PIONEERS IN U.S. CRYPTOLOGY

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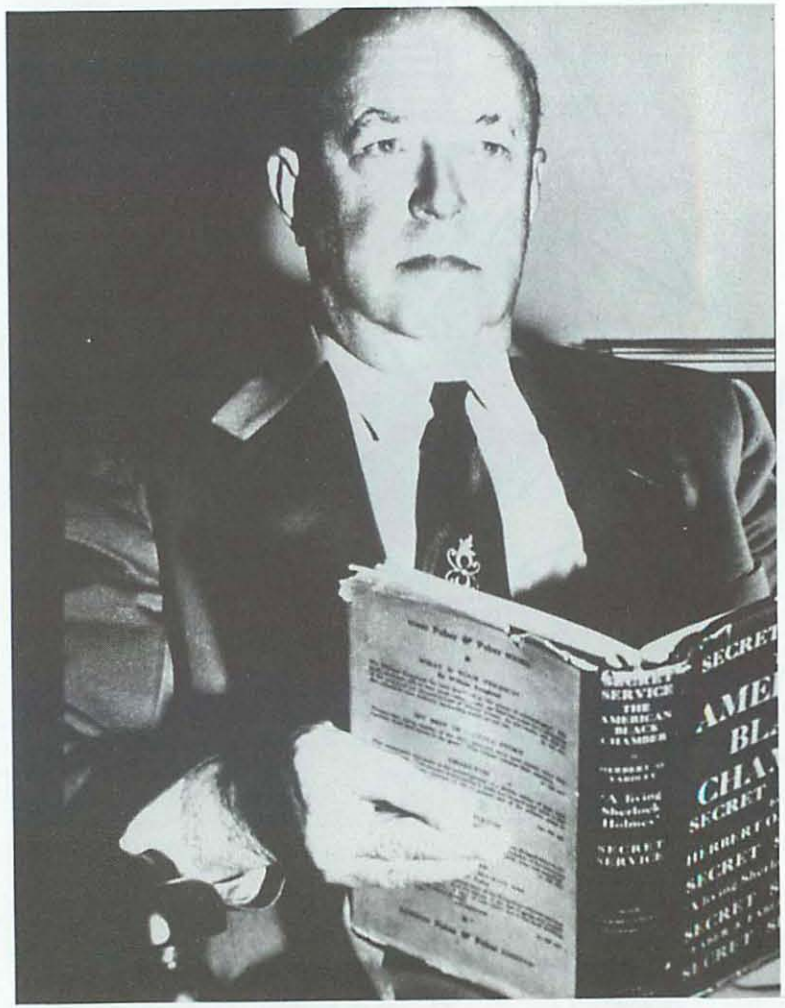


Herbert O. Yardley

young officers undertook to create records of systems, methods, and other data from a decade of effort. Their foremost source for this was Mrs. Driscoll's memory. The value of this collection of knowledge to future students and analysts was not yet known, but its worth was to be proven shortly.

In 1937, Mrs. Driscoll was seriously injured in an automobile accident which kept her from her work for an entire year. When she returned, not only was she physically changed, but her personality and attitude had apparently been affected as well. Oral history interviews with those who worked with her before and after her accident show almost two entirely different women. But all co-workers agree on one point – despite her problems and her unwillingness to change to more modern methods, Agnes M. Driscoll was indeed one of the pioneers in cryptology. By 1959 when she retired at age 70 from NSA, Mrs. Driscoll was considered a character by some, a mystery by others, and a genius to the few who had known her at the height of her career.

Agnes Meyer Driscoll

Agnes May Meyer was born in 1889 in Illinois. Before beginning her cryptologic career, she had earned an undergraduate degree from Ohio State University and had served as director of music and then as head of the mathematics department of two Texas schools.

In 1918, Miss Meyer entered the Navy Reserve, bringing with her teaching experience, abilities in language, statistics, mathematics, physics, engineering and clerical skills, and began what was to be a remarkable career as a pioneer cryptanalyst and cryptographer. After the First World War, she worked in the Office of the Director of Naval Communications (DNC) first as a stenographer and then as a clerk for several years.

It was during this time that a turning point came. Miss Meyer was invited in 1920 to join an elite group of people studying at the Department of Ciphers at Riverbank Laboratories in Illinois, owned and overseen by millionaire George Fabyan. Fabyan paid her expenses and her salary, and the Navy gave its blessing to the venture. She showed remarkable aptitude for the field, and after she returned to Washington, she proved her skills by solving an "unbreakable" message enciphered using a new machine developed by Edward Hebern. Miss Meyer took a leave of absence to help Mr. Hebern evaluate his machine but returned to the Navy offices in 1924.

Back at DNC and since married, the new Mrs. Driscoll took on the responsibilities of teacher as well as expert cryptanalyst. Many of her pupils, including Laurance F. Safford, then a young lieutenant, later became famous in their own rights.

Throughout the late 1920s and 1930s, Mrs. Driscoll consistently worked on solutions for new systems and was often the first in a group of analysts to have any success. In 1943, Captain Safford wrote concerning the 1930 Japanese Orange Grand Naval Maneuvers cipher: "All hands turned to on these messages, Mrs. Driscoll got the first break as usual, and the various daily keys were solved without too much effort." Known as the Navy's foremost expert on Japanese naval codes, Mrs. Driscoll had been the senior analyst to break the Japanese "Red Book" and "Blue Book" superencipherments, had solved the M1 machine cipher, and had made the first breaks into the JN-25 cipher in 1939. The volume of Japanese material coming in, combined with the small staff, left little time to consider the documenting of work already done. Two

Herbert O. Yardley

Herbert O. Yardley was born in 1889 in Worthington, Indiana. After working as a railroad telegrapher and spending a year taking an English course at the University of Chicago, he became a code clerk for the Department of State. In June 1917, Yardley received a commission in the Signal Officers Reserve Corps; in July Colonel Ralph Van Deman appointed him chief of the new cryptanalytic unit, MI-8, in the Military Intelligence division. MI-8, or the Cipher Bureau, consisted of Yardley and two clerks.

At MI-8's peak in November 1918, Yardley had 18 officers, 24 civilians, and 109 typists. The section had expanded to include secret inks, code and cipher compilation, communications, and shorthand. This was the first formally organized cryptanalytic unit in the history of the U.S. government.

When World War I ended, the Army was considering disbanding MI-8. Yardley presented a persuasive argument for retaining it for peacetime use. His plan called for the permanent retention of a code and cipher organization funded jointly by the State and War Departments. He demonstrated that in the past eighteen months MI-8 had read almost 11,000 messages in 579 cryptographic systems. This was in addition to everything that had been examined in connection with postal censorship. On 17 May Acting Secretary of State Frank L. Polk approved the plan, and two days later the Army Chief of Staff, General Peyton C. March, added his endorsement. The "Black Chamber" was officially in operation.

One of the notable achievements of the Cipher Bureau was its contributions during the Washington Limitation of Arms Conference in 1920–21. Yardley and his staff had been reading the traffic between the Japanese Foreign Ministry and its delegation at the conference. On the crucial issue of the ratios to be adhered to by the U.S., Great Britain, and Japan on capital ship tonnage, the Japanese had been insisting on a 10–7 ratio with the U.S. and Britain. But Tokyo had instructed its delegates to accept, as a minimum, a 5–5–3 ratio for the U.S., Britain, and Japan, respectively. This information was passed to the U.S. delegate, Secretary of State Charles Evans Hughes, who pressed for the 5–5–3 ratio. And ultimately the Japanese agreed to that ratio. Yardley received a letter of appreciation from Hughes and a bonus for the entire staff. In 1924 Yardley also received the Army's Distinguished Service Medal, ostensibly for his work during World I. In reality it was for MI-8's contributions during the conference.

In the late 1920s, the pace had slackened considerably. Although Yardley had received another DSM and he could report success against 35–40 countries, his staff had been reduced to two analysts. The office had moved to more modest quarters, still covertly located in New York City, and the telegraph and cable companies were increasingly reluctant to supply copies of messages.

The end came in November 1929 when the Department of State withdrew its funding for the Cipher Bureau. Although a theory has been advanced that President Herbert Hoover ordered his new secretary of state, Henry L. Stimson, to close the Cipher Bureau, evidence in the Stimson papers clearly indicates a different explanation. When Stimson discovered that such an organization existed, he ordered two of his staff members to investigate its operations. Upon learning the nature of its activities, Stimson believed them to be unprincipled and ordered Department of State funding to cease. At any rate, early in 1929 the Army was already making plans to transfer cryptanalytic work to the Signal Corps. In October 1929, William F. Friedman went to New York to take possession of Yardley's files and records. Yardley was offered a position with the new Signal Intelligence Service but at a salary he was expected to refuse, which he did.

In 1931, embittered by his dismissal and needing funds, Yardley published *The American Black Chamber*. His book revealed the operations of MI-8, its major successes, its organizational structure, and even included actual decrypts and translations of messages. The book created an immediate sensation and although officials publicly disavowed the activities of the Black Chamber, privately they sought ways to prosecute Yardley for treason. A more serious consequence of the book's publication was the Japanese Navy's introduction of a machine cipher system which became a precursor of the later Japanese diplomatic machine systems.

Following publication of the book, Yardley continued to write. He supplied articles on cryptology to various magazines, and he wrote a second book which the government seized before it could be published. He traveled the U.S. on speaking tours and completed a novel, *The Blonde Countess*, which Hollywood made into a movie, *Rendezvous*, starring William Powell and Rosalind Russell.

In 1938 Yardley accepted an invitation from the Chinese government to establish a cryptanalytic unit to exploit the communications of the Japanese Army then operating in China. After he left China in July 1940, the U.S. Army contracted with him to supply a full report on the Japanese systems on which he had worked.

Agnes Meyer Driscoll

the Customs Investigative Service, her cases centered on smuggling operations in the Gulf of Mexico and on the Pacific Coast. She appeared as an expert witness in several cases in Galveston, Houston, and New Orleans. In 1933 she was the star prosecution witness in the New Orleans Federal Court as cryptanalyst for the Coast Guard, testifying to her solutions of messages from the Consolidated Exporters Company, Prohibition's largest and most powerful bootlegging ring. These messages connected ringleaders to the actual operations of the rum-running vessels, and Elizebeth's evidence at the trial indicted 35 rumrunners for conspiracy to violate the National Prohibition Act.

Another outstanding case on which Elizebeth Friedman worked involved messages of opium dealers smuggling their wares. In 1937 the Canadian government sought her help. She went to Vancouver to testify in the trial of Gordon Lim and several other criminals. Their secret messages dealing with opium smuggling were cast in a complicated system involving a code she solved even without knowing Chinese. They were convicted and sentenced to seven years' imprisonment, where, as a Pacific Coast columnist observed, they would have plenty of time "to devise a code that a woman couldn't break."

Following her service as a cryptanalyst with the government in World War II, Mrs. Friedman continued working in cryptology as a consultant. Among other accomplishments, she created communications security systems for the International Monetary Fund.

After her husband's death in 1969, Mrs. Friedman spent her retirement compiling a bibliography of his work and library for presentation to the George C. Marshall Research Library in Lexington, Virginia. It is considered to be one of the most extensive private collections of cryptographic materials in the world.

Elizebeth Friedman died on 31 October 1980. For years the cryptologic community has rightly revered William F. Friedman as a giant in the evolution and development of modern American cryptology. But as time passes and more historical research is conducted, it has become apparent that in the shadow of the giant there was an equally brilliant pioneer, Elizebeth Smith Friedman.

In 1941 Yardley was off to another foreign country to establish a cryptanalytic bureau. This time it was Canada that desired his services. After creating the Examination Unit, as it was known, Yardley began to have some success against German agent communications. But by this time, the British had discovered Yardley's presence in Canada, and his American benefactor had retired. Both the British and Americans pressured the Canadians against renewing Yardley's contract. Although they objected, the Canadians had no choice, and Yardley left Canada and cryptology forever.

The remainder of Yardley's career was spent in other government service, operating an electrical sales company, construction, and writing. His last book, *The Education of a Poker Player*, had fourteen printings and sold over 100,000 copies. He died in 1958 and was buried at Arlington National Cemetery with full military honors. Several obituaries referred to Yardley as "the father of cryptography in America."

There is, however, a final postscript. In his 1967 book, *The Broken Seal*, Ladislas Farago alleged that Yardley had sold cryptographic secrets to the Japanese government in 1928 for $7,000. Independent investigations indicated that although much of Farago's description of the transaction was undocumented or wrong (e.g., the date), the basic claim was true. The key document, an internal Japanese Foreign Ministry memorandum, indicated that Yardley was paid the stated amount in 1930 (after the closing of the Black Chamber).

Thus Herbert O. Yardley remains the most controversial figure in American cryptology. But his contributions also remain a vital part of our cryptologic heritage.

William F. Friedman

Elizebeth Smith Friedman

Elizebeth Smith Friedman

Elizebeth Smith Friedman, the wife of William F. Friedman, was herself a pioneer in U.S. cryptology. Coauthor (with her husband) of *The Shakespearean Ciphers Examined* and author of many technical papers, she was employed at various times by the U.S. Treasury Department, the U.S. Army, the U.S. Navy, and the International Monetary Fund. She served the nation as a cryptologist in both World Wars, and in the period between she won distinction for her work on international drug and liquor smuggling cases.

Elizebeth Smith was born in Huntington, Indiana, in 1892. She attended Wooster College briefly and completed her degree in English at Hillsdale College in Michigan. While working at the Newberry Library in Chicago in 1916, Miss Smith was recruited by "Colonel" George Fabyan to work on his 500-acre estate, Riverbank, in Geneva, Illinois. Fabyan, a wealthy textile merchant who maintained laboratories in acoustics, chemistry, and genetics at Riverbank, had also established a Department of Ciphers, consisting of a staff of fifteen who lived on the estate. Elizebeth was assigned to a group attempting to prove that Sir Francis Bacon had written the plays and sonnets attributed to William Shakespeare.

It was at Riverbank that Elizebeth met William F. Friedman, who, at that time, headed Fabyan's Department of Genetics. They were married in May 1917, and after William transferred into the Cipher Department, worked together in the only cryptologic laboratory in the country, solving messages sent in by various government agencies. During World War I, the Friedmans developed courses in cryptology and trained U.S. Army and Navy officers and civilians. In 1921, the couple moved to Washington where they both were employed by the War Department.

It was Elizebeth Friedman's work for various branches of the government which brought her to prominence, first as assistant cryptanalyst for the War Department in 1921–22, and then as a cryptanalyst for the U.S. Navy in 1923 – later leading to her employment at the U.S. Treasury Bureaus of Prohibition and Customs. Most of her professional career was spent working against such international enterprises as smuggling and drug running.

Her early career began during the era of Prohibition, when rumrunners turned to radio and encoded messages to control their offshore operations. During 1928–1930, while she was assigned to

William F. Friedman

William F. Friedman may be said to be the dean of modern American cryptologists, the most eminent pioneer in the application of scientific principles to cryptology, and the man who created the organizational and technical basis for the U.S. Army's cryptographic and cryptanalytic successes in World War II. Born in Kishinev, Russia, on 24 September 1891, he came to the United States in 1892; he retired from the National Security Agency in 1955, after 35 years of service with U.S. cryptologic activities. He died in Washington, D.C., on 2 November 1969.

William F. Friedman graduated from Cornell University in 1914 with a major in genetics. While teaching in graduate school, he was recruited by a wealthy eccentric, "Colonel" George Fabyan, for work in his department of genetics on his 500-acre estate, Riverbank, in Geneva, Illinois. Fabyan maintained laboratories for private research at Riverbank in acoustics, chemistry, genetics, and ciphers. Although Friedman was supposed to improve the grains and livestock on the estate, he soon became involved with the cipher department, which at the time was attempting to ascertain whether Francis Bacon actually wrote the plays and sonnets ascribed to William Shakespeare. From 1916 to 1918 Friedman headed the cipher department, where his early training began, not only working on the Bacon question but also on ciphers sent to Riverbank under arrangements Fabyan had concluded with Army and Navy intelligence organizations. He received additional training as a lieutenant with the American Expeditionary Forces (G6A2, the crypt unit) in World War I. After another stay at Riverbank (1919 to 1920), he went to Washington where he worked in the Office of the Chief Signal Officer. From 1922 to 1929 Friedman served as the head of the Code and Cipher Compilation Section in the Office of the Chief Signal Officer.

In 1929, Friedman was selected to become the chief of the new Signal Intelligence Service which replaced Herbert O. Yardley's Cipher Bureau. Throughout the early and middle 1930s, Friedman created the organizational foundations of a cryptologic structure which evolved into the Army Security Agency in World War II. Technically, Friedman led the transition from pencil and paper cryptology into the modern era characterized by the application of machines to both cryptography and cryptanalysis. Further, although his administrative duties and his later illness prevented him from being totally immersed in the cryptanalytic work of the late 1930s and early 1940s, the accomplishments of his protégés –

Frank Rowlett, Abraham Sinkov, Solomon Kullback, Larry Clark, Frank Lewis, and others – against the Japanese Purple and other systems during the war stand as testimony to Friedman's abilities as a teacher and as creator of the modern science of cryptology.

Following World War II, Friedman served as the director, Communications Research (1947–49); cryptologic consultant, Armed Forces Security Agency (1949–51); research consultant, NSA (1952–54); special assistant to the director, NSA (1954–55); member of the NSA Scientific Advisory Board (1954–60), and also special consultant to NSA (1955–1969).

For the many contributions to his country, Friedman received the War Department Medal for Exceptional Civilian Service (1944), the Presidential Medal for Merit (1946), the Presidential National Security Medal (1955), and a special congressional award of $100,000 for inventions and patents in the field of cryptology held secret by the government.

Perhaps Friedman's greatest contribution, technically, was leading the profession from the traditional methods and approaches of cryptanalysis into the modern world. He did this primarily by codifying what had already been written and by applying mathematics, particularly statistical analysis, to cryptology. Friedman's writings – beginning with the Riverbank Publications, and including *The Index of Coincidence*, *The Elements of Cryptanalysis*, and extending through the "Black Books" and *Military Cryptanalysis Parts I–IV* in the late 1930s – enabled cryptanalysts to make the transition into the modern age. Friedman's writings, which included his own techniques plus the ideas of others, formed a body of knowledge which served as a foundation upon which the new science was created. The connection of mathematics to cryptology accomplished two things. First, it provided an intellectual discipline from within which the experts worked and were expected to approach cryptanalytic problems, i.e., logic, precision, and scientific method. Second, the application of mathematics and statistical analysis uncovered new solutions to problems which in turn led to general solutions to similar problems. It was upon this foundation that his pupils and later cryptanalysts were able to build attacks on increasingly difficult problems with which they were confronted during World War II and beyond. The body of knowledge codified and created by this legend is indeed the foundation upon which modern machine cryptanalysis rests and stands forever as a tribute to the pioneering genius of William F. Friedman.

War II. The Germans never penetrated the system, and the Japanese even abandoned their effort at breaking it.

Also in the mid-1930s, the SIS began to attack the high-level Japanese diplomatic machine system designated as Red. Rowlett, Kullback, John Hurt (a Japanese linguist) and others under Friedman's direction managed to reconstruct an analog of the Japanese machine solely from the principles they had derived from examining intercepted messages. Because of a lack of funds, the group had to suffice with a hand-operated analog until the Navy came to their aid and built an electromechanical model.

In 1938 the Japanese replaced the Red machine with the Type B machine – which came to be known as Purple. It took a much larger team under Frank Rowlett's direction eighteen months to break into this system; the first translation was produced in September 1940. It came one week after a crucial key to the puzzle had been suggested by Genevieve Grotjan (an SIS junior cryptanalyst). An analog was constructed under the direction of Leo Rosen (an SIS engineer), and when it was operational, the U.S. had access to all of the high-level Japanese diplomatic communications.

In 1946 Frank Rowlett became chief of the Intelligence Division of the Army Security Agency. In 1949 he was the technical director of operations in the Armed Forces Security Agency, and in 1952 transferred to the Central Intelligence Agency as a special advisor to the director of Central Intelligence. In 1958 Rowlett became a special assistant to the director, NSA, and served under three successive directors. In 1965 he became the first commandant of the National Cryptologic School at the Agency – the position from which he retired in late 1965.

Mr. Rowlett's awards include NSA's Exceptional Civilian Service Award, the National Intelligence Distinguished Service Medal, the President's Award for Distinguished Federal Civilian Service, the National Security Medal, the Legion of Merit, and the Order of the British Empire, and in 1964 Congress awarded him $100,000 for his inventions held secret by the government.

Frank B. Rowlett

In 1929, when William F. Friedman, director of the Signal Intelligence Service, was sorting through the Civil Service Register, he chose three names from the list and offered these individuals positions as junior cryptanalysts in the newly created SIS. The three were Frank B. Rowlett, Abraham Sinkov, and Solomon Kullback. Although Frank Rowlett is singled out here, both Sinkov and Kullback, as well as others, are equally deserving of the title cryptologic pioneer.

The first of the three to report for duty on 1 April 1930 was Frank B. Rowlett. Born in Rose Hill, Virginia, on 2 May 1908, Rowlett had graduated in 1929 from Emory and Henry College in Virginia with majors in mathematics, chemistry, physics, and Latin. He taught briefly at his alma mater and was teaching math and chemistry at Rocky Mount High School when he applied for and passed the Civil Service Commission examination. Friedman saw his name on the Civil Service Register and offered him a position.

From the very early days, Friedman began to train Rowlett and the other junior cryptanalysts in both cryptography (the design or use of cryptosystems) and cryptanalysis (the analysis of encrypted messages). Friedman believed strongly that a good cryptanalyst should participate in the construction and generation of codes and ciphers and conversely, if he understood the cryptographic processes and principles, he would be a better cryptanalyst. Friedman demanded that his cryptanalysts learn everything they could about cryptology as it was known at the time. In addition to having them read the few available texts on the subject, Friedman locked them in a vault with the files from Herbert O. Yardley's "Black Chamber" and made them rework systems that Yardley and his analysts had solved. In this fashion, they became familiar with the old systems and the methods and techniques of their solutions.

In 1931 the young cryptanalysts began to work on machine systems (those in which encipherment and decipherment are performed by means of a machine). Beginning with the Wheatstone device, they progressed to the German Kryha machine, the Damm machine, Vernam's A.T. & T. device, and the Hebern machine. At the same time, they were also compiling U.S. codes and ciphers. One of the projects was upgrading the M134 machine. This machine, a result of joint contributions by Friedman and Rowlett, ultimately came to be known as the SIGABA and was the most secure cryptographic system in U.S. communications throughout World

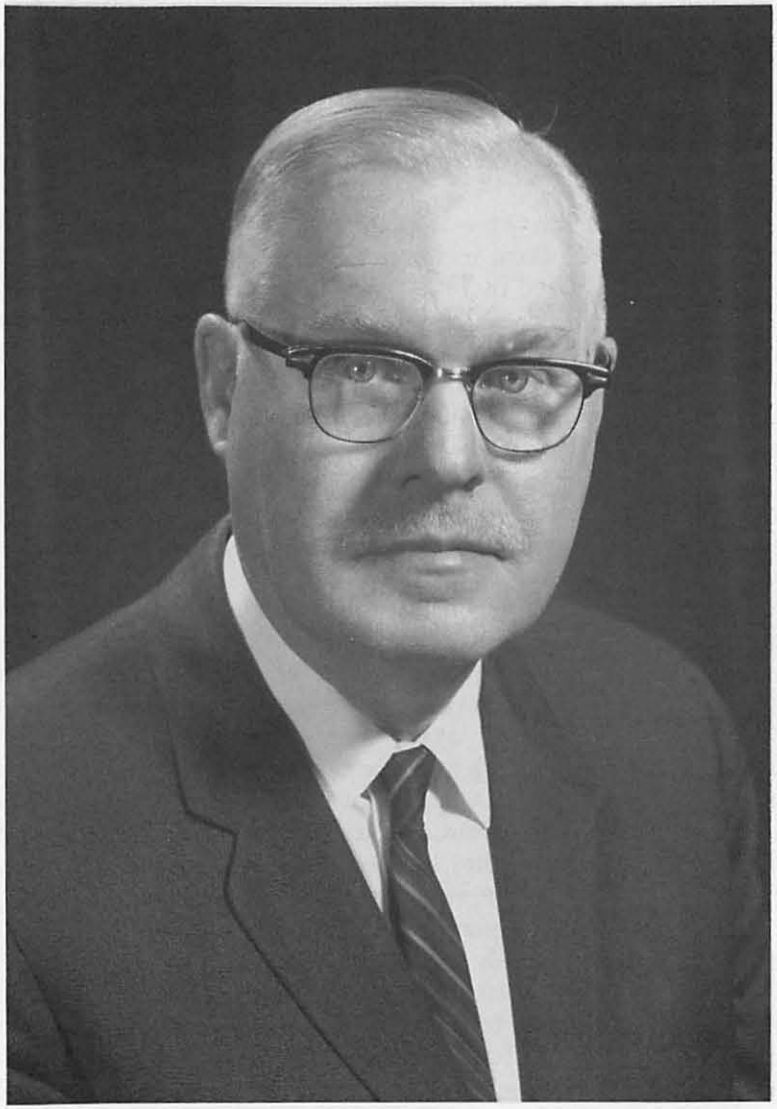
Laurance F. Safford

Although the strands of U.S. naval cryptologic history reach back to the Civil War era, they were not woven together into an effective organization until 1924, when Lieutenant Laurance Safford became the Officer-in-Charge of the (Cryptologic) Research Desk within the Code and Signal Section of the Division of Naval Communications. Drawing upon modest resources, Lieutenant Safford catalyzed the development of the U.S. naval communications intelligence organization (OP-20-G), which in turn provided building blocks for the creation of the Armed Forces Security Agency in 1949 and ultimately the National Security Agency in 1952. Given the importance and sensitive nature of Safford's contribution to the development of the national signals intelligence effort, it is not surprising that he was occasionally surrounded by controversy, especially his testimony given during the Pearl Harbor investigations in which he insisted that a "Winds Execute" message had actually been intercepted.

Born in Somerville, Massachusetts, in 1893, Laurance Frye Safford was graduated from the U.S. Naval Academy and commissioned an ensign on 6 June 1916. Prior to his assignment to the Research Desk, he experienced wartime destroyer duty – which included two trips to Europe – and served as commanding officer of several submarines. His submarine duty included a tour with the Asiatic Fleet.

As the OIC of the Research Desk, Safford emphasized the creation of an organization dedicated to both the collection and exploitation of foreign communications intelligence and to the security of U.S. naval communications. Up until Safford's arrival at OP-20-G, these responsibilities had been shared by the Office of Naval Intelligence (ONI) and the Division of Naval Communications (DNC). Although the working relationship was a good one, the lack of a dedicated COMINT organization did not promote the most effective use of available resources. By providing both an architecture and direction, Safford was able to build upon earlier successes, such as the acquisition of the Imperial Japanese Navy Secret Operations Code-1918, through systematic exploitation. To Safford, the success of the organization was dependent upon dedicated resources, which included trained personnel, specialized equipment, and independent operational sites.

Captain Laurance F. Safford, USN



Frank B. Rowlett

the Navy's effort in the field of machine processing and aided in the development and refinement of cipher devices which were adopted by the U.S. Navy.

Shortly after the outbreak of World War II, Wenger was once again in Washington in the headquarters of OP-20-G. He was instrumental in designing the plan for the reorganization of the naval COMINT structure which was completed in February 1942. This reorganization was a significant attempt to change the nature of OP-20-G from a decentralized operation to a centralized one. Wenger emerged as the deputy for OP-20-G and as such provided a technical continuity which lasted throughout the war.

At the end of the war, Wenger worked to insure the continuity of the Navy's cryptologic efforts, threatened by demobilization, by retaining experienced personnel and promoting a reservoir of reservists. Wenger also strongly supported the creation of a company, Engineering Research Associates of St. Paul, Minnesota, which helped lay the foundations for the contemporary computer industry. In the late 1940s he initiated a computer-based research project which became the first project undertaken by International Business Machines (IBM) for the United States government.

Captain Wenger became a deputy director for COMINT of the Armed Forces Security Agency in 1949 and also served as the deputy coordinator of Joint Operations for the United States Communications Intelligence Board (USCIB). When the National Security Agency was established in 1952, he became vice director.

In 1953 Admiral Wenger received the National Security Medal from President Eisenhower for his planning and organizational work in communications research. He served as director of Communications-Electronics on the Joint Staff of the U.S. European Command and coordinator of both U.S. and NATO communications-electronics plans and programs. In 1956 he was appointed director of Communications-Electronics for the Joint Chiefs of Staff and in 1957 designated as the chairman and U.S. member of the Communications-Electronics Board, Standing Group, NATO.

After his retirement from the Navy in 1958, Wenger continued to serve as a member of the National Security Agency's Scientific Advisory Board. He was also a technical consultant for RCA and the Syracuse University Research Corporation. His professional involvement in cryptology ended only with his death in 1970.

Beginning in 1924 Lieutenant Safford outlined a cryptologic training course for officers, based upon his own training sessions with Miss Agnes May Meyer, the primary civilian cryptanalyst in OP-20-G. The first guinea pig was apparently Ensign Joseph N. Wenger – later to become the Navy's first cryptologic flag officer. These courses were later expanded and specialized to include the training of enlisted personnel through the integration of the experience of self-taught intercept operators.

Safford quickly realized the importance of "machines" for cryptology, both for cryptanalysis and cryptography. Together with the Underwood Typewriter Company, he developed the "Underwood Code Machine" (also known as Radio Intelligence Publication or RIP–5), a typewriter with forty-six Japanese-English keys which allowed intercept operators to copy traffic more efficiently.

In the years prior to the outbreak of the Second World War, Safford constantly stressed the importance of high frequency direction finding (HFDF), extending nets into both the Atlantic and Pacific.

Although Safford was periodically called to sea duty until 1936, when he was designated as an Engineering Duty Officer in cryptology (the first such designator of its kind), the activities of OP-20-G expanded upon the base he developed. In February 1942 he became the assistant director of Naval Communications for Cryptographic Research, a position which he held until September 1945. For his "exceptionally meritorious conduct" in this position, he was awarded the Legion of Merit.

Captain Safford continued to serve as assistant director of Naval Communications for Cryptographic Research until January 1949, when he became special assistant to the director of the Armed Forces Security Agency. In January 1952 Safford became the special assistant to the head of the Security Branch in the Division of Naval Communications. He was relieved of all active duty on 2 March 1953, after having been placed on the Retired List of the U.S. Navy on 30 June 1951.

The Eighty-fifth United States Congress awarded Captain Safford $100,000 in 1958 for cryptographic inventions which he could not patent for reasons of national security.

His death on 15 May 1973 at the Bethesda Naval Hospital ended an important chapter in both U.S. naval and national cryptologic history.

Joseph N. Wenger

Rear Admiral Joseph N. Wenger played a leading role in the development of both the Naval Security Group Command and the National Security Agency. Along with Frank B. Rowlett, Agnes M. Meyer Driscoll, and Elizebeth S. Friedman, he can be considered one of the seminal figures in U.S. cryptologic history. Wenger was one of the first U.S. naval officers to realize the role of communications intelligence and its value – particularly in traffic analysis – to military planners. He was a pioneer in the development of machines for use in cryptanalysis, and he was among the first to recognize the need for centralization within the naval COMINT establishment as well as within the national COMINT establishment.

Born in Patterson, Louisiana, in 1901, Wenger was admitted to the Naval Academy in 1919 and graduated from there in 1923. His subsequent career in the Navy was typical of other naval cryptologists of the 1920s and 1930s since his participation in cryptology was limited to shore duty when he wasn't on sea duty. Thus, Wenger's associations with OP-20-G (code and signal section in the Office of Naval Communications) in the early days were limited to his participation in training courses in 1925 and 1931 and correspondence with Laurance F. Safford about cryptology.

Wenger's first real involvement with COMINT came while he was radio intelligence officer for the Asiatic Fleet, 1932–1934. In 1933 or early 1934 he began to assemble the reports of the various RI elements which had participated in obtaining intelligence on the Japanese Imperial Fleet maneuvers of 1933. His study and consolidation of these reports into a major study of his own crystallized his thinking on the value of COMINT, and particularly the importance of traffic analysis in a military environment. He realized the valuable information which could be gained from studying Japanese communications procedures, traffic associations, systems, callsigns, and other message externals and recognized that this information could be just as important as that derived from reading message texts. In 1937 he returned to his earlier work on traffic analysis and submitted a lengthy study which compared his conclusions in 1933 to what he learned four years later when he could read the messages he had been analyzing.

In 1935, Wenger returned to Washington to take charge of the research section (OP-20-GY) of the Navy's nascent communications intelligence organization. While in this position, he helped launch

Rear Admiral Joseph N. Wenger, USN