OFFICE OF SCIENTIFIC INTELLIGENCE:

THE ORIGINAL WIZARDS OF LANGLEY

A Symposium Commemorating 60 Years of S&T Intelligence Analysis

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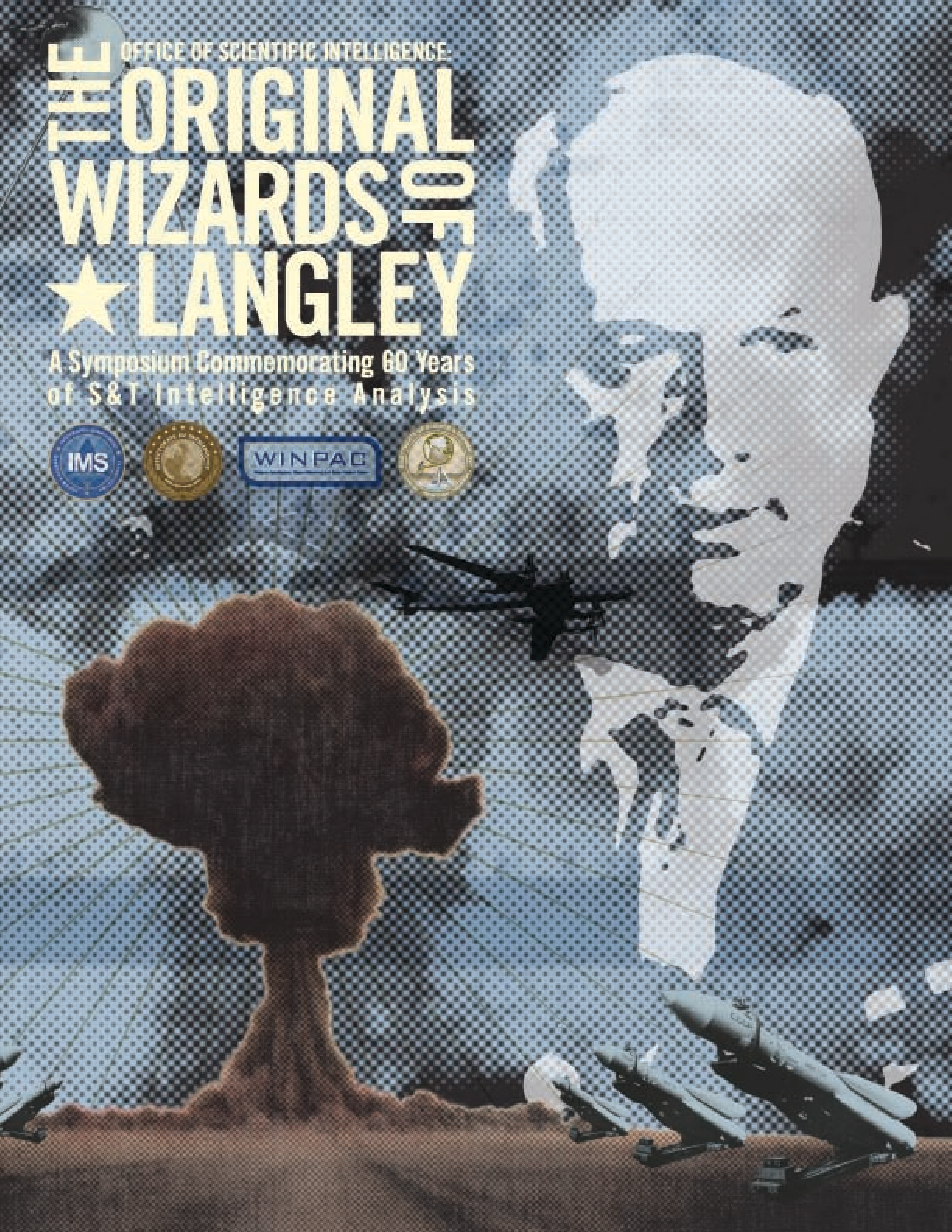
WINPAC



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JOHN WARNER
VIRGINIA

ARMED SERVICES
ENVIRONMENT AND PUBLIC WORKS
SELECT COMMITTEE ON INTELLIGENCE
HOMELAND SECURITY AND GOVERNMENTAL AFFAIRS

United States Senate

October 3, 2008

General Michael V. Hayden
United States Air Force
Director
Central Intelligence Agency
Washington, D.C.

Dear General Hayden:

I am writing to congratulate you and the members of the Directorate of Science and Technology (DS&T) for 60 proud years of noble service to the intelligence community and the United States. The Directorate of Science and Technology deserves great credit for its longstanding history of legendary achievements.

With the emergence of the cold war, the Central Intelligence Agency (CIA) formed the Office of Scientific Intelligence (OSI) in January of 1949. Since its creation, OSI has undergone three name changes, assuming its present name in 1965. OSI's revolutionary projects, such as the design and operation of national overhead systems, were vital in the nation's success during the cold war. The important work of OSI and its successor organizations have continued to play a critical role in providing the United States with a significant advantage in intelligence and special operations through their involvement with such projects as the collection of signals intelligence, the electronic intelligence program, the technical analysis of foreign missile and space systems, and satellite development.

During my more than 50 years of public service, including 30 of those years representing the Commonwealth of Virginia in the United States Senate, the times our nation faces today are the most complex, most dangerous, and most challenging I have seen. The intelligence community plays a vital role in our nation's success during such times. Several of the most important collection systems the United States operates today are direct descendants of earlier programs of OSI and its successor organizations. As our nation continues to face these challenges, the work of DS&T will carry on its proud tradition of serving a monumental role in the intelligence community.

Congratulations again to all of those who worked so hard over the past 60 years and for DS&T's contributions to the intelligence community and our nation!

With kind regards, I am,

Sincerely,

John Warner

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TABLE OF CONTENTS

SERIES

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The Historical Collections Division (HCD) of the Office of Information Management Services is responsible for executing the CIA's Historical Review Program. This program seeks to identify, collect, and review for possible release to the public significant historical information. The mission of HCD is to:

- Provide an accurate, objective understanding of the information and intelligence that has helped shape the foundation of major US policy decisions.
- Improve access to lessons learned, presenting historical material to emphasize the scope and context of past actions.
- Improve current decision-making and analysis by facilitating reflection on the impacts and effects arising from past decisions.
- Uphold Agency leadership commitments to openness, while protecting the national security interests of the US.
- Provide the American public with valuable insight into the workings of their Government.

CENTER FOR THE STUDY OF INTELLIGENCE

The History Staff in the CIA Center for the Study of Intelligence fosters understanding of the Agency's history and its relationship to today's intelligence challenges by communicating instructive historical insights to the CIA workforce, other US Government agencies, and the public. CIA historians research topics on all aspects of Agency activities and disseminate their knowledge through publications, courses, briefings, and Web-based products. They also work with other Intelligence Community historians on publication and education projects that highlight interagency approaches to intelligence issues. Lastly, the CIA History Staff conducts an ambitious program of oral history interviews that are invaluable for preserving institutional memories that are not captured in the documentary record.

WINPAC
Weapons Intelligence, Nonproliferation, and Arms Control Center

The Weapons Intelligence, Nonproliferation, and Arms Control Center (WINPAC) is the Directorate of Intelligence's focal point for analysis and policy support on foreign weapons and technology, nonproliferation, and arms control-related issues. WINPAC's areas of responsibility include:

- The production of all-source intelligence relating to the threat of foreign strategic weapons, to include nuclear, biological and chemical weapons (WMD); missile and space systems; and emerging conventional threats and countermeasures.
- Monitoring compliance to arms control, nonproliferation, and threat reduction regimes; support to treaty negotiation and implementation; strategic interdiction of WMD-related networks.
- Collection programs and specialized signals intelligence analyses.

WINPAC and—to a lesser extent—the Office of Transnational Issues now embrace much of what was in the Office of Scientific Intelligence when it and the Office of Weapons Intelligence were merged in 1980.

The Directorate of Science and Technology (DS&T) is the Central Intelligence Agency's lead component for tackling technical challenges. The Directorate history can be traced back to the years 1954 through 1962 when the U-2 program was conceived and the Director of Central Intelligence (DCI) consolidated the scientific and technical talents of the CIA. DS&T offices create and apply innovative technology to meet intelligence needs. The Directorate's work ranges from exploratory research to the design, development, and operation of specialized intelligence systems, both large and small. The Directorate is actively engaged in every collection discipline: imagery intelligence (IMINT), signals intelligence (SIGINT), human sources intelligence (HUMINT), and measurement and signature intelligence (MASINT). By providing critical technology and technical know-how, it also supports all phases of the intelligence process, from collection through analysis and dissemination of the intelligence product.

OVERVIEW OF THE OFFICE OF ★SCIENTIFIC INTELLIGENCE

THE OFFICE OF SCIENTIFIC INTELLIGENCE: WAGING AND WINNING THE COLD WAR

This overview and collection of documents and other material related to the Office of Scientific Intelligence (OSI) offer a glimpse of CIA's overall contribution to the analysis of Soviet capabilities in science and technology during the Cold War. It is by no means intended to be definitive, or even complete, with respect to all the activities associated with the Agency's scientific and technological capabilities, analysis, and resulting reporting. It does, however, highlight some key events and selected activities that contribute to our understanding of the unique role OSI played in the Agency's history.[1]

1 This overview is excerpted in large part from Clarence E. Smith's essay on CIA's Analysis of Soviet Science and Technology in Watching the Bear: Essays on CIA's Analysis of the Soviet Union, published in 1996. "Smitty" was a long-time career analyst and manager in the Defensive Systems Division of the Office of Scientific Intelligence, who later served as a senior manager in the Intelligence Community Staff as the Vice Chairman of the Committee on Imagery Requirements and Exploitation and as a Special Assistant to the Director of Central Intelligence.

The period following World War II saw unparalleled growth in technological developments, and nowhere was this truer than in the East-West competition during the Cold War. New and technological capabilities on both sides offered opportunities for new weapons and new collection techniques. The prospect of new Soviet capabilities led US policymakers to demand that we understand not only the new technologies (for our own purposes) but also the extent and nature of Soviet capabilities. Urgent new collection requirements necessitated new, more sophisticated means of collection, which in turn required new technical analysis techniques and capabilities. The data acquired by these new collection systems often helped clarify gaps in our intelligence. Thus, the need for scientific and technical intelligence on the Soviet Union generated a whole new set of requirements for new sources and methods, many of which remain current today.

With this as background, it is clear that the development of technical intelligence capabilities at CIA[2] led to significant successes in the analysis of Soviet S&T capabilities. A corollary to this development was that it led to major bureaucratic and organizational changes within CIA and the wider Intelligence Community. The major expansion of CIA's technical intelligence capabilities provided unique advantages to the United States and its allies in waging and winning the Cold War.

THE NEED FOR S&T INTELLIGENCE

The emergence of the Cold War accelerated the development of ever more technically advanced weapons and generated early recognition of the need for additional technical intelligence. For US policymakers this meant obtaining data on Soviet weapons developments and operational concepts, identifying important new systems and, most important, developing the technical means for collecting and processing such data.

US intelligence on Soviet nuclear weapons development played an especially important role in the initial extension of technical intelligence into the Cold War. In this regard, the transfer of the Manhattan Project intelligence group from the Department of State to the new

2 Technical intelligence (including collection, processing, and analysis)—as a new, distinct discipline—was not unique to CIA. It was integral to the Intelligence Community as a whole, as well as to the military services, nonintelligence elements of the Department of Defense, other federal government agencies, and related private-sector entities.

CIA enabled the Agency to build its scientific and technical intelligence capabilities. The complexity of the technical structure of the Soviet nuclear weapons development program and the many distinctive observables associated with it provided a classic technical intelligence challenge to US analysts. In particular, the Soviet program demanded technical data that could be obtained only by new collection techniques.

By the 1950s, it was clear that the USSR possessed both nuclear weapons and the means of long-range delivery. But key questions remained for US policymakers. How far advanced and how effective were these capabilities? Could they be used against the continental United States as well as its allies? The answers to these questions were fundamental to US strategic deterrence.

Technical intelligence was the primary tool US officials used to address these questions. Because the USSR, Eastern Europe, and China were "denied areas," they posed difficult challenges to traditional forms of human and military reconnaissance collection. These countries were highly efficient police states that severely restricted internal movement and contacts with foreigners; they also had effective, modern air defenses. This meant traditional means of espionage and reconnaissance were limited in providing the needed information, much less access, by the West to Soviet Bloc weapons designers and remote test sites.

To counter this, CIA and the Intelligence Community developed new and innovative collection approaches, including overhead systems to collect images. These new systems allowed US analysts to discover the physical characteristics and locations of weapons, test ranges, operational sites, and support structures. Signals intelligence (SIGINT) collectors in these new systems eavesdropped on military exercises and administrative communications. Telemetry collectors intercepted and recorded the instrumentation signals transmitted by weapons undergoing tests; blast-detection sensors assessed the power of a detonation. Signal and power collectors measured emitter specifications, and there were a host of other collection techniques. S&T collection assets were deployed, both in the air and in space, under sea, and on the periphery of the USSR and were placed clandestinely within the USSR itself.

The lack of hard intelligence facts and having few human intelligence resources within the Soviet Bloc were the key drivers in developing both US aircraft and satellite imaging and signals intelligence collection systems. In addition to the actual technical collection, however, there was a parallel development in the analytical field as US analysts sought to make sense of the raw data. The challenge to the Intelligence Community was not only to create new collection methods but also to be able to derive useful information from the resultant data. The CIA's Office of Scientific Intelligence, and later the Directorate of Science and Technology (DS&T), was in the forefront of the development of both the new technical intelligence collection systems and the expanded analytical capabilities.

The intelligence reports and estimates included in this collection cover the period from the early 1950s through the mid- to late 1960s, and the effect of advancements in technical collection and analysis is readily apparent. There were no disagreements within the Intelligence Community on Soviet capabilities as surveyed in National Intelligence Estimate (NIE) 11-5-59, *Soviet Capabilities in Guided Missiles and Space Vehicles*, but by October 1964 (in NIE 11-8-64) debates had emerged over both the capabilities and the number of deployed sites for Soviet intercontinental ballistic missiles (ICBMs). These disagreements primarily resulted from having more data which meant more opportunities to have different interpretations of the available information. Similarly, in the defensive missile area, Intelligence Community analysts using the same data now disagreed in NIE 11-3-65 over whether and how the Soviets were upgrading their surface-to-air missiles (SAMs). These strategic offensive and defensive missile concerns stayed in the forefront of the intelligence debate well into the 1970s.

SCIENTIFIC AND TECHNICAL INTELLIGENCE ISSUES

In the course of the Cold War, any number of issues arose that had to be addressed urgently by means of technical intelligence. In time, OSI and the Intelligence Community at large acquired an infrastructure of techniques, tools, facilities, and technical specialists that was able to respond to new questions as they arose. Some of the key issues are not surprising:

- Soviet nuclear weapons developments dominated in the early years, shifting later to matters of weapons and material inventories, compliance with testing agreements, and the transfer of nuclear technology to potential proliferators.
- Soviet ballistic missile development and deployment stayed high on the priority list throughout, but also underwent many changes of focus--counting numbers, determining characteristics, and monitoring for compliance with arms control agreements.
- The Soviet space challenge began with a burst of publicity and quickly became a matter of US military concern but did not materialize as a real threat issue.
- Soviet air defenses, antiballistic missile (ABM), and SAM missile upgrades became entangled with one another throughout the period, producing great concern and posing one of the most severe challenges to US technical intelligence.
- Chemical and biological warfare concerns emerged (and continue to this day), plagued by uncertainties and posing extraordinarily difficult intelligence problems, primarily because of the type of collection access required.
- Arms-control monitoring emerged as a highly defined issue and intelligence problem with the early nuclear weapons testing agreements and leapt to the forefront with the negotiation and conclusion of agreements with the Soviets covering reduction of arms and forces and qualitative constraints.

Two other issues that generated attention were (1) the assessments of existing and emerging Soviet scientific and technical capabilities (such as stealth and supercomputers), and (2) the detailed characterization of the Soviet research and development cycle that led to the fielding of advanced (and sometimes unexpected) Soviet weaponry, achievements in space, or scientific breakthroughs.

THE BIRTH OF OSI

As early as 1946, when the Cewntral Intelligence Group (CIG) was established, the need for scientific intelligence was recognized. Its importance was further emphasized in the 1948 report of the Eberstadt Task Force of the Hoover Commission, which stressed the likely overriding importance of scientific and technical intelligence and the need for a central authority responsible for assimilating all scientific information from abroad as well as competent to estimate its significance. The report concluded that "failure to properly appraise the extent of scientific developments in enemy countries may have more immediate and catastrophic consequences than failure in any other field of intelligence."[3] Recognizing the importance of scientific and technical intelligence, CIA on 31 December 1948 created the Office of Scientific Intelligence (OSI), an organization that brought together the collectors and the processors of intelligence information.

Concern that other countries might develop nuclear weapons and an awareness that advanced knowledge was the only practical shield against a surprise attack fed a sense of urgency among US policymakers. Concern extended to biological and chemical warfare and to the likely development of guided missiles, which would increase the danger of surprise attack on the continental United States. Despite such concern, little real progress took place until President Harry Truman's 23 September 1949 announcement of the first Soviet nuclear explosion. The next month the Director of Central Intelligence (DCI) created the Scientific Intelligence Committee (SIC) to coordinate the entire US scientific intelligence effort.

3 Department of State, *Foreign Relations of the United States: Emergence of the Intelligence Establishment*, 1945-1950 (Washington, DC: US Government Printing Office, 1996), p. 1012.

The required coordination, however, did not come easily. CIA chaired this new committee, charged with responsibility for scientific and technical intelligence, including all research and development up to the initiation of weapons systems series production. This concept was opposed by the US military, which sought to distinguish between basic scientific capabilities and weapons systems applications and keep the latter to itself.

There was some support for CIA's having this responsibility even within the defense establishment itself, however. The Research and Development Board in the Department of Defense, for example, was extremely dissatisfied with the intelligence support it received from the military intelligence agencies and supported the SIC as its primary source of intelligence support. Because of OSI's competence in Soviet nuclear capabilities, the military also accepted the Joint Atomic Energy Intelligence Committee (JAEIC) as a subcommittee of SIC, to be concerned with that subject exclusively. Shortly thereafter, other subcommittees were established on biological warfare, chemical warfare, electronics and guided missiles, and later on aircraft and antiaircraft weapons systems.[4]

The services did not give up, however. During the early 1950s, there was a long struggle within the SIC between its military and civilian members: Army-Navy-Air Force versus CIA-State-Atomic Energy Commission. In August 1952, the original directive establishing SIC (OSI's lifeline) was rescinded. A new directive dissolved the SIC and all of its subcommittees except the JAEIC. It was retained as a subcommittee of the interdepartmental Intelligence Advisory Committee itself. The intelligence agencies of the Department of Defense were given primary intelligence production responsibility with regard to weapons, weapon systems, and military equipment and techniques, including intelligence on related scientific research and development. The new directive assigned to CIA's OSI primary responsibility for scientific research in general, fundamental research in the basic sciences, and medicine (other than military medicine). The Defense Department agencies as well as CIA were now given responsibility for atomic energy intelligence, the original basis for CIA's scientific and technical effort.

The new directive had a negative impact on the morale of OSI. In reaction, it began to devote less attention and energy to asserting CIA's authority to coordinate scientific intelligence and more to developing its own capabilities for research in all fields of scientific intelligence, including weapon systems development in anticipation of a day when a new DCI would value such independent capabilities.

4 Several noted scientists in the Boston area, involved in US weapons-system developments and very concerned about the lack of US intelligence on corresponding Soviet developments, approached CIA/OSI in late 1950 and offered to assist. This group included the men who became the first three Presidential Scientific Advisors: James Killian, George Kistiakowski, and Jerome Weisner. They constituted what was known as the Boston Scientific Advisory Panel and were very valuable to OSI.

While OSI refocused its efforts in the Directorate of Intelligence (DI), there was a similar growth in electronic intelligence (ELINT) collection capabilities within CIA's Directorate of Plans, later to be known as the Directorate of Operations (DO). CIA's ELINT efforts furthered its scientific and technical credentials through the 1950s. With the advent of the U-2 and later technical collection programs, it continued to grow. By the time S&T activity was first consolidated at CIA—in a Directorate of Research in 1962—there were well-established organizational units dedicated to scientific and technical intelligence in both the Directorate of Plans and OSI.

CREATING A NEW DIRECTORATE

It was the creation of CIA's DS&T by DCI John McCone in 1963, however, that finally brought together the key scientific and technical functions from the DI, the DO, and the short-lived research directorate. From that point, true synergy began with respect to scientific and technical collection and analysis at CIA. And it did so—with Albert (Bud) Wheelon as the Agency's first Deputy Director for Science and Technology (DDS&T)—at a moment in history when decisive action was required.

A tremendous breadth of technical disciplines was drawn together in the new directorate. The DI's OSI, concerned with basic scientific research conducted by foreign countries, became a part, as did a computer services group from the DI. The Office of ELINT (OEL), which had some of it origins in OSI, came from the Directorate of Plans. The Development Projects Division, which had been responsible for developing the U-2, the A-12 OXCART, and the CORONA overhead systems, now joined the new directorate as did the Office of Research and Development, charged with applying new technologies to intelligence, and the Foreign Missile and Space Analysis Center (FMSAC), a group established to monitor foreign missile and space programs.

Wheelon did not merely create a new organization, however. The usefulness of the U-2 airborne reconnaissance program against the Soviet Union had ended in 1960 with the shootdown of Gary Powers, and new ways to gather intelligence over denied areas were needed. New intelligence technologies would have to meet the urgent requirement for reliable and comprehensive intelligence collection. The new DS&T was focused on tackling this challenge, and Wheelon became one of the earliest proponents of CIA's participation in making greater use of outer space as a venue for future intelligence collection. Wheelon greatly enhanced CIA's S&T capabilities with the integration of systems development, collection operations, data processing, and intelligence analysis.

Throughout the rest of the Cold War there were bureaucratic adjustments in the S&T directorate reflecting changing capabilities and requirements in order to integrate intelligence analysis better across multiple disciplines. OSI had spun off OEL in July 1962 and the FMSAC in November 1963. In November 1976 OSI and the Office of Weapons Intelligence (OWI)—which had been formed from FMSAC and the Defensive Systems Division of OSI in September 1973—were transferred back to the DI from DS&T in order to have all finished intelligence production under one Directorate, reversing Bud Wheelon's achievement in 1963 to secure all of CIA's S&T intelligence functions in one Directorate. At the same time, the Foreign Broadcast Information Service (FBIS) and the National Photographic Interpretations Center (NPIC) were moved to the DS&T.

The Office of Scientific Intelligence ceased to exist as an entity—after 31 years of service—when it and OWI were merged on 25 February 1980 to form the Office of Scientific and Weapons Research (OSWR), which evolved into the current Weapons Intelligence Non-Proliferation and Arms Control Center (WINPAC).

COLLECTING, PROCESSING, AND ANALYZING THE NEW DATA

The overriding problem in the early years of technical intelligence was simply gaining access to information about Soviet facilities and activities. Because of the closed Soviet society and the extensive controls on movement and access, clandestine operations launched from outside the Soviet Union had a long history of being foiled.

Nuclear issues dominated US concerns from the time of the Soviets' first atomic weapons test in 1949, but during the 1950s, new and somewhat different problems began to compete for US intelligence attention. These included Soviet bacteriological warfare and chemical warfare developments and Soviet aircraft and electronics innovations.

In the early years, before hard intelligence on Soviet developments became available, US reports on a number of Soviet scientific and technical subjects were simply derivative. For example, the basic data in a 12 October 1949 memorandum on Soviet capabilities in air-to-air guided missiles and related proximity fuses were only extrapolations of information on missiles that were under development by the Germans. Once in operation, however, US technical intelligence could exploit technical data generated during the course of Soviet weapons development or manufacture. Such data appear in many portions of the electromagnetic spectrum (visual, radio and radar signals, infrared emanations, etc.), acoustic phenomena, nuclear radioactivity, forensic samples, and material and actual equipment available for analysis. Each required a different kind of access ranging from actual physical presence in a laboratory or plant to detection from many thousands of miles distant from a specific target.

On the one hand, the United States would collect whatever it could with the access available so long as there was some hope that the collected data would shed light on the matter of concern. On the other hand, the nature of the data required would dictate the kind of access. The US focus was on Soviet air, space, naval, and defensive systems (although selected ground forces systems were sometimes assessed) and on sensors, nuclear weapons, and chemical/biological weapons. In time, it became apparent that to acquire all the key performance characteristics of any of these systems, we would need a suite of new intelligence collectors and analytic tools.

Technical intelligence was the primary tool used to address these questions. The Intelligence Community was obliged to invent new and innovative approaches to collection via remote sensors, the most well-known of which were the U-2 and OXCART manned aircraft, ELINT (i.e., radar and FIS) operations, satellite imaging, and SIGINT systems. These systems revolutionized intelligence collection.

Following the unique manned aircraft reconnaissance programs, satellite imagery provided the foundation whereby compliance with highly complex arms control provisions could be adjudged by even the most paranoid elements of national security establishments. It was quite an accomplishment.

Other collection operations were mounted on the periphery of the Soviet Union. The Berlin tunnel is an early, somewhat bizarre example of a SIGINT collection operation. More important in the long run were facilities established close to Soviet borders so as to collect signals generated at installations (targeted by means of overhead imagery) within the USSR. Electronic collection aircraft flew and ships sailed along the periphery for this same purpose.

The CORONA program, the first space-based reconnaissance program, provided an intelligence windfall for several years before the Soviets took defensive measures against it. The *Glomar Explorer*, a ship built specifically to raise a sunken Soviet submarine from the bottom of the Pacific to salvage communications equipment and nuclear components, was a feat beyond the imagination of the Soviets until the story was disclosed in the US press. These are but two examples of a highly successful technical collection program.

A significant and critical counterpart of technical collection was the ability to apply new analytical techniques to emerging collection capabilities such as telemetry and precision parametric measurements analysis from ELINT, as well as systems and processes to deal with film and then digital satellite imagery. When Soviet designers flew aircraft or missiles, they placed sensors on critical components and radioed their status to the ground so that analysis could identify problems in the event of a flight failure. While the Soviet designer had the key to which sensors were being monitored by the hundreds of telemetry traces, US intelligence analyst had to unscramble them and make sense of the reading. The challenge to the US technical community was to deliver identifiable, useable data.

The wide distribution of collection system elements and the huge amounts of data collected required a system with the capacity to pass vast amounts of data, and containing data links able to ensure the security of the information carried, able to maintain connection with a range of collection platforms and data processing facilities, and able to serve a number of data recipients. The development of these links enabled the control of collection operations as well as the retrieval of the information collected. Getting the diverse sorts of data into a form suitable for interpretation and analysis depended on major advancements in computer technology. As collection systems became more capable, the need for speed and automated handling of overwhelming quantities of information also became critical. Meeting this major technological challenge led over time to the ability of US analysts to support near-real-time delivery of data and reporting.

Not all collection systems were developed and managed by CIA. Other parts of the Intelligence Community operated aircraft, satellites, maritime resources, ground-collection sites, data links, and processing facilities. All of them tended to operate with some independence but did a remarkable job of delivering vast amounts of needed data in processed form to the many different US intelligence analysis and production organizations.

ANALYTIC ISSUES AND CAPABILITIES

By the late 1950s, the number and scope of major technical intelligence challenges facing the Agency had grown immensely. Concerns emerged about Soviet technological advances, the testing of Soviet thermonuclear weapons and, increasingly, Soviet ballistic and defensive missile developments and the Soviet space challenge. A primary response by OSI was to establish close relationships with contractors deeply involved in similar US programs, such as the Livermore and Sandia National Laboratories and various private corporations, notably TRW Incorporated. Each relationship entailed unique arrangements that allowed unusually broad access to intelligence information, wide contractor latitude in the definition of studies performed, and the inclusion of a broad tutorial role for the contractors in enhancing the capabilities of OSI analysts. These connections played a large role in developing unique technical intelligence capabilities within OSI itself.

OSI analysts of weapons systems, in addition to seeking help from the academic disciplines of science and engineering, had several core capabilities that set them apart. They were subject-matter experts, thoroughly familiar with programs of the type they were to assess, such as radar, aircraft, ICBMs, or nuclear weapons. They maintained close ties to US industry and its research and development activities. Thus, when looking at new or unfamiliar Soviet programs, they could draw on overall US experience or on relevant Soviet experience and bring insights from US development processes for similar weapons capabilities.

In addition, technical analysts were adept at team-research management. Just as it took many collectors to provide data on a specific Soviet system's characteristics, it took many technical specialists to compile all of the characteristics for a single weapon system. In the case of the Moscow Anti-Ballistic Missile system, for example, dozens of analysts were involved in assessing acquisition and engagement radars, interceptor vehicles, nuclear warheads, launchers, and command and control systems. Analysts had to be innovative and given to "out of the box" thinking as they confronted complex programs being developed by an adversary striving for technological surprises and also trying to not only minimize the information available to analysts but to mislead them if possible.

The analytical issues addressed by the S&T encompassed the discovery and assessment of hundreds of weapons and technology programs during the course of the Cold War. Many were controversial within the Intelligence Community, as four decades of declassified NIEs illustrate. Here are some examples that give a sense of the variety of the topics and challenges Soviet developments provided OSI and other IC analysts:

SS-8: Determining whether it was a new large missile or one smaller than the SS-6.

SS-9 MIRV: Determining whether the multiple warheads on the SS-9 could be independently targeted, as well as the implications of a first strike against the US missile deterrent.

SS-18 throw-weight: Assessing to what extent the large throw-weight would allow payload fractionation (additional Multiple Independently Targetable Reentry Vehicles MIRVs) without reducing the counter-silo capabilities of a single MIRV.

SS-NX-22: Determining the target-discrimination capability, reaction time and effectiveness of an advanced antiship missile intended for use against US surface combatants.

Nuclear yields: Assessing the results of weapons tests and correlating the size and yield of the device with a strategic delivery system.

SA-5 high-altitude capabilities: Determining whether unusual tests of the SA-5 portended an ABM capability.

Range of the Backfire bomber: Determining the extent to which the Backfire presented a threat against the continental US.

Alpha-class submarine: Assessing the capabilities of the world's fastest and deepest diving new submarine.

ASW detection technology: Determining the extent to which shipborn acoustic sensors or bottom-laid arrays and their associated signal-processing capabilities would permit the location or tracking of US submarines.

Soviet reconnaissance satellites: Determining the resolution capabilities of imaging satellite systems.

BMEWS battle management capabilities: Analyzing whether the ballistic missile early warning radars being built on the periphery of the USSR possessed additional, sophisticated capabilities that might facilitate the accelerated deployment of a future ABM system.

Analysts in the S&T were predominately focused on the qualitative aspects of Soviet strategic systems. Using an array of data from diverse technical collectors, human sources, and occasionally open sources, they would derive the capabilities of weapons and model them on computers. In modeling flight vehicles, for example, new data would be incorporated—the telemetry from a flight test or new external characteristics from photography—and the models refined until they conformed as closely to observed test results as possible. It became possible, for example, to run simulations of Soviet weapon system performance using data inputs collected from the Soviet's weapons systems themselves. Eventually, high confidence statements about a system's performance and limitations could be derived for use by US policymakers.

SUMMARY AND CONCLUSIONS

The development of the S&T intelligence efforts in OSI and later the DS&T and the DI produced a remarkable change in collection and analysis procedures. CIA gradually developed the organization, capabilities, and talent to identify the intelligence questions that had to be answered, to establish the data essential to answering these questions, to define ways to capture the data, and to process the data so that analysts could have hard facts in helping them resolve the problem at hand. Developing these capabilities constituted CIA's greatest contribution to US understanding of Soviet technical capabilities.

Without diminishing the contributions of the National Security Agency, the military services or the national laboratories, two developments that can be credited primarily to CIA's OSI and DS&T were of seminal importance to the assessment of the Soviet strategic threat. The first is the creation of both airborne imagery collectors and space-based imaging satellites. The second is the art of signals analysis (specifically radar systems emissions and FIS). Both were critical to addressing policymaker questions of how many, how capable, and where located. Ultimately, they made arms control agreements feasible.

First, the U-2 photography, then satellite imagery provided sufficient breadth of coverage to locate and count Soviet strike forces with relatively high confidence. Data from imaging satellites provided the basic order-of-battle inputs for the calculus of deterrence, the fundamental military strategy used by the United States during the Cold War. As film-return satellite systems were phased out and near-real-time systems introduced, the United States became increasingly confident of its ability to discern major Soviet military buildups and to give warning to policymakers and US commands. The ability of the United States to minimize the likelihood of the Soviets inflicting a "Pearl Harbor" brought with it an era of international stability despite the large numbers of nuclear weapons possessed by both sides. Thus, major strategic rivals armed with vast nuclear capabilities were able to coexist--in conflict without combat--during half a century of political and economic competition.

Telemetry and performance-measurement analysis is an arcane art form, and nowhere was it practiced more imaginatively than in OSI. It was the most productive of the sources needed to assess the qualitative capabilities of aerospace vehicles. The Soviets never understood the extent to which OSI excelled at this. As a result, from performance data collected on a wide array of flight systems came the analysis of range, fuel utilization, maneuverability, throw weight, MIRV potential, and other answers to the question of "how capable." The results were used to design US countermeasures, to calculate deterrence in qualitative and not just numerical terms, and to construct the qualitative constraints of arms limitation proposals.

In general, it can be said that OSI's contributions in producing intelligence on Soviet technical capabilities and programs came not just in the form of reports on those topics but, more important, in providing leadership in building and operating the range of capabilities that enabled such reporting. Most of the critical questions regarding Soviet systems were answered. CIA contributions were successful enough to enable the negotiation of strategic arms limitations relying heavily on the US Intelligence Community to monitor compliance with their provisions. The trust of the national security elements of the US government in the ability of the Intelligence Community to do this job is a testament to the value of the contribution it made.

CIA/OSI deserves much credit, not only for what it learned about what the Soviets were doing but, perhaps more important, for putting in place a key national asset of integrated scientific and technical intelligence collection and analysis. This is not to imply that CIA's success was achieved in isolation. It could not have been done without the support and cooperation of the military services, other government agencies, and industry. CIA's early partnership with the US Air Force was especially important in this regard and set a precedent for later cooperation.

FOOTNOTES:

[1] The term S&T is used when referring to scientific and technical intelligence, or capabilities associated with its collection or analysis, whether CIA's or elsewhere in the US Intelligence Community. S&T, even at CIA, was accomplished in many organizational elements, not only within what we know as the Directorate of Science and Technology. Many of the CIA's reports on Soviet S&T capabilities remain classified because sensitive collection methods and analytical techniques could damage current national security interests. Thus, more than with political, military, and economic intelligence issues, CIA's scientific and technical analysis available for scrutiny is included primarily in broader National Intelligence Estimates. Nevertheless, there is sufficient information available to support the conclusions of this overview. That said, this paper draws more on inference and personal insight than is the case in other disciplines.

OSI TIMELINE

1947

01.23.47
Scientific Intelligence Branch created in the Office of Research and Evaluation/Central Intelligence Group

09.18.47
CIA officially created

01.01.49
OSI established; created from the ORE's SIB and the Nuclear Energy Group/Office of Special Operations

08.28.49
Soviet Union explodes its first atomic bomb

01.01.52
Directorate of Intelligence established

1953
Soviet Union explodes its first hydrogen device

08.08.55
Herbert SCOVILLE named Assistant Director for Scientific Intelligence (AD/SI) and D/OSI

07.04.56
First U-2 mission over USSR

08.01.57
Soviets test their first ICBM

10.04.57
SPUTNIK-1 launched

07.21.59
First NIE published on Soviet S&T

05.01.60
Gary Powers U-2 shot down over USSR

08.1960
First photo-reconnaissance satellite launched

02.19.62
Directorate of Research created, SCOVILLE leaves OSI, becomes DD/R

06.04.62
Albert D ('Bud') WHEELON becomes AD/SI, D/OSI

10.1962
Cuban Missile Crisis

03.08.63
PFIAB recommends top priority for S&T intelligence

06.15.63
SCOVILLE resigns; D/OSI WHEELON takes over as DD/R

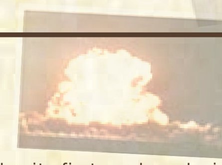
08.05.63
DDS&T formed; WHEELON becomes DD/S&T

08.22.63
OSI moved from the DI to DDS&T

10.01.63
Don CHAMBERLAIN named D/OSI

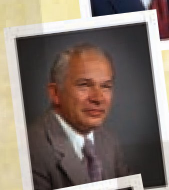
11.07.63
Carl DUCKETT becomes Deputy Asst Director of OSI for Collection and C/GMAIC

11.07.63
FMSAC established in DDS&T; Duckett named Chief, FMSAC



10.16.64
China explodes its first nuclear device

09.26.66
WHEELON leaves; Duckett becomes acting DDS&T



09.04.73
OWI formed from merger of FMSAC and OSI/Defensive Systems Division

09.20.73
Karl H. WEBER named Director, OSI

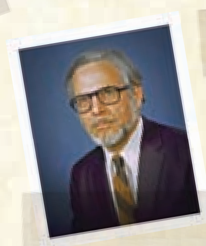
01.06.75
Ernest (Zeke) ZELLMER named D/OWI

06.01.76
Carl Duckett takes medical retirement; **Les DIRKS** becomes DDS&T

Zellmer named ADDS&T
Sayre STEVENS becomes DDI

11.22.76
OSI and OWI moved back to the DI from the DS&T

01.12.80
Karl WEBER retires;
Herbert ROTHENBERG named acting D/OSI



02.25.80
OSWR formed from merger of OSI and OWI;
OSI no longer exists after 31 years

11.1988
New Headquarters Building opens

CIA Trailblazers

09.18.97
Of the **50 original CIA Trailblazers** honored during the CIA's 50th Anniversary celebration, seven were former OSIers: Bud Wheelon, Carl Duckett, Hank Lowenhaupt, Lloyd Lauderdale, Joseph Castillo, Archie Roy Burks, and Leslie Dirks.

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CENTRAL INTELLIGENCE AGENCY
Washington, D.C.

1/28/49

31 December 1948

GENERAL ORDER
NUMBER 13

1. The revised organization charts now being distributed confirm the establishment of the Office of Scientific Intelligence, replacing the Scientific Branch of the Office of Reports and Estimates.

2. Dr. Willard Machle has been appointed as Assistant Director for Scientific Intelligence.

R. H. HILLENKOETTER
Rear Admiral, USN
Director of Central Intelligence

DISTRIBUTION: A

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ANNEX "A"

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General Order No. 13, dated 31 December 1948, established the Office with an authorized Table of Organization of [redacted]. This order established O/SI:

"As the primary intelligence evaluation, analysis and production component of CIA with exclusive responsibility for the production and presentation of national scientific intelligence:

"1. Prepares scientific intelligence reports and estimates designed to present and interpret the status, progress and significance of foreign scientific research and developments which affect the capabilities and potentials of all foreign nations.

"2. Makes substantive review of basic scientific intelligence produced by other agencies and advises ORE on its adequacy for inclusion in the National Intelligence Surveys.

"3. Participates in the formulation of the National Scientific Intelligence Objectives.

"4. Evaluates available scientific intelligence information and intelligence; assesses its adequacy, accuracy, and timeliness, and prepares reports of such assessments for the guidance of collection, source exploitation and producing agencies to assure that all significant fields of scientific intelligence bearing on the National security are adequately covered.

"5. Formulates requirements for the collection and exploitation of scientific intelligence data in order to insure receipt of materials necessary for fulfillment of production requirements.

"6. In collaboration with appropriate CIA components and the IAC agencies, advises and aids in the development, coordination and execution of the overall plans and policies for inter-agency scientific intelligence production."

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The Office of Scientific Intelligence, 1949-68

I. Background

WW II saw the first stirrings of U.S. intelligence interest in the scientific and technical capabilities of foreign countries. Largely under the impetus of German development of radar, missiles and diverse weapons-related technologies, the separate armed services and various committees of the Office of Scientific Research and Development (OSRD) became customers for scientific and technical intelligence on foreign activities. In these wartime years information on such subjects was most often obtained through combat intelligence and the exploitation of captured materiel, with occasional assists from clandestine and intercept operations. British success in fathoming German secret weapons programs contributed to the awakening of interest in U.S. official circles.

In the early 40s, however, no discrete U.S. organization could be labeled an "office of scientific intelligence". Scientific and technical intelligence was more an offshoot of the interests of the research and development (R&D) elements than an entity in its own right. In rather distinct contrast, the British had an identifiable unit under Dr. R. V. Jones in the

Intelligence Branch, Air Ministry which played a major role in the wartime efforts against German aircraft and secret weapons programs.

One exception to this general state of affairs in the U.S. was a foreign intelligence unit, the Foreign Intelligence Branch, in the Manhattan Engineering District (MED), the wartime agency under General Leslie Groves concerned with nuclear weapons development. It may be recalled that considerable fear was felt in some quarters, as the feasibility of nuclear weapons seemed increasingly assured, that the Germans might be carrying on a nuclear weapons program. It was reasoned that the early experiments on atomic fission had been performed by Germans, notably the Nobel Prize winners Otto Hahn and Lisa Meitner, and hence German understanding of the underlying principles of nuclear weapons was as great as ours. Attempts to establish the existence of a German program through clandestine operations were not altogether reassuring. Anxiety continued throughout the war in the West and even into the final stages of the war against Japan.

At the close of the war, while the soul-searching into the Pearl Harbor disaster was taking place, the assets of the Office of Strategic Services (OSS) were transferred in 1946 to an interim agency, the Central

Intelligence Group (CIG), under the general surveillance of a National Intelligence Authority. This was the first attempt to consolidate and centralize the highest level intelligence functions of the U.S. Government.

In CIG the analytical functions were centered in the Office of Research and Evaluation (ORE).* Under the persistent urging of the Joint Research and Development Board (JRDB),** the peace-time successor to the OSRD [redacted] Through an agreement between General Groves and General Hoyt S. Vandenberg, the Director of the CIG, the Foreign Intelligence Branch of MED was transferred to

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*The Office of Research and Evaluation, organized 22 July 1946, was renamed the Office of Reports and Estimates on 27 October of the same year.

**Eventually an agreement, entitled "Program for JRDB-CIG cooperation in the field of scientific intelligence," was signed by Gen. Hoyt S. Vandenberg and Dr. Vannevar Bush on 10 January 1947. The agreement followed much discussion and investigation by JRDB. It was perhaps the first high-level recognition of the desirability of combining intelligence considerations with scientific and military factors in the planning of weapons R&D in the U.S.

[redacted]

the CIG on 25 February 1947 and assigned to the [redacted] by order of the DDCI on 28 March 1947. [redacted]

As might be expected, [redacted] was seriously hampered by lack of experienced personnel. Of equal importance, it also lacked sources of information and there is evidence to suggest that its support from top management was less than vigorous. [redacted]

Despite these shortcomings of the [redacted] the JRDB persisted in its demands for intelligence support during 1946-47 and into early 1948 with [redacted] and Ralph L. Clark* as the two most outspoken advocates.

[redacted]

[redacted]

In its testimony before the Eberstadt Commitee of the Hoover Commission* in 1948, the JRDB voiced its general dissatisfaction with the intelligence support it was receiving. Prompted by this view, which one can imagine was presented with vigor by Dr. Bush (Chairman, RDB) backed up by Ralph Clark, the Eberstadt Committee in turn expressed its view as follows:

> "The Committee is particularly concerned over the nation's inadequacies in the fields of scientific and medical intelligence. There are difficulties peculiar to this situation which the Committee has not overlooked. Yet the vital importance of reliable and up-to-date scientific and medical information is such as to call for far greater efforts than appear to have been devoted to this essential need in the past."

Persistent JRDB prodding of CIG and CIA may well have been the most important external pressure leading to the eventual establishment of OSI.

With the passage of the National Security Act of 1947 and the creation of the CIA, the heretofore uncertain responsibilities of the CIG gave way to the statutorily defined mission of a greatly strengthened and centralized intelligence service, the CIA. The change to a more encompassing role for CIA and the growing capabilities of the military intelligence

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* More properly named the Committee on the National Security Organization of the Commission on Reorganization of the Executive Branch of the Government.

agencies prompted Admiral Hillenkoetter, who had succeeded General Vandenberg, to ask Dr. Bush in 1948 whether the old JRDB-CIG agreement should not be supplanted. Bush's reply was both assent and complaint for he felt that the Agency had never really begun to satisfy JRDB's needs. He agreed, however, in a letter of 26 March 1948 to set aside the formal agreement.

In particular, the coordinating and estimate producing functions of the new Agency were more firmly rooted and its resources greatly increased over those of the old. More or less concurrently, the period of uncertainty about the true intentions of the USSR and its threat to the U.S. ended. Doubts about the reality of a U.S. monopoly in nuclear weapons were fed by reports of Soviet interest in the advanced technology acquired from the Germans. There was an increasing sense of urgency about strengthening the U.S. intelligence posture.

At about the same time as the Eberstadt Committee was making its review for the Hoover Commission in 1948 another and separate review was being conducted for the National Security Council (NSC) by a team consisting of Allen W. Dulles, William H. Jackson, and Mathias F. Correa. The latter investigation resulted in the so-called Dulles Report of 1 January 1949 which had this to say about scientific intelligence:

> "We believe that there is an obvious need for more centralization of scientific intelligence. Where centralization is not practical there should be the closest coordination among the existing agencies through the use of committees such as the present interdepartmental atomic energy intelligence committee which works in consultation with the [redacted] of the Office of Special Operations (. . .). A strong [redacted] as a common service within the Central Intelligence Agency, would be the logical focal point for the coordination and appropriate centralization of scientific intelligence. There appears to be no overriding reason for the segregation of the [redacted] within the Office of Special Operations, and it would be preferable to reattach this Group to the [redacted] even though some insulation may be necessary for security reasons."*

> "To fulfill its responsibilities as the chief analytical and evaluating unit for scientific intelligence, and consequently as the principal guide for collection, the Branch would have to be staffed by scientists of the highest qualifications. We appreciate that in such a Branch it would be impossible to obtain a leading scientist for each of the many segments of scientific and technological intelligence,

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*We understand that since this report was written steps have been taken to create a separate Office of Scientific Intelligence which is to include the [redacted] (Author's Note: The foregoing sentence was a footnote to the Dulles Report. NSC approval of the portions of the Dulles Report dealing with the strengthening of scientific intelligence did not come until 7 July 1949. CIA in the meantime had moved to establish OSI without waiting for NSC action.)