nonetheless forcing him to plan for an 85% cut in personnel, while hoping to maintain rates of R&D funding. When the engineers and scientists gave evidence, they echoed the military, and following Bush, wishfully suggested that R&D and the military should be equals— "equal in authority, prestige, and funds." Hearings in the Woodrum and similar committees in late 1944 and early 1945 characterized battles on Capitol Hill for the next year.⁴⁰

With Japan's surrender on 2 September 1945, Arnold and Spaatz were weary of political proceedings, but otherwise loaded with air power and "scientific ammunition." Through the fall of 1945, hearings and public meetings occupied the AAF's top ranks. In particular, the Senate Subcommittee on War Mobilization and Commerce Committee kept officers busy. At times, Arnold was a disciplined commanding general, alternating reserve with secrets to pique curiosity and raise fear in the hearts and minds of politicians with indiscriminate remarks about "revolutionary developments as yet unconceived." In joint hearings of the War Mobilization and Commerce committees, he fought with the "spectacular innovations in technical warfare"— atomic explosives, aerodynamics, radar, remote controlled and homing missiles, jet propulsion, and rockets that threatened the US. R&D funds, he concluded, "must be mobilized continuously and without delay."⁴¹

The week before the SAG submitted their final report, Arnold advised Spaatz that "we must never lose these contacts." Intelligence that engineers and scientists had pooled was inaccessible to the average AAF officer. However, Arnold was in a habit of playing the SAG against the NACA and Secretary of War Henry Stimson's scientific advisor, Edward Bowles. For congressional battles, the SAG, Operation LUSTY, and Project OVERCAST provided a steady supply of intelligence documents and technologies from interrogations and reparations. Quite dramatically at times, this intelligence made its way into the hearings and Arnold's third *Report of the Commanding General of the AAF to the Secretary of War*, delivered November 12th 1945.

After describing the destruction in Europe in this final report to Stimson and Congress, Arnold played on fears at home, suggesting that "no one is immune from the ravages" of war. If the difference between defeat and victory, war and peace, was merely a few tactical blunders, national security was dependent on a continuous mobilization of air power or total activity—"civilian and military, commercial and private, potential as well as existing." "Continuous knowledge of potential enemies," Arnold continued, "covering their entire political, social, industrial, scientific and military life is also necessary to provide warning of impending danger." Total war had its analogue in total intelligence. Responding to the dismantlement of the OSS in mid-September, Arnold called for a permanent, centralized agency to generate a "continuous stream of intelligence." Publicly, the AAF rallied behind centralized intelligence and research agencies. Privately, AAF officers were skeptical of bureaucracies not directly under their control, and worked behind the scenes with consultants such as von Kármán and Bowles. Arnold wanted their permanent "in-house" specialists to generate and "give intelligence guidance at every turn."⁴²

Arnold's sights were fixed on Congress and the dates used by the SAG for their forecasts in *Toward New Horizons*: 1965, 1975, 1985 and 1995 (forecast dates in the report and Arnold's directive). Recalling the Nazis' Mittelwerk, Arnold feared the underground assembly of an "annihilating war machine," descending on the US in the form of "thousands of robots passing unannounced" in the dark of night. He drew directly from the SAG's reports. He brought in three intelligence photos of the German's secret Bachem BP-20 Natter, or "Viper," a wicked-looking piloted rocket that was hauled back to Wright Field in June 1945 (fig. 3). Described as a "rocket propelled interceptor," it accelerated to 620 mph and 16,400 feet after take-off. The pilot had thirty-six minutes of total flight time to pull up behind targets, such as B-29 bombers, and release any number of twenty-four 7.3 cm shells. Once the pilot cut the nosecone loose and pulled parachutes for himself and the fuselage intact with rocket engine, both floated to safety. The nosecone was expended upon impact with the ground. The SAG reported that "a former Luftwaffe pilot, who had been convicted of some crime, acted as a test pilot in the first flight of the Natter and was killed." It never saw combat and was obviously a dubious military technology, yet Dryden reported that "the project was well advanced when Germany fell." Arnold admitted that the Me-262 was the "greatest threat" to his bombers but opted to exploit the intelligence on the Natter instead.⁴³

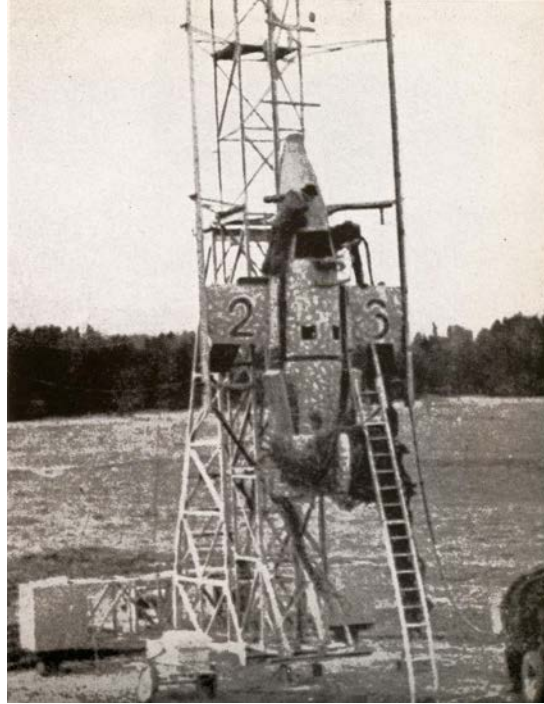


Fig. 3. Preparing the Bachem BA-349 Natter, or "Viper," for launching in Germany. This photo was used by Arnold in his third report to the Secretary of War.

While Arnold was dramatizing the future of air power for Congress, military brass were not surprisingly accusing the media of sensationalizing atomic warfare and fueling mass hysteria. On November 19th, 1945, *Life* transformed Arnold's report into "The 36 Hour War," an illustrated documentary on "robot" bombs, or missiles, that could deliver nuclear warheads to "13 key U.S. centers," including Boulder Dam, Chicago, and New York. The only defense against such an attack was a powerful air force with missiles— "U.S. rockets lay waste to the enemy's cities. U.S. airborne troops successfully occupy his country. The U.S. wins the atomic war." It was difficult to distinguish between the magazine's journalists, AAF generals, and the SAG, which generated this "Defense Against the Atomic Bomb" intelligence report in August for Arnold. In their February 1946 issue, *National Geographic Magazine* published about three-quarters of Arnold's report verbatim. With eighteen photos, the AAF never looked so independent, high-tech, and picturesque to the public. Alexander Seversky's *Victory Through Air Power* and Disney's film portrayal raised the bar for these slick mixes of fact and fiction in 1942 and 1943. AAF officers and the SAG anticipated these dramatic displays and, in ways, controlled and staged them. Boeing's representative on the SAG, George Schairer, confessed that he allowed his "imagination to roam slightly wildly" when he prepared his intelligence report on aircraft. Arnold wanted persuasive ammunition, ordering that SAG intelligence reports be "specifically spiked" to support his conclusions. Exaggerations and colorful, spiked reports were not merely tactics of journalism, politics, and optics; to the contrary, such was the intelligence gathered by the SAG and used by military brass.⁴⁴

* * * * *

In February 1946, Josef Stalin delivered what some interpreted as "the declaration of World War III," the SAG's charter expired; the reparations story broke in the news; Arnold retired; and Spaatz took command of the AAF. Spaatz was left to broker deals for the AAF's future with the new Chief of Staff, General Dwight Eisenhower. From September 1945 to February 1946, 734,715 AAF personnel were released. Nonetheless, Spaatz had visions for independent air power (fig. 4). In February as well, a journalist broke a story on "The World's Greatest Treasure Hunt," wherein Operation LUSTY was described. This coincided with a run by industry on the intelligence and reparations. Still classified, Project OVERCAST was renamed Project PAPERCLIP on 13 March, marking a policy shift from short-term to long-term or permanent contracts for the Germans. Back in October 1945, Arnold arranged with Bowles to establish the logistics of an AAF missile program, leaving Spaatz to sign-off on Project RAND (Research AND Development) in March 1946. RAND circulated a futuristic report on 2 May, *Preliminary Design of an Experimental World-Circling Spaceship*, "judiciously based on German experience with V-2." By 16 April, when the US launched its first V-2 at White Sands (Project HERMeS) under supervision of von Braun and thirty-eight other Peenemünders, 165 Germans had been recruited, with about half contracted to the AAF. By this time, the new Commanding General was working the phones to invite von Kármán and the SAG back for a permanent home in the AAF. On 17 June, the AAF Scientific Advisory Board (SAB) was chartered, with von Kármán in charge again.⁴⁵

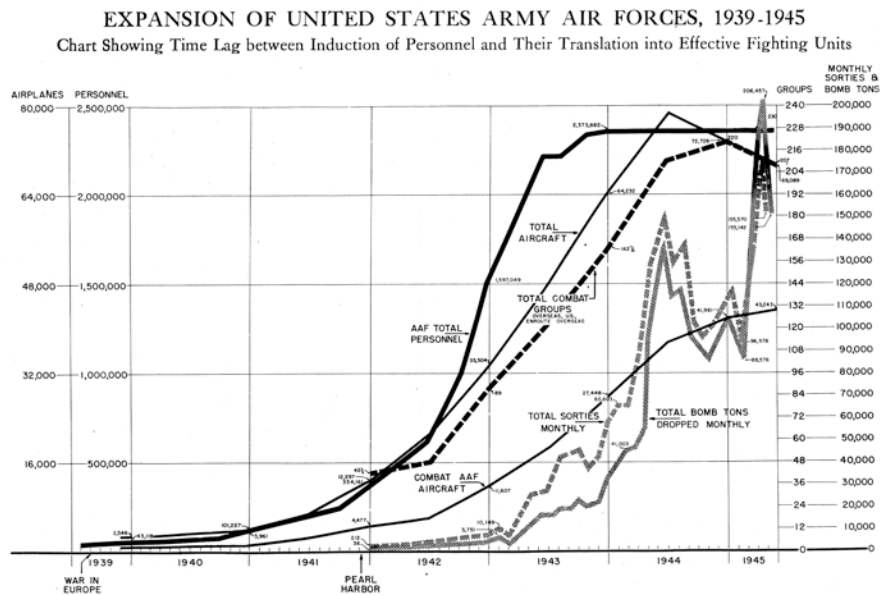


Fig. 4. Arnold and Spaatz relied on this chart to demonstrate the expansion of air power into an Air Force and politic for AAF independence. Source: Carl Spaatz, "Strategic Air Power," *Foreign Affairs* 24 (1946): overleaf.

Meanwhile, President Truman disbanded the OSS in September 1945, and signed the Central Intelligence Group (CIG) into existence on 22 January 1946. On 10 June, AAF General Hoyt Vandenberg was appointed Director, and in his eleven month term, swelled the CIG from 165 to nearly 3,000 clerks and agents. As Director, Vandenberg temporarily shored up military trust in centralized intelligence. In early August, the Vinson Act effectively created the Office of Naval Research, and reinforced the SAG's and SAB's directions for in-house R&D. On 21 November, the Nuremberg War Crimes Trial began with the prosecution of twenty-three Nazi defendants— at least three (i.e., Becker-Freysing, Ruff, and Schafer) accused of pressure chamber and potable water experiments were already employed by the AAF. The official denazification policy stated that any German found "to have been a member of the Nazi party and more than a nominal participant in its activities, or an active supporter of Nazism or militarism shall not be brought to the U.S. hereunder." Three other denazification policies provided contradictory directives, field detachments had no details of the policies ("top secret") in their hands, or policies were reinterpreted, revised, and rewritten at various levels. Hence recruitment practices easily contravened policy. As author of various policies Elmer Plischke candidly acknowledged, "there consequently was considerable variation in the application of the denazification program among the various sections of Germany under the control of the American occupation forces."⁴⁶

Anticipating damaging publicity at home, the War Department staged a public relations event for Project PAPERCLIP. On 18 and 19 November, reporters were given entry to Wright Field and Fort Bliss to talk to some of the 300 engineers and scientists now in the US. Of the total, about half were at Wright Field or contracted to industry in the Dayton area. Adopting an approach he used strategically over the next four months, Colonel Putt hand-picked sixteen for the reporters to photograph and interview, and with the War Department, edited the stories to conform with the press release. Busemann, Doblhoff, Hermann, Lippisch, Schmitt, von Döpp, and Zobel were among the usual cast from Wright Field, along with SS Officer von Braun at White Sands, who were profiled as AAF celebrities for the next four months (fig. 5). Echoing the farce of denazification tribunals, the group was represented as talented victims of the Reich's policies and not very good or loyal Nazis. For the military *a la* media, LUSTY plus PAPERCLIP equaled "an unprecedented amalgamation into the victors' technology of the defeated nation's industrial and military secrets." FIAT's estimate of the total take of materiel reparations was "at least \$5 billion," while the War Department claimed that "cerebral reparations" saved the military two to ten years and \$750 million in rocket R&D alone. German estimates were similar, ranging from \$5 billion to \$12 billion. The AAF conservatively estimated a \$30 million savings, discounting materiel, in aeronautics R&D between 1945 and 1947.⁴⁷



Fig. 5. Lippisch pointing to his Komet and appearing as celebrity in *The American Magazine* 145, March 1948, 24.

In July 1947, Congress passed the National Security Act, effectively creating a National Military Establishment from the War Department and Department of Navy, a Central Intelligence Agency from the CIG, and an Air Force (USAF) from the AAF. Demobilization had taken its toll on the military— AAF personnel were reduced to about 300,000, and total military budgets were slashed from \$45 billion to \$14.5 billion. Military brass and the JIOA were questioned over their exploitation and immigration practices. Despite attempts to paint a happy face on LUSTY, PAPERCLIP, and the War Crimes Trial, criticisms mounted. One powerful group, including Albert Einstein, cautioned the President that the military's new specialists were "potentially dangerous carriers of racial and religious hatred." Their former eminence as Nazi party members and supporters raised suspicion. In July, the JIOA ran up against this suspicion. Embarrassed and angry, JIOA officers exerted tighter control over Nazi dossiers by discrediting lists of Nazi hunters, withholding incriminating files and generating newer, cleaner security reports. Whereas two years earlier Hermann was "untrustworthy" and twice picked up by G-2 agents for alleged Nazi activities, his dossier now cleared him of crimes and prior commitments to the Third Reich (although his wife was imprisoned for leading the Nazi youth movement). After two years in a British jail, Dornberger traveled in September to Wright Field and the USAF, and eventually to Tullahoma, his dossier cleared of Nazi wrongdoings.⁴⁸ Whether or not the military "was sold— or sold itself— an expensive bill of goods" by Nazi scientists and technologists, as a reporter concluded at the time, remains a historical question.⁴⁹

Intelligence and reparations looked fairly chaotic to observers at the end of the war, but LUSTY, OVERCAST, PAPERCLIP, and the SAG represented coordinated efforts to harness Nazi R&D for AAF postwar policies and politics for independence. Although initially cautious about the implications of recruiting personnel for R&D in the US, engineers and scientists in the

SAG were anxious to transfer Nazi technologies to the AAF. Policies nonetheless dictated that with materiel reparations would come cerebral reparations or expertise. LUSTY transferred technologies while OVERCAST and PAPERCLIP recruited Nazi specialists for continuing and initiating new R&D programs in the US. AAF brass confronted Congress with intelligence suggesting the dire consequences of reducing R&D funding, and eluded the politicians with transfers of Nazi capital and personnel. With LUSTY, OVERCAST, and PAPERCLIP, in tandem, the SAG delivered "scientific ammunition" while the AAF brass fired it at Congress. Key resources for AAF independence, this articulation and narrative of intelligence, reparations, and politics at the same time reinforced postwar interdependence among scientists, engineers, and the military.

Endnotes

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³² 79th Congress, First Session, *Elimination of German Resources for War, Hearings Before a Subcommittee of the Committee on Military Affairs* (Washington, DC: US Government Printing Office, 1945), 14; "Instructions to German Scientists," September 1945, Reel 3823, IRISRef A2055, Frames 962-963, AFHRA, Maxwell AFB. On PAPERCLIP history, see note 6 above; Gimbel (n. 1 above), 37-59.

³³ On history of the atomic bomb and its aftermath, see Rhodes (n. 5 above). Sherry noted the difficulty of accurate body counts and reasoned that there were over 200,000 deaths from the two bombs. Sherry (n. 2 above), 353-357. On the AAF's deliberations, see Arnold, (n. 13 above), 389. For details of atomic bomb targets, see Otos Cary, "Atomic Bomb Targeting— Myths and Realities," *Japan Quarterly* 26 (1979): 506-514.

³⁴ On Arnold's reservations, see Arnold, 389; SAG's quotes are from "Science, the Key to Air Supremacy," in Gorn *Prophecy Fulfilled* (n. 2 above), 97; SAG, 28 August 1945, "Defense Against the Atomic Bomb," RG 18.7.11, Box 3, Folder 385, AAF SAG Collection, National Archives; Eaker to Kenney, 6 September 1945, RG 18.7.1, Folder 360.2, Box 171, AAF AAG Collection, National Archives. The SAG's Wattendorf, Pickering, Williams, and Walkowicz were sent to Japan on intelligence missions attached to ADVON FEAF (Advanced Echelon, Far East Air Forces). **On the SAG in Japan**, see Frank Williams, "Japan's Aeronautic Research Program and Achievements" in *Toward New Horizons, Technical Intelligence Supplement*, Part IV (December 1945), 151-162; F. Zwicky, "Remarks on the Japanese War Technical Effort" in *Toward New Horizons, Technical Intelligence Supplement*, Part V (December 1945), 163-168; Karl T. Compton, "Mission to Tokyo," *Technology Review* 48 (December, 1945): 99-102, 114, 116, 118, 120; Bowen C. Dees, *The Allied Occupation and Japan's Economic Miracle* (New York: Routledge, 1997/2013); Sheldon Harris, *Factories of Death: Japanese Biological Warfare 1932-45 and the American Cover-up* (New York: Routledge, 1994); United States Strategic Bombing Survey [Pacific], *Interrogations of Japanese Officials*, Volumes 1-2 (Washington, DC: Naval Analysis Division, 1946). Helpful records at the National Archives include RG 18.7.11, AAF SAG Collection and RG 331.46.4, SCAP Economic and Scientific Section 1944-52. For historiography and records, see Home and Low (n. 14 above). In summary, the SAG's intelligence exploitation in Japan has yet to be recounted by historians.

³⁵ SAG, 15 December 1945, *Toward New Horizons*, Boxes 193-194, Arnold Papers, Library of Congress; Theodore von Kármán, "Where We Stand," in Gorn *Prophecy Fulfilled* (n. 2 above); SAG, "Science, the Key to Air Supremacy," 5; "Abstract of Dr. von Kármán's Report," Box 249, Arnold Papers, Library of Congress; SAG, 1 August 1945, "Organization of Postwar Research in the AAF," RG 18.7.11, Box 3, Folder 385, AAF SAG Collection, National Archives. For an evaluation of *Toward New Horizons*, see Thomas J. O'Connor, *A Study of Some Effects of the SAG's Recommendations on Air Force R&D for the Period 1945-1950* (MA Thesis, Univ. of Denver, 1969). For the full *Toward New Horizons* report, see the Arnold and Spaatz collections

at the Library of Congress or online at <http://www.afhra.af.mil/Information/Timelines/> and <http://www.governmentattic.org/TwardNewHorizons.html>.

³⁶ Kármán to Arnold, 15 December 1945, Forward to *Toward New Horizons*; SAG, "Science, the Key to Air Supremacy," 85, 101; O. W. Hammonds, 31 March 1945, "Organization of AAF Postwar Research," RG 18.7.11, Box 6, Postwar Folder, AAF SAG Collection, National Archives; Gasser and Doubleday to Phillips, 15 March 1945, RG 18.7.11, Box 6, Postwar Folder, AAF SAG Collection, National Archives.

³⁷ For Bush's NRF, the Joint Research and Development Board, and the National Science Foundation Act of 1950, see Michael Aaron Dennis, "Reconstructing Sociotechnical Order: Vannevar Bush and US Science Policy," in *States of Knowledge: The Co-Production of Science and Social Order*, ed. Sheila Jasanoff (New York: Routledge, 2004), 225-253; Daniel J. Kevles, "Scientists, the Military, and the Control of Postwar Defense Research: The Case of the Research Board for National Security, 1944-46," *Technology and Culture* 16 (1975): 20-47; Vannevar Bush, *Science, the Endless Frontier* (Washington, DC: US Government Printing Office, 1945); Dael Wolfe, "National Science Foundation: The First Six Years," *Science* 126 (23 August 1957): 335-343; Kevles (n. 7 above); Daniel Kleinman, *Politics on the Endless Frontier: Postwar Research Policy in the United States* (Durham, NC: Duke University Press, 1995); Nathan Reingold, "Vannevar Bush's New Deal for Research: Or the Triumph of the Old Order," *Historical Studies in the Physical and Biological Sciences* 17 (1987): 299-344; Giles to Compton, 22 February 1945, RG 18.7.1, Box 469, File 360.2, AAG Collection, National Archives. **On the SAG correspondence with Bush and the OSRD**, see RG 18.7.1, Box 171, File 360.2, AAG Collection, National Archives. On postwar NACA, see Alex Roland, "The Impact of War Upon Aeronautical Progress: The Experience of the NACA," in *Air Power and Warfare*, eds. Alfred F. Hurley and Robert C. Ehrhart (Washington, DC: Office of Air Force History, 1979), 362-387; Alex Roland, *Model Research: The National Advisory Committee for Aeronautics* (Washington, DC: NASA, 1985).

³⁸ On the military-industrial-academic complex, see notes 3-5, 7 and 19 above; On scientists and technologists in postwar planning, see notes 7-8 above; Kevles, 20-47; Daniel Kevles, "Cold War and Hot Physics: Science, Society and the American State, 1945-56," *Historical Studies in the Physical and Biological Sciences* 20 (1990): 239-264; Carroll Pursell, "Alternative American Science Policies During World War II," in *World War II: An Account of its Documents*, eds. James E. O'Neill and Robert W. Krauskopf (Washington, DC: Howard University Press, 1976), 151-162; Alice Kimbell Smith, *A Peril and a Hope: The Scientists' Movement in America, 1945-47* (Chicago: University of Chicago Press, 1965); Herbert York and G. Allen Greb, "Military Research and Development: A Postwar History," *Bulletin of the Atomic Scientists* 33 (1977): 13-26; "Facing up to an Atomic World," *Business World*, 10 October 1953, 27-30. **On the official histories of engineers and scientists at war**, see James P. Baxter, *Scientists Against Time* (Boston: Little, Brown and Company, 1948); Thiesmeyer and Burchard (n. 14 above); Wattendorf (n. 24 above), 4; "Difficulty and Expense of Replacing Presently Employed German Scientific Talent," [October 1946], Reel 3823, IRISRef A2055, Frame 220, AFHRA, Maxwell AFB; Arnold's objective to "obtain money from Congress" is from Kármán (n. 2 above). **Sources for Table 1:** "AAF Air Corps Army Funds," Reel 42675, Frame 986, AFHRA, Maxwell AFB; Office of Statistical Control, AAF, *Army Air Forces Statistical Digest: World War II, 1945* (Washington, DC: Office of Statistical Control, 1945), 297; Byron D.

Shiner, *A Review of the United States Air Force Research and Development Organizations and Functions* (Air War College Thesis, Maxwell AFB, 1963), 14; Headquarters USAF, *USAF Statistical Digest* (Washington, DC: Office of Statistical Control, 1947, 1948, January 1949-June 1950), 250, 276, 303. See also Alan T. Waterman, J. Carlton Ward and Mervin Kelly, "Scientific Research and National Security," *Scientific Monthly* 78 (1954): 214-224.

³⁹ On Woodrum committee, see Michael Sherry, *Preparing for the Next War: American Plans for Postwar Defense, 1941-45* (New Haven: Yale University Press, 1977), 61-65; Moody (n. 7 above), 29-66; "Digest of Hearings Before the Select Committee on Postwar Military Policy," February 1945, pp. 1, 5, 19, RG 18.7.11, Box 6, Postwar Folder, AAF SAG Collection, National Archives; "Types of Reasons for the Necessity of Postwar Research by the Armed Forces," 29 March 1945, RG 18.7.11, Box 6, Postwar Folder, AAF SAG Collection, National Archives.

⁴⁰ 78th Congress, Second Session, *Hearings Before the Select Committee on Post-War Military Policy, Part 1* (Washington, DC: US Government Printing Office, 1944).

⁴¹ O. W. Hammonds, 1 August 1945, "Organization for AAF Research," RG 18.7.11, Box 6, Postwar Folder, AAF SAG Collection, National Archives; 78th Congress, Second Session, Subcommittee on War Mobilization to the Committee on Military Affairs, *The Government's Wartime Research and Development, 1940-1944, Part II, Findings and Recommendations* (Washington, DC: US Government Printing Office, 1945); **For Arnold's remarks to Congress**, see H. H. Arnold, 18 October 1945, "Statement by H. H. Arnold, Commanding General, Army Air Forces," pp. 1, 3-4, 9, Box 38, "Special Office File," Arnold Papers, Library of Congress.

⁴² Arnold quoted in Daso, (n. 1 above), 33; Gorn, *Universal Man* (n. 2 above), 116; H. H. Arnold, "Third Report of the Commanding General of the Army Air Forces," in *The War Reports of the General of the Army George C. Marshall, Chief of Staff, General of the Army H. H. Arnold and Fleet Admiral Ernest J. King*, ed. Walter Millis (New York: JB Lippincott, 1947), 452, 455, 461, 467; On Bowles and the AAF, see Collins (n. 7 above).

⁴³ Arnold, 454, 466, 426; Kármán, "Where We Stand" (n. 35 above), 39-40. The Luftwaffe's secret technologies have been documented in a range of media. See e.g., note 1 above and Dieter Herwig and Heinz Rode, *Luftwaffe Secret Projects: Fighters 1935-1945* (Leicester: Midland Publishing, 1999); idem, *Luftwaffe Secret Projects: Ground Attack & Special Purpose Aircraft* (Leicester: Midland Publishing, 2003); Ian V. Hogg, *German Secret Weapons of the Second World War* (New York: Skyhorse, 2002/2016); Walter Schick and Ingolf Meyer, *Luftwaffe Secret Projects: Strategic Bombers 1939-1945* (Leicester: Midland Publishing, 1997); *Secret Luftwaffe Aircraft of WWII*, A&E Television Networks, 1999, DVD; *Secret Weapons of the Luftwaffe*, prog. Lawrence Holland, Lucas Films, 1991, CD ROM.

⁴⁴ "The 36 Hour War: Arnold Report Hints at the Catastrophe of the Next Great Conflict," *Life*, 19 November 1945, 26-34; Arnold, 462-464; SAG, "Defense Against the Atomic Bomb" (n. 34 above); L. E. DuBridg, E. M. Purcell and G. E. Valley, "Defense Against the Atomic Bomb," in *Toward New Horizons*, volume 8-3; Schairer to Kármán, 25 July 1945, RG 18.7.11, Box 2, AAF SAG Collection, National Archives; O. W. Hammonds, 31 March 1945, "Organization of AAF Postwar Research," RG 18.7.11, Box 6, Postwar Folder, AAF SAG Collection, National Archives. See also, Arnold (n. 17 above); Arnold, "Science and Air Power" (n. 2 above); Ira Eaker, "Winning Strategies in Aerial Warfare," in 79th Congress, 1st Session, *Appendix to the Congressional Record* (Washington DC: US Government Printing Office, 1945),

A5196-A5198; Carl Spaatz, "The Future of the Army Air Forces," in 79th Congress, 2nd Session, *Appendix to the Congressional Record* (Washington DC: US Government Printing Office, 1946), A1355-A1357.

⁴⁵ Karl A. Wittfogel, "Review of *The Sino-Soviet Conflict, 1956-1961*," *Russian Review* 21 (October, 1962): 380-382, WWII comment on 380; Carl Spaatz, "Strategic Air Power," *Foreign Affairs* 24 (1946): 385-396; idem, "Evolution of Air Power: Our Urgent Need for an Air Force Second to None," *Military Affairs* 11 (1947): 2-16. Ciesla calculated that the AAF's and USAF's share of OVERCAST AND PAPERCLIP recruits was 40% through 1952. Ciesla (n. 4 above), 97. **For tally to 1947**, see Buyer and Jensen (n. 30 above), frames 686-750. On RAND and its role in the postwar Air Force, see Douglas Aircraft Company, *Preliminary Design of an Experimental World-Circling Spaceship* (Santa Monica, CA: Douglas, 2 May 1946), 1; Collins (n. 7 above); David Hounshell, "The Cold War, RAND, and the Generation of Knowledge, 1946-1962," *Historical Studies in the Physical and Biological Sciences* 27 (1997): 237-267. **On SAB**, see Gorn, *Harnessing the Genie* (n. 2 above), 46-186; Gorn, *Universal Man* (n. 2 above), 118-129; Komons (n. 8 above), 1-27; Sturm (n. 2 above).

⁴⁶ On CIG, see Leary (n. 12 above), 18-23; Troy (n. 12 above), 359-402; Zegart (n. 12 above), 163-184. On AAF and Nuremberg, see Hunt, "U.S. Coverup" (n. 6 above), 21-22; Pieszkiewicz (n. 27 above), 215-246. International trials began in August 1945. On denazification, see John Herz, "The Fiasco of Denazification in Germany," *Political Science Quarterly* 63 (1948): 569-594; Elmer Plischke, "Denazifying the Reich," *Review of Politics* 9 (1947): 153-172, on 166; Harold Zink, "The American Denazification Program in Germany," *Journal of Central European Affairs* 6 (1946): 223-240.

⁴⁷ On PAPERCLIP press, see Crim (n. 6 above), 111-118; Gimbel (n. 6 above), 455; Hunt, *Secret Agenda* (n. 6 above), 57-62; Lasby (n. 6 above), 184-187; "Operation Paperclip," *Air Technical Bulletin*, 4 December 1946, 1-2; Buyer and Jensen (n. 30 above), frames 686-750; **On bad press from Nuremberg**, see "The Nurnberg Confusion," *Fortune*, December 1946, 120-122. For photos of the specialists with their technologies, see e.g., Herbert Shaw, "Wright Field Reveals 'Operation Paperclip'," *The Dayton News*, 4 December 1946, D-5; "Nazi Brains Help U.S.," *Life*, 9 December 1946, 49-52; "Secrets From Hitler," *Newsweek*, 9 December 1946, 64, 69; Joachim Joesten, "This Brain for Hire: Nazi Science on the Market," *The Nation*, 11 January 1947, 36-38; "Science has no Nationality," *Science Illustrated* 2 (1947): 13. **For estimates on reparations**, see Christenson (n. 1 above), 190; Gimbel (n. 1 above), 155; Lasby (n. 6 above), 186; Gerhardt B. Thamm, "The Potsdam Archive: Sorting Through 19 Linear Miles of German Records," *Studies in Intelligence* 58 (March 2014): 1-7; For German estimates, see Johannes Bahr, Paul Erker and Geoffrey Giles, "The Politics of Ambiguity: Reparations, Business Relations, Denazification and the Allied Transfer of Technology," in *Technology Transfer* (n. 4 above), 131-144, on 135.

⁴⁸ On the creation of the USAF, see n. 10 above, especially Moody, 67-186. On the creation of the CIA, see n. 12 above, especially Troy, 351-410. On JIOA controversy and doctoring of Nazi dossiers, see Bower (n. 6 above), 185-213; Gimbel, (n. 6 above), 458-462; Hunt, "U.S. Coverup" (n. 6 above), 17-19; Hunt *Secret Agenda* (n. 6 above), 78-142. For Einstein letter, see Lasby (n. 6 above), 191; "Citizenship Opposed for Nazi Scientists," *New York Times*, 30 December 1946, 21. The letter from the forty distinguished individuals, including Einstein, articulated concerns that the PAPERCLIP recruits were "potentially dangerous carriers of racial

and religious hatred. Their former eminence as Nazi Party members and supporters raises the issue of their fitness to become American citizens or hold key positions in American industrial, scientific, and educational institutions. If it is deemed imperative to utilize these individuals in this country we earnestly petition you to make sure that they will not be granted permanent residence or citizenship in the United States with the opportunity which that would afford of inculcating those anti-democratic doctrines which seek to undermine and destroy our national unity."

⁴⁹ For bill of goods question, see Seymour Nagan, "Top Secret: Nazis at Work," *New Republic* 11 (August 1947): 24-26. Mumford weighed in at the end of the war, recognizing that WWII and its aftermath made science, technology *and* the military equally bad investments. Lewis Mumford, "Social Effects," *Air Affairs* 1 (1947): 370-382. For peace promises, see David DeVorkin, "The Military Origins of the Space Sciences in the American V-2 Era," in *National Military Establishments*, eds. Paul Forman and José Sánchez-Ron (Dordrecht: Kluwer, 1996), 233-260, on 242. In 1963, when Dornberger and von Braun graced the pages of *Technology and Culture*, they looked toward the moon and the future while demonstrating how to manage the past and world history. Rationalizing the "mistakes" of the V-2 and Mittelwerk as "only a first step into the future of space travel," Dornberger protested that "criticism from hindsight comes easy at this stage." Less reflective but equally spoiled by fulfillment, von Braun ignored all contradictions between his rockets "bolstering the nation's defense posture in their primary role as weapons" and their "intermediate contributions" to a "growing knowledge of the universe." Minister of Armaments and War Production Albert Speer expressed similar sentiments. Blaming Himmler for the "barbarous" conditions at Dora, Speer was convinced that the V-2 was a "technical marvel" and "technical miracle" and praised the Peenemünders as a "circle of nonpolitical young scientists and investors." Walter Dornberger, "The German V-2," *Technology and Culture* 4 (1963): 393-409, on 408-409; Wernher von Braun, "The Redstone, Jupiter, and Juno," *Technology and Culture* 4 (1963): 452-465, on 465; Albert Speer, *Inside the Third Reich: Memoirs*, trans. Richard and Clara Winston (New York: Macmillan, 1970), 436-443, on 366. On these issues, see Crim (n. 6 above) and Neufeld, *Von Braun* (n. 4 above).