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HISTORY OF THE SIGNAL SECURITY AGENCY

THE GENERAL CRYPTANALYTIC PROBLEM

VOLUME TWO

ARMY SECURITY AGENCY
WASHINGTON, D C.
1946

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WASHINGTON, D. C.

HISTORY OF THE SIGNAL SECURITY AGENCY

VOLUME TWO

THE GENERAL CRYPTANALYTIC PROBLEMS

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HISTORICAL NOTE

The original draft of this history of the General Cryptanalytic Branch was prepared in the Recorder's Office under the direction of Dr. Albert Howard Carter. Responsibility for work on the various chapters was assigned as follows:

Dr. Albert Howard Carter: chapters XVII (The Hagelin Section); XX, sections B (The Recorders Group) and D (Documents Section).

Captain George E. McCracken: chapters V (Italian Systems); VI (The French Systems); VII (The Swiss Systems); VIII (The Spanish and Spanish-American Systems); IX (The Portuguese and Brazilian Systems); X (The Systems of the Near and Middle Eastern Governments); XI (The Far Eastern and Central European Systems); XII (Miscellaneous Systems); XIII (The Solution of Meteorological Systems), XIV (The Special Examination Unit); XV (Traffic in Commercial Codes; XX, section E (The Decryptographing Unit); XXI (Assistance from Espionage).

Dr. Carter and Captain McCracken: chapter I (The General Cryptanalytic Branch.

Miss Gertrude Ullman: chapter III (The Japanese Military Attaché Systems).

Miss Ullman and Captain McCracken: chapters II (Japanese Diplomatic Systems); IV (German Diplomatic Systems).

Miss Ullman and Dr. Carter: chapter XX, section A (The Research Section).

Mrs. Marjory Max-Muller: chapter XVI (The Machine Cipher Section); XVIII (The Yellow Project).

Mrs. Max-Muller and Miss Ullman: chapter XIX (The RAM Section).

Miss Dale Wallace and Dr. Carter: chapter XX, section C (The Planning and Priorities Unit).

Rough drafts of the chapters were submitted to the heads of the respective sections for approval before being incorporated into the history; they were then edited in the Historical Unit to conform with the general plan of the History; and finally, the completed volume was reviewed by Mr. Frank Rowlett and revised by Miss Ullman in collaboration with the Historian, AS-13.

For data regarding the total production of B-III, attention is invited to Tabs 15 and 16. Detailed information as to the production of various units of the organization will be found throughout the text.

Historian, AS-13

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HISTORY OF THE SIGNAL SECURITY AGENCY

VOLUME TWO: THE GENERAL CRYPTANALYTIC PROBLEMS

CHAPTER I. THE GENERAL CRYPTANALYTIC BRANCH[1]

A. Organization and Reorganization

When, in 1930, the Signal Intelligence Service was established under the Chief Signal Officer, with the Assistant Chief of Staff, G-2 exercizing staff supervision, the directive under which the new Service was to operate emphasized, so far as solution of foreign cryptographic systems was concerned, training for an emergency rather than solution of current systems for the production of intelligence.[2]

Fulfillment of the training program, however, necessitated attempts to intercept sufficient raw traffic to provide material for instructional purposes, and though establishment of adequate intercept facilities was difficult, a certain amount of traffic was intercepted and solved. This was at first chiefly Japanese traffic. When success was achieved in the solution of a given Japanese system, translations were, on occasion, forwarded to G-2, more as an indication of what could be and had been done than because G-2 was expected to make use of the specific contents of the messages thus made readable.

As time passed, interest began to grow in solution of current

---

1. The present volume will contain the story of all cryptanalytic projects undertaken by the Signal Security Agency during World War II except only those of the Japanese Army systems which, because of their magnitude and importance, require separate treatment. See volumes Three (B-II) and Five (B-IV).

2. See Historical Background of the Signal Security Agency, volume Three, chapter V.

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traffic on an operational basis, rather than as merely incidental to training, and by the outbreak of the War in Europe, on 1 September 1939, there were in the Signal Intelligence Service four cryptanalytic units, under the technical direction of Mr. William F. Friedman. They were designated as follows:

J Section	Japanese Diplomatic, activated about 1935 under Mr. Frank B. Rowlett
G Section	German Diplomatic, activated about 1938 under Dr. Solomon Kullback
I Section	Italian Diplomatic, activated about 1938 under Dr. Abraham Sinkov
M Section	Mexican Diplomatic, activated about 1938 under Mr. H. F. Bearce

These four units were at work, under directives from G-2, on the current solution of diplomatic traffic sent out by the governments concerned. Organization was not rigid, however, since there was a good deal of collaboration between the four units. Successes reached in this early period will be discussed individually in subsequent chapters.

No further cryptanalytic units were established before the attack on Pearl Harbor, but soon after the M Section began its existence it expanded its scope to include a few other Spanish-American countries (chiefly Colombia and Venezuela), and early in 1941 it also commenced attempts at solution of the systems of Vichy France, Spain, Portugal, Brazil, and still other Spanish-American governments. It was thus the forerunner of all units which during the War attacked the systems based

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on Romance languages except only those in Italian, which, as we have seen, were studied in a special section established at an early date.

Some time in the winter of 1941--whether before 7 December 1941 or as an immediate result of the momentous events of that day--the Signal Intelligence Service as a whole was reorganized into four sections (Tab 1):

A Section	Administrative
A-1	Personnel
A-2	Tabulating Machinery
B Section	Cryptanalytic
B-1	Japanese
B-2	German
B-3	Italian
B-4	Mexican, etc.
B-5	Stenographic
B-6	Traffic
C Section	Cryptographic
D Section	Secret Ink and Photographic Laboratory

The duties of subsections B-1, B-2, B-3, and B-4 continued to be the same as before: B-5 was a group of typists who prepared finished copies of the translated messages, and B-6 was a small unit responsible for giving directives to the intercept stations--the officer in charge was also commanding officer of the Second Signal Service Company--and caring for the routing of traffic within the Cryptanalytic Section. In addition to these two service units, there was another, Tabulating Machinery (A-2), the work of which was largely in support of the Cryptanalytic Section, but since it contributed to some extent to the activities of the Cryptographic Section, the Tabulating Machinery Unit was attached to the Administrative Section.

Between the beginning of the War in December 1941 and the move

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to Arlington Hall Station in the summer of 1942 certain changes were made. (Tab 2) The old M Section was almost at once divided, B-4 being the designation of the new unit assigned to French traffic and B-7 that of the unit assigned to solution of traffic in the Spanish and Portuguese languages. The former Tabulating Machinery Unit (A-2) was, at about the same time, transferred from the Administrative Section and set up as B-8, though of course it continued as before to work also for the Cryptographic Section. In May 1942 a beginning was made in an organized effort to provide information services for the cryptanalysts, and this new unit was designated B-9. Finally, a new unit (B-10) was set up in the same month to study weather reports transmitted in enciphered forms of the International Meteorological Code. The Cryptanalytic Section was thus organized as follows:

Cryptanalytic Section, OIC Lieutenant Colonel Harold Doud
- B-1 Japanese, OIC Major E. H. F. Svensson
- B-2 German, OIC Captain S. Kullback
- B-3 Italian, OIC Major A. Sinkov
- B-4 French, OIC Lieutenant H. F. Bearce
- B-5 Stenographic, CIC Miss M. Louise Prather
- B-6 Traffic, OIC Major R. E. Schukraft
- B-7 South American, OIC Lieutenant L. M. Glodell
- B-8 Tabulating Machinery, OIC Lieutenant R. H. Adams
- B-9 Information, NCOIC Corporal Ivan Bash
- B-10 Weather, OIC Captain U. S. Lyons

Five of these units were engaged in solution of the varied types of cryptography met with in the systems of a single government or group of governments. In Tab 3 is shown a work schedule for the period 18 - 30 May 1942. Operations involved not only cryptanalysis but decoding and deciphering, and finally, translation of the messages. Another

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unit (B-10) was engaged in applying cryptanalytic techniques to a special type of traffic sent out by a number of governments. The remaining four units provided services of one sort or another to all the others.

The first result of the great expansion which the Signal Intelligence Service experienced in the first six months of 1942 was the removal of the Traffic Unit (B-6) from the Cryptanalytic Section and its establishment on an autonomous basis as E Section in May 1942. Henceforth, the Cryptanalytic Section was no longer responsible for interception and related functions. But the reorganization went much further than that; the nine remaining units were regrouped, and in some cases dissolved to reform on a new principle of organization, namely, similarity as regards cryptographic type of system involved.

This departure from what had previously been the norm was probably motivated by experience in the solution of ciphers. In this instance a knowledge of the basic language underlying the system is less urgently needed than in the case of code reconstruction. Moreover, the solution of one cipher has more in common with the solution of another in a different language than with the solution of a code in the same language. It was felt therefore that if solution of all codes were made the function of one subdivision, solution of all ciphers the function of another, and possibly also code encipherments were separated from both, progress would be greatly facilitated.

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To put such a policy into operation, the Cryptanalytic Section was reorganized at the time of the move to Arlington Hall Station (June to August 1942), and the final result was as follows:

Cryptanalytic Section, OIC Lieutenant Colonel Harold Doud
- B-1 Miscellaneous service units, OIC Captain Verner C. Aurell
  - Translation
  - Decryptographing
  - Traffic
  - Bulletin
  - Information
- B-2 Code and additive encipherment solution, OIC Captain S. Kullback
  - Code reconstruction
  - Additive encipherment solution
- B-3 Cipher solution and solution of code encipherments other than additive encipherments, OIC Lieutenant Frank B. Rowlett
- B-4 Tabulating machinery, OIC, Captain Perry Molstad

It will be seen that except for Tabulating Machinery, all service units were gathered together in a miscellaneous subsection (B-1), but while this subsection was responsible for Japanese translation and for some of the translation in French and Spanish, it did not prepare translations in other languages, or, indeed, all of those in French and Spanish. Moreover, its decryptographing work was limited to solved systems only, and its traffic function was restricted to sorting and routing traffic after it had reached B Section: it was not responsible for issuing directives to the intercept stations, which was then a function of E Section.

B-2 maintained (1) a subsection which carried on code reconstruction in four units devoted to the French, Italian, Portuguese, and Spanish languages--code reconstruction was not needed in German, owing

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to compromised code books—; (2) another subsection devoted to solution of additive encipherments (German, Spanish, and weather systems); and (3) also small units devoted to the study of new systems used by the Japanese diplomatic, military attaché, and army communications. See Tabs 5 and 6.

It was in B-2 that the disadvantages of the new arrangement were first keenly felt. In the Italian Unit, for example, which had previously been successful by combining cryptanalytic and linguistic operations in solving the same traffic, the division of solution of encipherment from code reconstruction had a hampering effect upon operations, particularly since the additive encipherment unit was located at a distance from the code reconstruction unit. Each of these two units had more in common with each other than either had with other units practicing the same techniques upon different traffic. Even before the reorganization of 1943 eliminated this disadvantage, attempts had been made to overcome the difficulty by assigning the units to contiguous quarters; then they were joined operationally though separated administratively; and finally, when the reorganization came at last, they were once more amalgamated.

The same disadvantage was felt also in the French units, of which there were actually four instead of two: French Code Reconstruction, French Additive Solution, French Decoding, and French Translation, but here the emergency solution was the establishment of a coordinating committee, which did much to bring about amalgamation of all French

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units. It must be admitted that this division of functions did not have a bad effect upon solution of systems using Spanish and Portuguese, since only the Spanish Government used additive encipherment and in that case the codes used had been compromised and no reconstruction was necessary. The Portuguese and Brazilian systems were also almost wholly code reconstruction problems. Moreover, in the field of ciphers, that is, in B-3, the new arrangement worked remarkably well.

The Fiscal Year 1943, the first at Arlington Hall Station, was passed with the four-fold organization just described, but it was becoming obvious that a number of factors would soon demand a thorough-going revision. The chief factor which brought this revision about was the cryptanalytic success reached in late spring by the small unit studying the Japanese Army problems. Exploitation of this success was at once necessary, and since this would involve tremendous expansion, the Japanese Army problems were set up, 1 September 1943; as one of the major sections (B-2) of the Cryptanalytic Branch, which the old Cryptanalytic Section had now become. The remainder of B-2 was then amalgamated with B-3, and a new internal organization was effected whereby a return was made to the older form of organization by language units, with a number of units devoted to cipher problems remaining independent (Tab 7). The new B-3 Section also assumed certain of the functions formerly belonging to B-1, which now retained control only of matters pertaining to the Japanese language (translation, code reconstruction, and training) but gave up everything else. The Bulletin, Information, and Liaison Units of B-1,

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were for a temporary period administered by Headquarters Branch, Signal Security Agency. See Tab 8. The new arrangement of the Cryptanalytic Branch was therefore as follows:

Cryptanalytic Branch, OIC Lieutenant Colonel Earle F. Cook
- B-1 Japanese Language, OIC Major Verner C. Aurell
- B-2 Japanese Military Cryptanalysis, OIC Lieutenant Colonel S. Kullback
- B-3 General Cryptanalysis, OIC Major Frank B. Rowlett
- B-4 Tabulating Machinery, OIC Major Perry Molstad

Some idea of the extent of the expansion in personnel strength of the Branch is afforded by a Proposed Supplemental Table of Organization dated 1 July 1943, revised 17 August 1943, which shows the Cryptanalytic Branch at its actual strength and the increase which was asked for, as follows:

SUMMARY BY CLASSIFICATIONS

Classification	Actual	Proposed
Officers	157	240
Enlisted	240	240
Civilians	1713	4784
Total	2110	5264

SUMMARY BY SECTIONS OF THE BRANCH

Administrative	17	17
Section I	566	1289
Section II	544	2606
Section III	337	312
Section IV	646	1040
Total	2110	5264

The great increase in the needs of Section I (Japanese Language), Section II (Japanese Military Cryptanalysis), and Section IV (Tabulating Machinery), coupled with the slight decline in the requirements for Section III (General Cryptanalysis) reflects the success in solving

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the Japanese Army systems which had recently been achieved.

Not long after this reorganization of September 1943, B-4 (Tabulating Machinery) was given an autonomous relation as G Branch, and in its place were transferred from E Branch those units engaged in Traffic Analysis, which, as was now recognized, were performing operations more closely akin to the intelligence functions of the Cryptanalytic Branch than to the communications functions of E Branch. Later, in 1944, still other E Branch units concerned with Traffic Control were also transferred to B-4.

From February to August 1944 a project set up at Vint Hill Farms Station which utilized Nisei enlisted personnel for translation and a limited amount of cryptanalysis was given the designation of B-5 (Tabs 9 and 10), but this section was later subordinated to B-1 and designated B-I-5. This produced the following organization:

Cryptanalytic Branch, OIC Colonel Harold G. Hayes
- B-1 Japanese Language, OIC Lieutenant Colonel Verner C. Aurell
- B-2 Japanese Military Cryptanalysis, OIC Lieutenant Colonel S. Kullback
- B-3 General Cryptanalysis, OIC Lieutenant Colonel F. B. Rowlett
- B-4 Traffic Analysis and Control, OIC Captain Ralph J. McCartney
- [B-5] Vint Hill Translation Section (temporarily), OIC Major Gordon T. Fish

Finally, those units of the old Cryptanalytic Section which had gone to Headquarters Branch were, on 1 March 1944, set up as the Information and Liaison Branch under Captain James H. Frier, Jr., who was relieved as Officer in Charge on 12 January 1945 by Captain John H. Connor.

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While each of these components of the Cryptanalytic Branch underwent further internal reorganizations from time to time, no other changes in their essential relationships one to another were made throughout the War. In August 1944, however, an Agency-wide reorganization resulted in the redesignation of the Cryptanalytic Branch as the Intelligence Division and the consequent elevation of its component sections to the status of branches. (See Tab 11.) While this change had many advantages of an administrative nature, it did not affect in any was the organization of the five component branches of the Intelligence Division: Language, Military Cryptanalytic, General Cryptanalytic (Tab 12), Traffic Analysis and Control, Information and Liaison.

B. Cryptanalytic Liaison with the British[2]

In the summer of 1940 the War Department had made, as we have seen,[3] a decision to exchange military information with the British, but so far as the Signal Intelligence Service was concerned, this decision was not implemented by actual interchanges until early in 1941. A mission was then sent to England consisting of Captain Abraham Sinkov and First Lieutenant Leo Rosen, who spent February and March 1941 in

---

2. The plan of this History limits the scope of the present volume to cryptanalytic attack upon all foreign systems of communications except those of the Japanese Army, which are discussed in volume Three, but much that is said here is equally applicable to the work on the Japanese Army problem. Indeed, the Sinkov-Rosen mission, as will shortly appear, first made arrangements for an exchange on these problems also.

3. In volume One, chapter IV, section B.

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the study of information which the British possessed and in visiting the British cryptanalytic units, then located, except for the compilation unit at Oxford, at Bletchley Park, Bletchley, where they had been moved from London to provide a somewhat greater degree of safety during the Battle of Britain.[4]

According to their report of 11 April 1941, addressed to the Assistant Chief of Staff, G-2, "the primary mission related to German, Japanese, Italian and Russian secret systems." In addition, they received information regarding minor European powers and Latin America.[5] Neither this report, however, nor the longer account[6] which they submitted to the Chief, SIS mentioned what was probably the most significant evidence of the willingness of the British to cooperate:[7]

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4. Originally it had been intended that Mr. William F. Friedman would participate in the mission and, indeed, the state of his health was one of the factors in postponing the departure. Mr. Friedman was then, however, a Reserve Officer on active duty, and, in spite of the fact that orders had been written, he did not go. Later, the Surgeon General declared him to be permanently incapacitated for active duty because of physical disability, and he therefore reverted to the status of civilian employee, which he had previously held since 1 January 1921. This did not prevent him from making two later missions (1943 and 1945) to England, as will shortly be described.

5. Memorandum to Assistant Chief of Staff, G-2 "Report of Technical mission to England," signed by Captain A. Sinkov and Lieutenant Leo Rosen, 11 April 1941, filed in MID.

6. This is now filed in the Army Security Agency as IL 413.

7. They omitted this fact, of course, for security reasons, as will shortly be seen.

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the British, after obtaining special pledges of absolute secrecy,[8] revealed to these American officers the existence of their "E" operations (a successful attack upon traffic enciphered by the German high-security cryptographic machine known as the Enigma and used throughout the War by the German Army, Navy, Air Force, and Railway Service for secret communications). "It is significant to observe (and with some measure of chagrin) that this pledge was publicly violated by the Pearl Harbor investigation."[9]

The report cited, evaluating the fruits of the Sinkov-Rosen mission, was the first of a long series of reports which pointed out that "the material which was furnished . . . will result in a saving of several years of labor on the part of a fairly large staff." In return, these first liaison officers supplied the British with the greatest treasure of the Signal Intelligence Service: the solution of the Japanese high-security diplomatic machine and system, designated by the Signal Intelligence Service as the "Purple." In addition GCCS was given one analogue of this machine, together with all the technical information necessary for its operation in deciphering messages. GCCS was also supplied with the results of American work on the Italian diplomatic problems with which Captain Sinkov had been

8. They were required to take a special oath to reveal what they had learned of the Enigma solution only to three persons: the Assistant Chief of Staff, G-2; the Chief, SIS; and Mr. William F. Friedman.

9. Colonel Abraham Sinkov, interview of 24 May 1946 with Historian, ASA.

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closely associated. For their part GCCS "suggested definite plans for . . . cooperation including the possibility of a division of effort to avoid duplication." Especially interested in cooperating on Far Eastern problems, GCCS was willing to supply the technical data elaborated by its "cipher section in Singapore,[10] which is getting fairly good results" if the United States would supply competent Japanese translators to make up a deficiency in that field.[11]

In addition to information concerning the results of British study, the two American officers brought back in complete form a Mexican twenty-alphabet cipher and keys, a Brazilian code, several German Air Force code books, as well as partial reconstructions of an Argentine and a Chilean code.

At this point it will be well to digress for a moment to pay some attention to the question as to which side gained most from the Anglo-American collaboration. Persons whose high technical capacities had confined their experience to but one or at most a few fields of operation, particularly when it was in those fields that the British had been able to make very significant contributions to the progress of the Signal Security Agency, have often informally discussed the question, but because they were not in a position to assess the entire history of the liaison and match a British contribution here with an

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10. Ibid.

11. The sequel to this move will be discussed in volume Three, especially chapter II.

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American contribution there, no conclusion could generally be reached. Indeed, in a question of this kind, when imponderables are involved, it is advisable to refrain from expressing conclusions hastily arrived at.

Yet some definite conclusions can be stated: the British made their largest contribution in providing a vast supply of information concerning the results of their cryptanalytic studies of past and current systems. Cryptanalytic continuity had begun for the British in 1914, whereas for the Signal Intelligence Service it was broken in 1930 when MI-8 was dissolved. In only one field (Japanese diplomatic systems) had the Signal Intelligence Service been able by 1941 to amass enough data to be able to say that cryptanalytic information was once more continuous, and, significantly enough, it was in this very field that the Signal Security Agency was able to give the British at the outset its most valuable contribution (the "Purple").

On the other hand, the Americans were, all through the War, able to exploit to a much fuller extent than the British the vast possibilities for cryptanalytic purposes inherent in the use of the newer mechanical, electrical, and electronic techniques. Perhaps the best indication that the Anglo-American collaboration was mutually helpful was the fact that it was continued throughout the War and is planned also for the postwar period.

After the return of the Sinkov-Rosen mission, the next event in the history of Anglo-American liaison on cryptanalytic attacks was a

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visit by Mr. (Commander) A. G. Denniston, then head of GCCS, who discussed with the several SIS sections "matters of general interest in connection with joint cryptanalytic activities."[12] At this time he arranged for Captain (later Major) Geoffrey G. Stevens to come to Washington as an observer of Japanese cryptanalysis.[13] Captain Stevens was to report to and be under the jurisdiction of Captain Edward Hastings, British Liaison Officer for GCCS in Washington.

The first record of a routine exchange of cryptanalytic material is dated just after the Pearl Harbor attack. On 14 December 1941 the Signal Intelligence Service agreed to the proposal made by GCCS that "frequent exchange of material [was] desirable" concerning the principal diplomatic system (GEC).[14] Shortly thereafter the Signal Intelligence Service sent a complete list of recovered daily keys for 1930 and 1940[15] to GCCS, which, indeed, had earlier given Captain Sinkov the results of their work on this system.

In May and June of the following year (1942) Captain Solomon Kullback was assigned to temporary duty at GCCS, where he studied

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12. "Minutes of Conference," 16 August 1941, Room 3341, Munitions Building, attended by Lieutenant Colonel R. W. Minckler, then Chief, SIS; Captain Harold G. Hayes, then Executive Officer, SIS; Captain Earle F. Cook; Captain A. Sinkov; Lieutenant Leo Rosen; Mr. William F. Friedman; Mr. Frank B. Rowlett; and Dr. S. Kullback. Document on file in the Office of the Director of Communications Research.

13. Recollection of Colonel Harold G. Hayes, 28 May 1945.

14. Telegram dated 14 December 1941, copy in IL 414. See chapter IV.

15. Contained in Document No. IL 414.

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German, Japanese, French, Spanish, Italian, Middle Eastern, Near Eastern, Chinese, South American, and Swedish diplomatic systems, German military systems, and other systems. The material which he brought back was perhaps the largest single shipment received from GCCS: it included GEC keys, work sheets, and a technical description of that system; French keys and instructions concerning encipherment; a number of reconstructions of codes, among which were French, Spanish and Japanese codes; and, finally, the facts then known concerning the solution of German military traffic. Captain Kullback had "found the British most helpful and cooperative and was permitted access to every section [of GCCS] at Bletchley[16] and London.[17] They were completely frank, open and aboveboard with me and kept [back] no detail of their operation, procedures, technique, or results."[18]

In the month of July 1942 the President reviewed the situation[19]

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16. Bletchley Park, Bletchley.

17. Berkeley Street.

18. Major Kullback's report, dated 1 August 1942, is filed in IL 412. When the Sinkov-Rosen mission went to England, all the sections of GCCS were located at Bletchley Park, Bletchley, about 50 miles northwest of London. By the spring of 1942, when the Battle of Britain had been won, and it was deemed sufficiently safe to move some sections back to London, the diplomatic sections, under Commander Denniston were moved to Nos. 8-9, Berkeley Street, London, and that part of GCCS was thereafter generally referred to as "Berkeley Street." The part remaining in Bletchley was often referred to as "the Park" or "BP".

19. Memorandum for General Marshall, 9 July 1942, signed "F.D.R." A copy of this memorandum and of Major General Strong's reply to General Marshall of the same date are now filed in the Office of the Director of Communications Research. General Marshall's own memorandum, dated 11 July 1942, is filed in MID.

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and was assured by the Chief of Staff that "an interchange of cryptanalytic information had been in progress for over a year and appears to be satisfactory to both services." Indeed, the examples of the uninterrupted flow of materials between the two centers cited throughout this volume show that this cooperation was not only satisfactory but essential to the success of the two organizations.

Meanwhile, the exchange of material with the Examination Unit at Ottawa had begun. The Canadian organization had been founded in 1941; but since Mr. Herbert O. Yardley, who had been head of MI-8 from 1917 to 1929,[20] was employed there, the Signal Intelligence Service and GCCS refused to cooperate with EU until Mr. Yardley was dismissed.[21]

Mr. Oliver Strachey, one of the most experienced members of the GCCS staff, was the first head of EU sent to Ottawa after Yardley's dismissal. He remained for one year and was succeeded by Mr. F. A. Kendrick, who paid several visits to the Signal Intelligence Service during 1942 and thereafter until he returned to England in 1945. The first recorded instance of cooperation between the Signal Intelligence Service and EU involved the receipt from the Canadians of a copy of one of the French codes captured in January 1942 at Miquelon. Cooperation

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20. On his work see Historical Backgrounds of the Signal Security Agency, prepared by the Historical Unit, Army Security Agency, especially volumes Two, (chapters I-VI) and Three (chapters II-IV). The reason for the attitude of GCCS and the SIS toward Yardley is discussed in volume Two (chapter IV).

21. This was one of the results of the discussions with Commander Denniston.

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with EU has been as cordial and profitable as that with GCCS in every sphere in which EU operates, but it should be pointed out that EU did not carry on a program of cryptanalytic study of any systems except those of the French and Japanese.

In 1943 Mr. William F. Friedman visited GCCS, and between 25 April and 13 July he studied all their operations except those relating to German naval traffic.[22] This visit provided the data on which work in the Signal Security Agency on German military systems was later to be based. Mr. Friedman was not only permitted to view these operations without restriction but he was allowed to prepare a voluminous series of reports on the organization and technique of the British units engaged on this work, something that had never hitherto been permitted even a member of the British staffs![23] About the same time Captain Roy D. Johnson returned from a tour of several months temporary duty at GCCS with a great body of technical knowledge and experience to be applied to the German military problem.

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22. It should be pointed out that GCCS is an intra-service organization and carries on work in diplomatic, military, and naval systems, whereas in the United States responsibility for attack on different categories of traffic is divided between the Army, the Navy, and the FBI.

23. See "Preliminary Report of Trip to England", 8 July 1943; a fuller account is to be found in "Report on E Operations of the GC & CS at Bletchley Park," 12 August 1943, 113 pages; "Report on 'ISSOS' and 'ISK' Sections," 25 November 1943; "Report on 'E' Operations of the GC & CS," 7 January 1944 (by Lieutenant Clarence S. Barasch); "Report on IBM Operations," 4 October 1943; and "Report on Visit to the Intercept Station at Cheadle and War Office Y Group," 28 August 1943.

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Cooperation with the two GCCS centers (Bletchley Park and Berkeley Street) was also carried on by representatives of the Military Intelligence Service. Colonel Alfred McCormack and Lieutenant Colonel Telford Taylor were in England at the same time as Mr. Friedman, and it was agreed between the Assistant Chief of Staff, G-2 and GCCS to appoint an MIS liaison officer at GCCS. Colonel Taylor, who was designated as the first MIS liaison officer, was given space and set up his office in Berkeley Street. For some months Colonel Taylor divided his time between Bletchley Park and Berkeley Street, but later in the summer Mr. Roger S. Randolph of MIS was assigned to assist Colonel Taylor, who was then able to spend more time at Bletchley Park, devoting his attention to the military operations there, leaving the diplomatic to Mr. Randolph. To these men goes much of the credit for the cordial relations between the two centers and for the rapid interchange of information. When, in August 1943, a regular liaison officer was appointed from the Signal Security Agency, these men enabled him to keep informed regarding GCCS operations at both places; the SSA liaison officer made his headquarters at "the Park," and the MIS liaison officer at Berkeley Street assisted in keeping him abreast of the work at that center. Naturally, there was a reciprocal exchange of pertinent information.

In August 1943, when Colonel W. Preston Corderman visited GCCS, Captain John N. Seaman was designated as the first SSA liaison officer, to serve at GCCS as the counterpart of Major Stevens, the GCCS liaison

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officer at Arlington Hall.[24] While there, Captain Seaman wrote some 50 reports. He was accompanied by Mr. Robert O. Ferner, who studied machine ciphers and worked on other problems at Bletchley Park and in November returned to Arlington Hall. In the autumn of the same year, Mr. Randolph wrote his Personnel Study of Berkeley Street Prepared for Arlington Hall.

In December Captain E. B. C. Thornett, head of Japanese diplomatic work at GCCS, and Captain P. W. Filby, head of the German code work, spent two weeks at Arlington Hall. Liaison between the British and American sections progressed thereafter without interruption, and regular interchange of information made possible the great advances in the cryptanalysis of Japanese and German diplomatic systems which proved to be important factors in the winning of the War.

In March 1944 Captain Walter J. Fried relieved Captain Seaman as SSA liaison officer at GCCS. Upon his return Captain Seaman set up an office to coordinate and expedite the flow of information from Arlington Hall to GCCS and to keep Captain Fried informed of the needs here. He initiated the monthly information letter to the SSA liaison officer abroad as a vehicle for keeping him informed of developments at home. Captain Fried, for his part, between 2 March and 29 November 1944, wrote 123 reports and sent almost 9,000 pages and 32 microfilms of

24. Major Stevens also served as GCCS liaison officer to OP-20-G, while Captain Seaman had no equivalent duty at the Naval Section of GCCS, since OP-20-G had its own liaison officer there.

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technical information to the Signal Security Agency--this in addition to the daily exchange of telegrams and the transmission of documents regularly established between sections which, because of their routine nature, did not require the personal attention of the liaison officer.

In the summer of the same year, from May to August, Lieutenant Colonel Frank B. Rowlett, Chief of the General Cryptanalytic Branch, worked in GCCS, and in the autumn Captain Herbert H. Maass and Sergeant Walter Jacobs went there for study. Mr. Samuel S. Snyder, head of the Japanese diplomatic and military attaché work at Arlington Hall, visited EU in the autumn of 1944 to perfect the exchange of information on Japanese diplomatic systems; in December Dr. Calvin S. Brown was there for the same purpose with respect to French systems.

On 19 October 1944 Mr. Albert W. Small arrived in GCCS and took over the duties of Captain Fried, who remained until the end of November. Mr. Small, in turn, stayed until May 1945 when Major Seaman was given a second tour of duty as liaison officer.

At the beginning of the new year the value of a great body of miscellaneous traffic sent on the Japanese domestic net was recognized, and some agreement was necessary for the allocation of responsibility for this traffic. Accordingly, in March 1945 representatives of the three cooperating centers (GCCS, EU, and the Signal Security Agency) met in Washington and arrived at an agreement which increased in scope their cooperative effort.

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C. Cooperation with OP-20-G

Mention should be made of still another aspect of cooperation, established long before the attack on Pearl Harbor--that between the Signal Security Agency and OP-20-G. Throughout this volume references to such cooperation show that, as the War progressed, the cooperation between the two services increased in scope. When, in 1942, OP-20-G abandoned the study of diplomatic systems,[25] the cooperation between the two services involved largely joint work on the weather systems and technical consultation on machine ciphers. OP-20-G was especially generous in making cryptanalytic-machine time available to the Signal Security Agency.

25. See volume One, chapter IV, section D.

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CHAPTER II. JAPANESE DIPLOMATIC SYSTEMS[1]

A. Early Work

Japanese diplomatic systems were among the first to receive the attention of the original nucleus of cryptanalysts in the Signal Intelligence Service,[2] who had the advantage of possessing a considerable body of Japanese material from the files of MI-8. Between 1919 and 1929 MI-8 had recognized a total of 31 different Japanese systems, of which 18 were diplomatic, 5 military attaché, and five naval attaché systems.[3] The personnel of MI-8 had also prepared a number of reports, the most important being a description of the method of attack used in the case of the so-called "U-Type" codes (JU and its relatives), which were in use between April 1924 and March 1925. Most, but not all of these systems, were made readable in MI-8. For the most part they were the type of codes known as a syllabary; that is, plain-text digraphs

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1. Sources for this chapter include documents on file in the Japanese Diplomatic Section, General Cryptanalytic Branch: progress reports, historical accounts, descriptions of systems, diaries, publications of the Recorder's Group; RIP-37, publication of OP-20-G; historical files of MI-8; a "Special Historical Report on the Solution of the 'B' Machine," prepared by William F. Friedman on 14 October 1940; interviews with Captain Robert F. Packard, Messrs William F. Friedman, Samuel S. Snyder, Gustavus F. Swift, Dale Underwood, and Miss Elizabeth Stephens; and a lecture by Lieutenant Colonel Frank B. Rowlett.

2. See Historical Background of the Signal Security Agency, volume Three, chapters II-IV, and Japanese Codes and Ciphers 1919-1929, both publications of the Historical Unit, Army Security Agency.

3. The remaining three (JD, JF and JH) are not represented by any material in the files. It should be pointed out that MI-8 referred to the attaché systems as "Army Codes" and "Navy Codes," but the evidence is clear that these systems were in use for the communications of military and naval attachés only.

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were represented by two-letter code groups, which in some cases stood for a frequently-used word. An innovation first observed in the code JG, introduced in June 1921, consisted of adding to the two-letter syllabary a small number of four-letter code groups all beginning with the same initial letter, in this case "B". The only other point of interest was that codes JL and JW were in English and not Japanese.[4]

Not until 1933 were the cryptanalysts of the Signal Intelligence Service able to turn their attention to Japanese problems. In that year Dr. Solomon Kullback and Mr. John B. Hurt were assigned some Japanese messages which they found to be encoded in a system of the same two-letter and four-letter type known to MI-8.[5] Although these messages and others contained no information of real value as intelligence, they did provide a basis for a study of the type of vocabulary, the grammatical forms, frequencies, and cryptographic habits to be expected in other Japanese traffic. Typical of the solution activities of this period is that of J-6, a system using three-letter and four-letter code groups.[6]

Between 1933 and 1935 five Japanese diplomatic systems were used in rotation at intervals of three months. These systems, solved and

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4. The attaché systems were distinctly more mature than the diplomatic, showing clear evidence of independent compilation.

5. Mr. Hurt stated on 22 October 1945 that solution and translations were accomplished in a few hours.

6. The description of the attack and the reconstruction are reported in IR 5010-5012 (5 March 1934).

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read, were all of the familiar two-letter and four-letter type of code with syllabary and vocabulary. By 1938 nine Japanese diplomatic systems had been read by the Signal Intelligence Service. The appearance of new systems and the increasing complexity observed in them during the 1930's may have been the result of the publication in 1931 of The American Black Chamber by Herbert O. Yardley, who had been the Chief of MI-8. If this book had not been published, Japanese diplomatic cryptography probably would not have experienced the variation and improvement that marked its course after 1931. Though for a time the older, very insecure type of syllabary continued in use, the Japanese at least as early as 1932, whether to reduce expenses or to increase the security of their communications, were employing a machine cipher designated by them as the "A" Machine and by the Signal Intelligence Service as the "Red" Machine.[7]

Japanese systems known to the Signal Intelligence Service during the 10 years prior to World War II include the following:

Digraphic substitution:

code		
AW	effective	July 1932 to December 1934
CA	"	November 1936
YO	"	September 1938

7. This is described in section B of this chapter. According to an unsigned typed report based on deciphered messages (on file in the Recorder's Office, B-III), on 1 December 1938 a modification of the Red Machine was contemplated by the Japanese for the purpose of enciphering certain messages of a particularly secret nature.

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Polygraphic substitution:

code		
XA	effective	(1931-32?)
XB	"	
DA	"	October 1932 to 15 October 1935
EG	"	January 1933 to 15 October 1935
WI	"	April 1933 to 15 October 1935
IK	"	December 1933 to October 1934
J-6	"	15 October 1935 to 28 February 1938
J-7	"	1 January 1936 to 26 February 1936 Revived March 1940
J-8	"	27 February 1936 to 30 June 1938
J-9	"	1 July 1936 to 31 October 1938
J-10	"	1 November 1938 to 9 April 1939
K-1	"	1 November 1938
J-11	"	10 April 1939 to 1 January 1940
KO	"	April 1939
J-12	"	2 January 1940 to 31 May 1940
J-13	"	1 June 1940 to 15 July 1940
J-14	"	15 July 1940
J-15	"	15 July 1940
P-1	"	15 July 1940
J-16	"	15 August 1940 to 30 November 1940
K-1	"	19 January 1939 to 1 July 1940
K-2	"	19 January 1939
K-3	"	1 July 1940
K-4	"	15 July 1940 to 15 November 1940
K-5	"	15 August 1940 to 30 November 1940
K-6	"	1 December 1940 to 28 February 1940
K-7	"	
K-8	"	1 March 1941
K-9	"	11 March to 25 April 1941
K-10	"	23 June 1941 to 15 August 1943

Spelling Tables:

JE English Spelling
English Spelling and Vocabulary
French Spelling and Vocabulary
"HE" Code
"EX" Code
"OG" Code
"UJ" Code
"CH" Code
"B" Table
PA English Spelling
CA English Spelling

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Transposition, used in conjunction with the earlier systems, became more and more frequent and more and more complicated in the later systems. Characteristic of all Japanese diplomatic systems, and especially of the transposition systems, was the tendency of introducing an innovation in a simple form and following it with a series of complicating changes.[8] Solution of such systems would have been very difficult had analysis been limited to the final stages of these systems. Solution of cryptographic problems is frequently facilitated however by the reading of cryptographic-instruction messages, that is, messages, prepared in a current system or key, giving the users instructions relative to impending changes in the system or indicating new keys and the like. Hence, although cryptographic continuity is always profitable, it was exceptionally so in the analysis and exploitation of Japanese diplomatic systems. Japanese diplomatic traffic supplied the first translation for the Bulletin, submitted 28 January 1935, and the first transmittal of a message from the Signal Corps to G-2 in April 1936. As solutions were made and translations became possible, they were not always forwarded to G-2. At the time of the establishment of the Signal Intelligence Service in 1930, G-2 had expressed the opinion that the fundamental task of the Signal Intelligence Service should be training for a future emergency, not the production of intelligence from current material. As a result, transla-

8. As is now known, such a procedure is not confined to the Japanese.

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tions were forwarded at first more in the interest of showing what Signal Intelligence Service could do than for the purpose of providing intelligence.[9]

B. The Red Machine

Though the personnel of the Signal Intelligence Service had studied cipher machines at an early date, the first machine of this type which they encountered in actual intercepts was that known to the Japanese as the "A" Machine, a designation which was not then known to SIS personnel, who called it the Japanese "Red" Machine.[10] Originally the Red Machine contained, as it was later learned, two cryptographic mechanisms hereinafter called for convenience "cipher wheels" although they were not wheels at all in the ordinary sense. One "wheel" enciphered the 6 vowels and the other the 20 consonants. Thus, the resulting cipher text was composed of vowels enciphered only by vowels and consonants enciphered only by consonants--an attempt to reduce telegraphic expense by producing artificial words in the cipher text. Later the "six" wheel was used for any six letters.

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9. The personnel engaged in this early solution work, under the direction of Mr. William F. Friedman, were Messrs Frank B. Rowlett, Solomon Kullback, Abraham Sinkov, and, later Messrs Robert O. Ferner, Samuel S. Snyder, Lawrence Clark, and Herrick F. Bearce. Mr. John B. Hurt served as translator. By 1938 Mr. Rowlett had the general supervision of Japanese solution; he and Mr. Ferner were concentrating in particular on the Japanese Red Machine.

10. The use of colors as cover names was adopted about this time, though not universally.

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A third mechanism, called for convenience a "control wheel", controlled the motion of the cipher wheels. In addition to the daily cipher sequence, 240 indicators for the three wheel settings had to be solved. The system, put into use before 1932, was undertaken for study in about 1935 and was solved by 1936. When work on the solution of the "Red" diplomatic machine had already been begun in the Signal Intelligence Service, Mr. Friedman, through a chance conversation with Commander J. N. Wenger of the Navy Code and Signal Section, learned certain details concerning the information which the Navy then had regarding a Japanese Navy cipher machine which the Navy was investigating. Acting on the assumption that the diplomatic machine might prove to be of similar type, the cryptanalysts of the Signal Intelligence Service attempted to determine the number of wheels in use in the machine, and this line of attack proved successful. As revealed in the report cited in footnote 7, page 26, a modification of the machine was on 1 December 1938 contemplated by the Japanese for the purpose of increasing its security. The last message received in this system was dated 21 August 1941, the system being superseded by the more secure "Purple" Machine, which had already been in use for several months and was employed concurrently with the "Red" Machine during those months by a few correspondents.

C. The Purple Machine

The most outstanding achievement in the cryptanalysis of Japanese diplomatic systems, indeed of any diplomatic systems, was the

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solution of the machine known to the Japanese as the "B" Machine and to the Signal Intelligence Service as the "Purple" Machine. It was the solution of this extremely secure system which was referred to in testimony given to the Joint Congressional Investigation into the Pearl Harbor Disaster as "the breaking of the Japanese Code."

Fortunately, the earlier and less elaborate "Red" Machine had already been successfully analyzed by the Signal Intelligence Service, and the traffic in that system was readable, but it was in a special secret Japanese cipher that messages appeared in the latter part of 1938 giving the authorization for travel for a "Communications Expert" named Okamoto, in order that he might put into service certain cryptographic paraphernalia termed by the Japanese diplomatic offices as the Type "B" Cipher Machine. This machine was to replace the then currently used Type "A" Machine for highly secret communications among the important Japanese embassies[11] throughout the world and the Foreign Office in Tokyo. On 19 February 1939 a message, bearing the date of origin as 18 February 1939 and sent in superenciphered code (K-1 transposed and enciphered by special "A" Machine procedure), was intercepted and found to give the effective date of the initiation of the "B" Machine as 20 February 1939. The "A" Machine was still to be used by all holders for certain classes of communications.

Among the first messages received after the effective date of

11. At Washington, Berlin, London, Paris, Moscow, Rome, Geneva, Brussels, Ankara, Shanghai, and Peking.

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the "B" Machine were three messages, originating in Warsaw, which had a new type of indicator instead of the normal "A" type indicator. Since examination showed that these messages had not been produced by the "A" Machine, it was assumed that they had been prepared by the "B" Machine; but since 6 of the 26 letters were more or less of abnormally high frequency (as was also the case with the "A" Machine messages) it was also assumed that the "B" Machine used some of the basic principles of the "A" Machine. Further intercepts tended to corroborate this theory. The "A" Machine was continued in regular use at Hsinking and Shanghai and very occasionally (apparently when the "B" Machine was out of commission) the "A" Machine continued to be employed at the places which had been provided with "B" Machines.

After a brief study it was confirmed that the division of the letters into two categories (one group of 6 letters and another group of 20 letters), which was the basis of the cryptographic treatment in the "A" Machine, was retained in the "B" Machine but with a very important change: whereas in the "A" Machine the six letters comprising the "6's", as well as the twenty comprising the "20's", were enciphered by means of what had been deduced as being a rotating commutator, the stepping of which was controlled by a break wheel of 47 positions with certain skips in the cycle (the commutator could advance 1, 2, or 3 steps at a time), in the "B" Machine the "6's" were enciphered by means of a series of 25 heterogeneous and differently mixed alphabets, which were merely a carefully selected set of 25 of the possible

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720 permutations or transpositions of six elements taken six at a time.

A deciphering chart or "development" was constructed to correspond with these 25 permutations. This chart was revised and corrected from day to day until it became certain that all its elements were absolutely correct. This having been accomplished (by 10 April 1939), it became possible, as a result of cryptanalytic techniques elaborated for the purpose, to decipher the "6's" in practically every message of any considerable length in the "B" Machine. It was found that, so far as the "6's" between two messages with unlike indicators were concerned, the only difference between one indicator and another was the starting point in the cycle of 25 alphabets. There were 120 different indicators but only 25 different starting points, so that four (in certain cases, five) different indicators represented the same starting point.

When the "6's" in a given message were deciphered, the plaintext values of cipher letters scattered here and there throughout the text became available, so that the skeletons of words and phrases offered themselves for completion by the ingenuity and the imagination of the cryptanalyst. For example, suppose that on a given day the six letters forming the "6's" were E, Q, A, D, R, and H, and the following text was at hand:

Cipher: B R A X E F Q C E V Q O O X H E C F D L N H Q R V Q P P L C E R P . . .
Plain: _ H E _ A _ A _ E _ E _ _ _ E R _ _ E _ _ R E Q _ E _ _ _ _ H A _ . . .

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It is not difficult to imagine that the missing letters are those shown below:

Cipher: B R A X E F Q C E V Q O O X H E C F D L N H Q R V Q P P L C E R P . . .
Plain: T H E J A P A N E S E G O V E R N M E N T R E Q U E S T S T H A T . . .

In this process of filling in the plain-text values of the "20's" the cryptanalyst could be guided only by two things: (1) the positions and identities of the deciphered "6's" and (2) the context. For it speedily became apparent that any cryptographic relationship between the plain-text and the constantly-shifting cipher-text values in the case of the letters constituting the group of "20's" had been most carefully eliminated, disguised, or suppressed. This fact corroborated the conclusion drawn from all statistical and analytical tests made on the cipher texts of the various messages studied.

The process of filling in the plain-text values of the "20's" was therefore, as a rule, a very difficult matter, depending usually upon the particular assortment of letters constituting the "6's". If the text was in Japanese, there was, in addition to the difficulty inherent in the language itself, the added perturbation occasioned by the fact that the Japanese Foreign Office had, on 1 May 1939, instituted a species of "Phillips Code" in connection with their use of the "B" Machine, with a long series of arbitrary letters and abbreviations standing for numbers, punctuation signs, and frequently used combinations of letters, syllables, words, and sometimes complete phrases. For instance, the combination C F C represented period;

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C C F represented paragraph; the single letter L (not normally used in Japanese) represented the diphthong ai; P represented ni; V represented long U; Q T Q represented Arita (shi) itashi tashi; B K W represented Beikoku (= United States); T K W represented Teikokuseifu (= Japanese Government); S N W represented Sukunakarazu, etc. The difficulties introduced by this code writing alone were quite staggering as well as exasperating, for often the "text", even when finally reconstructed, appeared more like code or a random assortment of letters than plain text. The following sequence, usually found at the beginning of messages, is a combination of Japanese plain text and the code groups already alluded to:

XFCGJ WFOVD DNOBB FYXFO CFYLC CFMSG TSJVR KHIFI CGURV FELBK WTLSI . . .

When separated into the proper lengths and decoded and translated, it stood for "Number 15 (part 1 of 2 parts) Secret, to be kept within the Department paragraph On March 16th the American Ambassador Grew," etc.

For the reconstruction of such text, the services of the Japanese experts were absolutely essential, and the work went very slowly, not only because of its difficulty, but also because the services of these translators were available for this problem only a small part of the time, when the traffic for the daily Bulletin permitted, and this was very seldom. It was found occasionally, however, after the "6's" in a given message had been deciphered, that these letters and their distribution throughout the message gave good indications of

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the presence, in whole or in part, of normal English text. In such cases, the "guessing" process was likely to be considerably easier because of the absence of abbreviations (except for punctuation signs, in which case these were a help), both because of the cryptanalyst's greater familiarity with the language, and because a larger number of workers was available. It happened that in several cases, after a few words had thus been obtained by pure "guessing," a clue was afforded as to the general nature of the message, and this led to a frantic search for a complete document which might be available either in our own files or in the files of other Government agencies. One case was found in which the "B" Machine message contained a paraphrased version of a message which had been transmitted in K-1 code. Advantage was, of course, immediately taken of this circumstance, but the entire text of the "B" Machine message could never be reconstructed from the paraphrased K-1 version, possibly because of the excellence of the paraphrasing, possibly because of the presence of abbreviations, or both.

At this point mention should be made of a favorable circumstance without which the Signal Intelligence Service probably could never have solved the "Purple" Machine. At this very period the United States Government was conducting negotiations with the Japanese Government looking towards an extension of the commercial treaty which had been in effect for a number of years but which was about to expire. As a result, a number of messages in English text had

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been transmitted between Washington and Tokyo, and a small percentage of the intercepted traffic therefore happened to be in English. This fact greatly lessened the task of "guessing" words, phrases, and sentences in these specific messages, once the distribution and identities of the "6's" had indicated that the text of a message was in English. Now certain of these English-text messages could be fairly readily reconstructed, some of them to the extent of 90 to 95 per cent, because they consisted of quotations from documents and the documents in question were fortunately located and obtained, most often through the cooperation and good offices of G-2.[12] Had it been necessary to reconstruct the plain text of messages from Japanese text alone, the project would doubtless have failed, as did the British attempt being made at the same time, as was afterwards learned. The British, moreover, were handicapped by the fact that they were not in a position to obtain the texts of documents quoted in their original English form in messages enciphered on the machine, as in the case of the Signal Intelligence Service, which had access, through G-2, to the State Department records. However, even the Signal Intelligence Service found on some occasions that to obtain a document

12. The Signal Intelligence Service was forbidden to make any contact of this kind with any other Governmental agency, but every request had to go through G-2, with attendant delays.

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from the State Department required a comparatively long time.[13]

In all, the plain text for parts of some 15 fairly lengthy messages were obtained by the methods indicated, and these were subjected to most intensive and exhaustive cryptanalytic studies. To the consternation of the cryptanalysts, it was found that not only was there a complete and absolute absence of any causal repetitions within any single message, no matter how long, or between two messages with different indicators on the same day, but also that when repetitions of three, or occasionally four, cipher letters were found, these never represented the same plain text. In fact, a statistical calculation gave the astonishing result that the number of repetitions actually present in these cryptograms was less than the number to be expected had the letters comprising them been drawn at random out of a hat! Apparently, the machine had been brilliantly constructed to suppress all plain-text repetition. Nevertheless, the cryptanalysts had a feeling that this very circumstance would, in the final analysis, prove to be the undoing of the system and mechanism, and so it turned out.

In all the foregoing studies, several factors stood out. First,

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13. In that early period the techniques of obtaining information of this kind had not yet been developed. In one important case, after G-2 had reiterated that a certain document did not exist in the State Department files, Mr. Friedman, by direct contact with the chief of the files of that department, obtained the document in question.

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the basic law underlying the "B" Machine was of such character that the ciphering mechanisms seemed to start from certain initial settings and to progress absolutely methodically without cyclic repetition of any sort straight through to the end of the messages, the longest of which for which plain text had been recovered comprising over 1,500 letters. Secondly, two identical plain-text letters in sequence could never be represented by two identical cipher-text letters; nor could two identical plain-text letters 26 letters apart be identically enciphered. This phenomenon which was termed "suppression of duplicate encipherments at the 1st and 26th intervals" formed the subject of long and arduous study, fruitless experimentation, and much discussion. Thirdly, two messages with identical indicators on the same day appeared to be identically enciphered, and on direct superimposition (and written in a cycle of 26) showed themselves to be monoalphabetic within columns, but with the monoalphabets constantly, irregularly and unpredictably shifting from column to column. Fourthly, two messages with identical indicators on different days (with different plugboard arrangements into the machine) were absolutely different. Fifthly, two messages with different indicators on the same day (same plugboard arrangement) were absolutely different and showed no cryptographic similarities whatsoever, Sixthly, in each line of 26 letters two identical letters could be identically enciphered except at the first interval, that is, identical encipherments

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could, and often did, occur within a line of 26 letters at all intervals, except at the first interval, although this phenomenon was rare at the second, third, fourth, and fifth intervals.

At the same time as the foregoing phenomena were being studied, intensive research was continued in an endeavor to establish primary or basic cipher sequences of the nature of those usually found in cryptographs with rotating commutators, rotors, and the like, such as the Hebern[14] and Enigma[15] cryptographs and our own M-134,[16] etc. For it was inconceivable that the machine employed a nonrepeating key of length corresponding to the total lengths of the messages. Moreover, theoretical considerations eliminated the possibility that an infinite nonrepeating key was being used. Somewhere, somehow, the existence of cyclically-repeating keys or sequences must be uncovered before solution could be effected. But all efforts to disclose the presence of cyclically-repeating sequences were fruitless. In one, and only one, case was there found even the slightest hint

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14. On machines invented by Hebern, see Historical Background of the Signal Security Agency, volume Three, chapter VI.

15. On the Enigma as used by the Germans, see below chapters XVI and XVII. On a modification of the Enigma used by the United States Army (the Converter M-325, SIGFOY), see History of the Signal Security Agency, volume Eight, chapter II.

16. On the M-134, see Historical Background of the Signal Security Agency, volume Three, chapter VI; History of the Signal Security Agency, volume Eight, chapter II.

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of such sequences as were being sought. In a certain English-text message the letter E was found to be represented by Q, 26 letters away another E was found to be represented by Y, and again 26 letters away another E was found to be represented by V, making the sequence QYV; in the very same message the same trigraph QYV was found to represent three E's similarly spaced. Attempts to add to this QYV sequence were absolutely unavailing. In this long, exhaustive and tedious search for repeated sequences or partially repeated sequences much labor and energy was expended but it was realized that the difficulty was probably due to the paucity of the text, despite the number and length of the individual messages available for study and for which the plain text had been reconstructed. It became apparent that what would be necessary was to obtain, by some manner or other, several messages in the same indicator and on the same day, or else to convert several messages with the same indicator but on different days to the same base, before even the existence of such cyclic sequences could be detected.

In all the thousand or more messages on hand there were but a mere baker's half dozen or so cases in which there were two messages on the same day and in the same indicator. More than two had never been found and this was to be expected in a system with 120 different indicators available for each day. In one case of this rare phenomenon the plain text for one of the two messages was available, but very

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little could be done even then as regards the solution of the other. For such a method of attack at least 20 to 25 messages, all in the same indicator and on the same day, would be necessary, and this was, of course, recognized as a perfectly hopeless expectation. There remained the possibility of converting several messages with the same indicator but on different days to the same base, and while this method of attack looked extremely difficult, it did not appear hopeless.

A method for this conversion to the same base was developed and termed the "identification of homologs." That is, an attempt was to be made to establish that a given letter on a certain day and another letter on a different day were treated in an absolutely identical or, more accurately speaking, homologous manner by the machine when set to the same indicator. This conversion process is too involved to explain here; it is sufficient to point out that, difficult though it is, it was successful in two cases. One of these yielded a set of six messages, all in indicator 59173, which could all be reduced to the same base. These formed the crucial set of messages from the study of which success in solution of the machine was finally achieved. (Tab 17)

Distribution tables of the letters constituting the text of these six messages were made. It should be stated that in four of these six crucial messages only fragments of plain text had been reconstructed, here and there; the complete or nearly complete plain texts of

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only two of these six messages had been reconstructed. However, enough data were accumulated from these two completely reconstructed, and the other partially reconstructed, messages to yield distribution tables, which, on careful examination disclosed here and there the presence of repeated sequences. This, coming on 20 September 1940 at about 1400 hours, was the very first indication that a successful attack might be possible. There was excitement at this first glimmer of light upon a subject that had for so many months been shrouded in complete darkness and regarded at times with some discouragement. The nature of the distribution tables referred to is also too involved to explain here, but it should suffice to indicate that they exhibited certain relationships between the successive cipher equivalents of a given plain-text letter and the successive appearances of that plain-text letter in the cryptographic text.

As soon as the existence of cyclic or symmetric sequences became clear, attempts were made to uncover complete basic sequences of the type theoretically predicted. But many conflicts and inconsistencies soon developed, owing to the fact that the cryptographic laws underlying the shifting from sequence to sequence were still unknown. Concurrently with the work connected with straightening out and removing inconsistencies in these reconstructed basic sequences ran the work of uncovering the cryptographic laws referred to, and very soon the general nature of the latter became quite clear. All efforts were

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concentrated upon the development of the specific laws and specific basic sequences applicable to the indicator under study, viz. 59173, with a view to uncovering all the cryptographic phenomena in this case and then searching for analogous phenomena in the case of other indicators. Certain qualified personnel from other sections were brought in to assist, and a considerable amount of night work was found desirable in order to push this study to completion at the earliest possible moment.

By 27 September 1940, just one week later, the work had progressed to a point where it became possible to hand in two translations representing the very first "solution" to the "B" Machine. Two messages of recent dates, both in the 59173 indicator, were available and were solved by applying the principles of solution by homologs, guided by the aid of the reconstructed basic sequences. It was all the more gratifying that this could be done on the very day that announcement was made of the signing of the Tripartite Agreement among Germany, Italy, and Japan.

Much work remained to be done, however, since only the data applicable to but one out of the whole set of 120 indicators were at hand. To solve the remaining 119 indicators appeared still to present a large problem. These solutions consisted of finding the initial settings of three 20-level rotary electrical cryptographic elements of 25 points each and finding the order in which these three elements

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were brought into play within each indicator system. With but little slackening of the pace set by the personnel themselves, work progressed with vigor, and by 14 October 1940, when the first written report on the "Purple" Machine was prepared--a report, incidentally, which has been closely followed in the foregoing paragraphs—solutions were available for over one-third of the 120 indicators.

As to the mechanics of the "B" Machine, naturally the basic principles of its construction and operation were deduced from the cryptographic phenomena observable in the messages, and immediately plans were initiated for the construction of an equivalent machine for our own purposes. Orders for the material for two fully automatic machines were placed and expedited. While awaiting the arrival of this material, personnel of the Section designed and constructed a hand-operated machine, which was put into operation in the daily decipherment of current Japanese traffic. The cost of the parts in one "Purple" analogue amounted to $290.97, that for one keyboard typewriter unit $393.68. At the same time, a "Red" cryptograph was reconstructed on the basis of the new knowledge presented by the solution of the "Purple," at a cost of $174.17 for the necessary parts.

It cannot be too strongly emphasized that the construction of these analogues, as they are termed in the literature of cryptology, was based entirely on observation of the effect of the unknown and unseen Japanese cryptographic machines upon the plain text of the

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messages sent in diplomatic correspondence. How closely the American analogues resemble their Japanese counterparts is unknown, since no American cryptanalyst has even at this late date (June 1946) ever seen one of the Japanese "B" Machines. It is clear, however, that the analogues could and did perfectly reproduce the action of the "B" Machines. It would serve no useful purpose to give in detail at this point an elaborate description of the machine as reconstructed,[17] but it should be pointed out that a significant advance had been made by the use of switches of the type employed in automatic telephony. Tab 26.

The solution of the "Purple" Machine was the culmination of 18 months of intensive study, but there still remained the additional problem of the day-to-day solution of the keys themselves, the establishment, that is, of the daily plugboard arrangement or the order and identity of the wires leading from the keyboard into the cryptograph and thence out of the cryptograph into the printing unit. Eventually it was possible to predict what sequences were to be repeated when new ones were no longer being issued to the holders of this system. Machine-enciphered traffic continued to produce valuable intelligence and, with the changes in keys (as with the fall of Germany) and special methods of use and superencipherment (JAA-1,

17. For details concerning these early analogues see the report of 14 October 1940, by William F. Friedman, filed in the Office of the Director of Communications Research.

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JAB, JAD, etc.), new cryptanalytic problems had to be solved. But, in general, the processing of this traffic was speeded up to the point where only a few minutes sufficed to decipher a message for translation. Top priority was early placed on the handling of the traffic in this system used for the most secret and important diplomatic matters, and this continued until the capitulation of Japan in August 1945 caused the traffic to cease.

The story of the solution of the Japanese "B" Machine has been given in much greater detail than it will be possible to reach in the description of other solutions which will appear in subsequent chapters, partly because of the tremendous importance both to the production of valuable intelligence and to the development of the science of cryptanalysis, but also because from this one example the reader may derive a fair notion of the sort of development involved in all.

That solution was at all possible was due in very large measure to two facts. The first of these, the fortunate circumstance which made it possible for the cryptanalysts to have a considerable body of English text at their disposal, has already been treated sufficiently. The other factor which contributed to the success was the harmonious, well-coordinated, and cooperative teamwork of a group of cryptanalysts working for more than a year and a half on the

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problem.[18]

Before leaving the topic, some attention should be given to the fact that it was solution of the "Purple" Machine which made possible (as was brought out in 1945 and 1946 by the Joint Congressional Investigation of the Pearl Harbor Disaster) the reading of a considerable body of Japanese diplomatic traffic which was of great value in revealing the intentions of the Japanese in the months preceding the attack of 7 December 1941. This traffic did not, of course, reveal the exact time and place of the attack, but it did make clear that war was imminent. In this connection the testimony of Major General Sherman Miles, who in December 1941 was Assistant Chief of Staff, G-2, as reported in the Washington Evening Star of 3 December 1945 (p. A-4), is of the greatest interest:

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18. The report of 14 October 1940, written very soon after success was achieved, mentions the following names of persons who participated in the problem: general supervision: William F. Friedman; specific supervision and coordination: Frank B. Rowlett and Robert O. Ferner; recovery of the "6's": chiefly Genevieve M. Grotjahn, Albert W. Small, and Samuel S. Snyder, assisted at times by Cyrus C. Sturgis, Jr., Kenneth D. Miller, and Glenn S. Laudig; engineering problems: Leo Rosen; assistance on the engineering problems: E. J. Hawkins, Sergeants Oscar Wilder, Jr., and Lawrence B. Roy; tabulations: Ulrich J. Kropfl, Mary Joe Dunning and Hazel Dronenburg; Japanese language: John B. Hurt and Paul S. Cate; clerical work: Frances M. Jerome and Mary Louise Prather; part-time assistance from other sections: Abraham Sinkov, Lawrence Clark, Delia Ann Taylor, Wilma Z. Berryman, and Edward E. Christopher, Jr. Mention is also made of the fact that through Commander L. S. Safford, Office of Naval Communications, the facilities of the Radio Laboratory, Navy Yard, were put at the disposal of the SIS in the construction of the analogues.

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Mr. Gesell [counsel for the committee] informed the committee that he will be prepared later to offer a detailed record of the handling of important Japanese messages intercepted during the week before December 7, 1941, but not decoded and translated until a week or more after the attack.

Mr. Gesell said he is gathering data to show the monitor stations that picked up each message, when it was transmitted to Washington, whether by airmail or radio, and when it was received for decoding.

In discussing the delay in decoding these messages today, General Miles told the committee:

"The astonishing thing, gentlemen, is not that these messages were delayed, but that they were able to do it at all. It was a marvelous piece of work."

Among the possible causes for the delay in decoding were these:

a. The necessity for intercepting a considerable volume of traffic all sent in a single key before solution of that key is possible.

b. The creation of a backlog of traffic by a sharp rise in volume of intercepted traffic.

c. The extreme scarcity of competent Japanese translators.[19]

d. The fact that it is impossible to tell from raw traffic which message will be important and which may safely be laid aside until there is time for all. Only when a message has been converted to Japanese plain text can any one, and then only one who knows Japanese, tell which is important and which is not.

In making public earlier reports of investigations of the background of the Pearl Harbor disaster, the Government for security reasons withheld certain passages. As had now been made clear by

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19. On this point, see volume Four, chapter III, section A, page 23.

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the Congressional Investigation, those passages contained references to the success of the Signal Intelligence Service in solving the "Purple" Machine. (The machine was not so called but this is what was meant.) The reasons for concealing this fact were based on two considerations. In the first place, it was imperative that every effort be made to prevent the Japanese from learning that their most secret diplomatic system had been solved, for if they should learn the fact, they would most certainly either abandon the system entirely, in which case the work of the best cryptanalysts for several years would be nullified, or they would change as many elements in the enciphering process as possible under the prevailing conditions of distribution. In either case, the loss to current military intelligence would have been tremendous, as General Marshall eloquently pointed out in his letters to Governor Dewey of 25 and 27 September 1944. With the cessation of hostilities, of course, this consideration lost much of its force, but there was another consideration, in the long run much more vital to the defense of the United States: any success in solving a cryptographic system, if disclosed to the general public, has the immediate effect of stimulating other governments whose messages may now or at a later date be under study to endeavor to improve their systems in such a way as to render them impregnable. This is, of course, the aim of all cryptographic compilation bureaus at all times: knowledge that a given type of cryptography

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has been solved by any government will at once greatly accelerate the process of research and development.

The publication in 1931 of Herbert O. Yardley's indiscreet book, [20] The American Black Chamber, had, indeed, precisely this effect: many governments, including some which were not even mentioned in the book (e.g. the Brazilian Government), at once began to prepare new types of cryptographic systems which would at least not be open to the specific kinds of attack which Yardley had shown to be successful. The cryptographic techniques which had been regarded as adequate in World War I were infantile when compared with those encountered in World War II, of which the "Purple" Machine is a conspicuous example. Had Yardley's book never been published, such a development in the cryptographic art might never have taken place.

Now that the solution of the "Purple" Machine has been disclosed to the world, all governments have been given notice that even a system of such high security as this is not invulnerable to attack. That several governments were aware of the existence of the system is a good presumption: at least two (the British and the German) are known to have attempted solution and failed, and their cryptanalysts (among the best in the world) may well have regarded a machine cipher of this type as indecipherable. Not only these two governments but all others

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20. For a full discussion of this point, see Historical Background of the Signal Security Agency, volume Three, chapter IV.

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now know the contrary, and the race for a really indecipherable system will henceforth become much keener. It is not beyond the range of possibility that other governments will achieve success and that in a future war the enemy may have provided himself with an absolutely secure system.[21] The consequences of such a state of affairs to the gathering of military intelligence are, in the light of the recent development of the atomic bomb and its effect upon military techniques, incalculable. Yet even if the enemy does not devise an absolutely indecipherable system but only one of relatively high security, another war may then find the American signal intelligence services of that period without the forunate circumstances which, added to the skill of the cryptanalysts, made possible the solution of the "Purple" Machine.

D. Transposition

Transposition, long a favorite type of encipherment with the Japanese, became increasingly elaborate as new systems were introduced. Since new transpositions were usually introduced for basic codes already in use in older systems, the new systems were all the more readily solved. This was especially true of J-19 (JAE), a system put into use 1 July 1941. Although a difficult transposition problem with such complicating factors as a changing pattern of blanks within a matrix was

21. That this is perhaps not a purely academic possibility, but may be achieved before we realize it, is clear from developments in the cryptographic art. On this point, see volumes Eight and Nine.

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encountered in J-19, fortunately the known CA code was used for the base in a few early messages. The four daily keys, one for each of the four communication channels (Europe, the Americas, the Orient, and general) varied in length from 19 to 25 numbers. In addition to the daily changing keys, the pattern of blanks changed every ten days. Although the basic principles of this system remained practically unchanged during the two years during which it was used, certain changes were introduced in the second year of its existence. The same indicators were repeated, but changes were made in the sequences and patterns of blanks for the corresponding date of the previous year. Not only were the new keys recovered, but rules governing the changes were set up by which new keys could be predicted. A special auxiliary system (Q2 and Q3) involving a superencipherment was also encountered and solved.

In order to speed the solution of J-19, a special technique was evolved,[22] an adaptation of an IBM tabulator which would compare a sequence of cipher text with other sequences and show at what position digraphs most likely to occur could be produced. This machine, known as the electromechanagrammer, effectively reduced the time required for anagramming and increased the accuracy of the

22. By Messrs Rowlett, Ferner, Small, and Snyder.

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tedious operation.[23]

E. Organization of the Japanese Diplomatic Section

In September 1943 all Japanese diplomatic problems, formerly scattered according to their diverse cryptography, were brought together directly under one administrative head (Mr. Samuel S. Snyder) and designated B-III-c-4 (later B-III-f). The various phases of the work were divided among the following units: (1) Traffic and Indexing, (2) Purple Machine Cipher, (3) Decryptographing and Transposed Code Solution, and (4) Additive Problems.

The organization of the Section by the spring of 1944 is represented schematically in Tab . On 13 January 1945, when subsection B-III-f-1 handling Japanese diplomatic problems became section B-III-f, First Lieutenant (now Captain) Robert F. Packard was appointed Officer in Charge of the B-III-f Section.

F. The Work of the Section

The status of work on Japanese diplomatic systems in September 1943, when the group headed by Mr. Snyder was formed to handle all such problems, was as follows. The "Purple" Machine cipher system (JAA) had

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23. Lieutenant John Skinner contributed much to developing the machine, and those who contributed to the recovery of keys included Messrs William Bryan, Joseph Petersen, Maurice Waltz, Sergeants George Hurley, Gwyn Evans, and Irving Massarsky, Misses Elizabeth Stephens, and Isabel Murdock, and Lieutenant Vilar Kelly. The J-19 section was headed for several months by Colonel J. J. Verkuyl of the Netherlands Army, who later became the head of the Netherlands cipher bureau in Brisbane.

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been solved three years previously, and all current traffic was in the stage of exploitation, and only occasionally (where new keys were used) of development. A cryptographic-instruction message had announced the termination of JAE (J-19) in July 1943. Several new Japanese diplomatic systems had been introduced: JBC, JBD, JBA, and JBB. JBB (transposition) was quickly solved in the J-19 unit with assistance from the Research Section of the General Cryptanalytic Section (B-3). As for JBA, a much more complicated transposition system, entry into the system was accomplished by the Research Section. This solution represents the accomplishment of an unusually difficult cryptanalytic task, the solution of an unknown code using two-letter and three-letter groups with an unknown transposition. On 15 December 1943 a change was discovered in the system whereby the pattern of blanks within the matrixes changed. Two recently introduced additive problems (JAM and JBC) were under study by a small unit, and the initial entry into the JAM system had been made. See Tabs 18 and 19 for JBA and JBC.

The newly organized Japanese Diplomatic Unit had made no provision for solving new systems. Available personnel was already devoting full time to the development of known systems and to exploitation. It was not possible to solve new systems in the scanty spare time that could be found for such matters. Accordingly, plans were made to install a special research group for these problems. The B-III Research Unit as it was then called, was asked to lend special assistance during

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February and March 1944. The limitations that characterize the JBC system had been discovered, and through them entry into the system was made. Work on JBC went forward rapidly, once advantage could be taken of the limitation and of the additive pattern reflected in the cipher text. Solution of JBD was begun in March 1944. Development of JAM was suspended in December 1943 for lack of traffic in order to devote full time to the more profitable system, JBC; later, in September 1944, work on JAM was resumed. A study of the new systems introduced for the Greater East Asia Ministry (such as JBD and JBB) showed that they were of the same general type as the diplomatic systems.

A reorganization of the Japanese Diplomatic Section was required when, in March 1944, the Research Unit had progressed far enough with JBC so that the system was ready for exploitation. A Recovery Unit to handle JBC and JBA was set up. The decoding activities were thereupon transferred to the Indexing Unit. The Research Unit turned its attention in July 1944 to other unsolved problems (JAO, JBE, and others).

Although JBC and JBD had reached the stage of exploitation (the key books were completely recovered and all traffic was readable), the indicator systems remained unsolved. Messages could be placed in the key book by analysis and comparison of the pattern of the cipher text with that of the recovered key. In beginning work on the unsolved indicator systems, JBD was undertaken first, and it soon yielded to attack in June 1944. Following a similar procedure, the JBC indicator system was solved.

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G. Commercial Systems

Among the new systems facing the Research Unit was JBH, regarded as one of several new Japanese diplomatic systems. Unlike the additive systems (JBC, JBD, JAM) it used kana symbols. Since the Research Unit was concentrating all its effort on the additive problems, JBH was assigned in the spring of 1944 to a small group of cryptanalysts from the Machine Cipher Section. Both transposition and autokey substitution were involved. With the close cooperation of GCCS the traffic became readable and the system was then discovered to be commercial rather than diplomatic. It was concerned with the dealings of the great commercial companies in Japan, their subsidiaries, colonial development companies, and the various trade-control bodies in the government designed to exploit the conquered territories. The valuable economic information was welcomed by the Military Intelligence Service, and this provided an impetus for further work on commercial traffic.

Interest in traffic passed over the Japanese Domestic Network began in December 1943 with the visit of a British officer, Captain E. B. C. Thornett. The British considered that such traffic would be the main source of information after the War and of increasing importance during the War. It was not until the autumn of 1944, however,

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24. An autokey system is defined in the ASA Glossary of Terms as an aperiodic substitution system in which the key following the application of a previously arranged unit of key is generated from elements of the plain or cipher text of the message.

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that interest became active. The reorganization to strengthen the Solution Unit made possible the handling of this additional traffic, which was of two main types, one sent in kana and the other in digits. Large commercial companies, banks, shipping firms, and consular offices all sent messages in many different systems over the Japanese Domestic Network, established for such purposes in the Japanese-controlled Greater East Asia area. This traffic was considered to be the best source of information on economic data, and the Military Intelligence Service valued it as much as the diplomatic information.

H. Liaison

Exchange of information and the sharing with cooperating cryptanalytic centers of responsibility for Japanese diplomatic problems had been the rule for several years. As early as 1938 collaboration with the Navy had become very close and a complete exchange of information was carried on. Between 2 February 1941 and June 1942 an unusual arrangement to share responsibility for Japanese diplomatic traffic was in force: the intercepted traffic was divided according to odd and even days of the month. Although this division was fair enough as regards credit, it was absurd from the technical point of view where continuity was essential. On his visit to GCCS during February and March 1941 Dr. Sinkov informed the British of the solution of the "Purple" Machine cipher system; since all their efforts to enter the system had failed, the British were delighted to receive the technical details of this solution. Of especial importance in liaison was the visit paid

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the Signal Security Agency in December 1943 by Captain E. B. C. Thornett, head of the Japanese diplomatic work at GCCS. During his two weeks' stay a conference on Japanese diplomatic solution work was held (20 December 1943) to analyze and perfect liaison between the British and American sections. Those participating in the conference were Major G. G. Stevens as British Liaison Officer, Captain Thornett as head of the British Section, Major Aurell as Chief of B-I, Major Rowlett as Chief of B-III, and Mr. Snyder as head of the Japanese Subsection of the Signal Security Agency. It was agreed that each section would inform the other of any cryptanalytic discoveries and would provide evidence in support of them; that messages of cryptanalytic value would be exchanged as well as texts of messages of intelligence value. It was also agreed that the American short titles would be used in referring to systems; a list of short titles with full description would be supplied Captain Thornett. Other data to be supplied included copies of work sheets, tables, IBM listings, JAA ("Purple" Machine cipher) development sheets, and a description of the IBM technique used on JAM traffic. GCCS would in turn supply messages and a report on JBG. There would also be a complete interchange of JBA traffic by cable to eliminate the serious traffic shortage. On 15 May 1945 many of the commercial systems (the readable systems JHE, JJI, JLV, JLA, JKC. JLR, JLS, and JLT) were turned over to the British as their responsibility. All the back traffic in these systems was sent to GCCS. The Signal Security Agency continued to be responsible for JHC, JLM, JLL, JJA-2,

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JLW, JLD, JHC, and JLX.

Mr. Snyder went to Ottawa on 30 August 1944 to spend a week at the Canadian Examination Unit. After his return a new agreement was drawn up: results of research would be exchanged except for systems on which EU was known not to be working; IBM listings of research significance would also be exchanged as well as messages containing interesting cryptographic properties or cryptographic intelligence. EU would be notified of new systems and their short titles. A copy of the IBM decoding of JBC messages from Key Book I (prior to 1 February 1944) and selected translations on the Tokyo-Kabul, Tokyo-Kuibishev, and Tokyo-Vatican City circuits would be sent to EU. As cooperation went forward other material was also sent and the agreement was put to the test of application.

I. Training

Along with analysis and production, training was always a constant objective. From time to time special programs varying in intensity, length of time, and number of personnel involved were put into effect. Early in 1944 an extensive training program was instituted for all personnel in the Japanese Diplomatic Section. This was for several reasons:

1. To overcome isolation between groups formerly separated physically and administratively;

2. To make the Training Section more flexible by permitting easy reassignment of personnel within the Section;

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3. To improve morale by showing the contribution of each person to the whole problem;

4. To develop personnel for newer and better jobs.

A course was given in cryptographic instruction in Japanese diplomatic systems; the general types, peculiarities, and analytic methods used on the systems were presented. An introduction to the Japanese language was offered by B-I in a two-week course constantly repeated for new classes of students. A few persons from the Section were assigned every other week to this special course. On the basis of performance in this introductory course, some students were selected to take the intensive six-month course in Japanese language given in the B-I school. Further cryptanalytic training was given to these graduates of the B-I school. From time to time also a short intensive course on Japanese diplomatic language was given for the benefit of the cryptanalysts.

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CHAPTER III. THE JAPANESE MILITARY ATTACHE SYSTEMS[1]

A. Early Work

The earliest Japanese military attaché systems known to the SSA were five codes studied by MI-8 in New York. The staff there referred to them regularly as "Army Codes" but the evidence is clear that they were the prototypes of the later JMA systems (Japanese Military Attaché). They were known as JK, JM, JN, JQ, and JR. JK was in use between May 1920 and February 1921, and was a syllabary using two-letter groups for plain digraphs and a few frequently-used words. It was not dissimilar from diplomatic systems of the same period. JM was a syllabary of the same type but was used (between October 1920 and January 1921) in eleven different encipherments, each with a distinguishing indicator. JN, in use between January 1921 and October 1922, was similar to JN, except that instead of using a single encipherment throughout a message, the code clerk might choose any of several, changing from one key to another merely by inserting a "switch group." JQ, in use between April 1921 and January 1922, and JR, used between November 1921 and January 1922, were both of the same type as JN.

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1. The statements in this chapter are based largely on interviews with Mr. Samuel S. Snyder, Dr. Waldo H. Dubberstein, Captain Maurice H. Klein, and Mr. Edward E. Christopher, Jr., all of whom have long been associated with the problem, and upon the following documents: a. A. Sinkov and S. Kullback, diary kept during their study of JRL-3 (8 April--6 September 1938); b. S. S. Snyder, Cryptographic Description of the "88 .." System dated 21 July 1942; c. S. S. Snyder, Notes on RIK-5--JRN-4, dated 28 October 1944; d. Unsigned and undated description of JAQ; e. S. S. Snyder, diary of his work from 6 May 1940 to June 1942, the period of early study of JAS; f. Mary Hill and Kathryn Dubois (Buffham), Description of JAS (registered document 426-D). A report especially prepared for this History by Dr. Charles Prouty provided the main source of information for the later period.

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No other information is available concerning JMA systems until we come to the year 1938 when on 8 April Drs. Abraham Sinkov and Solomon Kullback first examined the current traffic in the system known as "RIK-International" or JRL-3 (Japanese Rikugun Letters No. 3). This system was in use from 1 January 1937 to 4 May 1939. Intensive study of the messages resulted in the discovery of the general outlines of the cryptography of the system and the reconstruction of 32 of the cipher squares used in it.

Following JRL-3, and for a short time concurrently with it, the Japanese used between 1 January 1939 and 31 January 1940 a system known in the SIS as "88.." (the four-digit discriminant regularily began with 88). It was partially solved during the summer of 1941 by Messrs. H. L. Clark and S. S. Snyder, who had, at the beginning of their work, the benefit of the solution by the British, brought back by Captain Sinkov on his return from his visit to GCCS in 1941, of the master additive chart used for the encipherment of the indicator, as well as the values of some of the four-digit groups.

Some progress was also made in still another system, JRN-4, (i.e., Japanese Rikugun Numbers, No. 4) in use during 1939. The analysts found that the basic code was the same as that of "88.." and that the additive keys were pages or blocks of 80 four-digit groups. The fourth of these earlier military attaché systems, Rikugunken, introduced in January 1937, was used during its six years of existence for material of low intelligence value. A

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relatively insecure unenciphered trigraphic code, in 1937 it was reconstructed sufficiently so that the traffic could be read. The Japanese materially altered the system in October 1939 by changing the permutation table from which the code groups were generated, by enlarging the vocabulary, and by assigning code groups to plain equivalents after a new fashion. In a comparatively short time the revised code was recovered to the point where practically all messages could be read.

B. The Principal System (JAS)

By far the most important of the JMA systems, however, was that designated after September 1943 by the arbitrarily assigned short title JAS, formerly known successively as: RIK-2 (after Rikugun), "Scarlet" (a cover name), JRL-4, JMA (Japanese military attaché), and JAP (a short title). Introduced by the Japanese on 1 February 1940, JAS was the principal means of communication employed during the War for intercommunication among Japanese military attachés and between them and Tokyo. The cryptographic structure of JAS, while somewhat akin to its immediate predecessors, is much more complicated. JAS is an enciphered code. The code is based on: (1) a digraphic chart of 676 groups used to represent kana syllables, Japanese characters, punctuation, paragraph headings, and numerals; and (2) a tetragraphic chart of 676 groups, of which half represent further kana symbols and characters, the other half place names and the letters of the Cyrillic alphabet.[2]

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2. These are necessary in order to spell Russian place names.

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Encipherment is by digraphic substitution using a cipher square of 26 alphabets. The earliest square contained symmetrical standard alphabets but later mixed alphabets were used symmetrically, and finally, after 26 October 1943, 26 different mixed alphabets were used. The key is taken from a key book containing a random sequence of 135,200 letters arranged in five-letter groups, ten rows and eight columns on each of the 338 pages. The pages were designated by two letters (AA to MZ) and the second half of the alphabet provides variants (AA = NA). The ten rows and eight columns are designated by letters in a random sequence different for each page.

The code clerk, having encoded his message by the use of the two charts, writes out a key sequence over the code text and then converts by means of the cipher square to enciphered code text. He has chosen the key sequence at random, and so he must show by an indicator the point in the key book at which he began. The Japanese also indicated (though this was not technically essential but was added as a check on accuracy) where the encipherment stopped, by another indicator. The indicators are then enciphered by the use of a 26 x 26 chart, each of the cells containing four letters chosen at random. Finally, the message serial number is also enciphered by use of a 10 x 8 chart containing 80 five-digit groups of key to be used for this purpose. (The indicator was formerly enciphered by a prearranged group on a page of key book; the page was indicated by the control located in the first textual

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group).

All five elements change at irregular intervals; furthermore, the serial number chart and the indicator key chart are integral parts of the key book and change as it changes. On 1 January 1945, for example, the third code chart, the ninth (or "I") key book, and the thirty-sixth cipher square were in current use. Aside from these periodic changes of the three elements of JAS cryptography, the principal cryptographic improvement in the system noticed since 1940 lay in the change in the type of cipher square used. The first contained standard sequences slid against each other; although the second to twelfth squares used a mixed sequence, the square still exhibited direct symmetry; finally beginning with square 13, introduced on the 26 October 1943, twenty-six unrelated random-mixed sequences were adopted. The Japanese, well aware of security requirements, in introducing these numerous changes in the elements of the system created a variety of cryptanalytic problems, no two of which were cryptanalytically alike. The extent of these changes is well shown by the following list of cryptanalytic achievements: 41 conversion squares recovered (12 had a single mixed sequence, and the remaining 29 were made up of 26 differently mixed sequences in each square); eleven[3] serial number key tables reconstructed, together with more than 16,000 letters of indicator key, and 862,000 letters of key

3. The serial number chart for JAS-1 has been recovered.

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in eight[4] key books recovered. At the end of the War the third code chart, the tenth key book with its subtractor and indicator key chart, and the forty-first conversion square were in use.

The successive changes (with American designations) are listed below:

code chart	key book	square no.	type of square	date introduced
1	A	1	Vigenère, standard sequence	1 Feb. 1940
2	B		standard	25 Jul. 1940
	C			4 Apr. 1941
		2	single-mixed	20 Aug. 1941
	D			25 Nov. 1941
		3	single-mixed	20 May 1942
	E			30 Jul. 1942
	F			1 Feb. 1943
		4	single-mixed	11 Feb. 1943
		5	single-mixed	22 Mar. 1943
		6	single-mixed	22 Apr. 1943
		7	single-mixed	25 May 1943
	G	8	single-mixed	10 Jul. 1943
		9	single-mixed	25 Aug. 1943
	H	10	single-mixed	18 Sep. 1943
		11	single-mixed	27 Sep. 1943
		12	single-mixed	5 Oct. 1943
		13	random-mixed	26 Oct. 1943
		14	random-mixed	10 Nov. 1943
		15	random-mixed	22 Nov. 1943
		16	random-mixed	1 Dec. 1943
		17	random-mixed	11 Dec. 1943
		18	random-mixed	21 Dec. 1943
3		19	random-mixed	1 Jan. 1944
		20	random-mixed	11 Jan. 1944

4. No key has been recovered in the first or "A" key book, or in the second or "B" key book. These were already obsolete when solution began, and the traffic is not thought likely to be of sufficient interest to justify the labor of solution at this late date.

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code chart	key book	square no.	type of square	date introduced
		21	random-mixed	21 Jan. 1944
		22	random-mixed	1 Feb. 1944
		23	random-mixed	15 Feb. 1944
		24	random-mixed	14 Mar. 1944
		25	random-mixed	4 Apr. 1944
		26	random-mixed	25 Apr. 1944
	I	27	random-mixed	11 May 1944
		28	random-mixed	1 Jun. 1944
		29	random-mixed	15 Jun. 1944
		30	random-mixed	5 Jul. 1944
		31	random-mixed	1 Aug. 1944
		32	random-mixed	17 Aug. 1944
		33	random-mixed	6 Sep. 1944
		34	random-mixed	14 Oct. 1944
		35	random-mixed	15 Nov. 1944
36		36	random-mixed	17 Dec. 1944
		37	random-mixed	28 Jan. 1945
		38	random-mixed	5 Mar. 1945
		39	random-mixed	10 Jun. 1945
	J[5]	40	random-mixed	6 Mar. 1945
		41	random-mixed	10 Jun. 1945

This list reveals that, except for the date of the original introduction (1 February 1940), the Japanese have never introduced a new code table, a new cipher square, and a new key book simultaneously. At every change in the system, at least one of the three elements remained unchanged, and for the most part two remained unchanged. Not until 10 July 1943, when key book G and square 8 were introduced simultaneously, were the analysts forced to reconstruct both a new square and a new key book at the same time. Even then, the square introduced was of the same general type as its predecessor.

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5. Used concurrently with I-period key book from 5 March 1945.

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C. The Cryptanalytic Attack

By 1 February 1943 the cryptography of the system was clearly understood, and methods of cryptanalytic attack on the problem had been developed. Some preliminary study had been conducted by the Signal Security Agency in 1940. In November 1941 the British Government Code and Cypher School (GCCS) informed the Signal Security Agency by cable that it was concentrating on JAS and presented its achievements. These consisted in the identification of the serial numbers, the control, the structure of the serial number key chart, and the discovery that the groups now known to be the enciphered indicators were nontextual. A month later GCCS had discovered the nature of the indicator, its control, and the use of the variant in one of the letters indicating the page of the key book. This use of a variant was for some time a troublesome problem, since GCCS thought that a table 13 x 26 (instead of a standard square 26 x 26) was used to encipher the first page letter. This problem was finally solved by the Signal Security Agency in June 1942 after recovery of the first mixed square (the second cipher square used).

In the meantime further progress had been made. The dates of various changes in the system were ascertained, and traffic could thus be studied in the proper groupings. In April 1942 Colonel Tiltman of GCCS, who had made the initial entry, visited the Section, bringing with him the results of his study and the pertinent data on a long series of London-Tokyo messages. These messages were carefully studied with the result that the page numbers of the key book which they used were recovered. The true

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structure of the key-book page was at last understood to be ten rows and eight columns of five-letter groups.

GCCS had begun the study of the more recent material and in June 1942 reported the first successful entry into the text of JAS messages. British intercept stations had gathered, in very complete form, a special series of messages broadcast from an illicit station later identified as Budapest. Because these messages were found to be enciphered consistently with key beginning in the top left corner of every other successive page, and because plain-text cribs were available, it was possible to superimpose messages and to derive code values, first for numbers and then for punctuation and simple kana. This series was the basis of code reconstruction, which proceeded rapidly when other messages broadcast in normal channels (traffic between Tokyo and military attaches in various capitals) were included in the overlaps. In October 1942 structure of the tetragraphic code chart was established, and a rapid recovery of code groups was effected by reason of this knowledge.

With this successful entry into the plain text messages, the various problems of recovering key from overlaps were first encountered. It was decided to concentrate all efforts on the most recent traffic available, that of the "C" and "D" (arbitrary designations assigned by the SSA) key books: "C" was in use from 4 April 1941 to 24 November 1941 and "D" from 25 November 1941 to 29 July 1942. Preliminary study was made of the newly instituted "E" period, but it was realized that traffic would have to accumulate before a successful attack could be made.

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During the ensuing months traffic in both "C" and "D" periods was read, and "E" period messages were gradually placed in depth and indicator keys recovered.

D. Production Methods

The experience gained in the early recovery work proved of inestimable value. Various cryptanalytic techniques involving indicator, key, and conversion square were explored. The recovery of key from overlaps was studied from many points of view; frequency tables, grilles used in conjunction with charts of logarithmic value, frequency of code digraphs, and isologs were all examined and exploited as a means of rapid key recovery. Growing experience and a study of solved messages for stereotypes led to an increased production of key and deciphered messages. The Section began to divide into groups of specialists who became exceedingly proficient in their respective tasks. The Traffic group processed all incoming messages and listed the important cryptographic data of each message on a five-fold card, three copies of which were used for research purposes. The Research Group recovered serial numbers, key charts, indicator keys, and conversion squares to give the Overlap Unit the correct placement of messages in depth and the squares necessary for the recovery of key. The Processing Unit prepared the deciphered and decoded messages for the translators. See Tab 20.

From that time on the Section made a notable record of production and subsequent solution. For example, the possibility of a simultaneous

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change of key book and conversion square had long been regarded as posing an exceedingly difficult problemn. Such a change was first made on 10 July 1943. The fact that the order for the change sent by Tokyo was read in a cryptographic-instruction message saved considerable time. On 25 August recovery of the cipher component of the new square was completed by the section and sent to GCCS. From then on solution proceeded rapidly. Of somewhat less importance, perhaps, was the discovery by the SSA that the cipher square introduced on 25 October 1943 consisted of 26 differently mixed sequences. Hence the immediate development of new techniques of indicator key recovery was necessary since the "H" period had begun only on 18 September, and the key recovery was not complete. Moreover, the technique that had been developed for use with a square having a single mixed sequence was no longer possible. Since the new type of square required more traffic and more study for its recovery, the time lag at first was from three to four weeks. Gradually techniques were improved to the point where squares were recovered within three or four days of their introduction. In this work, the analysts were materially aided by the fact that key had been recovered so extensively that messages enciphered by means of the new square could be placed by matching key to pairs of cipher and plain text that conform to limitations of the square; i.e., because of the structure of the square certain constatations signified that identical letters of key had been used and a search in the key book could be made to locate repeated letters at the same intervals as those between the

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significant constatations. In the subsequent reconstruction, personnel experienced in overlap work and translators did excellent work in recovering plain text. The great success of this unit in rapid square recovery led GCCS to request its liaison officer to report in detail on the techniques employed.

Courses in key recovery from overlaps developed the talents of new members of the Section, and courses in research techniques made experienced specialists available. Of great assistance in speeding up production were the electromechanical deciphering machines. By depressing successively the keys on a typewriter keyboard to correspond to successive elements of the text, electrical impulses were set up which were then combined by means of a plugboard with electrical impulses corresponding to the successive elements of the key. A printer then printed the resultant text. These machines made it possible to place messages before indicator keys were solved and in general performed tasks that had hitherto been regarded as impossible because of the man hours required for the manual performance of such tasks.

Another great timesaver was the use of an IBM procedure evolved after the introduction of the square employing 26 different mixed sequences. Listings of all possible decipherments of a column of an overlap doubled the speed of key recovery. During the winter of 1943-44 the code texts of a large number of deciphered messages were prepared, and an index of solved messages was printed by IBM. This index, showing code text which

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had in previous messages followed each digraph, was most valuable in key recovery. At about the same time work was begun on a noun and topical index of JAS traffic. This, too, has been fruitful especially in cases where only a few messages used the same key or where the content and structure could be inferred. In addition it was found by B-III in January 1943 that Tokyo sent out each Saturday beginning 17 January 1943, a multipart stereotypic report on the progress of the war in all theaters. This report, as was discovered in B-II on 31 May 1944, was duplicated in Japanese Army systems, and the isologs thus available were exploited by both Sections. Repeated messages and messages containing reference to other messages were also a fruitful source of partial cribs which increased production.

The most serious problems facing the research group following the "G" period and the subsequent introduction of the square using 26 different mixed sequences were the "I" and "J" periods, when the Japanese changed key book and conversion square simultaneously. In preparation for such a problemn the research group had already made intensive studies, using "H" period traffic for experiments in the use of new techniques. The experience and techniques gained from this study indicated that solution was possible if enough traffic was available and if the Japanese code clerks continued to follow their customary practices in the use of code and key materials.

In both instances, the Japanese inadvertently afforded considerable help. Before 11 May 1944, the date of introduction of the "I" book,

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two valuable messages had been read. The first of these revealed that because of travel difficulties, Madrid could send to Tangier by cable (using the "H" book) two new conversion squares for use with the "I" book. Since these were to be sent by cable, it was questionable whether copies could be obtained. Work proceeded on the basis of the second message, which revealed that Bucharest would continue using the "H" book and the current conversion square. This meant that all circulars out of Tokyo would be sent in both "H" and "I" books and that plain text would be available for the "I" messages. From these isologs the limitations of the new square were determined; that is, the letters missing from the columns of a square, each row of which contained a different mixed sequence. Recovery was proceeding slowly but was speeded up when GCCS obtained copies of the Madrid-Tangier messages containing one of the cipher squares.

The introduction of the "J" period on 5 March 1945 brought additional difficulties: it was known that key book and conversion square would both be changed and that the Japanese were taking precautions to avoid sending isologs. A special system for circular messages was established since the Japanese had been unable to provide Madrid and Lisbon with new cryptographic materials because of the allied blockade. Fortunately however, the attaché in Cortina d'Ampezzo never received the special instructions for circular messages, and some eighty messages sent to him in the usual way provided the needed isologs for the messages in

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the special circular system. These isologs were quickly and effectively compared by rapid cryptanalytic machinery (RAM) in a search for instances where the plain fit the cipher text and for two such instances falling on the same page of the key book. Several overlaps, established in record time, made possible the reconstruction of the current cipher square and the recovery of indicator key. At the present time indicator key recovery is very nearly complete; 144 overlap pages have been set up, and 21,000 letters of key have been recovered. As traffic accumulates the recovery of the remaining key will proceed, and the information received and sent by the military attaches and the War Office in Tokyo will be available.

By 31 May 1945, 40,028 message parts sent to or by Japanese military attachés and the War Office in Tokio had been processed by the Section for translation; 17, 565 such messages represent a complete coverage of all JAS traffic from 18 September 1943 to 5 March 1945. During this period nearly half of the messages received were available for translation within a few hours of their receipt. And even now, after a series of changes in cryptography has posed difficult cryptanalytic problems, some messages are read upon receipt. The intelligence contained in this traffic has been of great interest to G-2, who consider JAS to be the most important and reliable source of information out of Europe during the War. Indeed, it has been remarked that the Japanese military attachés were the most valuable secret agents working in Europe for the United States. The language is extremely technical and the diversified subject matter includes detailed descrip-

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tion of German equipment, installations, and troop concentrations. One group of messages contained information of such vital importance about German installations on the French coast that they were flown immediately to the President and the Prime Minister in conference in Teheran.

E. Other JMA Systems

Another military attaché system that has yielded valuable information is JAT. It was instituted in February 1943 exclusively for the transmission of cryptanalytic material. Until November 1941 such traffic had been sent in JAS and from that time until February 1943 in an adaptation of JAS using an obsolete key book. JAT traffic, though infrequent, did yield results when studied; it was found to be enciphered by a 10 x 26 square and to use stereotyped message beginnings. The conversion square, which was in use during the entire life of the system, was recovered, and the traffic was read. A lapse in the use of this system from October 1943 to July 1944 prevented any further study; but with an increase of traffic after July, study was resumed, and the successful overlapping of messages resulted.

References in JAS traffic revealed the general nature of some of the JAT traffic. In addition the specific content was sometimes known; e.g. U. S. State Department cryptographic materials. With this information analysts were able to secure the correct materials and use them as cribs. The key thus recovered was used to read a long sequence of

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Helsinki traffic, which revealed cryptanalytic work on American systems. Outlines of Russian codes, descriptions of Russian, American, and Turkish systems as well as raw American and Turkish traffic constitute some of the substance of the traffic of this system, practically all of which has been read.

Two other systems, JAR and JAS-1, have been examined by the Section. The former, used exclusively by the attaché in Moscow and occasionally by other attachés, is known to be a one-time system, consequently little hope of solution can be offered. JAS-1 used key book "M" or 13 and a separate set of conversion squares, but it is cryptographically identical with JAS. Introduced in February 1944, it was discontinued in January 1945. The bulk of its traffic dates after August 1944 and is known to consist of technical data and reports sent from Germany to Japan. Research is continuing, even though solution seems unlikely. GCCS regards the problem as unsolvable with the available traffic considered inadequate for successful analysis.

F. Liaison

Close operational liaison has always been maintained with GCCS. Telegrams, letters, and packages are sent and received daily. Information received from the British regarding Japanese military attaché problems antedates Pearl Harbor; in November 1941 a telegram was received containing observations on the encipherment of the message number. Exchange of information became more and more frequent as progress was made in both agencies. In April 1942 Colonel Tiltman of GCCS visited

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the Section and brought material with him. By October 1942 it was agreed that the two sections divide the work of recovering the key book, each section being responsible for the recovery of one-half of the total number of pages. This arrangement proved satisfactory and had continued for the recovery of subsequent key books. The relative contributions of the two centers cannot really be evaluated, but GCCS contributed more in the way of original entry into the system, and the SSA more in the enormous number of keys and sequences which it recovered and in the constant research and techniques which it developed for recovery after a change in one of the elements.

G. Personnel and Training

A number of cryptanalysts have been associated with the Japanese military attaché problems. Preliminary analysis was carried on by Colonels Kullback and Sinkov. Mr. S. S. Snyder had the longest experience: he made the preliminary studies in 1940 and carried on his work from November 1941 to June 1943. Mr. Frank Lewis contributed various techniques of indicator recovery. Dr. Ronald Cassity was in charge of indicator research from October 1942 to 1943.

The present Research Unit has had the benefit of a nucleus of the same personnel since work began on the "G" period in July 1943. Mr. E. E. Christopher has been in charge during this entire period, and with him have been Mr. Emmett Bennett and Dr. Charles Prouty.

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Others who have been associated with the problem are Mr. Dale Underwood (summer of 1942 until May 1944) Dr. William M. Seaman, (September 1943 until February 1945), Mr. Gustavus Swift, and Miss Virginia Alexander.

Following Mr. Snyder's departure from the JMA Section, Captain Donald McCown became head of the Section, and when he left for overseas duty in March 1944, his assistant, Captain Maurice H. Klein, became head. Dr. Waldo H. Dubberstein has been in charge of all overlap work since the autumn of 1942.

Among the senior members of the overlap group are Miss Anne Barker, who has been with the Section since July 1942, Mr. Laurence Bordy, who has been in charge of the swing shift since April 1943, Miss Lorna Pottberg, with the Section since September 1942, Miss Dorothy Moore, Mrs. Peyton Jacobson, and Mrs. Edith Wright.

The personnel of the Section, now numbering more than eighty persons, is subdivided into a number of units, but this organization is not rigid and personnel may be shifted easily from one to another as occasion demands. The units are:

1. Research Unit (Mr. Edward E. Christopher, Jr.)
2. Key Recovery or Overlap Unit (Dr. Waldo H. Dubberstein)
3. Traffic Unit (Miss Nellie Butler)
4. Records Unit (Miss Anita Schwab)
5. Machine Unit (Mrs. Katherine Zimmerman)
6. Aids to Translators Unit (Miss Josephine Worth)
7. Administrative Services Unit (Miss Lena Robertson)

The functions of most of these Units are explained by their titles;

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the Records Unit performs the task of decoding and deciphering by hand methods, while the Machine Unit performs the same operation by machine methods. The Aids-to-Translators Unit renders valuable service to the translators who are, however, not an administrative part of the JMA Section but belong to a Unit of the Language Branch (B-I), which occupies contiguous quarters and works in the closest of liaison with the JMA personnel. It is deemed worthy of nothing that the integration of cryptanalytic and translator personnel within the same section contributed much toward the high efficiency of the Section. Such integration was not applied in the case of other Sections of the SSA engaged in work on Japanese communications. This Unit (B-I-m), under Mr. Francis R. Millard, translates all the messages which the JMA Section has made readable and also gives much needed linguistic assistance to the research and key recovery units of the section. This form of cooperation between the branches has been carried on officially since 1 July 1943, but before that period certain Japanese experts from B-1, notably Dr. Percy Buchanan and Mr. Charles M. Legalley, had been more or less permanently on loan to the JMA section.

The achievements of the present JMA section may be attributed in large part to the fact that for more than two years a large section has been continuously at work on one principal problem. More than two hundred different persons have now been part of the JMA section, of whom more than eighty are still present. (These figures are exclusive of the 18 persons in B-I-m.) More than fifty of the eighty persons in the Section had been in it for more than a year on 1 January 1945.

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CHAPTER IV. GERMAN DIPLOMATIC SYSTEMS[1]

A. Early Work

Exploratory work was first done on German diplomatic systems in 1937 by Dr. Solomon Kullback while he was stationed as a cryptanalyst in the Hawaiian Department.[2] Upon his return to Washington in the spring of 1938 he began to develop a German section by interesting a number of other cryptanalysts in the problem.[3] The first task was the reconstruction of the unenciphered German code book DESAB No. 3 (the discriminant and abbreviation for Deutsches Satzbuch). This code book, insofar as the literal groups were concerned, was made largely readable before the book itself was compromised in July 1940, when the FBI obtained a copy in Panama while going through the effects of an unregistered German diplomatic agent. Other problems that engaged

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1. Source material for the statements in this chapter include reports on file in the German Diplomatic Section and the General Cryptanalytic Branch, and interviews with Dr. Carl P. Klitzke, Dr. Ray W. Pettengill, Colonel Solomon Kullback, and Mr. T. A. Waggoner.

2. On his work in this period, see Historical Background of the Signal Security Agency, Volume Three, Chapter VII.

3. Among those associated with German diplomatic solution in the early period were the late Dr. Charles J. Mendelsohn (who had been a member of MI-8 in World War I and was at this time a reserve officer); Messrs Frank Lewis; Robert O. Ferner; Samuel S. Snyder; Miss Delia Ann Taylor (Mrs. Sinkov); and Dr. Ray W. Pettengill. Later the section expanded rapidly as solution progressed. By the summer of 1943 it was organized as follows under Lieutenant (now Major) Leonard J. Seidenglanz with a total strength of nearly 100 people: Analysis (Messrs F. A. Brugger and C. E. Reed); Files, Production, and Translation (Lt. G. H. Mundinger); Special Problems, New Problems (Lt. A. T. Prengel); Related Problems and Reading.

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the attention of the analysts in the early days were an encipherment by the Kryha Cipher Machine of the Rudolf Mosse Commercial Code, some clandestine systems used in South America, and the Port au Prince digraphic substitution system. But the principal problems and greatest achievements lay in the solution of the so-called Keyword, or "Floradora",[4] system (GEC), and the one-time pad system known as GEE.

B. The Solution of GEC

GEC was the most important German problem in respect to volume of traffic and value of intelligence, at least until the solution of GEE, which did not occur until 1945. By September 1939 the GEC system was in full use between Berlin and the German diplomatic missions throughout the world and therefore carried information concerning Nazi political intentions and operations. Early examination revealed the use of additive-enciphered five-digit one-part code; later investigation led to the recovery of a key book of 10,000 lines of basic additive to provide double encipherment, books of daily indicator keys, and a conversion square. The Germans, relying for security on the double encipherment, made continual changes in the daily indicator keys, changed the basic text additive book once during the War, and introduced changes in the manner of indicator and text encipherment. The underlying code (DESAB Code Book No. 3) remained in effect for several years. On 1 January 1942 it was superseded, except in Dublin, by Code Book No. 4,

4. This name is a good example of the spontaneous coinage of vigorous and humorous terminology by GCCS.

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which had been compromised by the Navy about July 1941. Each of the two text additive key books contained 5,000 lines of six five-digit groups (apparently made up at random) and 5,000 lines complementary to the first 5,000. A message was normally subject to double encipherment; one line of additive was first applied to the plain-code text and then a second line of additive was applied to the sum thus produced. Since, when the system was being solved, there were 10,000 lines in all and each line of basic additive could be combined with itself and with all other lines, the effect was a potential resultant additive key of 100,000,000 ÷ 2 lines, each containing six five-digit groups.[5] This eight-digit indicator for the two lines of additive used was enciphered by an eight-digit indicator key which changed every two days. These keys probably were, as later discovered, made up by the same machine[6] (with alterations) which was used to make up the GEE additive. There were several different books of these keys for each station for different types of traffic.

Initially, the entire cryptographic system was deduced at the SSA strictly by analysis. The British, who were aware of the nature of the system through information furnished by agents, had given up the system as hopeless and had stopped intercepting the traffic. Solution at first

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5. This was true potentially, but of course the system was not initially set up in such a way that there could be no repetitions of additive lines. Actually, lines were reused and this fact permitted recovery of key by the overlap method. Later modifications prevented deliberate reuse of resultant key.

6. See section C below.

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involved discovering messages enciphered with the same combination of additive lines and recovering the combined additive and the two-day-period indicator keys. Early in the analysis, the two-day period for the encipherment of the indicator, its bipartite nature, and the fact that additive was arranged in six five-digit groups to a line were recognized.

The assumptions about the indicator were verified when, in 1940, copies of indicator keys to be used for 1941 were obtained from material also compromised by the FBI in Panama. The Germans added constants to these keys in order to disguise them for use after their compromise until new keys could be provided. [redacted]

[redacted]

EO 3.3(h)(2)
EO 3.3b(6)
PL 86-36/50 USC 3605

[redacted] Of great importance in the more rapid derivation of basic additive key from the combined additive key already recovered was the first 50 lines of the basic additive book, which had been turned over to the British by a French agent after the fall of France. With the occupation of Iceland, some complete and partial substitution tables were captured which led to the solution of that traffic which contained isologs of Keyword traffic. In April 1942 worksheets found by British agents in a waste basket in the German consulate in

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Monrovia provided the clue to a new procedure used in the double encipherment. Throughout the work such cribs as circular numbers, signatures, and isologs in other readable systems, especially the solved Port au Prince system, proved helpful. Early in 1941 the code clerks in Buenos Aires and Rio de Janeiro fell into the habit of preparing in advance combined additive lines using shifting starting points in order to save the time and trouble of adding different lines together; thus, a number of messages were readable before the system was completely solved.

The problem facing the German Diplomatic Section from the beginning was one of recovering the 5,000 lines of basic additives from which the 50,000,000 lines were to be made up. The compromise of the first 50 additive lines by the French agent in 1940 speeded the solution because, through the use of the 50 compromised basic lines of additives, any combined additives which contained one of the 50 lines could be split and the other line of the combination be determined. Progress was rapid, and the cooperation with GCCS was of great importance in speeding the work. The first translation was submitted in March 1941. By April 1942 recovery of basic additives was progressing rapidly, for, as more additives were accumulated, more messages could be superimposed and more basic additives and two-day period keys could be derived. Also, there was the consideration that the recovery of one basic additive yielded its complementary line as well, so that the solution of one additive key yielded two. By 15 February 1943 all of the 5,000 basic lines of additives of the first book (TANGENSTAFEL) had been

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derived. By late August 1943 all of the basic additives of the second book (GRADTAFEL), which had come into effect in most stations on 1 January 1942, had been derived. Recovery of the latter was speeded (1) by the fact that resultant additive was used as soon as recovered either by combining two lines from one book or a line from each book, and (2) by the fact that many isologs were sent. By May 1943, 50 per cent of the back traffic and 25 per cent of the current traffic was readable. Full-scale production methods had been in the process of being set up. Earlier the magnitude of the problem had made it imperative to devise for current traffic machine methods of indicator-key recovery. New procedures were added for handling a growing accumulation of traffic that became available for development and exploitation once the original entry was made. A process of IBM decoding of messages was worked out, but the greatest contribution of IBM to the problem lay in the field of two-day period key recovery, a method being devised which ran a possible crib through 50,000,000 possibilities in two hours. A system of priority rating speeded the handling of the most important messages. By the summer of 1943 some 500 messages a week were being decoded, of which 350 were translated and published in the Bulletin. In 1944 some 4,000 messages were read, approximately 95 per cent of the traffic intercepted. The intelligence in these messages included among other things the most secret diplomatic transactions, commercial dealings, and the reports of German spies throughout the world. Since this system continued in use to the last chaotic days of the War, even when the location of the German Foreign Ministry

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was unknown, the German Diplomatic Section was able to maintain its production of valuable intelligence to the very end.

C. The GEE System

The chief efforts of the German Diplomatic Section were directed in 1945 to the solution of the German Foreign Office cryptographic system, which was designated by the Signal Security Agency as GEE. This system had been in use since at least 1925 for the highest-security traffic, and a tremendous volume of intercepts had been accumulated in GEE. Early study had indicated that GEE was an example of a one-time pad system. As this term is defined within the Signal Security Agency, a true one-time system involves encipherment by a completely random key specially prepared for use with a single message and of such length that it does not repeat within a message. One-time systems are of two basic types: (1) those which use pads of key sheets which are torn off and destroyed when they have been used, and (2) those which use tape which can be fed into a cipher machine and then destroyed. It was known that in GEE the Germans were using the pad system because some of these pads had been captured in 1940 by the FBI from a German agent passing through the Panama Canal. Since the cryptanalysts of the Signal Security Agency believed then, as they still believe, that a system which uses a completely random key never repeated either within a message or in other messages, is indecipherable, there was little hope in their minds that GEE could be solved unless keys were reused. Therefore,

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except for comparison of key recovered from cribs with captured pads, work on the problem was abandoned in 1940, though traffic was still intercepted and stored. In September 1943 the research was taken up again by Mr. Thomas A. Waggoner, at that time head of the Cryptanalytic Unit of the German Section, and was continued with some difficulty until approximately March 1944, when a few workers were assigned to it for clerical assistance. From August 1944 until January 1945 the research was carried on by Mr. Waggoner and a staff of from 10 to 18 of the clerical personnel.

Research had begun to a certain extent in 1940 when the pads of additive were taken from the agent in Panama. At that time, a standard IBM Index, referred to as the "XYZ Index", was made up, and the distribution of five-digit groups was of random expectation.

Research was then dropped, but it began again in September 1943 on the supposition that GEE additives had been reused as, indeed, some cryptographic instruction messages read in GEC had directed. In a long and careful study of data collected in testing this hypothesis, it was natural that a close scrutiny should be directed to the series of captured pads of additive already mentioned. Finally, however, it was decided to study all the compromised additives and all additives which could be derived from GEC-GEE circular isologs in the same index. This complete additive index revealed relationships between the additive digits on various pages of a number of pads, so that it became clear that the additive groups comprising the key were not really random, as had

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been supposed.

This discovery was like a shot in the arm to the personnel of the German Diplomatic Section. In December 1944, shortly after the discovery was made, the entire Research Group together with a great number of new personnel was assigned to the GEE problem.

This arrangement was to continue for many months, and most of the normal increment of the Branch was earmarked for it. By June 1944, 110 people were working on the problem. GCCS was, of course, promptly informed of every step in progress from almost the very beginning of the early discoveries. The first real entry into the system is dated from January 1945, when a message was read in the SSA through the prediction of the additives employed in its encipherment.

In the course of one and one-half month's research following the initial discovery that the additive groups were only apparently random, the cryptanalysts discovered the principle by which the additives had been constructed. The discovery of relationships between corresponding digits on different sheets of the same and of different pads made it possible to reconstruct 240 basic sequences of digits used in the construction of a homogeneous block of sheets. When those were studied, it seemed probable that some kind of machine had been used in the construction of the additive. The recovery of the elements of the machines used in the construction of the compromised additive and of the additive derived from GEC-GEE isologs made much easier the recovery of the elements in other homogeneous blocks of material used.

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The cryptanalysts of the Signal Security Agency did not know exactly what the German machine was like, nor did they need or wish to know, but the principles of key reconstruction discovered were incorporated by them into a specially designed additive-generating machine which greatly facilitated the exploitation of unread messages, especially in the case of the traffic sent between Tokyo and Berlin.

A working plan for the exchange of cryptanalytic information with GCCS proved most satisfactory in keeping the two centers thoroughly up to date in matters of sequence solution and identification, indicator systems, and the like. Certain special cribs, together with cribs provided by messages in GEC, aided considerably in the placement and solution of messages. In order to produce current intelligence, translations were made directly from the overlapped messages. After the 240 sequences for a given setting of the additive-manufacturing machine had been derived, the Research Section was faced with the problem of determining the setting point for each of the 240 wheels. Moreover, when the wheels were reset by hand for a new batch of material, the settings for each of the wheels had again to be determined. In most cases earlier settings of the wheels in the machine were of no help in determining later resettings of the wheels. These resettings, many of which were recovered, were solved on overlaps in which the arithmetic of solution of normal additive was supplanted by the arithmetic of a machine-generated sequence. With the pressure for intelligence, means of rapid recovery and

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production, IBM processes for slide-testing cipher text against known settings of the additive machine were devised as well as high-speed decoding methods for large quantities of messages. Various IBM listings for the purpose of studying all pad sheets which had not been placed on the Berlin-Tokyo and Tokyo-Berlin circuits were tremendous time-savers and facilitated all phases of the work beyond all possible hand methods.

Vital intelligence of immediate value was supplied to persons or agencies requesting this priority material. In the case of several long, partially-placed messages containing important intelligence, the Director of MIS made a special request for urgent action in order to complete them. Many other messages containing intelligence of special interest to MIS were processed upon receipt of priority request lists. According to a member of MIS, the intelligence recovered was of utmost importance in the spheres of politics, scientific advance, technical data, and production (especially of aerial and other munitions). For example, these messages revealed that the Japanese were using a medium tank, certain types of aircraft, and a jet-propelled jeep hitherto unsuspected. As regards knowledge of enemy materiel, these were the most noteworthy bits of information received in the final months of the War.

It is only proper to say, in the case of both GEC and GEE, that even though solution <u>was</u> theoretically possible without the material compromised by the FBI and by the French agent, both solutions would

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have been highly unlikely without that material. As for GEC, overlaps on the 50,000,000 possible lines of combined additives were very scarce. In fact, it is doubtless the case that, given the total bulk of traffic in GEC, many of the 50,000,000 lines were never used more than once. In the case of GEE, however, the most important factor in making solution possible was that GEC had been solved previously, thus providing cross-system cribs from which very valuable additive could be removed. The books of additive compromised by the FBI, in addition to the thousands of additive groups available from the cross-system cribs, facilitated solution immeasurably.

It might be said, therefore, that the cryptanalytic achievements in the solutions of GEC and GEE stand about on a par with one another, considering all aspects of both solutions. The GEC solution was certainly more painfully laborious than that of GEE, and in some points it was more difficult; but the fact that the GEE system had long been put aside because it was known to be a one-time system caused the success in solving the system to seem far more spectacular than had seemed the success achieved with GEC. The GEE solution caused debate as to whether or not the system were really a one-time pad system, since the additives, when looked at in the one right way of the all but countless numbers of possible ways, was <u>not</u> random in the strictest sense of the term. Nevertheless, the solution emphasized the fact that the sole weakness of many a so-called "one-time" pad system might

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lie in the nature of the construction of the key, and also raised the question whether or not the keys used by the Signal Security Agency for American one-time systems were really random.[7]

The whole question had an interesting sequel when the Signal Security Agency began to obtain the studies of German signal-intelligence services based on captured documents and interrogation of prisoners (the TICOM Studies). Evidence has come to light that the Germans called the machine which they used for producing the GEE keys the "Nummerier-maschine" or "Nummerierwerk"; that they had three such machines, introduced in 1925, 1927, and 1933; that these were nothing but job presses with an arrangement for printing digits by means of 240 (in a later model 250) wheels on the periphery of which were embossed printing types. The machines were so arranged that these wheels could be prevented from stepping for 30 impressions; that is, if desired, 30 copies of each printed page could be made before stepping would take place. But in actual practice they printed only two copies of each page: one for enciphering, the other for deciphering. How the machine worked was, for the most part, not known. The foregoing statements are based largely on a folder containing papers (TICOM 1282) relating to the maintenance of the machines.

From a British source, however, it is known that in 1925 a Mr. Lorant of the British firm, Loranco Limited, offered the British

7. See volume Eight.

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Foreign Office information concerning a machine which they were supplying to the German Government. The cryptanalysts of GCCS did not show much interest in this machine, but it was clear from the description that the Germans would use the machine for precisely the same purpose as the "Nummeriermaschine" described above. The captured documents, however, contain no hint that the source of the machines was British: they rather point to certain German manufacturers known by name. It therefore becomes doubtful as to whether the machine of which the British knew as early as 1932--the year Mr. Lorant divulged the information to the British Foreign Office--was exactly the same one now under discussion; but it seems clear that it was the source of the idea for the "Nummerierwerk". It is interesting, however, to speculate on what savings of time and money might have been made had the British attempted to exploit in the solution of GEE traffic the information they had obtained in 1932.

D. Miscellaneous Systems

A special adaptation of the Keyword system was introduced late in 1941 for Dublin, where the Germans found it impossible to deliver new key books or code books safely. Three lines of additives were used in the encipherment of the message which gave cryptographic instructions for the system, involving elaborate disguises and a transposition of the digits of the additive. But, despite the additional complexity of the system, the Dublin two-day period indicator keys were recovered,

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and by May 1943, 90 per cent of the traffic was readable.

In 1944 instructions came for a new system of encipherment of certain portions of the total GEC traffic with three additive lines, which were to be obtained by a special usage of the two-day period indicator keys. The nature of the special usage of the indicator keys and certain pattern limitations in the construction of the indicator keys made possible, in many cases, the solution of the three additive lines used.

The reconstruction of DESAB (plain code called GED), an unenciphered one-part code in use since 1922 and the underlying code of GEC and GEE, was an easier task than the solution of GEC and GEE but quite laborious. About 90 per cent of the traffic was readable from a partial reconstruction, and the first translation was submitted in 1940. When a compromised copy of the code was obtained in July 1940, the work of the code reconstructors was verified, and the analysts could devote all their time to key recovery in GEC.

The Port au Prince digraphic substitution system, GEB, in use between 16 November 1939 and 15 July 1941 and solved early in 1942, employed 100 tables and 1000 keys. Isologs in GEC proved of great benefit to the solution of this system, which in turn, made available isologs to be used in the solution of GEC.

Another solution was that of the so-called "FELIX" system, an encipherment of the one-part Rudolf Mosse Commercial Code, used for espionage in South Africa. Still another system was the GEG system,

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employed in Las Palmas, which was put into use on 15 January 1943 and on which work began the following November, the first translation being submitted on 5 June 1944.

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CHAPTER V. THE ITALIAN SYSTEMS[1]

A. Early Work

Active work on the solution of Italian cryptographic systems began in the SIS toward the end of 1938, though traffic had been collected over a period of four years. In charge of this study was Dr. Abraham Sinkov[2], who was assisted at various times by a group of cryptanalysts, among whom were Messrs Samuel S. Snyder, Albert W. Small, Vernon E. Cooley (April 1939-May 1940), and Mrs. Wilma Z. Berryman (November 1939-February 1942).

Since the new Italian Section possessed no information concerning current Italian systems or any used in previous years,[3] attention was turned to a general examination of all available intercepts, to the segregation of homogeneous bodies of traffic, and to a study of the systems in which sufficient traffic seemed to justify a hope that solution was possible.

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1. The statements made in this chapter are based on the personal recollections of Mr. A. Ferdinand Engel, who during 1942 prepared an account of the progress made up to that time in solution of Italian systems. This account was, in 1944, brought up to date by Captain George E. McCracken.

2. Dr. Sinkov, who was one of the earliest cryptanalysts to be employed by the SIS, was from 1936 to 1938 at work at Headquarters, Panama Canal Department, in cryptanalytic activity. While there, he had first studied Italian diplomatic traffic, but not much progress was made before he was ordered back to Washington. During World War II he was on active duty and rose to rank of Colonel.

3. An attempt had been made during the First World War to solve one Italian system, but no success had been realized.

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A large two-part pentagraphic code (AR30 = ITD), tentatively designated as "X", and a smaller one-part code (RA = ITI), tentatively designated as "TRUJILLO" from the fact that it was the only system used for communication with Ciudad Trujillo, received the special attention of the small group of analysts during the year 1939. AR 30, only recently introduced by the Italians but very widely distributed, was at first believed to be unenciphered. It was discovered, however, that a simple transposition of the elements of each code group was used in the case of some stations, but, since most of the traffic came from stations which did not use this transposition, the effect was almost the same as if no transposition had been used. When, in 1944, a photograph of the code book became available, it was discovered that all[4] of the traffic was transposed, but by then the effect of the transposition had been completely minimized, since the reconstructions had all been made in the most widely used transposition.

Meanwhile, occasional circular messages sent elsewhere in AR 30 were sent also to Ciudad Trujillo in RA-1, a circumstance which afforded an entry into the latter system, even though little traffic was then available. By February 1940 solution of both AR 30 and RA-1 had progressed to a point where the problem had become increasingly linguistic. To meet this need, Mr. A. Ferdinand Engel joined the staff, and in April 1940 Mr.

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4. As a matter of fact, it was later discovered that a very small number of messages had been received in which the form of the code group was identical with that in the code book.

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Edward E. Christopher, Jr. joined the cryptanalysts at work on the Italian problems. Dr. Sinkov, Mrs. Berryman, and Messrs Engel and Christopher continued to devote most of their time to the reconstruction of the AR 30 code book, and, as new traffic permitted, to that of the RA-1 code book as well. Though progress was necessarily slow (since AR 30 contains more than 30,000 groups), the results of this work were generally reliable, so that by the end of 1940 occasional translations were possible in both systems. From that point on it was a matter merely of carrying forward the day-to-day study of the partially recovered text to increase the breadth and prediction of the identified vocabulary.

Early in 1941 Dr. Sinkov was temporarily relieved of his duties with the Italian Section and ordered to active duty as Captain in the Signal Reserve for the purpose of making a visit to the British Government Code and Cypher School (GCCS) in London in connection with Anglo-American plans for cooperation in the cryptanalytic field. The choice of Dr. Sinkov for this mission proved especially lucky, for the British were prepared to make their first major contributions to American cryptanalysis precisely in the Italian sphere. It is gratifying to recall that the accuracy of the first American solutions in the Italian field was fully confirmed by the longer experience of the British analysts.

Consequently, upon his return to Washington in April 1941 Captain Sinkov was in a position to extend the activities of the Section to those Italian systems which formerly had been impossible to solve

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chiefly because the Section was not familiar with Italian cryptographic habits. To help handle the greatly expanded activities of the Section, six reserve officers, all with some training in cryptanalysis, were assigned to the Italian Section in May 1941: Lieutenants M. E. Rada, C. H. Hiser, O. W. Stephenson, P. E. Neff, C. E. Girhard, and L. G. Derbyshire,[5] of whom all but the last were transferred to other sections or sent into the field in the course of the following year.

Besides the continuation of the studies of AR 30 and RA-1, cryptanalytic attention was turned to new systems for which a considerable backlog of traffic was available:

1. RA-1, in a more difficult encipherment than the one already studied;
2. AR 38 (tentatively called "Y"), a two-part code similar to AR 30, to which some study had already been devoted;
3. Additive encipherments;
4. Impero code reconstruction;
5. AR 25 code reconstruction.

This additional work involved the solution of digraphic substitutions as well as additive and code recovery.

Captain Sinkov, Mr. Christopher, Mrs. Berryman, and the officers devoted their attention to problems of encipherment. After having acquainted himself with these, Mr. Engel turned to the problems of code recovery, especially to that of Impero, for which the British had

5. Major Derbyshire was Officer in Charge of the Romance Language Section at the time of his reversion to inactive duty in October 1945.

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supplied a partial reconstruction. Current traffic, almost always readable, was light. For this reason, and because of insufficient personnel, code recovery of one of the codes (AR 25) was abandoned until the following year, when special circumstances made a restudy of this code imperative. As soon as possible after the return of Captain Sinkov from England, two specialists in the Italian language, Miss Elizabeth S. Doane and Mr. Henry A. Sauerwein, Jr., were added to the Section in order to satisfy the greatly increased linguistic needs. Thus, extensive code recovery and, for the first time, regular translations of current messages in several systems were made possible. Regular exchange of information with the Italian Diplomatic Section of GCCS was mutually advantageous in the recovery of substitution tables, additives, and the code values. Less specific but equally important was the information which the British generously made available from their previous experience to fill the American picture of Italian cryptographic history.

At various times in the first half of 1942 the Italian Section was increased by a number of persons.[6] The new personnel made up for the

6. These included Miss Olga Brod, Private Stuart W. Frazier, Captain (now Major) Gordon T. Fish, Dr. Burton Phillips, Sergeant (afterwards Lieutenant) Joseph Greenberg, Dr. Margaret J. Rickert, Dr. Mary T. Campbell, Dr. Collice H. Portznoff, Miss Frances G. Blank, Mrs. Frances R. Moss, and Sergeant (now Lieutenant) Donald F. LaSala. Miss Blank is the only one of these persons who had remained with the Section continuously; Dr. Campbell, after nearly two years in the Military Cryptanalytic Branch, has recently returned.

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gradual loss, in the course of the preceding year, of the reserve officers who had been transferred elsewhere and also for the departure of Mr. Sauerwein in June 1942. A very serious loss was caused by the transfer of Major Sinkov in May 1942 to the Cipher Bureau, Brisbane, at which time he was succeeded by Captain Derbyshire with Mr. Engel as technical director.

Up to this point all work on Italian cryptographic systems had been carried on by a single unit. While additive recovery and code recovery frequently require somewhat different skills not always united in a single person, both operations are best carried out by personnel working side by side, with constant collaboration resulting in advantage to both. Such collaboration had been constant in the administrative organization of the SIS during the period when it was housed in the Munitions Building. When, however, the units were transferred to Arlington Hall Station on 24 August 1942, a radical change was made in the administrative arrangements of all units in what was then called "B Branch", the cryptanalytic branch of SIS. The older sections, organized around the various languages, were broken up and a new arrangement made on the basis of method. Thus all additive units were brought under one administration and all code units under another. The old Italian Section was divided into two units, one of which was assigned to code recovery and put under Captain Fish, while the other, made up of the additive recovery personnel, was placed under Dr. Phillips, since Captain Derbyshire was relieved

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at this time of his duties with either unit.[7]

After the abandonment of the linguistic organization, constant liaison was necessary between the two Italian units, located as they were, at a considerable distance from each other. A compromise arrangement was made by the assignment of two members of the Code Recovery Unit to the Additive Unit while remaining, administratively, part of the Code Unit. Still later it was possible for the two units to be quartered in the same wing of Operations B Building, and finally, in the summer of 1943, the two units were administratively reunited under Lieutenant Duke, who had in May succeeded Major Fish as Officer in Charge of the Code Unit.[8]

The Code Unit continued the study of Impero, RA-1, AR 30, and AR 38. Another code (AR 40) of the same type as AR 30 and AR 38 was introduced in June 1942. The problem of reconstruction was undertaken by Miss Doane.[9] By October 1943 current traffic was almost completely readable. Meanwhile, the British sent a compromised copy of an older code, RA Tascabile,

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7. Shortly before the change was made, First Lieutenant (now Captain) Francis Duke had joined the Section, and simultaneously with the change First Lieutenant (now Captain) George E. McCracken was also added. Both of these officers were assigned to the Code Recovery Unit under Captain Fish.

8. At this time Captain Derbyshire, who had rejoined the Additive Unit as its supervisor in January 1943, was assigned elsewhere.

9. Miss Doane was assisted at various times by Lieutenants Harold M. Barnes, Jr., and Glanville Downey.

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the predecessor of RA-1, which thereby relieved the American analysts of this task. They also sent a copy of Y-1, which proved useful in additive recovery and permitted the decoding of a small number of older messages, which, had they been readable when received, would have had a high intelligence value.

Upon resuming his direction of the Italian Additive Recovery Unit in January 1943, Captain Derbyshire, with the assistance of an enlarged staff (11 new members), laid the groundwork for a new attack on Italian additive and digraphic-substitution encipherment. This work was greatly impeded, however, by a decline in the bulk of intercepts in the enciphered systems. This decline had begun as early as November 1942, when Chile broke relations with the Axis, and the volume of intercepts continued gradually to decrease until the fall of Mussolini on 25 July 1943. As an aid to additive recovery, the older messages in AR 25, which had not been seriously studied since 1941, were again examined through the preparation of completely new message print. This new message print was necessary because the encode of AR 25 was now being used for generating additive sequences. The successful solution of traffic in an Italian commercial system, which had been received ever since 1940, was accomplished between February and April 1943. When the encipherment was removed, the basic code proved to be a repagination of a standard, non-secret Italian commercial code.

Most of the Italian diplomatic systems were in code, but one cipher

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system, the so-called Digepol (Direzione Generale di Polizia), used since the end of 1941 by secret service agents in East Africa, was examined by the Cipher Section (then called B-III). The nature of the cipher was discovered, and key recovery was progressing rapidly in the Cipher Section when a complete solution was received from the British in April 1943; thereafter the traffic was processed by the Decryptographing Unit (B-I-c), and translated by the Italian Section.[10]

It was in August 1943 that the two Italian units were finally reunited under Lieutenant Duke, but this arrangement was of short duration, owing to the fact that after the fall of Mussolini in July, traffic declined to such an extent that there was too little work for the large staff. Accordingly, on 27 September 1943, Captain Duke was given administrative duties elsewhere, and at the same time Lieutenant McCracken, Miss Doane, Dr. Campbell, Dr. Rickert, and Mrs. Moss, were transferred to a new unit, leaving to carry on the Italian systems only Dr. Silber, Miss Blank, and Miss Price. Soon afterwards Dr. Silber was also transferred elsewhere and Miss Price was reassigned, with the result that for the first six months of 1944 the Italian Unit consisted solely of Miss Blank.

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10. Two new persons were added to the staff in the early summer, Dr. Gordon R. Silber and Miss Jehanne Price, who were responsible for the solution, in October 1943, of the Funchal digraphic substitution system.

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A description of Italian problems was begun by Mr. Engel in the autumn of 1942 and carried on by him until he left the Italian Section in the summer of 1943; it was finally completed and edited by the co-operation of members of that Section, particularly Dr. Silber and Miss Blank. This was issued as Italian Codes and Ciphers 1939-1943, a landmark in the description of foreign cryptographic materials and their solution. In October 1944 the study was continued by Lieutenant McCracken, then a member of the Recorder's Section, in Epilogue: Summer 1944, which completed the story of Italian solution to that date.

Since the autumn of 1943 intercepted Italian traffic continued to remain at a low volume. The enciphered codes, AR 30, AR 38, and AR 40, were still used by such European stations as continued operations. The most striking change, however, was the great rise in the use of plain text for governmental traffic, particularly in the Far East, where the representatives of the Republican Fascist Government were not, at least at that time, permitted to communicate with their government in code. Occasionally they used Japanese systems for their messages, but for the most part they employed plain text. The existence at the same time of two Italian governments created some confusion, but in the end no system was used in identical fashion by both governments, though each government continued to use some of the older materials in different ways.

The year was marked by a new form of Impero traffic (ITA), introduced in 1944 by the Royalist government. This was similar to the

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older form of ITA used by the Mussolini government prior to 1943, that is, the Impero code enciphered by five-digit additive. The additive sequence is taken from the encode of the Impero code itself, of which a photograph is available. A polyalphabetic substitution cipher was introduced for communication between the Royalist military attachés at Madrid and Ankara. The British were fortunate enough to intercept information giving most, if not all, of the details, so solution was rapid.

The Republican Fascist government introduced a new encipherment of the old book RA-1 (IMS), solved even though only seven messages were available. The encipherment consisted of a seven-digit running additive. The same government also introduced a new code of the general type of AR 30, AR 38, and AR 40, which, providing sufficient traffic is intercepted, will yield to code recovery, and a second system of which little is yet known. Later the Italians were once more permitted to employ code communications in the Far East, using AR 38 in two forms of encipherment, one very simple transposition, the other not yet solved.

The most significant developments of the year, however, involved, not the current traffic intercepted, but the fortunate capture of a large number of cryptographic materials which did much to increase our knowledge of the various cryptographic bureaus maintained in the past by the Italian ministries of Foreign Affairs, War, Navy, Aeronautics, and Interior. These materials were obtained partly by capture in the

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course of military operations and partly as a result of diplomatic negotiations made possible after Royalist Italy became an ally of the United Nations. Included are copies of all but one of the Italian diplomatic codes which had been studied and many others which had been used prior to American interception (one 30 years old), as well as three diplomatic codes which were apparently available for future use but had never been found in traffic intercepted here. In addition, the Italian Section now possesses copies of ten military codes ranging from large two-part codes for use by highest echelons to divisional and regimental units, and also some codes for highly specialized purposes, as well as two naval codes and one used for police work by the Ministry of the Interior. All of these materials are discussed in the Epilogue: Summer 1944 already mentioned.

The most gratifying result of the receipt of this material is to be derived from a careful comparison of the captured codes with the reconstructions made in the Signal Security Agency. No essential feature of these systems escaped the notice of the cryptanalysts engaged in their reconstruction. Objective tests to prove the accuracy of the identifications of code-group values showed that the reconstructions were extremely accurate.

In the following list are presented the results of a comparison of a hundred groups, chosen at random from each of the five codes indicated:

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Code	Percentage Identical	Percentage Nearly Identical	Total[11]
AR 25	50	45	95
AR 30	51	44	95
AR 38	47	32	79
AR 40	53	32	85
Impero	54	38	89
Average	51	37	88

This means that an average of 88 per cent of the code groups in the reconstructions were correctly identified. The 12 per cent incorrectly identified would not greatly effect the accuracy of translations, since it may be presumed that these were groups which occurred but rarely in the traffic. One of the erroneous identifications in AR 38, for example, was a group which had occurred but once in more than 10,000 messages. It may therefore be stated with confidence that accuracy of the translations approximated 100 per cent.

In the year which has passed since the receipt of the captured cryptographic material, the Section has continued to read with little difficulty the systems used by the Republican Fascist Government, though minor changes had been made. The Allied Control Commission in Rome required the use of deposited cryptographic material. When Allied control ceased in May 1945, the Italian Government instituted new systems, which at the end of the Fiscal Year 1945 had not been read, though excellent

11. An Analysis of Captured Italian Cryptographic Material, a summary of Epilogue: Summer 1944 to Italian Codes and Ciphers 1939-1943) is presented in IL 3834-A.

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progress had been made on their solution, particularly in the traffic of the Rome-Washington circuit.

Captain Duke, who served as American representative on the Cipher Security Mission in Rome, returned to the SSA with added insight into the cryptographic habits of the Italians. The information gained from cooperation with the British in this mission will doubtless be useful for a long time to come.

A summary of the achievements of the Italian Section include the following:

1. Independent solution of several two-part codes and several systems of encipherment, as well as the completion of many partial solutions supplied by the British.

2. Correlation of fragmentary information gathered by both the Signal Security Agency and the Government Code and Cypher School by cryptanalytic means, together with the evidence presented by the captured documents themselves, into a fairly complete picture of Italian cryptographic habits, not only for the period of five years when active cryptanalysis of Italian systems was being carried on in the Signal Security Agency, but also throughout the last 30 years.

3. Production of a considerable volume of translations of the Italian diplomatic correspondence in the period 1939 to the present, containing intelligence of value to G-2.

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CHAPTER VI. THE FRENCH SYSTEMS[1]

The history of the solution of systems used by the various French governments may be divided into three periods: (1) the period from April 1941 to June 1942, when all work on French systems was concentrated in a single section;[2] (2) the period from June 1942 to September 1943, when the different functions of solving and processing French traffic were performed in a number of smaller units, each charged with a single operation; and (3) the period from September 1943 to the present, when all of these operations were once more united in a single French Section.

A. The Early Period (April 1941 to June 1942)

Work began in April 1941, or perhaps a little earlier, in a new unit which was known simply as "Mr. Bearce's section," from the name

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1. The statements made in this section are based on interviews with the following persons; Majors Stanley Clark and John N. Seaman; Captains William S. Smith, Thomas H. Glenn, and John E. Carroll; Drs. Caleb Bevans, Albert Howard Carter, Ruth Cherniss, and Katheleen Munn; Miss Helen J. Bradley; Mrs. Helen Siegel; Mr. Paul K. Hartstall; Miss Katharine L. Swift; and Mrs. Marjory M. Max-Muller. In addition, the following progress reports were examined: Captain John E. Carroll (1 September 1942 to 29 January 1944); Captain Thomas H. Glenn (22 February 1943 to 29 January 1944); Captain William F. Edgerton (8 and 15 February 1943); First Lieutenant Lee P. Howard (10 November 1942 to 17 April 1943); a special report by First Lieutenant Stanley Clarke (31 August 1942); records of the French Decode Unit kept by Miss Katharine L. Swift (16 October 1942 to the present); and a volume containing information pertaining to all French systems. These documents are now on file in the French Section (B-III-a-1).

2. Until January 1942 this unit also had in its care those systems in Spanish and Portuguese which then received any attention, but in that month the so-called South American Section was formed, and these systems were thereafter studied in it. See chapter IX. See Tab : a diagram showing the successive changes in the administration of the French problems.

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of its supervisor, Herrick F. Bearce, who was identified with work in French until shortly before his transfer overseas as Captain Bearce at the time of the North African invasion.[3]

This was, of course, a period of pioneer work, and the staff was also responsible until January 1942 for traffic in all other Romance languages except Italian,[4] which, since late 1938, had been studied in a special unit.[5] In spite of the extent of this task, the staff had by September 1941 succeeded in isolating from the voluminous traffic then available two French systems, both unenciphered codes: one a one-part code (FBT) with a five-letter group; the other, a two-part code (FAV) with a four-letter group. Progress on the recovery of FBT, carried on up to this time by Mr. Garman alone, was more advanced than that on the other. IBM indexes had been made, and the result of the combined efforts of Messrs Garman and Smith was that, in mid-December 1941, the one-part code was readable. The capture by the Canadians of the Miquelon copy in January 1942 compromised this system. Progress

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3. He had with him Mr. (now Major) James Moak; Lieutenant (now Major) E. Dale Marston; Miss Rosalie Harding (Mrs. Bash); and Miss Sudie Jones (Mrs. Hanson); and, for the language aspect of the work, Mr. Allen D. Garman, for many years a federal translator; and later in September 1941, Mr. (now Captain) William S. Smith. In October 1945 Lieutenant Colonel Bearce became Officer in Charge of the Romance Language Section.

4. As a matter of fact, only a few systems in French, Spanish, and Portuguese were being studied at this time.

5. See chapter V.

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on the two-part code was less satisfactory until on 26 December 1941 the Section received from the British a partial reconstruction of the code. The British also sent partial reconstructions, from 15 to 30 per cent complete, of seven Vichy French digit codes (FAC, FAH, FAD, FAE, FAF, FAG, and FAI) which had not hitherto been studied. The discriminants for these systems, though solved in London, had not been recovered here. Translations were possible at once in the case of FAC and FAH, and code recovery could be carried on in the other systems.[6]

In January 1942, the Section established a swing shift of four persons, the members of which tried their hands at solution of the substitution encipherments of other French systems ultimately compromised in November 1942. In March 1942 a compromised copy of the Hanoi code (FBM) and some information concerning the additive encipherment used with it was received from the British. By early summer of 1942 the strength[7] of the Section was about 25 persons, who performed the

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6. From November 1941 to April 1942 the staff was expanded by the addition of a number of persons: Mr. (now First Lieutenant) Richard Hallock; Sergeant (now Major) Carlisle C. Taylor; Mr. G. F. Swift; Mr. John R. Rafferty; Sergeant Willis Russell; Sergeant (now Captain) Gerrett L. Ewing; Sergeant Patrick F. Quinn; Lieutenant Stanley Clarke; Mr. (now Major) Edward Quereau; Dr. Albert Howard Carter; Mrs. Jeanne S. Fish; and Mrs. G. L. Lattin. Most of these persons know French, particularly Mrs. Fish and Mrs. Lattin, who are natives of France.

7. Before May 1942 the Section had again expanded by the addition of another group, comprised in the main of French specialists. These included: Drs. Caleb Bevans and Vista Clayton; Lieutenants John E. Carroll, Donald Miller, Reuben Y. Ellison, and Scott F. Runkle; Miss Helen J. Bradley; Mrs. Ray Pettengill; and, for a short time only, two cryptanalysts: Mr. Edward E. Christopher and Mr. Norman Dillinger.

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operations of cryptanalysis, code recovery, deciphering, decoding, and translating the French traffic. Though at this period much had already been accomplished, the larger achievements of the French Section were still to come. It was at this point that the move from the Munitions Building to Arlington Hall was imminent. Before the move took place, however, changes occurred which were to dissolve the unit as it had previously existed, and, as a result of the general reorganization that took place in the Signal Security Agency in the summer of 1942, Lieutenant Bearce was promoted to head a larger section (then called B-II-a).

B. The Period of Division (June 1942 to September 1943)

The reorganization, which also affected many other units, was based on the new principle of arrangement of function by type of cryptanalytic operation rather than by government, language, or homogeneity of traffic, a principle which had previously been followed. As a result the existing French Section was broken up into four smaller units, each of which assumed one of the functions which had previously been part of the assignment of the larger section. The function of decoding the traffic, however, was not performed in any of these units but in a new organization which decoded traffic in the Japanese and Spanish languages as well, formed somewhat later (September 1942) than the others. The new administration was as follows:

1. The French Cipher Unit, under Mr. William S. Smith, assigned to all French problems involving types of enciphered code other than those based on additive encipherment;

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2. The French Additive Recovery Unit, under Lieutenant Stanley Clarke, assigned to the solution of the encipherment of codes enciphered by additive;

3. The French Code Recovery Unit, under Lieutenant John E. Carroll, assigned to problems of code recovery, both unenciphered and those from which encipherment had been removed;

4. The French Translation Unit, under Lieutenant Lee P. Howard, assigned to translation of decoded messages and plaintext traffic in French; and occasionally to special translation problems; and

5. The Decode Unit, under Mrs. Jean Reischauer, assigned to the task of decoding, in addition to certain systems in the Japanese and Spanish languages, all French messages in systems sufficiently solved to permit decoding with little or no recovery work.[8]

While the traffic studied by these five units was homogeneous in that it was all transmitted by the Vichy French Government, the units themselves were not united administratively. The Cipher Unit, for example, was part of what was then called B-III, a cipher section under Lieutenant Frank B. Rowlett; the Additive Recovery Unit was part of B-II-b, then under Captain Leonard Bickwit; the Code Recovery Unit was part of B-II-a, then under Captain Bearce; while the Translation Unit and the Decode Unit were both parts of B-I, a group of service units under Captain Verner C. Aurell.

The dissolution of the old French Section into these units was not, however, completed on a single date. The Cipher Unit and the Additive Recovery Unit were first separated from the others and

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8. For a discussion of the work of this unit as a whole, see section G.

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moved to Arlington Hall Station in July 1942, whereas the others were not formed until the removal of the last of the Signal Security Service on 24 August 1942. Later, when a need for closer cooperation between the units arose, a central committee was formed to discuss technical problems with a view to the proper assignment of new traffic and the avoidance of duplication of effort. As of August 1943, this committee consisted of Lieutenant William S. Smith for the Cipher Unit, Dr. Caleb Bevans for the Code Recovery Unit, and Miss Helen J. Bradley for the Additive Recovery Unit, which by this time was performing preliminary research on new systems. The work of this committee helped in eventual amalgamation of all the French units in a single French Section on 21 September 1943; but before discussing that reorganization, the history of the various smaller units during the period of division will be considered.

C. The French Cipher Unit

B-III-d, as it was called in July 1942, was one of the first units to be separated from the original French Section and moved to Arlington Hall Station. It was under the direction of Mr. William

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S. Smith until 15 December 1942.[9]

The work of the French Cipher Unit was the study of Vichy French enciphered code systems, except for those employing additive encipherment. The encipherment of the system now called FBB was solved very early and the traffic turned over to the Code Recovery Unit with about 50 tentative values established. Some progress was also made on the substitution encipherment of the system now called FAO. In November 1942 the capture of copies of this code and several others on which the French Cipher Unit was working compromised the system and reduced the problem to the level of production in a few enciphered code systems.

Lieutenant Smith left the French Cipher Unit in December 1942 and was succeeded by Captain Edwin R. Phillips as head of the Unit, the function of which was by that time limited to a considerable extent, because of captured material, to training. In February 1943 the Unit took over the cryptanalysis of two Swiss systems (SZM and SZN), and in May it began to study some Chinese enciphered codes. The French

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9. Within a few weeks of its organization Messrs Hallock and Swift, who had come with Mr. Smith from Lieutenant Bearce's section, were transferred to the Japanese Military Attaché Section and were replaced by new personnel. The persons who spent the longest time in this unit in 1942, all of them new to the organization, included: Miss Marjory MacLeod (Mrs. Max-Muller); Miss (now Lieutenant) Mary Charlotte Lane; Mrs. Marion Nagel; Dr. (now Master Sergeant) Daniel M. Dribin; Dr. Leslie A. Rutledge; Dr. (now Captain) Edd W. Parks; and Miss Jeannette Early. Besides these, there were Lieutenants Edwin R. Phillips; Saul K. Raskin; Cyrus H. Gordon; Joseph R. Salem; Mr. Wayne S. Barker; Corporal Ruell E. Dawson; and Sergeant Frederick McComas.

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Cipher Unit as such was absorbed into the general Cipher Section in July 1943 and continued to work on the French (and Swiss) problems only until September 1943, when the French Section was once more activated.

D. The Additive Recovery Unit

B-II-b-1, which was also one of the first units to be moved to Arlington Hall Station, was under the direction of Lieutenant (now Major) Stanley Clarke.[10] In early September Captain Clarke was selected for overseas duty and was succeeded by Captain William F. Edgerton; but on 1 February 1943 Captain Edgerton exchanged positions with Captain John E. Carroll, head of the Code Recovery Unit, and the latter remained in his new post until 29 January 1944, when he was transferred to the Military Cryptanalytic Branch (B-II). He was then succeeded by Miss Helen J. Bradley, who remained supervisor of the Additive Recovery Unit until the reorganization of August 1944, at which time she became head of the French Section as a whole. At first the Unit continued research, which had already begun in the Munitions Building, on French colonial additive systems. Shortly after the move to Arlington Hall, the British sent decodements of three

10. He had with him at the beginning Lieutenant Reuben Y. Ellison and Miss Helen J. Bradley. Shortly afterwards, there were added in succession: Mr. Norman Dillinger and Mrs. Helen Siegel (both temporary); Mr. Robert O. Moore; Lieutenant (now Captain) Stanley Simonds; Dr. Calvin Brown; Miss Kathryn Wood; Miss Harryett Willis; Mr. Edward Quereau (temporary); and Corporal Sidney Jaffe.

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messages in FBM, a system which they had previously compromised by capture of the basic code book, though the exact nature of the additive table used with it was unknown. By using the three decodements, however, it was possible to begin placing new FBM traffic in depth, and solution of the additive keys could now be achieved. Study of other colonial additive systems was carried on chiefly by Dr. Brown and Mr. Dillinger. Of these FBN, FBO, FBP, FBQ, and FBR, have remained unsolved for lack of traffic. At the time of the invasion of North Africa, however, the Canadian Examination Unit discovered that Vichy was sending identical news reports to Hanoi in FBM and to the other colonies in the system known as Colonial E-5. The basis of E-5 was a two-part code using a pentanomic group. Each colony used a different additive key book. By use of Hanoi cribs, about 600 relative code values and the corresponding amount of additive keys were recovered. The additive system FBI (Chinov) was compromised in its entirety, and the little traffic received here was deciphered and translated. [11]

Shortly after the invasion of North Africa all Vichy colonial traffic ceased except the Vichy-Hanoi system (FBM) which became very

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11. Prior to 1 January 1945 the following persons were added to the Unit: Misses Marion Lathrop; Alice Van Hoesen; Rosamund Deutsch; Constance Hyslop; Charlotte Morris and Dr. Vista Clayton; Sergeant Harold Spain; Corporal Ralph Carl; and Mr. Paul K. Hartstall. Sergeant (now Lieutenant) Jaffe was sent to Officer Candidate School in December 1943 and was replaced by Lieutenant (now Captain) Seymour Bloom.

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light.[12] In April 1943, however, an examination of the Free French traffic, which hitherto had been stored, began. Systems proving to be unenciphered code were turned over to the Code Recovery Unit, the first of these on 2 May 1943. Codes enciphered by means other than additive were sent to the Cipher Unit. Additive systems, such as FFC, FMB, FMF, FMD, and FME, were retained. The first of these was isolated on 19 April 1943. All of the additives for FME (a daily strip system based on a five-digit code) were recovered, but since only 30 messages were received, code recovery was impossible. Both FMB and FMD, however, became readable; the code recovery for the former was done in the Code Recovery Unit under the direction of Dr. Clayton. FFC, a naval system, was turned over to the Navy in November 1943, but a fair amount of additive had been recovered under the supervision of Mr. Hartstall. FMF, based on a five-digit code, yielded several good columns of additives but was not read before the spring of 1944 because of lack of material. On 23 June 1943 a Free French transposition system (FMC) was turned over to a new unit recently formed for problems of this kind under the direction of Mrs. Siegel.[13]

In July 1943 work on unknown systems was taken over by the French

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12. As a result, between January and April 1943 Mr. Dillinger, Dr. Brown, Sergeant Spain, Miss Hyslop, and Lieutenant Bloom were transferred to other units.

13. See page 129

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Cipher Unit under Lieutenant Smith.[14] The status of the systems being worked on in this Unit was reported on 3 July 1943 as follows:

Vichy systems (retained by B-II-b-1):

FMB (Vichy-Hanoi) - nearly 50 per cent solved; i.e., the enciphering keys used with a compromised code were solved in 90 out of a possible 186 cases.

"E-5" - 615 relative code groups recovered, and additive groups used in enciphering most of the messages sent in November and December 1942 recovered.

French Mission systems (retained by B-II-b-1):

FMB - 170-digit repeating additive based on a one-part code; code recovery and translation were done in this unit. The first translation made on 6 June 1943, shortly after traffic had ceased.

FMF - in research

FME - Daily additive key, two of which have been reconstructed.

FMD - a strip additive, in research.

French Mission systems (not retained by B-II-b-1 after isolation):

FMA - unenciphered code using old Vichy DX code, sent to Code Recovery Unit.

FMC - the so-called "Eel" system, sent to the Cipher Unit.
FMH - the so-called "Jelly-fish," sent to the Cipher Unit.

Free French Systems (retained in B-II-b-1):

FFC - the so-called "Lib-7," a four-digit additive, sent to the Navy on 9 November 1943.

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14. By August the Unit had expanded by the addition of Misses Kathryn Clark (Mrs. Novak); Helen Smith; Janet Hunter; Betty Casassa; Lieutenant Talbot O. Ferguson (WAC); and Sergeant Mary B. Vanderhoof.

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Free French systems (not retained by B-II-b-1 after isolation):

"Lib-8" - a Navy system sent to the Navy in May 1943; no real study made in this unit.

FFA - the so-called "Fido," unenciphered two-part code sent to Code Recovery Unit.

FFB - the so-called "Fraco," unenciphered two-part code sent to Code Recovery Unit.

FFE - the so-called "Lib-1," a substitution and transposition sent to the Cipher Unit.

FFD - the so-called "Lib-2," and

FFF - the so-called "Lib-3," both unknown systems sent to the Cipher Unit.

Five additional systems were isolated but not identified. These were also sent to the Cipher Unit.

At this period (July 1943) 20 systems were known to have been used by the French Mission and the Free French government, of which 20 had been isolated. Such was the situation at the time B-II-b-1 was united with the other French units on 23 September 1943.

E. The Code Recovery Unit

This Unit (B-II-a-1), with Lieutenant John E. Carroll as head, was moved to Arlington Hall Station on 24 August 1942.[15] The function of

15. The staff included at the beginning: Mr. Allen D. Garman; Dr. Caleb Bevans; Mrs. Constance Clark; Miss Mary B. Francis (Mrs. Vandenberg); Dr. Vista M. Clayton; Mrs. Jeanne S. Fish; Mrs. G. L. Lattin; and Corporal (now Captain) Paul Everett. Mr. Edward Quereau and Lt. Richard Ligon were also with this Unit for a short period, and in 1943 Lieutenant Victor A. Noel and Mr. E. Prentice Abbott were added.

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the Code Recovery Unit was the recovery of the French unenciphered codes and of codes from which the encipherment had been removed.

On 1 February 1943 Captain Carroll exchanged positions with Captain Edgerton, who had been supervisor of B-II-b-1 since September 1942, but Captain Edgerton remained in his new post only for two weeks, when he was succeeded by Captain Thomas H. Glenn, who had been a member of the Code Recovery Unit since 15 December 1942. Captains Carroll and Glen remained heads of B-II-b-1 and B-II-a-1 respectively until 29 January 1944, when they were both transferred to the Military Cryptanalytic Branch (B-II). On 1 March 1943 the transfer to another station of Captain Ulrich S. Lyons, the head of the Swiss Unit, left that Unit without a supervisor, and the Swiss Unit was amalgamated with the French Code Recovery Unit under Captain Glenn. This arrangement continued until August 1944, when the Swiss Unit once more became independent.[16]

On 1 September 1942 Captain Carroll reported that in addition to completely compromised codes, his unit was then working on the following systems, all of which were two-part codes having 10,000 groups:

Code	Percentage recovered	Percentage doubtful	Messages per month	Identifications per month
CV (FAV)	60	few	500	120
DE (FAE)	55	20	330	300
DV (FAH)	50	10	200	250
DQ (FAD)	53	20	200	150
DS (FAF)	35	no information	40	150
DT (FAG)	52	no information	50	125-150
DO (FAC)	40	20	35	60-90
DX (FAI)	35	30	25-30	60-90

16. See chapter VII.

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On 19 November 1942 Captain Carroll was able to report that his unit had recovered and sent to the British 1625 code values since 29 September 1942 and had in the same period received from the British 1575 values. Ten days later the FES code had been received from the Cipher Unit, and Mr. Hallock and Mr. A. Ferdinand Engel, a member of the Italian Code Recovery Unit, were at work on its recovery. The DR code (FAE) had been recovered sufficiently to be sent to the Translation Unit on 17 October 1942. The last report signed by Captain Carroll as supervisor of B-II-a-1 (1 February 1943) gave the following as the status of the systems then being studied:

Code		Percentage recovered	Readability
DS	(FAF)	42 %	95.6 %
DT	(FAG)	59 %	98.4 %
DX	(FAI)	37 %	95.0 %
FEA	(two-part, 35000 groups)	8 %	
FES	(two-part)	17 %	74.0 %

In his first report as supervisor of B-II-a-1 (22 February 1943) Captain Glenn stated that identifications had been made during the preceding week in the following systems: FAF, FAG, FAI, FAL, FAU, and FBB. The report for 15 May 1943 listed new identifications in FAD, FAE, FAF, FAG, FAI, FAU, FBB, FBT, and FBU and noted the following systems as compromised at this time: FAL, FAM, FAN, FAO, FAT, FAV, and FBX.

In addition to the work on Swiss systems already mentioned, the Code Recovery Unit also carried on study of systems in the French

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language sent by two other governments, those of Belgium and Haiti,[17] until 24 August 1944, when a special unit for these two governments was formed.

On 9 May 1943 the Code Recovery Unit was further enlarged by the personnel and functions of the French Translation Unit directed by Lieutenant (now Captain) Lee P. Howard.[18] In June 1943 the enlarged staff began work on FMC, from which the encipherment had been removed in the Transposed Cipher Unit directed by Mrs. Helen Siegel,[19] and progress was rapid. They also studied an unenciphered code (FFA). On 23 September 1943 this Unit was amalgamated with the other French units to form the present French Section.

F. The French Translation Unit

This Unit was first designated B-I-f and supervised by Lieutenant Lee P. Howard. It was formed on 24 August 1942 from personnel of the French Section directed by Lieutenant H. F. Bearce, and continued to exist as a unit until 9 May 1943, when it was amalgamated with the French Code Recovery Unit. Its function was the translation of all French plain text and of messages sent in such systems as had been

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17. See section I, page 130.

18. This brought Lieutenants Howard, George M. Sayre, and Clelland D. Jones, Dr. Ruth Cherniss, Misses Noe Cox, Martha L. Little, and Anne O'Brien into the Code Recovery Unit.

19. See page 129.

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compromised or rendered readable by analysis to such a point that further cryptanalysis was unnecessary. At first the systems so processed were FBT and FBU. On 16 November 1942 it was reported that the French Translation Unit had prepared a French version of the instructions used with the U.S. M-138-A cipher device, but for the most part the translations made in this unit were from French to English. A week later the Unit received another French code (probably FAE). Priority was given at this time to messages to and from Panama, then to Buenos Aires traffic, Washington traffic, and Santiago traffic, in that order.[20] Collaboration with the Japanese sections in the translation of French messages sent in Japanese systems was reported on 10 January 1943. The Unit was working at this time on FAC, FAH, FAT, FAV, and FBT, and during January translated 185 plain-text messages and 224 code messages. By 1 February 1943, B-I-f also was working on FAD and FAO. On 20 March 1943 FAE and FAG were reported as 90 and 80 per cent complete respectively. A week later the Unit examined a large number of photographs taken in the French consulate at Los Angeles and prepared translations of those which were of interest. Reports ceased on 17 April 1943, but the amalgamation of B-I-f with B-II-a-1 did not take place until 9 May 1943.

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20. At this period the French Translation Unit consisted of Lieutenants Howard and Sayre and two clerks. On 6 December 1942 Lieutenant Clelland D. Jones and Miss Charlotte Morris were added. Miss Morris was replaced on 26 December 1942 by Dr. Ruth Cherniss. Miss Anne O'Brien and Lt. J. C. Apollony were added on 20 February 1943, but the latter left for another section within a week.

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G. The French Decode Unit

Until the time of the breaking up of the French Section in August 1942, the task of decoding French messages had been one of the functions of the entire staff, but with the formation of the smaller units, this function was handed over to a newly organized unit known familiarly as the Decode Unit, at first under Mrs. Jean Reischauer, but soon afterwards under Lieutenant (now Major) James C. Taylor. In addition to the French traffic, chiefly in two systems (FBT and FBU), this Unit also processed messages in the Spanish and Japanese languages.[21] The French part of the Decode Unit was never formally activated but grew out of the Decode Unit (B-I-c) of which it remained a part until 21 September 1943. The following is a list of French systems on which this Unit worked prior to the amalgamation of all French units on 21 September 1943:

Before 12 October 1942	FBT,	a captured code;
	FBU,	a variant of FBT, encipherment recovered;
1 November 1942	FAE,	reconstructed at Arlington Hall
	FAH,	a code of which about 89 per cent was captured, the remainder recovered;
	FAV,	a captured code;
18 January 1943	FAC,	encode captured with part missing;
25 January 1943	FAO,	a captured code discontinued July 1943;
1 February 1943	FAD,	a captured code;

21. Until 12 October 1942 the French traffic was handled by Mrs. Helen Siegel and Dr. Ruth Cherniss, who were joined on that date by Miss Katharine L. Swift. Others were added later under the supervision of Miss Swift.

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15 February 1943	FAG,	Reconstructed at Arlington Hall;
8 March 1943	FAM,	a captured code, but some of the indicator tables were not captured and the Decode Unit solved these;
5 April 1943	FAN,	a captured code; indicator tables recovered as in the case of FAM;
19 April 1943	FBX,	a naval code turned over to the Navy after one week.

On 21 September 1943 the French Decode Unit was separated from those processing Japanese and Spanish traffic and was then amalgamated with the other French units to form the present French Section.

H. The French Transposed Cipher Unit

In May 1943 a new French Cipher Unit was formed with the object of studying transposition encipherments. Mrs. Helen Siegel, who had worked in other French units and on a Japanese transposition problem, was made the supervisor.[22] The solution of the FMC problem was aided by the receipt of two work sheets which had been carelessly handled by the code clerk in Washington and were made available for use through the alert cooperation of the Laboratory Branch. These work sheets showed the manner of encipherment and revealed the fact that, as had been suspected, FMC was a four-digit code enciphered by route and columnar transposition according to a mixed key sequence. As a result, the solution of the two keys made available by the intercepted work

22. Mrs. Siegel was assisted at first by various members of the larger Cipher Section under Lieutenant W. S. Smith and including Mrs. Genevieve G. Feinstein, Lieutenants Elwood Hill, J. C. O'Neill, Richard Hallock, and Dr. Calvin Brown.

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sheets produced code groups in about 50 messages sent in those two keys and led to the preparation of frequency distributions for this code which were useful in solving additional keys by anagramming. For illustration of captured FMC work sheets, see Tab 21.

Another French transposition encipherment (FFE) had begun to be studied shortly before the amalgamation of the French Transposed Cipher Unit with all the others engaged in studying French traffic on 23 September 1943.

I. September 1943 to the Present

During the first half of 1943 the French units described in the preceding paragraphs worked independently of each other, though with frequent liaison, which constantly increased after the formation of the central committee in July. At this period a reorganization of what was then called B Branch of the Signal Security Agency was under discussion, leading ultimately to the consolidation of all units except the Japanese Army Section into a section known as the General Cryptanalytic Section (B-III), later to become the General Cryptanalytic Branch in 1944. It was therefore proposed that the various French units, then five in number (since the Cipher Unit, originally B-III-d, had largely turned to problems other than French) be amalgamated in a French Section formed to process all French government traffic, and in addition the traffic of the Belgian and Haitian governments in French,

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and of the Swiss government in French and German.[23] The consolidated French Section, designated as B-III-d, was placed under the direction of Major William F. Edgerton, who, after leaving French problems in the preceding February, had been Director of Training for the Signal Security Agency. Lieutenant Sidney Jaffe served as Major Edgerton's administrative assistant. The new section contained the following subdivisions:

1. The Additive Recovery Unit under Captain Carroll (after January 1944 under Miss Bradley);

2. The Code Recovery Unit under Captain Glenn (after January 1944 under Mr. Hartstall);

3. The Cipher Unit under Mrs. Siegel;

4. The Decode Unit under Miss Swift;

5. The Traffic Unit under Miss Ruth Adams.

The functions of the last group had previously been performed in the Traffic Section of the entire Branch, but this section was now broken up and the personnel assigned to the language units with which they had previously worked in liaison. One other change in function was made: the Cipher Unit under Mrs. Siegel now assumed both preliminary research and all encipherment problems except those based on additive. The other groups functioned as before.

Major Edgerton and Lieutenant Jaffe continued to direct the French Section until they were relieved, Major Edgerton in May 1944 to become

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23. Though the language of part of the Swiss traffic is not French, cryptographically the German and English versions of the Swiss codes are identical with the French versions and, therefore, are handled together.

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acting chief of B-III during Lieutenant Colonel Rowlett's tour of duty at GCCS, and Lieutenant Jaffe in June for overseas duty. With the departure of Major Edgerton, the French Section was united with the other Romance language sections (Italian, Spanish, and Portuguese) under Captain Lowell G. Derbyshire (B-III-a), who for a short time continued to have jurisdiction also over the Near and Middle East Unit and the Chino-Thai Unit. The French Section continued as part of the Romance Language Section. Under Captain Derbyshire's supervision Miss Helen J. Bradley became supervisor of French problems, on 24 August 1944, Miss Kathryn Wood was appointed to head a new unit for Belgian and Haitian traffic, and the Swiss systems were once more given autonomy under Dr. Robert H. Weidman. The French systems were now once more reorganized as follows:

1. The Cryptanalytic Unit under Mrs. Siegel, charged with preliminary research, solution of cipher and encipherments including additive problems;

2. The Language Unit under Mr. Hartstall, charged with code recovery, decryptographing, and translation;

3. The Traffic Unit under Miss Adams.

Since January 1944 a group of expert cryptanalysts in B-III-a have been available for consultation by other units. Those who have worked principally with French problems are Dr. Caleb Bevans, Dr. Calvin Brown, and Miss Elizabeth S. Doane. The French Section suffered a sharp reduction in personnel on 29 January 1944, when seven officers

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were transferred to the Military Cryptanalysis Branch (B-II).[24]

In September 1943 FMF was still in the process of solution; FMN, another pentanomic code, and FMJ, a tetranomic code, both used with additive encipherment, were well under way when instructions were received in November 1943 to drop work on all save FBM. This suspension was made necessary to enable transfer of personnel to more urgent problems elsewhere. In February 1944 work on FMN was resumed, and wherever sufficient traffic was received to provide the necessary depth, additive was solved and code recovery was possible. The same basic code was also used with another current system (a transposition known as FMX). FMJ became obsolete and was laid aside until January 1945, when it was successfully solved. FMF proved to have the same basic code as a transposition system FFY, and at present all additive in sufficient depth is recovered, after which code recovery, still in progress, is possible. Solution of FMS, a Free French additive system based on the compromised code known as CTX-1, had been begun in cooperation with the British and Canadians. The first overlaps were, however, solved in the Additive Recovery Unit. Later, changes of indicator were solved, and the production of intelligence from FMS messages was carried on by the Additive Recovery Unit until August 1944.

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24. These were Captains Carroll and Glenn, Lieutenants Brown and Seele (who had been working chiefly on Swiss systems), and Lieutenants Bloom, Jones, and Noel.

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The first translation in FMD was prepared on 18 October 1943, only two days after Lieutenant Jaffe, who had at the beginning the benefit of only 246 values recovered by the Canadians, had begun to work. On 4 November 1943 FFA was compromised by the British, who sent also some information on an encipherment of the FFB system known as FFE. By 18 November 1943 the Code Recovery Unit was engaged mainly in decoding and translation except for work on FMA.

Traffic in FCB was reported for the first time on 27 February 1944. Meanwhile the Vichy additive system (FBM) underwent a number of major changes. The indicator was simply enciphered during a period beginning 1 August 1943, and the method of using the additive cards was changed. The new indicator was located and the new method of using the keys was revealed by a Code-Instruction message. On 1 January 1944 the encipherment of the indicator was again changed, and once more solved. Further complications introduced into the method of applying the encipherment were overcome. Moreover, methods of overlapping old traffic dating from 1941 to 1943 were devised. When traffic ceased in August 1944, about 75 per cent of all additive cards in depth had been recovered.

The solution of FFE, begun in May 1943 by the discovery of two messages which showed clearly that they were transposed code, was continued in the Transposed Code Section. This involved the development of new cryptanalytic techniques for solving two messages containing the

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same text but enciphered by transposition taken from matrices of different width. While FFE traffic was never heavy, this technique proved useful in other problems, notably FMP. The system called FCD, used by the Vichy government between late 1943 and August 1944 for communications on a few circuits, proved upon solution to be a system of digraphic substitution in which every fifth digit of the plain-code group was omitted and then enciphered in pairs.

FMV, solved 10 June 1944, ten days after the introduction of the system, proved to be an encipherment, using a daily additive of five digits, of the older basic code FAI. An additive system (FMF), which had been earlier attacked but abandoned because of pressure of work, was solved, as was also the indicator system. Another transposition system (FFY), used by the French Military Mission between 5 October 1943 and 26 January 1944, was solved on 23 March 1944, chiefly on the basis of a message in which many three-digit repetitions were to be seen. At first the system was thought to be unenciphered three-digit code, but attempts to fit the text in matrices of varying widths revealed five-digit code groups in the same basic code as was used with FMF, when a certain mixed key sequence was used. This sequence was found to be used with all messages after November and a second sequence to be used with all prior FFY messages. The code also proved to be the same as that used with FMP, so traffic in FFY, FMF, and FMP, could be used for code recovery.

The first French military cipher solved in the Signal Security

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Agency was FMP of which there were three varieties (FMP-A, FMP-B, and FMP-C). FMP-A was introduced late in 1943 but solution was not possible until the interception on 28 April 1944 of two messages bearing the same serial number and group count, and having almost the same frequency counts, but different indicators. It was assumed that the two messages were identical in plain text but had been enciphered by transposition from matrices of different widths. Using the same technique as had already been devised for FFE, a solution was reached and a report forwarded to the British and Canadians on 8 May 1944. The two sequences which were thus recovered proved to be based on the phrases VACCINATION ANTITYPHOIDIQUE and SECRETAIRE GENERAL which were later found to be code groups in the code itself. Consequently, the recovery of new key sequences may prove helpful in code recovery as well, and vice versa.

Progress was also made early in 1944 on code recovery of FFW, a one-part code with a five-digit group. The accuracy of the reconstruction was found to be very high when a captured copy of the code was received in January 1945. In May 1944 code recovery was begun on a basic code which, in various encipherments, was known as FMF, FFY, and FMP. The basic code was a large two-part military code using a five-digit group. Early progress on this project was slow because of the nature of the encoded messages containing many unfamiliar military abbreviations, but the patience, experience, and skill of the analysts

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finally brought the work to a satisfactory state of advancement. Though this is a large code, solution has been accomplished without the aid of an isolog or any assistance from the British and Canadian cryptanalysts.

Reconstruction of another code used with additive encipherment (FMN) and transposition encipherment (FMX) had been begun in the Additive Recovery Section early in 1944 but was laid aside for a time.

The task of decoding all French traffic was given to the decryptographing group of the French Section in January 1944. The task was formidable: the Vichy systems being read at that time numbered 16, but the group found time to do a certain amount of code recovery in two systems (FAC and FAH) which had been captured in incomplete form. At later periods four other Vichy systems were added. The translation of the huge amount of traffic was carried on by a group of about six persons. These Vichy codes provide information concerning such topics as bombings in the Far East, the state of mind of the Japanese people, relations between French Indo-China and Japan, intimations of impending political crises, reports on military and naval operations, and the like.

In the same period five Free French systems were read and translated regularly and code recovery on FAI was continued. FAI and FMV, its enciphered form, produced an enormous volume of traffic in 1944: in FAI 16,446 messages and in FMV 2,500. Complete decodements were

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thus made impossible, but every message was treated to an operation known in the Section as "spot decoding"; i. e., enough was decoded to determine the subject matter. Complete decoding was then performed only in the case of those messages with intelligence value. Traffic in the Free French system FMS provided information on the situation in Syria and Lebanon and gave reports of the Russo-Polish problems, as well as on vital developments in Turkey and the Balkans. The other Free French systems being read at present are FMO and FFA.

Mention has already been made at many points of assistance derived from the British Government Code and Cypher School (GCCS) in London. The French Section also profited frequently by assistance from the Canadian Examination Unit (EU) in Ottawa. An exchange of technical information, progress reports, and traffic was carried on regularly at the time this history was written with both EU and GCCS. As a result progress was greatly accelerated and new sources of intelligence made available.

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CHAPTER VII. THE SWISS SYSTEMS[1]

In December 1942 a unit was formed in the Romance Language Code Recovery Section (then called B-II-a) to solve the cryptographic systems used by the Swiss government. Priliminary cryptanalytic research was carried on by Captain (now Major) Ulrich S. Lyons, assisted by Lieutenant Theobald E. Frizelle, but both of these officers left the Swiss Unit when the problems became predominantly linguistic.[2]

About 1 March 1943 Captain Lyons was transferred, and the Swiss systems, together with the personnel studying them, were united with the French Code Recovery Unit (B-II-a-1), then under the direction of Captain Thomas H. Glenn, an arrangement which continued until 28 August 1944. Thus, the larger resources of

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1. The statements made in this section are based upon interviews with Captain W. Edward Brown, Miss Madeline Cournoyer, Dr. Robert H. Weidman, Mrs. Constance Clark, and Miss Alice Joys, and upon the following documents: a. Progress reports of the French Code Recovery Unit (1 March 1943 to 24 August 1944); b. miscellaneous reports of the Swiss Section.

2. Lieutenant (now Captain) W. Edward Brown was added almost immediately. His knowledge of both French and German proved of advantage to the Section, since the codes of the Swiss government are based on both these languages as well as English. Two other specialists in French joined the unit in January 1943. Lieutenant Richard Litton remained only for two months, but Miss Madeline Cournoyer remained until the summer of 1945.

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the French Unit were made available to the Swiss Section.[3]

After eighteen months as an integral part of the French Code Recovery Unit, Swiss systems were separated from the French Section and the Swiss Unit was again activated on 28 August 1944, headed by Dr. Robert H. Weidman, who had previously done considerable work on German and French translations and, while a member of the Cipher Section, had worked on some of the Swiss ciphers. By this time the problem had largely become one of production, and the strength of the Unit varied from 18 to 20 persons.

Captain Lyons and Lieutenant Frizelle began by sorting the accumulated traffic and, before the arrival of Lieutenant Brown, had edited a sufficient body of this traffic for IBM processing. The

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3. Messrs. Allan D. Garman and E. Prentice Abbott and Lieutenant Victor A. Noel were responsible for certain Swiss systems; Major and Mrs. Gordon T. Fish and Dr. Caleb Bevans assisted in the work as time permitted. To help with the German codes, Lieutenant Keith C. Seele was now transferred from the German Section and remained until January 1944. At about the same time came Miss Mary Bidwell, who remained with Swiss Problems until October 1944, and Miss Caroline Kennedy, who arrived in July and is still at work; they have spent most of their time on Swiss code recovery in French. Lieutenant Frizelle was transferred on 31 April 1943. From September 1943 to October 1944 Dr. Ruth Staley worked on code recovery problems in German. Early in 1944 Mrs. Constance Clark and Mrs. Mary B. F. Vandenberg, members of the French Code Recovery Unit for more than two years, spent some time on Swiss problems; and, later, Miss Margaret Fanning and Mrs. Antoinette Nelson were added. Dr. Helen Emerson, Dr. Walter Wall, and Miss Alvina Helmke joined the Unit to work primarily in German. Members of the Research Cipher Sections who worked on Swiss systems include Mr. Robert O. Ferner, Mrs. Genevieve G. Feinstein, Dr. A. H. Carter, Captain Herbert Maass, and Miss Betty Sherer.

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first group of messages sent to the Machine Room consisted of traffic in what was afterwards designated as the three systems SZA, SZB, and SZC. These codes were used exclusively by the Swiss for communications discussing the interests of the various belligerents whom the Swiss were representing. The confusion of the three systems in one index was natural: all three systems used the same code groups (each consisting of two digraphs of the vowel-consonant form), and the groups representing numbers had the same plain equivalents in SZA and SZB. The discriminants had been solved by the British, but the information did not reach the Signal Security Agency until January 1943. The method was quite simple: messages encoded in SZA were preceded by the date followed by the message number; messages in SZB used the reverse order for the number and date; while those in SZC omitted the date entirely.

The early index and message print had to be scrapped, since they contained heterogeneous material, but a new index and message print were completed on 22 February 1943. Several characteristics of Swiss cryptography provided fairly easy entry, and the first translation was prepared exactly two months later. The codes were uneciphered and one-part. The traffic from any station bore message numbers taken from the same series, and this included not only code messages but those in plain text as well. Thus, very early in the examination of the traffic the plain text was given careful attention.

[redacted]

EO 3.3b(6)
PL 86-36/50 USC 3605
EO 3.3(h)(2)

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EO 3.3b(6)
PL 86-36/50 USC 3605
EO 3.3(h)(2)

[redacted]

The British sent some additional information concerning these codes. They knew that most page symbols had a variant taken from the latter part of the alphabet, and that there was some sort of preliminary section placed before the vocabulary, but they seem not to have made much progress in the solution of these systems, and they sent no identifications. It was Lieutenant Brown who discovered the pattern for the digraph representing the line symbol for both the first variant code group and the second. In the case of the latter, the digraph was printed on the page in normal alphabetical order but with random omissions, each page following its own pattern, though there was some repetition of patterns.

The discovery was made on 28 March 1943 that each line of the code contained not one plain equivalent but two. The second was usually a spelling group, frequently, though not always, one composed of the first few letters of the plain equivalent which stood first on this

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line. At the bottom of each page the compilers had provided a begin-spell group for use with such spelling groups, and also a few groups for punctuation, as well as some blanks for addenda.

Another characteristic of Swiss cryptography which proved very helpful in analysis was the precision with which the code clerks indicated the exact inflectional ending desired. The cryptanalysts soon learned to take advantage of the aid.

At the outset of the work the English form of the code (SZC) did not appear in very great volume, but when traffic discussing the business of the English-speaking governments in the Far East began to be received, there was sufficient volume to justify an attempt at solution. Captain Glenn and Dr. Bevans worked for five days on this code early in April 1943. After that, there was a period when the system was neglected; in seven weeks several persons gave it some attention, estimated at about the time of one person for one month. Then on 18 June 1943 Mr. Abbott took over this work and produced the first decodement a week later.

In February 1943 the first solution of an SZD message was reached by the Cipher Section (B-III-c), which continues to process this traffic but sends it to the Swiss Unit for translation and reference.

The initial inquiry concerning Swiss systems elicited from the British the facts about SZA-SZB-SZC already noted, and also partial reconstructions of the two codes. The first was a trigraphic one-part

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enciphered code with French and German versions (SZG and SZH); the second, a tetranomic one-part enciphered code, also with French and German versions. These reconstructions were completed in the Signal Security Agency.

Another body of traffic early studied was found to be a trigraphic enciphered code with French and German versions (SZM and SZN). The solution was begun in the Swiss Section but in its initial stages was turned over to the Cipher Section. The encipherment was successfully removed with the collaboration on linguistic problems of the Swiss Section. Finally, the unenciphered material was returned to the Swiss Section in relative form for code recovery.[4] The first translations in this one-part code of 2000 groups was produced in a remarkably short time. Thirteen days, after code recovery began, sufficed for the French version, and only eight for the German. A compromised copy of each version was made available by the British on 25 September 1943. At the present time the process of removing the substitution encipherment of current traffic is performed by an electrical device consisting of two typewriters connected by a complex of wiring.

SZQ designates another pair of companion codes used by the Swiss for their most secret communications. Traffic in these codes produces

4. Lieutenants Brown and Seele worked on the German version (SZN), and Lieutenant Noel, Mrs. Clarke, and Mr. Garman did the work on the French (SZM).

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a high percentage of useful intelligence.[5] Work was begun in September 1943 but was soon laid aside since personnel was badly needed elsewhere. In the following month a partial reconstruction of the two codes (about three identifications on each page) was received from the British. The British also sent three keys for the encipherment. The study of the systems was thereupon resumed, and by March 1944 about a hundred keys had been recovered here.[6] Code recovery is now advanced to the point where every message can be translated.

SZR is the latest Swiss code to be studied, the only one in which much code recovery is still needed. While in many ways similar in type to SZA-SZB-SZC, it is two-part, and is the only code of this type used thus far by the Swiss. If there is a German version, it has not yet appeared in the traffic. The traffic is used exclusively for discussion of the interests of the belligerents represented by Switzerland. In December 1944 about 2,000 identifications had been made; the maximum number of permutations of the code group was 14,400, the largest of the known Swiss codes.[7]

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5. The preliminary research was performed by Miss Alice Joys and Miss Louise Koegel, assisted by Lieutenant Sidney Jaffe, a member of the French Code Recovery Unit.

6. The work on code recovery was performed in the case of the French version by Dr. Marion Griggs and Lieutenant Noel; in the case of the German version by Dr. Staley.

7. The work on code recovery was performed by Miss Madeleine Cournoyer, Miss Caroline Kennedy, and for a time by Miss Mary Bidwell.

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There remain to be mentioned two systems which were solved by the Cipher Section in 1943. SZP, the first, was a polyalphabetic substitution cipher using 10 alphabets. It appeared in traffic between Bern and all parts of the British Empire except London. Solution was reached, except for some minor details, in June 1943. SZS, the second, was another cipher system using 20 alphabets, which appeared only in the Bern-Caracas circuit. It was solved by the Cipher Section in October 1943.

Except for traffic in SZR, on which work is constantly in progress, all Swiss systems thus far observed have been solved except for a few messages which start in SZA-SZB-SZC and then switch to an unreadable system. This traffic is too light for solution and may be an encipherment of the basic code by displacement or by some form of substitution.

EO 3.3b(3)
EO 3.3(h)(2)
PL 86-36/50 USC 3605

The Swiss also used for [redacted] This traffic, which was given the short title SZD, was regularly studied by the Machine Cipher units but was sent upon solution to the Swiss Section for translation.

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CHAPTER VIII. THE SPANISH AND SPANISH-AMERICAN SYSTEMS[1]

As in the case of the French systems, the study of the Spanish and Spanish-American systems began in the unit known simply as "Mr. Bearce's section,"[2] which was formed about April 1941 and given the assignment of analyzing all systems using the Romance languages except Italian.[3] Some research on Spanish-American problems had been performed at an earlier period (1936-1938) by Dr. Abraham Sinkov on duty at Quarry Heights, Panama Canal Zone.[4] His report for the quarter ending 31 December 1937 is available (IR 5001). According to this report the Mexican government had previously used a polyalphabetic cipher with 15 random, unrelated alphabets (of which one set of alphabets had been solved) and a five-letter code. Work on Colombian traffic had revealed that the Colombians were using polyalphabetic ciphers based on five alphabets, each diplomatic representative being assigned a different set of five. The sets used in the Rio de Janeiro, Rome, and Washington circuits had been recovered. All that had been learned of the Venezuelan systems was that they were similar to the Colombian,

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1. The statements made in this section are based on interviews with Colonel Solomon Kullback, Major Javier H. Cerecedo, Captain Saul K. Raskin, Dr. James V. Rice, Mrs. Delia A. Sinkov, Mr. R. Woodrow Harrison, Mr. Donald L. Fabian and Misses Gertrude E. Ullman and Ann Davis.

2. See chapter VI, section A and footnote 2, page 112.

3. For beginnings of which, see chapter V, section A, page 98.

4. MI-8 had, between the years 1917 and 1929, done considerable work on systems in the Spanish language but the continuity had been broken in 1929. See Historical Background of the Signal Security Agency, volumes Two and Three.

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but traffic intercepted was too small in volume for solution. As for Costa Rica, the report states that there had been great difficulty in intercepting messages from Costa Rica and suggested that steps be taken to arrange for interception of Costa Rican traffic at some other station.

No further progress had been made on Spanish-American traffic, and Mr. Bearce's section seems to have been concentrating its efforts on Mexican traffic. Some progress had been made subsequent to April 1941 in the Signal Intelligence Service at the Munitions Building on certain Mexican cipher systems (MXC, MXD, MXE, and MXH), on a Colombian cipher (COA), as well as upon Brazilian code traffic, but continuity with the past had been broken, and knowledge of this early work was lost.

Shortly after Pearl Harbor--it is not certain whether in December 1941 or January 1942--a part of Mr. Bearce's staff was withdrawn and activated as the so-called South American Section under Lieutenant (now Major) Leroy M. Glodell. In spite of its designation, the Section studied traffic of both the Iberian governments and of some Central American governments as well.[5] The following types of traffic

5. With Lieutenant Glodell was Miss Rosalie Harding (Mrs. Bash), and, by January 1942, Lieutenant (now Major) Raymond R. McCurdy and Miss Delia A. Taylor (Mrs. Sinkov). Messrs. Wayne S. Barker, Hugh Davidson, Robert Evans, and Mortimer Proctor were in the Section by 1 March 1942, when Captain Javier H. Cerecedo joined the South American Section. They began work on SPA, a Spanish government system based on a compromised code enciphered with additive.

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were being studied during the first few months:

Spanish government traffic
Mexican code traffic
Mexican cipher traffic
Argentine code traffic
Chilean code traffic
Colombian cipher traffic
Dominican cipher traffic
Venezuelan cipher traffic
Brazilian code traffic
Portuguese code traffic

The last two could have been studied in the South American Section for only a very short time, for on 8 January 1942 all work on both Brazilian and Portuguese systems was suspended, not to be resumed again until just before the dissolution of the South American Section in August 1942.[6]

In the period from March to June 1942 the South American Section, in common with the entire Signal Intelligence Service, underwent considerable expansion.[7] The enlarged staff performed the operation of additive recovery, code recovery, cipher solution, and translation of

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6. See section D.

7. The following persons were added in this period: Lieutenants John H. Utley, George M. Sayre, and Jose Quintana; Sergeant Jose Armendariz; Drs. Revilo P. Oliver, James V. Rice, and Lowell B. Ellis; Messrs. Donald L. Fabian and Julian DeGray; Mrs. Marjorie Thielmann; and Misses Charlotte Morris, Ann O'Brien, Gertrude Ullman, Nancy McWhorter, and Martha Montooth. The Section now had the advantage of including several persons who had done graduate work in Spanish (Utley, Oliver, Rice, Ellis, Fabian, Ullman); another group for whom Spanish was a native language (Cerecado, Quintana, Armendariz); certain others who, belonging to neither of the first two categories, nevertheless spoke Spanish extremely well (Glodell, DeGray), besides a somewhat larger group containing cryptanalysts and others who knew Spanish well enough for the tasks before them.

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the resultant plain text.[8]

The progress of cipher analysis in the Section may be measured by the solution of the Mexican two-alphabet cipher and the Mexican "Guion" cipher (MXG) before April 1942, and of the Chilean five-alphabet cipher (CLE) in June. During the summer Colombian (COA), Dominican (DOA), Cuban (CUB and CUD), Venezuelan (VZB), and Mexican (MXC, MXE) ciphers were solved.

Another feature of the work of the South American Section was collaboration with the Office of Censorship in the cryptanalytic examination of certain questioned documents intercepted in the mail. This involved the reading of a considerable amount of material in an effort to discover open code. Most of the results were negative, but one letter, written in Catalan, was found to contain a polyalphabetic cipher concealing reports on espionage in Spanish ports.

In June 1942 the South American Section was gradually dissolved, as was the French Section from which it was an offshoot. Certain units were among those first moved to Arlington Hall in that month. Among these was a new unit formed by Lieutenant McCurdy and Mr. Evans which

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8. Lieutenant Utley and Mr. DeGray worked principally on Mexican codes (MXA, MXB); Mrs. Thielmann and Sergeant Armendariz chiefly on the Chilean code (CLA). Captain Cerecedo and Mr. Davidson were responsible for ARB and Mr. Fabian for ARA. Messrs. Proctor, Evans, and Barker attacked the cipher systems, and Lieutenant McCurdy and Miss Taylor (who, however, did not remain long in the Section) worked on the removal of the additive used with the Spanish code (SPA).

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continued to solve the additive encipherment of SPA. Shortly afterward, the study of Brazilian systems was resumed by Lieutenant Glodell and Dr. Revilo P. Oliver (who had recently joined the South American Section). Lieutenant Glodell and Dr. Oliver were detached, after the South American Section was moved to Arlington Hall in August 1942, to become the nucleus for the new Portuguese-Brazilian unit.[9] On 24 August 1942 the Spanish-American Section was broken up into four new units:

1. The Spanish Code Recovery Unit;
2. The Cipher Solution Unit;
3. The Translation Unit; and
4. The Spanish Additive Unit.

A. The Code Recovery Unit (B-II-a-5)

The new Unit was placed under the direction of Captain Javier H. Cerecedo, and formed an integral part of the Romance Language Code Recovery Unit (B-II-a), which was for a short time under Captain H. F. Bearce and then under Captain Gordon T. Fish, and which at this time contained the Italian, French, and Portuguese-Brazilian Code Recovery Units. Captain Cerecedo remained in charge until April 1943, when he was placed in charge of all additive-recovery units. His successor was Lieutenant Utley, who was transferred to another station in September 1943 and was succeeded by Lieutenant Carl McGee. Lieutenant McGee directed the work until February 1944, when the present head

9. See chapter IX.

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of the unit, Mr. Donald L. Fabian, took charge.[10]

The task of the Spanish Code Recovey Unit was, in general, the study of all codes used by Spanish-American governments, except the Mexican and Chilean codes, which were already assigned to the Translation Unit. Because some of the Spanish-American governments were at this time using only cipher systems, other government systems were not being intercepted at all, and some code traffic was not processed for lack of personnel, the Spanish Code Recovery Unit studied in the first few months of its existence the code systems of only five governments (Argentina, Bolivia, Chile, Ecuador, and Venezuela).

Since the codes used by Spanish-American governments were generally one-part with an occasional simple encipherment, the problem was largely one of code recovery. Such additives as were used presented no special problems, and there was no need for a special additive-recovery unit. The Spanish Additive Unit, under Lieutenant McCurdy, was engaged solely in the solution of Spanish government traffic, and there was no correspondence between this problem and those in Captain Cerecedo's unit.

Code systems have now appeared from all Spanish-American governments except Costa Rica,[11] which appears not to use cryptographic

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10. Besides Captain Cerecedo, the following persons constituted this group: Lieutenant Utley, Dr. Rice, Messrs. Davidson and Fabian, and Mrs. Thielman; and Lieutenant Maurice Silverstein soon joined the staff.

11. Strangely enough, it did during World War I.

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communications. Traffic from Paraguay is received but not studied, and Honduras traffic has not yet been identified as code or cipher. Code traffic from all other Spanish-American governments has been studied and the systems for the most part solved, so that at the present time the work of the Spanish Code Recovery Unit is largely in the production stage.

Three Spanish-American codes (MXA, MXB, and CLA), though belonging to the general field included in the assignment of the Spanish Code Recovery Unit, were sufficiently recovered to be turned over to the Translation Unit. The separation of these codes from the others proved unsatisfactory; eventually most of the personnel of the Translation Unit and all of its functions were absorbed by the Spanish Code Recovery Unit.

The Spanish Code Recovery Unit was not responsible for Spanish-American cipher systems, as they were assigned to the Miscellaneous Cipher Unit of the Cipher Section. In the summer of 1943, however, B Branch of the Signal Security Agency was reorganized in order to group the subsections according to language rather than cryptographic method. As a result, the Spanish-American cipher systems, by this time more or less solved, were turned over to the Spanish Code Recovery Unit. The absorption of both the Translation Unit and the Cipher Unit expanded the function of the Spanish Code Recovery Unit to include the study of all cryptographic systems employed by Spanish-

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American governments.[12]

At present most of the systems have entered the production stage; i.e. messages in cipher systems can be deciphered completely, or new keys solved upon receipt, and messages in code systems are for the most part readable. There remain, of course, a few cryptanalytic problems.

B. The Cipher Solution Unit

In August 1942, at the time of the move to Arlington Hall Station, a new Cipher Unit was formed from the old South American Section by the transfer of Mr. Proctor as head, and Misses Ullman and McWhorter as his assistants. The new unit formed part of the Cipher Section (then called B-III), under Lieutenant Frank B. Rowlett, and was known as the Miscellaneous Cipher Unit to distinguish it from units working on other specialized cipher problems. Its mission was the solution of all cipher systems not specifically belonging to the other cipher units, but in actual practice all of the systems studied turned out to be Spanish-American in origin. Heretofore, all of these ciphers had been substitution systems, but now transpositions were studied for the first time.

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12. The personnel transferred from the Translation Unit included Dr. Lowell B. Ellis, Mr. Julian DeGray, and Miss Betty McCann. Lieutenant Carl McGee joined the Unit in December 1942 upon receiving his commission. In 1943 Miss Noma Riley, Mr. Humes H. W. Hart, Miss Louise Walker, and Miss Margaret Woods were added, as was also Lieutenant J. C. Apollony. For a time Lieutenant Apollony was detached to be in charge of the Plain Text Unit, which existed between August 1943 and February 1944. Of these persons all have since been transferred elsewhere.

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Miss McWhorter was responsible for the solution of a number of transposition problems especially through the application to them of the electromechanagrammar. A loss was sustained when Mr. Proctor resigned at the end of October to enlist in the Army. Mr. Proctor had invented the process of rapid key recovery for Mexican MXC, recovered (on the basis of Lieutenant Barker's earlier work) substitution tables for MXE, and advanced the solution of Chilean ciphers. He was succeeded by Lieutenant Raskin, who had been working in the French Section.[13] Finally, after most of the cipher systems used by Spanish-American governments had been solved, the Cipher Solution Unit was joined, so far as its functions were concerned, with the Spanish Code Recovery Unit to form the present South American Section of B-III-a. The personnel, however, was transferred elsewhere.

C. The Translation Unit

At the time of the move to Arlington Hall Station (24 August 1942), a new unit, known as the Translation Unit,[14] was organized with Lieutenand Gordon W. Ross as its head.

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13. Lieutenant Raskin was in charge until March 1943 when he was succeeded by Lieutenant Louis Smadbeck, who, with Lieutenant Robert C. Masenga, had joined the Cipher Solution Unit somewhat earlier. Lieutenant J. C. O'Neill was a member of this Unit for a time in 1942, as were Mesdames Phyllis Rhodes and K. Burn, Miss Julia Barker, and Mr. Roscoe Adkins.

14. Not to be confused with the French Translation Unit (B-I-f) coexistent with it.

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The Translation Unit, charged with the translation of all plain text except the French, took over the task of rendering into English messages sent in certain Spanish-American codes (MXA, MXB, and CLA), which, having been sufficiently recovered, had reached the translation stage. It translated all traffic in solved Spanish-American cipher systems, but it did not translate the messages from the Spanish Code Recovery Unit under Captain Cerecedo, or from the Spanish Additive Unit under Lieutenant McCurdy; for these two units did their own translating.

Decoding and deciphering were not performed by the Translation Unit but by a part of the Decode Unit (B-I-c).[15] It was found, however, that the codes which the Translation Unit had already received, frequently involved considerable code recovery before a message could be translated. Furthermore, any cryptanalytic skill which the members of the Unit might develop (and at least two members of the staff did possess considerable skill in this direction) would be lost to the cryptanalytic units. It had always been the experience of the Signal Security Agency, moreover, that messages in one system, or even in plain text, might discuss subjects also treated in systems less completely solved and such isologs could be used to best advantage only when all the traffic of a government was processed by the same groups of persons. Dissatisfaction with the divided arrangement brought about a gradual

15. See chapter VI, section G.

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transfer of personnel to other units, the personnel working on Spanish traffic rejoining the Spanish Code Recovery Unit.[16] Lieutenant Ross was transferred elsewhere in June 1943, and after that the Translation Unit was abandoned and the function of translation was assigned to the several cryptanalytic units.

D. The Spanish Additive Unit

At various times separate units were formed for the purpose of studying the Iberian systems. Currently (August 1945) the South American and the two Iberian groups operate as three separate sections, but the original studies were made by members of Lieutenant Glodell's unit.

The first project undertaken by the Spanish Additive Unit in January 1942 was recovery of additive used to encipher the code held by the Spanish

[redacted]

16. Among these were Mr. DeGray, Dr. Ellis, and Miss McCann. Others who belonged to this unit included Lieutenant Carlos Bernstein (later transferred overseas) Mr. R. Woodrow Harrison (who later rejoined the Portuguese-Brazilian Section) Mr. Charles W. Wonder, and Sergeant Fred Allred.

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EO 3.3b(6)
PL 86-36/50 USC 3605
EO 3.3(h)(2)

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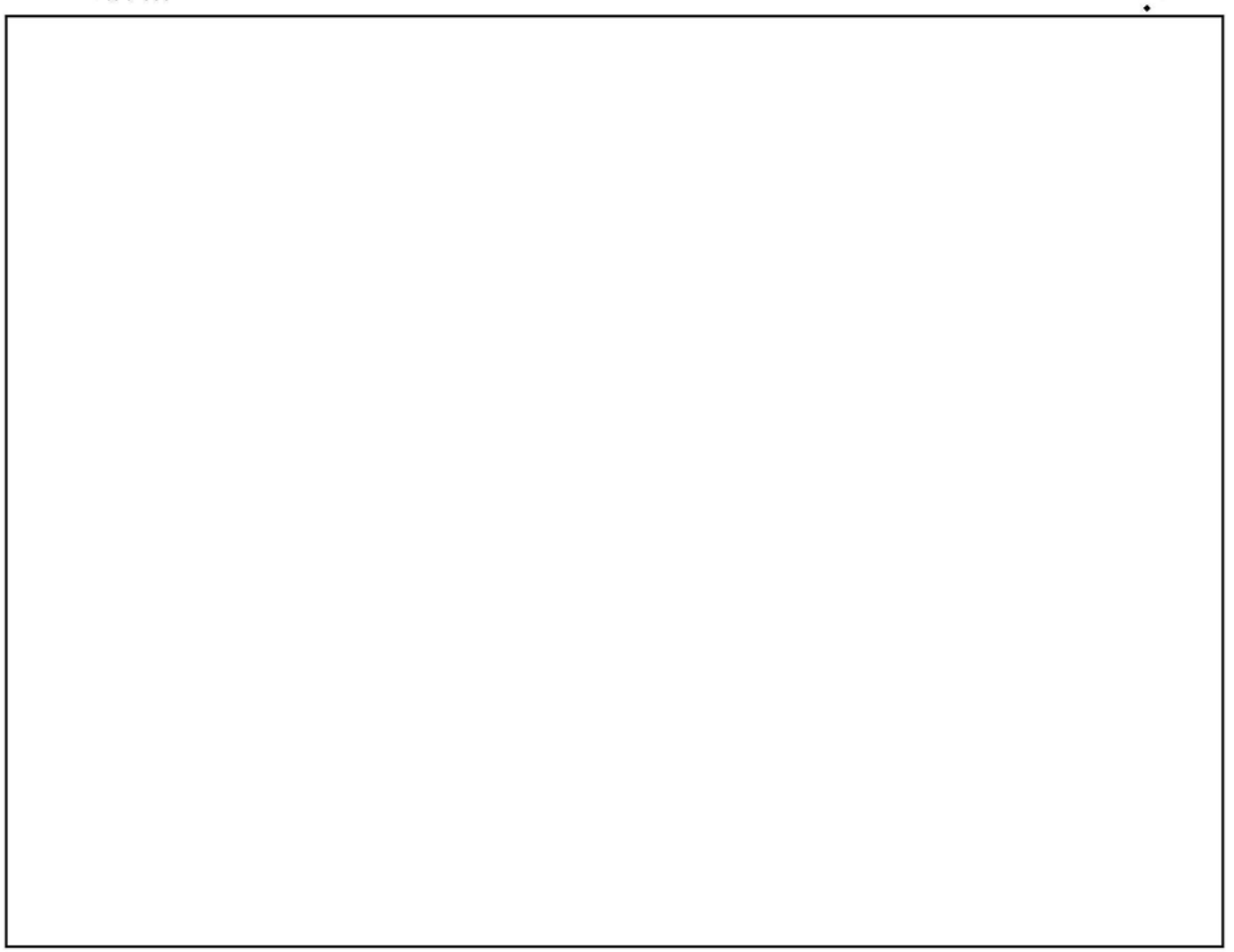
EO 3.3b(6)
PL 86-36/50 USC 3605
EO 3.3(h)(2)



Later the Spanish Additive Unit received from GCCS a photographed copy of the code book for SPE, another enciphered code system used by certain Spanish consular offices. In May 1945 the group received from the same source a copy of part of the additive tables used for the Istanbul circuit. Work on SPB, a diplomatic system using a re-paginated version of a one-part code published in 1915, yielded

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17. Ways and means were found to obtain a copy of a number of such tapes while they were current.

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consistently satisfactory results. A Spanish colonial system (SPC) in use between Madrid and Santa Isabel has been in research, but all results to date have been negative. SPD, a military attaché system, presumed to be machine cipher, has also been studied without satisfactory results.[18]

In addition to the three Spanish language units already described, there was a group, functioning as part of what was then known as the Decode Unit (B-I-c), which decoded the traffic in Spanish language code systems later to be translated in the unit under Lieutenant Ross.[19] Systems processed by this group included those of the governments of Argentina (ARB), Chile (CLA), Mexico (MXA, MXB), Cuba (CUA), Spain (SPB), and Venezuela (VZA). Toward the summer of 1943 the group also assisted in decoding traffic in some of the Portuguese systems. The Spanish Group of B-I-c was abandoned in July 1943 and its functions, as well as some of its personnel, were transferred to the Spanish Code Recovery Unit, which thus became responsible for all Spanish-American systems.

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18. Since April 1944 Miss Ann Davis has been in charge of the Spanish Section, with Miss Erma Taylor, Miss Clara Sigafoose, Miss Mary Leon, and Miss Ruth Peters responsible for cryptanalytic and linguistic phases of the work. Other personnel aid in logging and decoding.

19. The supervisor of the Spanish group of B-I-c was Miss Betty Moulton (Mrs. Leonard) who had with her among others, Miss Alda Ross, Mrs. Clara Weeks, Miss Fairfax Haar, and Miss Jean Brown.

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CHAPTER IX. THE PORTUGUESE AND BRAZILIAN SYSTEMS[1]

The first examination of Portuguese and Brazilian traffic in the Signal Intelligence Service was made in the spring of 1941, when Mr. Bearce's section was formed to work on the Romance language traffic.[2]

Only a small amount of information was available at the time, that produced by the cryptanalytic unit operating in Panama. The report of this work for the quarter ending 31 December 1937 (IR 5001) states that the permutation table of a Brazilian five-letter system (BZC) had been reconstructed, and it was known that the Brazilians were also using another five-letter system (BZD?) and a digit system (BZI?) as well. In December 1937 it was not known that the code groups of BZC were taken bodily from the first edition of the Mascotte Commercial Code (Hamburg, 1922). The Portuguese systems were examined in 1942 by Mr. Wayne S. Barker, who joined the Signal Intelligence Service in that year.

The results of some early work on BZD was received from the British after May 1941, when two members of Mr. Bearce's section, Mr. Allen D. Garman and Mr. G. W. Ross, assisted at times by Lieutenant Commander Rhodes of the United States Coast Guard, did some work on Brazilian traffic. A message print and index of the traffic in both

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1. The statements made in this chapter are based on interviews with Dr. Revilo P. Oliver and upon one document (undated), History of Portuguese-Brazilian Section, prepared by Dr. Oliver in the spring of 1943 with the help of Captain Leroy M. Glodell. See also Portuguese Codes and Ciphers 1941-1944 (IR 4051).

2. See chapter V, section A, page 112.

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BZC and BZD were prepared, with the result that the alphabetical range of many BZC pages was determined by the identification of the more common groups. It was also discovered that the book contained a preliminary section of punctuation and special signs, as well as an appendix of proper names. Additional identifications were made in BZD, but since the code is repaginated (i.e. partly one-part, partly two-part), progress was much slower. Translations of BZC messages were also prepared in some cases, but at this time only about half the groups in any BZC message had been identified.

Before January 1942 a small machine index of traffic in other Brazilian systems used in the Washington circuit and another index of Brazilian five-digit traffic used in various European circuits were prepared. This was the status of work on Portuguese and Brazilian systems when Lieutenant Glodell was directed to suspend temporarily all operations on those systems. Interception, however, continued, and, in the first half of May 1942 (the only period for which records are still available) 97 Brazilian and 141 Portuguese messages were received and filed for future use. In June 1942 Dr. Revilo P. Oliver, later to be closely identified with every phase of the solution of systems in the Portuguese language, joined Lieutenant Glodell's unit, and permission was obtained for him to resume the study of Brazilian (but not the Portuguese) systems. Since BZC was at that time readable, and the major part of most messages could be translated, attention was directed primarily to the traffic in this system and to a lesser degree to

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BZD, in which, about 1 August 1942, the first translation was prepared.

Soon after the arrival of Dr. Oliver a new unit was formed to work on all Portuguese and Brazilian systems and placed under the direction of Lieutenant Glodell, with Dr. Oliver and two clerks as the staff. The assignment at first did not include cipher systems, which at this time were being studied in a special unit. Since only one cipher system had been intercepted, however, the unit under Lieutenant Glodell was actually working on practically all Portuguese language traffic. A little later the two clerks were replaced by two enlisted men, Sergeant Robert Armstrong and Corporal Cecil Porter. The solutions of the two cipher systems POP and POQ were completed by Corporal Porter on the dates when the first messages were received.

Another period of expansion in the organization of the work on Portuguese and Brazilian systems took place in late November and early December 1942, when a group of officers were assigned to the unit.[3] These officers confined their attention to Brazilian systems. When Captain Glodell was transferred on 1 May 1943, Lieutenant Haggard succeeded him as Officer in Charge of the Portuguese-Brazilian Section, a post which he has held ever since, except for about three months in the summer of 1944.[4] Of these officers, only Lieutenant Haggard had had

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3. Lieutenants John V. Haggard, Eugene F. Frey, Wilbur Myers, Theodore F. DeGomar, and Alvaro F. Galvan.

4. Lieutenant Frey was transferred to another station in February 1944, as Lieutenant Myers had been somewhat earlier. Lieutenants De Gomar and Galvan were relieved of their assignments in 1944, but the former was returned to the unit in October.

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academic training in the Portuguese language, and Lieutenants Frey and Myers had taken a short course in Portuguese at the Officer Candidate School, Fort Monmouth. It cannot be said that, with the exception of Lieutenant Haggard, any of these officers possessed adequate linguistic training for the difficult tasks that they faced.

During the spring of 1943 both Sergeant Armstrong and Sergeant Porter were relieved for duty elsewhere. From time to time, beginning as early as November 1942, certain civilians had been added to the unit.[5]

In January 1944 Captain Lowell G. Derbyshire assumed direction of B-III-a, a section then comprising all units working in Romance languages, except French, and in other languages. He adopted at once a policy of greater fluidity in the work of the section under his command. In line with this policy and to make Dr. Oliver's experience available to other units, the latter, though still responsible for cryptanalytic progress in the Portuguese-Brazilian systems, was placed in charge of research in B-III-a. A further change was the use of clerical personnel in more than one unit. For example, decoders might be shifted at times from Spanish problems to Portuguese and vice versa.

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5. Mr. Sidney Glazier, Miss Eleanor Ely, Miss Letitia Williamson, Mrs. Inez Wright, and Miss Mary Dunn, the last two being still on the staff. In November 1943 Mr. R. Woodrow Harrison was assigned to work on the Brazilian systems, chiefly BZD and BZF; he recently completed in 1944 the reconstruction of the permutation table of the former system.

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Foreseeing the ultimate transfer of most of the military personnel in the Portuguese Unit, Captain Derbyshire instituted a course in the Portuguese language, which was taught by Dr. James V. Rice, who had been for about two years a member of the Spanish-American Section. This course was attended by about twenty persons, military and civilian, with the result that the better students were able, after six weeks (three hours a week) to read ordinary Portuguese plain text. It was hoped that by training a number of persons, a few at least would gain sufficient knowledge of the language for assignment to the Portuguese-Brazilian Section. Though this course, good as it was, was too short for adequately training any personnel to do code recovery in the Portuguese language, many of the problems had reached the stage at which they could be managed by less skilled personnel. Some students of the course are now engaged in decoding and translating traffic. Yet it cannot be said that the need for well-trained experts in Portuguese has ever been met.

After January 1942, active work in Portuguese systems did not begin again until midsummer, by which time the importance of Portuguese traffic had increased, since Lisbon had become one of the few neutral capitals still in contact with sources of information in the Axis countries. The newly activated unit under Lieutenant Glodell therefore turned the major portion of its attention to the Portuguese traffic.

Examination of the messages on the Washington circuit established

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the fact that several systems were in current use. Two enciphered codes were recognized, POD and POJ. Without a machine index, about 150 identifications had been made in POD, and a few tentative conclusions about encipherment of POJ had been reached, when, in September 1942, photographs of British work on both POD and POJ were received. In this, all common groups had been identified, and the cipher equivalents of about 80 per cent of the pages had been determined. Translation of current POD messages could now begin. The general outlines of the basic POJ code had been reconstructed by the British, and they had made progress on the substitution tables and transposition. Soon full tables of substitution and transposition were reconstructed. The British also knew that POK was only another encipherment of the basic code underlying POJ, and not, as had been supposed, a different book; so this system too could speedily be solved. Moreover, the British supplied information concerning the encipherments of POF and POI: a large number of groups in these encipherments had been correlated with the POJ encipherment. Work was at once started on POF and POI, and although at first messages could not be fully decoded, values were steadily recovered and partial translations were soon possible.

Late in September 1942 the unit received, through the cooperation of the FBI, photographs of two Portuguese codes. One of these proved to be the fourth edition of the diplomatic code, now known in three

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encipherments (POA, POB, and POR). Traffic in POA was relatively light; the system was even then practically obsolete. The relationship, however, between this code and the POB encipherment used in Mexico City traffic was recognized, and it was soon possible to submit partial POB translations also. The second code (the fifth edition) received from the FBI was used on the New York circuit; although unimportant in itself, this material proved to be extremely helpful in the solution of other Portuguese systems because of their relationship.

The substitution and transposition patterns of POH were solved, and a beginning was made on the recovery of values, with the result that the first translation was made about the first of December 1942. Traffic on the Buenos Aires, Ankara, Budapest, and Bucharest circuits was recognized as an encipherment of the sixth edition (POJ), and a beginning was made on what was then the most complicated Portuguese system (POG). Solution of this system was facilitated by the interception of a series of messages discussing the same subject in other systems, and the first translation was made on 23 December 1942.

By the beginning of 1943 the Portuguese Unit was reading current traffic in POA, POB, POC, POD, POE, POF, POG, POH, POI, and POJ. Translations were made of at least part of every message. Since the staff was too limited at the time to handle both the diplomatic and colonial systems, it was decided to do nothing with the less important colonial traffic. Later, however, in the summer of 1944, when the British sent

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reconstructions of a number of colonial systems, active work was taken up on the colonial systems so far as the scant volume of intercepted traffic permitted.

Early in 1943 a beginning was made on POK, which is a secondary encipherment added to POJ. In the first six months of 1943 also appeared the first Portuguese cipher systems: POQ appeared on 13 April 1943 and POP on 6 June 1943, and in both cases the first messages were solved on the day they were received. POR appeared on 20 April 1943 in the Washington and Mexico City circuit and was soon recognized as distinct from POA or POB but based on a repagination of the same code. POL appeared on 7 July 1942, but little was done on it until 1943, by which time sufficient traffic had appeared for a machine index. About this time a photograph of the sixth edition of the Portuguese diplomatic code was received from the FBI. This has proved invaluable, since this edition has been used with no fewer than eight encipherments up to the present.

In the autumn of 1943 the Portuguese colonial office adopted the Hagelin machine. This traffic, like later military ciphers, is processed by the Hagelin Section and sent, when deciphered, to the Portuguese Section for translation.

As for Brazilian systems, it was found that not only BZC and BZD but at least three other systems were present in the traffic, including

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a pentagraphic system with transposition or other encipherment, and a second with tetragraphic groups. The latter (BZF), which included the largest bulk of the traffic, was studied first. The system of "dominant letters" (a code-group limitation) used in the third position of each tetragraph was identified, and a message print and index was prepared. About 150 identifications in BZF had been made when it was decided to suspend work on it in order to give more time to Portuguese traffic. At the same time a general survey of other Brazilian systems was undertaken. The cipher system BZD was segregated and turned over to the Cipher Section for solution. A large part of unreadable traffic from Caracas, Mexico City, Bogota, and Ciudad Trujillo was recognized as a series of encipherments of the BZF system. Messages from Cayenne were in a code (BZH) not otherwise known and set aside for accumulation of traffic. Traffic in BZE, on the New York circuit, had been examined and sufficient identifications made to indicate its unimportance. It was later discovered to be nothing more than the second edition of the Mascotte Commercial Code in both enciphered and unenciphered forms. The importance of BZH was recognized, but no study of it was made for lack of sufficient personnel.

In August 1942 the attention of the Portuguese-Brazilian Section was largely focused on Portuguese systems, to the neglect of Brazilian systems, and this condition prevailed until November, when Mr. Glazier began work on BZC and BZD. Soon afterwards, Lieutenant Frey took over

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BZC, and in March 1943 Sergeant Armstrong took over BZD. At about the same time an index of BZF traffic was made, and active work on this system was initiated, the first translation being prepared in March 1943. Copies of British work needed to be done before current traffic could be completely read. In the case of BZA, traffic had almost entirely ceased.

In 1944 new systems were introduced but in such limited volume that solution was impossible, though the general nature of the new systems was understood. The chief solutions in the field of Brazilian cryptography include BZC, BZD, BZF, and, though less complete, BZH. BZA and BZM, systems based on the same compilation as BZD, have been solved. Lack of traffic has caused 16 of the known systems to remain unsolved. Of these, six are known only from British information (BZR-1 to BZR-6); five are ciphers in which little traffic is intercepted (BZB-1, BZB-2, BZO, BZP, BZR-7); two (BZG and BZR-8) are special purpose codes used very infrequently; and the remaining three (BZL, BZN, and BZQ) are codes with a limited distribution, introduced too recently for an adequate accumulation of traffic.

Descriptions of the cryptography and cryptanalysis of all Portuguese and Brazilian systems studied in the Signal Security Agency have been prepared for the Cryptanalytic Series: Portuguese Codes and Ciphers 1941-1944 (IR 4051) and Brazilian Codes and Ciphers 1917-1945 (IR 5044).

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CHAPTER X. THE SYSTEMS OF THE NEAR AND MIDDLE EASTERN GOVERNMENTS[1]

On 17 December 1942 a newly formed group, at first known as B-II-a-13 (later as B-III-a-5 and now as B-III-d-3) was assigned to cryptanalysis of systems used by governments in the Near and Middle East. These included at first the following governments: Egypt, Iran, Iraq, Saudi Arabia, and Turkey; Ethiopia was added to this list in June 1944. The task of this group may be presented as follows:

Arabic: Iraq (one system: IQA[2]); Saudi Arabia (two systems: ABA and ABB);[3]

English: Ethiopia (one system: ETB);

French: Egypt (one system: EGA); Ethiopia (one system: ETA);

Persian: Afghanistan (two systems: AFA, AFB); Iran (three systems: IRA, IRB, IRC);

Turkish: Turkey (ten systems: TUA, TUB, TUC, TUD, TUE, TUF, TUH, TUJ, TUK, TUL).[4]

When the group was activated, it consisted of two persons:

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1. This chapter is based on interviews with Lieutenant Joseph R. Salem, Mr. Hughes O. Gibbons, and Sergeant Oliver F. Egleston and upon the progress reports of the Near and Middle Eastern Section from December 1942 to the present, signed by Lieutenant Cyrus H. Gordon, Lieutenant Joseph R. Salem, and Messrs. Hughes O. Gibbons and Lewis E. Bates.

2. At the time two encipherments of this IQA were recognized (IQB and IQC) and were thought to be separate systems.

3. Two encipherments (ABC and ABD) were recognized at the time and were taken for separate systems.

4. Two encipherments of TUE (TUG and TUI) were regarded as separate systems.

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Lieutenant Cyrus H. Gordon, a professional Semitist with four years of graduate work in American universities and four years of travel in Arab lands, and Lieutenant Joseph R. Salem, a native of Syria with an excellent knowledge of colloquial Arabic. Less than a month later two other persons joined the group: Lieutenant Benjamin Schwartz, an Indologist with 16 years of experience in the Indic languages and Corporal Oliver F. Egleston, who had lived two years in Palestine and had studied Arabic in Harvard and Yale Universities.

Within the first few months the group was expanded by the addition of a number of other persons who possessed some previous acquaintance with one or another of the Semitic languages.[5] But not one was an expert in Turkish; indeed, only Lieutenants Schwartz and Downey had even slight acquaintance with it. In Persian and Turkish therefore, the unit lacked trained personnel entirely. The situation in Arabic was somewhat better, but none of the persons available was, at the time he entered the unit, able to read a newspaper in Arabic. Some of them knew colloquial Arabic well enough for conversational purposes, and Lieutenant Gordon knew it from the philological point of view, but, in general, adequate training in contemporary literary Arabic was lacking.

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5. These included Miss Clarice P. Bailey, a graduate student in Arabic in Columbia University; Lieutenant Glanville Downey; Mr. Lewis E. Bates; Mr. Hughes O. Gibbons, a librarian who had taught for five years on the faculty of the American University in Cairo; and Miss Ethel R. Albert, who, though born in America, is of Syrian descent and speaks Arabic.

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Linguistic deficiencies as serious as these might have been supplied by recruiting either professional scholars fully acquainted with the three languages or Americans long resident in the oriental countries, or even naturalized Americans who had been born in those countries. But professional scholars in these languages are few in number, and only one (Mr. Gibbons) was ever recruited from among the resident Americans of the second group; considerations of security made recruiting in the third category unattractive. Repeated attempts to recruit military personnel trained by the Army Specialist Training Program always resulted in failure.[6] The result was that the group working on systems of the Near and Middle East had to carry on its work with a staff insufficiently trained at the outset to perform the necessary linguistic tasks. This experience is in marked contrast to that of GCCS, which had the incalculable advantage of an adequate number of experts in all of the oriental languages.

The primary task, therefore, was that of increasing the knowledge of Arabic of those who already knew something of that language and to train the entire staff in Turkish. This situation was acute because of the volume of the traffic. The traffic in the Turkish systems was moreover, the most voluminous, and the importance of Turkish traffic

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6. This failure is surprising since in at least one instance an enlisted man working on Japanese problems in this Agency, reported that he had had ASTP training in Turkish!

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from the point of view of intelligence was, as always, greater than that of any of the other systems studied. It was necessary therefore to give instruction in Turkish to two groups: (1) persons already acquainted with one or another related language, and (2) persons without such experience but with aptitude and energy sufficient to approach a language unlike European tongues. Accordingly, an extensive program of training in Turkish was, almost from the very beginning, a constant feature of the work of the unit, at times as much as an hour a day being spent in such instruction. The burden of this instruction fell largely upon Lieutenant Schwartz; Sergeant Egleston completed, on 5 August 1943, a grammar of the Turkish language presented in eight lessons which drew illustrations from Turkish telegraphic texts. The training program was a decided success. Meanwhile, cryptanalytic problems were not ignored.[7]

When work began in December 1942 attention was directed to Iraqi traffic, though Turkish and Iranian were also studied, but by the end of the first month the emphasis had shifted to Turkish where it remained thereafter. For three weeks Lieutenant Salem and Corporal Egleston were detached from the unit to transcribe in the Library of

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7. Among the cryptanalysts were the following who joined the unit early in 1943: Mrs. Flobeth Ehninger, Miss Elmire Lobeck, Miss Sally Peebles, and Miss Mary M. Bennett. Others who have made substantial contributions to the cryptanalysis of the systems include Miss Margaret H. Holliday, Miss Margaret J. Craugh, Miss Gloria Templeman, Miss Jane E. Dunn, Miss Mary Keith, Miss Helen Rotter, Miss Marjorie Walker, and Mr. N. Lloyd Hampton.

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Congress an Arabic-English, English-Arabic glossary of more than 10,000 modern terms, which had been prepared by the Office of Strategic Services. Work continued in the unit on studies of plain-text frequencies in Arabic, and the traffic was edited for IBM processing. By 14 February 1943 the traffic in TUB, a Turkish two-part code using a four-digit group, was ready for processing, and the work was begun on TUA, a one-part code with a five-digit group. About the beginning of March 1943 work on a biographical file of prominent persons in all countries in the Near and Middle East was undertaken. This continued to grow and at present contains about 4000 entries. Later in the same month two forms of TUA (the so-called "01" and "98") were correlated, and language studies of Turkish were made by IBM methods. By this time the solution of an Iraqian cipher had been advanced, and by 4 April most of the groups for numbers in the Turkish TUB system had been recovered, the first current TUB was ready on 15 May, and the first translation appeared in the Bulletin on 21 May 1943. By the end of May four Turkish, three Iraqi, one Egyptian, and one Afghan system were under study, and by the first of July another Turkish system had been added.

In the middle of July GCCS sent photographs of three compromised Iranian codes (IRA, IRB, IRC) and their reconstruction of the basic Afghan code (AFA, AFB). These were transcribed from the Persian script into the Western form for use in the unit. The reconstructed

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TUB was also received about the same time. In this period 24 Turkish systems were recognized, but later study reduced this number to 12 basically different systems which employed only 8 different codes.

A report for 10 September 1943 shows the status of the various systems as follows:

> Turkish: TUB is compromised and everything of consequence in it is translated. TUA is far advanced and three people are working on code recovery. Two are working on the recovery of TUE--half of the groups in current messages are already identified. TUD has just been solved, while TUJ, a similar problem involving the encipherment of the first three digits of the four-digit TUB, is being cryptanalyzed. Three people are engaged in solving the forty-digit additive of the secret traffic from Washington, London, and the other cities.
>
> Persian: Under control. All encipherments of the compromised code are solved by Mrs. Ehninger and the messages are promptly translated by Mr. Gibbons. The latter is also working on the recovery of IRC.
>
> Afghanistan: Two people are simultaneously attacking this enciphered trigraphic code in Persian from the points of view of encipherment and code recovery.
>
> Iraqian: Solved and translated promptly.
>
> Egyptian: Over a third of the groups appearing in current messages are now translatable. One person is working on code recovery.
>
> Saudi Arabian: The two short messages that have reached us have been carefully analyzed, but we must have better coverage for a solution.

On 1 October 1943 Lieutenant Gordon was transferred, and Lieutenant Salem assumed charge of the unit, a position which he held except for five months (May-September 1944) until 19 May 1945, when he was transferred to the Supply Branch. About this time GCCS sent 3,000

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identifications in TUE. Of the 1,200 which had been recovered by the Signal Security Agency, 200 were not duplicated in this list. Early in October 1943, five days after the receipt of the first message, the unit solved ABB, a cipher used by the Arabian princes on their visit to the United States.

Throughout 1943 the unit continued gradually to expand and by the end of November had reached a strength of 20 persons. Soon afterwards, however, three persons were detached to work on Japanese problems. January 1944 saw a change in policy. Higher authority decided that the Signal Security Agency would turn over to GCCS the chief responsibility for processing traffic in the systems used by the governments in the Near and Middle East, maintaining, however, as a nucleus for cryptanalytic continuity, a small section of six persons. Accordingly, 14 of the members of the unit went to other units. Shortly thereafter the critical situation as regards personnel eased up somewhat, and the need for the intelligence produced by the unit was recognized. Hence, the Branch reactivated the original unit with its former personnel. Two returned in February, three in March, one at the beginning of April, and by 13 May 1944, all but one of these persons were again at work in the unit, which, with the addition of other personnel, now had a strength of 21.

On 28 April 1944 Lieutenant Salem, relieved for other duties, was succeeded by Mr. Bates, who himself resigned on 1 September 1944. During September Mr. Gibbons directed the Near and Middle East Section

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until Lieutenant Salem returned on 1 October 1944. In November Sergeant Egleston brought back with him the great advantage of experience gained during several months of work in collaboration with British cryptanalysts.

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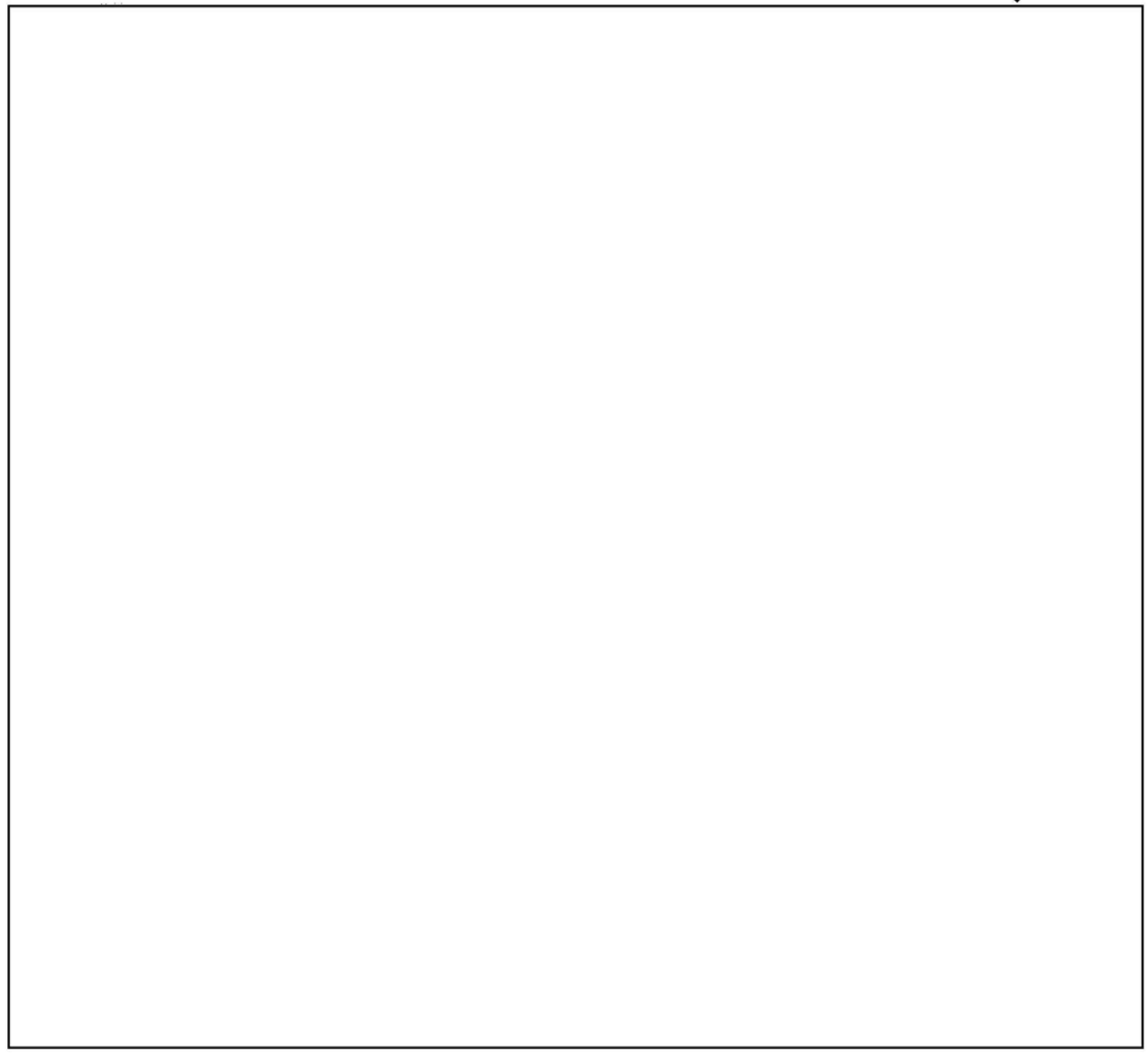

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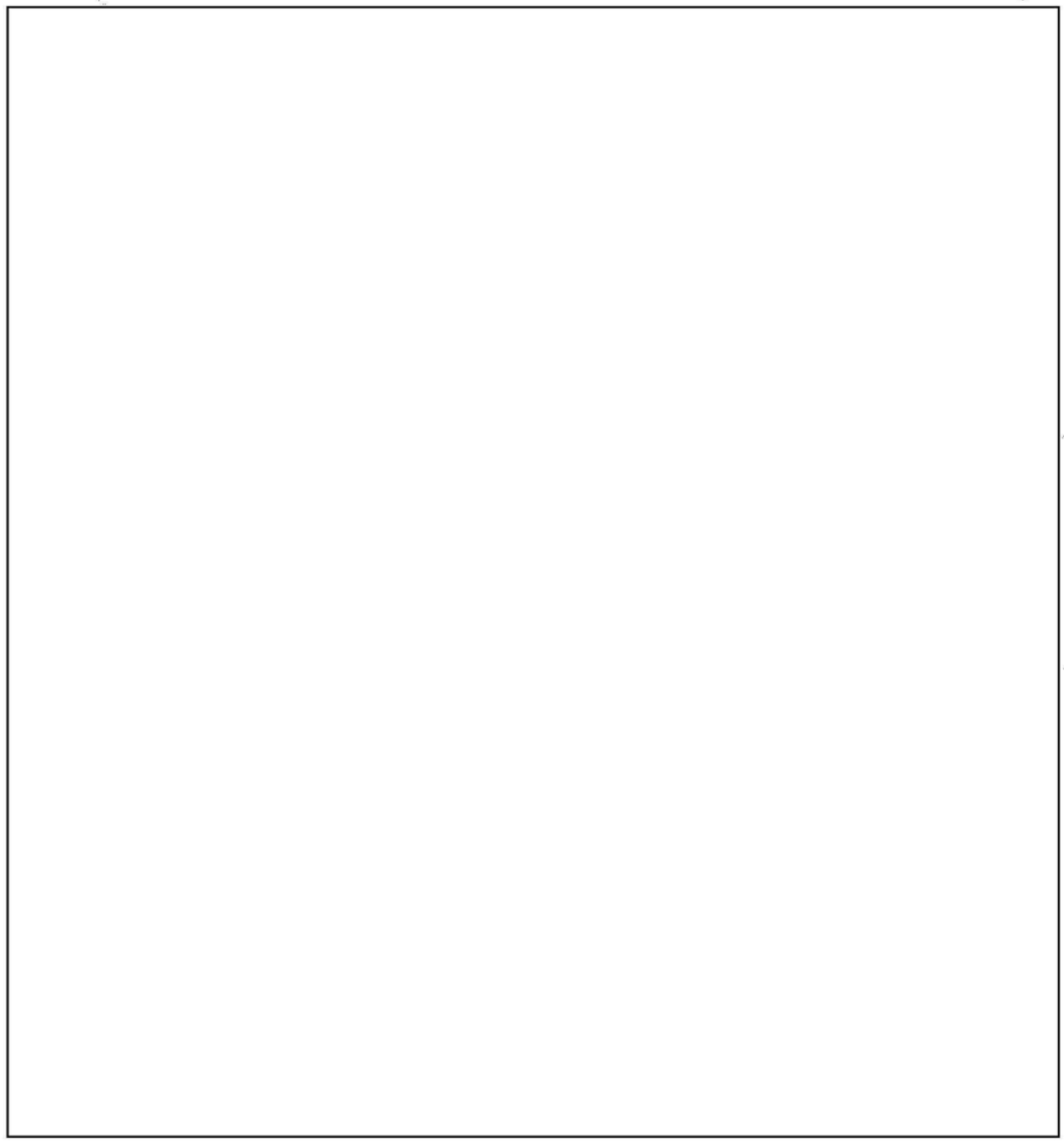

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CHAPTER XI. FAR EASTERN AND CENTRAL EUROPEAN SYSTEMS[1]

A. Chinese Systems

B-III-d-2 is at the present time (August 1945) charged with the production of intelligence from the traffic of certain governments in the Far East and in Central Europe. The governments in the Far East included at one time or another the Chungking government, the Nanking puppet government, the puppet government of Thailand, and the puppet government of the Philippines. The countries of Middle Europe included the Nazi government of Bulgaria, the royalist government of Yugoslavia, the puppet government of Croatia, the Czechoslovakian government in London, the Slovakian puppet government, the Polish government in London, and the royalist government of Greece. The two groups, though not related geographically, are combined in one unit because they require similar cryptanalytic techniques.

Chinese systems were the first to be studied in a unit composed largely of linguistic experts. Soon afterwards the system used by Thailand (THA) was added. As work progressed, however, more cryptanalysts were needed, and two separate units were formed. They had contiguous quarters and were finally united administratively in 1944. In the course of solving the encipherment of the Chinese systems, the staff of the cryptanalytic unit developed considerable skill precisely

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1. The statements made in this section are based on interviews with Dr. Leslie A. Rutledge, Lieutenant Laurence P. Roberts, and Mr. Raymond P. Tenney.

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of the type needed for other problems; so it was natural that when interest arose in 1944 in Balkan cryptography, the several Balkan systems, not easily fitting into any other then existing unit, were assigned to the now combined Far Eastern unit, which thus became a sort of catchall for many systems hard to classify elsewhere.[2]

Work began on Chinese systems in a unit organized in January 1943 under the direction of Captain (now Major) Franklin F. Russell, who had been for some time in the Japanese Military Attache Section. The chief expert in the Chinese language was Mr. Raymond P. Tenney, who for 20 years had resided in China as a member of the United States Consular Service and as an employee of the Chinese Government Salt Monopoly (the Salt Gabelle). Lieutenant Laurence P. Roberts, in civilian life Director of the Brooklyn Museum, had studied the language in China. For a short time Lieutenants Harry Koslow and John Haynes, both of whom had lived in China and knew colloquial Chinese, were with the unit before being transferred elsewhere. A little later Lieutenant Rudolph McShane, whose avocation for many years had been Chinese, and Miss Hazel Gosline, who had taught in China for 17 years and is skillful in Chinese calligraphy, joined the unit. Several other persons with some knowledge of Chinese, who joined the staff in 1944, are now at work: Miss Margaret Sells, who had been a missionary in

2. Rumanian and Hungarian systems, though geographically akin to other Middle European systems, were studied in another unit.

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North China for some years; Mrs. Elizabeth Warner; and Private First Class Robert King, one of the few persons trained by the Army Specialist Training Program in languages rarely studied in this country to come to the Branch. While the staff was at all times adequate in quality for the tasks at hand, sufficient personnel were never available for the linguistic problems.[3]

The unit began by sorting all of the accumulated Chinese traffic, a task which took some time since there were many systems and many circuits represented in it. Eventually the traffic in certain unenciphered codes was isolated and prepared for IBM processing. Among these codes were the Chinese Ming Code (CNA), available in the open market, and the secret codes Dryo (CNB), Win (CNC), and Invincible (CND). Although the intelligence contained in it was not particularly important, Mr. Tenney began to decode and translate the Ming traffic. This effort to find frequency characteristics in telegraphic Chinese which would assist in entering the unknown codes was somewhat disappointing, for the secret codes, unlike the single-character Ming code, were phrase books and lacked marked frequency characteristics. But CND was soon entered. A one-part code in English, it was studied only for the purpose of training. It became readable in July or August 1943. This

3. Captain Russell had meanwhile been succeeded, at first by Lieutenant Haynes, and then by Lieutenant Culver C. Chamberlain. By June 1943 Lieutenant Roberts assumed direction of the unit, a post which he still holds.

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date also marks the end of preliminary examination and experimentation in method and the beginning of serious solution and steady production.

At this time GCCS gave considerable help. Early in the summer a photograph of the British reconstruction of CNB soon made current traffic readable. A reconstruction of CNC was received at about the same time, and some two months later it became readable. Towards the end of the summer another Chinese code (CNF), partially reconstructed, was supplied by GCCS and additional identifications were exchanged from time to time until, at the end of the year, the code was readable.

Many Chinese encipherments used on the codes then being read had been explained in various communications from GCCS, and once their pattern and method was understood, others could be solved in most instances by the linguistic staff, but there were still other enciphered-code systems of which nothing was known. Two of the largest (CNG and CNH), used mainly by Dr. T. V. Soong in his correspondence with the Chinese Mission in Washington (SINODEFENS), had been isolated in the first sorting of the traffic and given to the Research Unit of B-III for study. Some suggestions made by Lieutenant (now Major) Charles J. Donahue of the Cipher Section for an attack on CNH were carried out during April by Miss Nellie F. Wood and Miss Edna Waldeck. In May Lieutenant William S. Smith directed a re-examination of both systems and set up elaborate logging and charting techniques; he also

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planned a more exhaustive indexing procedure for CNH.

In June 1943 Dr. Leslie A. Rutledge was made supervisor of Chinese cryptanalytic problems,[4] coming to this new work from extensive experience on a variety of cipher systems, and Lieutenant Elwood Hill joined the staff after some successful work on two Swiss systems (SZM, SZN), contributing to the analysis and decrypting of CNH.

By September 1943 the 70 digraphic substitution tables used in CNH had all been recovered, and two (later three) IBM message prints and indexes to 30 odd underlying codes (presumably different paginations of one basic code) had been given to Lieutenant Robert's staff for study. The Far Eastern Subsection determined that the codes were actually in Chinese and made a few identifications. But when the cryptanalysts discovered that the underlying codes had no arithmetical relationship to each other and had in fact to be considered as more than 30 separate problems, and that in some cases even a third encipherment had been superimposed on messages of special importance, the system was laid aside as unrewarding.

Facing this impasse, the Subsection turned in the autumn of 1943 to what seemed a still more highly enciphered Chinese code system (CNG), and made a fresh attempt at solution. Some earlier forms of this

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4. This new unit, which eventually grew to about eight persons, included Dr. Aubrey Diller; Miss Virginia Alderson, who had collaborated with Lieutenant Hill on the Swiss systems; Misses Wood and Waldeck; Mr. Max Lechter, Miss Abbie Cole, and Miss Catherine Snodgrass.

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system were solved[5] during the next two months. It was determined that the basic code was Bentley's Second Phrase Code, but encipherments were frequently changed. Three hundred messages dating from 1932 were decryptographed, which, however, had little value as intelligence.

When the language and cryptanalytic units were given contiguous quarters in January 1944, genuine cooperation on the CNH problems could begin. A still better arrangement was the amalgamation later in the year of the two units, with Lieutenant Roberts and Dr. Rutledge exercising joint supervision. The opportunity afforded members of the units to consult Mr. Tenney and the others on the background of the traffic in CNG, and to assist in the code recovery of CNH by solving spelling encipherments, for example, was gratifying in point of results obtained. The most profitable period of collaboration among the experts in Chinese and the experts in cryptanalysis now began. The cryptanalytic staff had become more experienced and resourceful and once more attacked CNG, which, however, still proved unyielding. The CNL encipherments were quickly solved, and the cryptanalysts then turned their attention to the traffic of the Nanking government (CPA). Among a great many unknown systems, three (CPB, CPC, CPD) were isolated. They were extensive repaginations of the Chinese Ming Code, but sufficient traffic was not available to make them readable until the middle of 1944. Much of the rest of what was at first designated CPA

5. See the paper on CNG prepared by the Recorder's Section.

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was proved in that period to be Japanese commercial traffic and turned over to the Japanese Diplomatic Section (B-III-f).

By the spring of 1944, CNB, CNC, CND, and CNF were easily readable. It was then possible for the staff to undertake the cryptanalysis of other unknown codes. The attack on CNJ, a modified one-part code in Chinese, was immediately successful, and--this time without assistance from GCCS--messages were regularly read within three months. In March 1944 the cryptanalysts had solved the polyalphabetic encipherment of messages in CNL, which was, according to the statements of the Chinese themselves, their most secret system. An attempt on code recovery showed this to be a large two-part code, but the staff was now experienced and confident, and 600 identifications had been made by the time the first exchange with GCCS took place. After two months, a few messages were partially readable, and by the end of summer, the major part of current traffic could be read.

After a short period in which Lieutenant Roberts shared with Dr. Rutledge joint supervision over the amalgamated unit, the latter assumed sole responsibility, while Lieutenant Roberts continued to supervise the Chinese language problems. Now began at once the exploration of all unknown Chungking systems, of which there appeared to be many. A number of air attaché systems (CNM) were investigated and eventually there was accomplished the removal of the encipherments from six of these codes, of which only two remained current. The deciphering was greatly facilitated by a machine devised and built by Dr. Martin Joos

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of the Research Unit. Several of the financial systems used by the Bank of China were studied, and the encipherment of Bentley's Second Phrase Code (CNK) was solved. Several unknown Chinese digit systems (CNQ), were examined. Another financial and diplomatic system based on an English code (CNN) was studied and solved. Some interesting solutions of transposed Chinese code (CNP, CNT) were made during the summer of 1944.

At this time all codes currently used by the Chinese Foreign Office (seven in Chinese and one in English) were readable, and current traffic in them was regularly processed. Besides those mentioned specifically, another (CNS), supplied by the British in a reconstruction, had then advanced to the point of being almost readable. During 1944 the cryptanalytic staff removed the encipherments from four Chinese government codes used for military traffic (two called CNM, CNO, and CNP), and a beginning was made on the recovery of all of them. CNP is rapidly approaching readability, and the reading of this military attaché system will no doubt facilitate the reading of the others, which have a vocabulary unlike that of the diplomatic codes. Sufficient transposition encipherment has been removed from CNT, another military attaché code, to make it ready for recovery.

Progress during the past year has continued in the Far Eastern field. Complete or partial solutions of four major Chungking systems were effected, and translations have been submitted in all of them.

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Of these four, CNL is one of the principal Chinese Foreign Office systems; it is a code enciphered by substitution and is the first two-part Chinese code to be solved in the Signal Security Agency. The other three, CNM (an Air Force code), CNP (a General Staff code), and CNT (a military and naval attaché system) are codes enciphered by digraphic substitution or by keyed columnar transposition. CNT, used by attachés throughout the world, employs a total of about 400 transposition sequences and at least 18 paginations of the basic code; most of the traffic is now fully readable as a result of the year's work. One minor system, CNX, was completely solved during the past year, and a special system, introduced for the United Nations Conference on International Organization and made up of transposition encipherments of several known codes, was partially read.

Entry was also made into the following major systems, the complete solution of which is progressing: CNG, a new additive encipherment which replaced the substitution encipherment of CNG solved last year; CNQ, an additive encipherment of several basic codes used by the National Military Council in Chungking; CNW, a running-key substitution of a new trigraphic Foreign Office code; and CNY, an additive and substitution encipherment of what is thought to be General Tai Li's code. In CNY, the solution of the old code, which apparently became obsolete in 1944, was undertaken by OP-20-G and that of the new code by the Signal Security Agency.

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Of the enciphered code systems used by the Nanking Government, the majority were entered or completely solved. The following systems were brought to readability during the past year: CPB, CPC, CPD, CPI, and CPJ. Translations were made in all except CPJ.

B. The Thai Systems

Not long after the first study of Chinese systems, plans were laid to begin the study of the messages sent by the government of Thailand. To hope for solution without the assistance of an expert in the Thai language was thought impossible, and for this purpose the services of Mrs. George B. McFarland were secured.[6] Cryptanalytic research was performed by Mr. A. Ferdinand Engel, then Technical Director of B-III-a, of which this unit was at the time a part, and by Lieutenant Karl Elmquist and Mr. John W. Little.[7] It was soon discovered that the Thai were using English rather than their own language--hence the linguistic difficulty which had been envisaged proved to be illusory, but the intimate acquaintance of Mrs. McFarland with the leading Thai officials proved to be extremely valuable in interpreting the Thai messages.

The Thai code, a relatively large one containing about 100,000 groups, was made readable by the end of 1943.[8] The constantly changing

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6. Mrs. McFarland had lived in Bangkok from 1908 to 1942 and had collaborated with her late husband on a monumental dictionary of the Thai language.

7. Mr. Little's close contact with the Thai problem was broken when he was inducted into the Army. Though his services were repeatedly requested after that time, he was ultimately sent overseas.

8. Miss Martha Stifler (Mrs. Waller) and Mr. David Kinney worked on code recovery after Mrs. McFarland's departure in January 1944.

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encipherments of Thai, which presented no great difficulty, finally could be removed as promptly as they appeared. The encipherment of a new code system used by the same government was solved in 1945, but the language of the basic code has not yet been determined. The intelligence recovered from Thai messages continued to be of interest; many of the messages were sent through German channels, one of the last to be sent before the surrender being in a new system (THC).

C. The Middle European Systems

In April 1944, shortly after the amalgamation of the Chinese language and the Chinese cryptanalytic units, the functions of the new subsection were extended to cover the traffic of seven minor European governments, both Axis satellite and Allied. Greek traffic was first examined because the subsection possessed a classical scholar who also knew modern Greek.[9]

The Slavic languages were at first represented by Captain Ferdinand W. Coudert, who did much of the preliminary research. The Polish group consisted of four persons,[10] while other Slavic languages were cared

9. Dr. Aubrey Diller. Later Miss Mary Fennel, who had studied ancient Greek, and Lieutenant Praxythea M. Coroneos (Mrs. L. A. Rutledge), and Miss Elaine Pulakos, who were of Greek descent, contributed to the new effort.

10. Privates Marcella Gwiazdzinska and Ruth Lowenthal, and Misses Sophie Shaffer and Phyllis Krus.

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for by another group of five.[11] Captain Coudert devised linguistic tests to determine the fitness of the personnel for this sort of work and began a training program in the minor Slavic languages so that those who possessed a knowledge of one of the languages might communicate this knowledge, if possible, to the others.[12] In addition to these persons, an enlarged staff of clerks and typists to carry on the heavy burden of indexing, filing, and typing, was necessary, with the result that the strength of the subsection (supervisors, linguists, cryptanalysts, and clerks) was and remained about 50 persons, who, in December 1944 were responsible for the cryptanalysis and processing of 4 Bulgarian, 2 Croatian, 4 Czech, 4 Greek, 1 Philippine (not studied), 7 Polish, 1 Slovakian, and 3 Yugoslavian systems in addition to the Chinese and Thai systems. In June 1945 these figures were 2 Bulgarian, 28 Chinese, 4 Czech, 5 Greek, 6 Polish, 1 Slovak, and 2 Yugoslavian systems in addition to plain text in 8 different languages.

As work began on new traffic, Lieutenant Coroneos took over the Greek problem as soon as it was discovered that one of the systems (GRB) could be read from a compromised code. Shortly afterward, regular

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11. Mr. Luther Meyer, Misses Regina Badnerosky, Viola Riegl and Julia Lovas, and Private Rosalie Goveker. Mrs. Anne M. Elmquist supplied a knowledge of both Czech and Slovak. Miss Nina Pleshkova applied a knowledge of Russian to the related languages of Bulgaria and Yugoslavia.

12. Somewhat later Lieutenant (now Captain) John Libera, who possessed a knowledge of Polish and also experience as a cryptanalyst, returned from overseas. Others who worked on cryptanalytic problems included Lieutenant E. G. Mann, Miss Charlotte McReynolds, and Miss Cordelia Greene.

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production of translations began. Most of the Greek systems seemed unimportant except for the highly enciphered GRA. A new system (GRE), however, introduced for the San Francisco Conference, was entered, and two of the digraphic substitution tables were solved. An isolog helped to identify several hundred groups in the new code. Traffic in Greek systems lapsed for approximately a month in October 1944 when the Papandreou government moved to Athens, but during the period of the San Francisco Conference 122 messages were received.

Lieutenant Coroneos was then put in charge of a new subunit assigned to the Balkan systems and to the traffic problems in general which were created largely by the new Balkan systems. A group of the newer linguistic personnel (eventually six) worked on the Yugoslavian (YOA) and Bulgarian (BUA) codes, and the Bulgarian military attaché ciphers (BUB, BUC, BUD). Some of the repaginations of the codes, together with deciphering tables and most of the cryptographic details of the military ciphers, were supplied by GCCS. YOA was fairly well recovered, but the photograph thereof was very difficult to read, and the typing of it required nearly a month. More time was needed, also, before any of the new personnel could independently translate a message. BUA was much more discouraging since the book was used with many paginations, of which only a few very scantily recovered ones came from GCCS. The amount of Bulgarian traffic intercepted was inadequate since normal communication was by land line rather than by radio, and the intercepts were often defective. Nevertheless, production gradually got under way.

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Several important messages in the military cipher (BUC) were deciphered and translated before the British translations arrived, and a few translations were finally achieved in the code systems. About the time (August 1944), when YOA was approaching regular production, the cipher tables changed, but constant key recovery kept most of the current messages readable. Progress was made also in BUA in filling in new values and in assimilating and processing additional paginations received from GCCS. An innovation in the principal Bulgarian cipher (BUC) was also solved. With the surrender of Bulgaria, this traffic decreased sharply in volume and in interest and the ciphers disappeared altogether. Work, however, is continuing on a large backlog.

The problems of the other systems were mainly cryptanalytic. SLA, the Slovakian cipher, was analyzed and partly solved by members of the B-III Research Unit, but too few messages were available in the same key for solution. The encipherments CTA and CTB, two forms of the code used by the puppet Croatian government, had already been solved by the B-III Research Unit, but it was felt at that time that insufficient linguistic personnel was available to make a successful attempt at code recovery.

The principal problem produced by the various Balkan systems at the beginning was the sorting, logging, and filing of the traffic in all the new systems and establishing the records necessary for handling translations, whether produced in the Research Unit or at GCCS. Experienced

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traffic personnel was temporarily assigned or lent by other units, and eventually the task was accomplished, although the difficulties created by the fact that messages bore numbers not taken from consecutive series, were considerable. When the traffic in partially readable systems was finally in shape, the new Traffic Unit attacked the Polish traffic, which it has logged for the past year and in some cases for the past two years.

The Yugoslavian system YOB and all the Czech and Polish systems were given to the members of the Cryptanalytic Unit for study. The plan was to transfer any systems which became readable back to the Processing Unit and to lend members of the cryptanalytic staff to that Unit when further cryptanalytic development was necessary. The major part of the work on Chinese encipherments was now done, and investigation of any further unknown Chinese systems was postponed until the growing interest in the Balkan situation had diminished sufficiently to permit a return to Chinese problems.

In June the B-III Research Unit attacked a cipher used by Mihailovic in occupied Yugoslavia (YOA), but the system appeared to be double transposition and insolvable with the traffic on hand. Meanwhile, Miss Virginia Alderson was put in charge of a unit devoted mainly to the analysis of the Czech systems, all of which were ciphers. Sergeant Jack Levine of B-III Research gave much time to this problem and established the period of a key in CZB which led eventually to solution. The first solution was that of monoalaphabetic substitution with variants

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(CZD), and in the deciphered material was an isolog which made possible the entering of CZB, a complicated polyalphabetic substitution system with a long running key. With things well under way, Mrs. Elmquist then took over the solution and production of CZB, her staff of three becoming another subunit in Lieutenant Coroneos's unit.

Sergeant Levine continued his researches on Czech systems and discovered that the alphabets used at Bern, recovered by GCCS in a companion system, were only a different form of those recovered here, and that 24 other variant forms could be postulated. This discovery made possible further advance with CZA.

The Polish systems were first attacked by a staff of about eight persons. The initial analysis led to additive recovery which was directed to successful conclusion in November by producing an index and message print of the first Polish code to be cleared of encipherment (PLF). The basis of the substitution encipherment in PLB had been discovered and recovery of the additive beneath the substitution began.

[redacted]

The indicator pattern of the largest of the Polish diplomatic systems, an enciphered code with digraphic substitution tables (PLC), has been solved.

EO 3.3b(6)
PL 86-36/50 USC 3605
EO 3.3(h)(2)

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To recapitulate, the achievements of the Research Unit include the independent solution of four codes used by the Chinese government and one by the Thai government; the completion of four other Chinese codes, one Yugoslavian, and one Bulgarian code partially reconstructed by GCCS; and the reconstruction of a large number of cryptographic systems and four complete cipher systems. This represents only work that has been completed to the point of full readability: many other systems have been partially solved.

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CHAPTER XII. MISCELLANEOUS SYSTEMS

The systems (all of minor importance) of several governments have been studied in the Signal Security Agency either in conjunction with those of some other government or in an independent unit of small size.

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EO 3.3(h)(2)

A. The Belgian Systems[1]

Initial study of Belgian traffic began in the months of February and March 1943 in the Commercial Section as then constituted.[2] This arrangement continued in force until 18 April 1943 when Belgian traffic was sent to the French Code Recovery Unit (B-II-a-1 at that time).

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1. The statements made concerning Belgian systems are based on interviews with Dr. Caleb Bevans, Miss Helen J. Bradley, and Miss Charlotte Morris. Incidental references to Belgian systems are made in the progress reports of the French Section (22 February 1943--29 January 1944), now on file in the French Section.

2. The reason for this study of diplomatic traffic in a commercial section was the fact that the head of the Section (then Captain William F. Edgerton) was formerly the head of the French Section, to which he ultimately returned at a later date. It has often happened in the Signal Security Agency that new projects have been initiated by those who were competent to undertake them. Later, when greater activity was involved, special organizations are set up to carry on.

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Code recovery of an unenciphered code (BEA) proceeded with success, but in September 1943 an enciphered form of the same code (BEB) was encountered and four days after study began was solved sufficiently to permit two translations to be made.

Belgian traffic continued to be received and read wherever possible in this same unit until 24 August 1944. In this period such traffic was received into the two categories BEA and BEB; but much of the traffic filed as BEB was unreadable, since actually a third system (BEC), which had not been isolated as yet, was confused with it. After the reorganization of 24 August 1944, a new unit was set up to process Belgian and Haitian traffic (Luxembourg traffic has since been added to the assignment) and as soon as the unit was organized BEC was isolated from BEB and machine indexes prepared for it, making code recovery possible.

In March 1945 these problems were turned over to the section known as B-III-b, which was organized to process commercial traffic. Thus, the story of Belgian solution begins and ends with a commercial section.

B. Haitian Systems[3]

The first traffic in HTA, the only system known to be used by the government of Haiti, was examined by the French Code Recovery Unit on 2 January 1943 and was then given a preliminary sorting, but nothing

3. The sources are the same as those for the Belgian systems.

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more was done apparently until, on 2 December 1943, an IBM index was prepared. It was discovered, however, on 9 December 1943, that the Haitian government was using a slight modification of the Sittler Commercial Code. All Haitian traffic has since then been completely readable. When on 24 August 1944 Belgian traffic was separated from the French, Haitian traffic was included in the assignment of the new unit, and still later (March 1945) was also turned over to B-III-b.

C. Luxembourg Systems[4]

Only a single system (LUA) is known to be used by the government of the Grand Duchy of Luxembourg. No study of this system was made until September 1944, when a copy of the code, not quite complete, was made available by capture.

[redacted]

EO 3.3b(6)
PL 86-36/50 USC 3605
EO 3.3(h)(2)

D. Irish Systems[5]

Irish traffic was first studied in the Traffic Section by Lieutenant (now Captain) Stanley H. Simonds. In the early autumn of 1944 the traffic was assigned for study to two members of the Near and Middle Eastern Section. Solution of this traffic has, however, not advanced

4. On Luxembourg traffic the source of information is an interview with Miss Charlotte Morris.

5. These statements are based on interviews with Mrs. Flobeth Ehninger and Miss Sally Peebles.

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beyond the stage of cryptanalytic research, since only part of their time is spent on Irish traffic.

E. Hungarian Systems[6]

In April 1944 Hungarian traffic was assigned for study to members of the German Section.[7] Mrs. Anne Henry Stallknecht worked on the problem for several weeks in May. Corporal James Bunting was assigned to the unit during May and June and again after his return from Officer Candidate School in November and December. Miss Mary Evalyn Hampton and Miss Mary Margaret Tenneis were added to the group as cryptanalytic aides, and Miss Bertha Pekare in July as translator.

As the traffic was indexed and studied, it revealed characteristics which augured well for its possible solution. Repetitions were well above random, with slightly over 50 per cent [redacted] yet it did not yield to the usual methods of additive recovery. The entering wedge was provided by the discovery in July that at least 12 long messages sent from Budapest to Tokyo in one encipherment had been sent as circulars to European points in a second encipherment.

EO 3.3b(3)
EO 3.3(h)(2)
PL 86-36/50 USC 3605

. . . . [redacted]

EO 3.3b(3)
EO 3.3(h)(2)
PL 86-36/50 USC 3605

6. These statements are based on an interview with Miss Margaret Tribble.

7. Miss Margaret Tribble, Mrs. Anne H. Stallkneckt, Mrs. Dorothy K. Watson, and Private Margaret Missko. Miss Bertha Pekare served as translator.

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compared, revealing their interrelationship. The Research Section of B-III was asked to interpret this, and Corporal Walter Jacobs worked out the exact mathematical relationship of the two encipherments of one message. About this time GCCS sent photographs of four different captured code books. Sergeant Daniel M. Dribin, also of the Research staff, reduced the first message to terms of the 1932 code book, since both the code limitations and key limitations indicated that this code was being used, and early in September the first message was readable.

Because the Tokyo system (HUA) derives its keys from the code book itself, solution was complete, and all traffic in this system has since been read. The second system (HUD) is in the key recovery stage. To assist in its solution four more persons were added in October.[8] IBM and RAM studies were made, as well as indexes, listings of differences, and other cryptanalytic devices; about 50 different overlaps provided material for key recovery. To date 51 key blocks and many individual keys have been recovered.

F. Rumanian Systems[9]

The study of Rumanian systems was carried on from February 1943 to October 1944, when, for the most part, Rumanian traffic ceased.

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8. Miss Ursula Kennedy, Miss Rachel Hoffman, Miss Mary Lou Coury, and Miss Pauline Miller. They worked under the direction of Sergeant Dribin and Miss Olivia Fulghum.

9. The statements made in this paragraph are based on interviews with Drs. James V. Rice, Caleb Bevans, and Calvin Brown.

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This period may be divided into two parts by the month of June 1944. Before June, Rumanian traffic was studied on a part-time basis by members of Romance language Code Recovery Units.[10] They had to begin a file of traffic in some instances dating back to 1937. This they sorted into two groups, one of which was clearly an unenciphered code designated as ROA and the other the remainder of the material. About 20 groups had been recovered when the system was laid aside and not taken up again until GCCS furnished a reconstruction, about five per cent complete, and some information concerning an enciphered form of the same code. With this assistance, code recovery was continued from time to time and a few translations were made.

In June 1944 the Rumanian problems were turned over to other cryptanalysts in the Romance Language Section.[11] They began the problem anew. The Rumanians appeared to be using a number of systems but chiefly two large five-digit codes, which were employed in both unenciphered forms (ROD and ROF) and in enciphered forms (ROE and ROG). Shortly before traffic ceased, another code of similar type was introduced and considerable work was done on solving the encipherment of the second type. Much work was also done on ROC, a monoalphabetic substitution of two digits for one letter applied to a combination of plain text and code groups of two and three letters each with many variants.

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10. Dr. James V. Rice and Lieutenant Seymour Bloom.

11. Drs. Caleb Bevans and Calvin S. Brown.

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When Bucharest fell to the Russians late in August 1944, Rumanian traffic ceased abruptly except for occasional traffic between points outside Rumania and for plain text. Such traffic as is intercepted is processed; plain text is translated and code recovery is carried on to some extent in the older traffic and in the new, since the systems were not changed with the new government.

G. Liberian Systems[12]

Traffic in the Liberian systems LBA, LBB, and LBC was intercepted as early as January 1942. Early in 1945 it was analyzed[13] and on 29 April the first entry was made into the diplomatic cipher system LBA. On 3 May the first message was read. Analysis of the traffic had revealed the fact that a polyalphabetic encipherment, consisting of 31 alphabets, was used for this system. The encipherment of the enciphered-code system LBB was also partly solved; but it is still unreadable and is believed to contain both diplomatic and commercial intelligence. The LBC system, identified as employing a commercial code book, was being used frequently for personal messages, rarely for diplomatic. Since the study of Liberian messages began, about 50 per cent of the decoded messages have been published in the Bulletin. The exploitation and development of the three systems has been carried on in B-III-b since their first solution.

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12. These statements are based on an interview with Miss Naomi McElwaine.

13. By Lieutenant Colonel Frank B. Rowlett and Master Sergeant Daniel M. Dribin.

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CHAPTER XIII. THE SOLUTION OF METEOROLOGICAL SYSTEMS[1]

A. The Problem

Accurate forecasting of weather conditions is, in peace time, highly important to many classes of people, especially to agriculturists, mariners, and aviators. For this reason nations in peace time broadcast weather reports from all parts of the world. In order to make these reports intelligible to those who need them, regardless of their language, the International Meteorological Code (IMC) is used, which consists of a synoptic, or succession of digits, indicating the state of various elements of the weather at the point when and where the weather observations were made. A scale of 1 to 10 is used to represent degrees of visibility, etc. As the eighth digit of a normal synoptic indicates visibility at ground level, an "8" or a "9" in this position in the sequence would indicate very good visibility at the time and place of the report. Single observations are broadcast separately, or several are combined in a bulletin known as a collective.

When war breaks out this broadcasting of weather reports and other meteorological information is needed all the more for efficient planning of military, naval, and aeronautical operations. Such reports, must, however, be sent in a form unintelligible to the

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1. The statements made in this section are based upon interviews with Major Edward J. Wrigley, Major Clinton C. Swears, and Captain William H. Hezlep, and upon the file of progress reports made by Major Wrigley and Captain Hezlep, dating from 15 August 1942 to the present. No progress reports are available for the period of Captain Lyons' supervision.

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enemy. For this reason the various governments have adopted procedures for enciphering the International Meteorological Code or similar systems.

To be useful, weather information must be current,and, since information derived from such reports declines in value very rapidly after the moment of transmission, and after a few hours becomes completely useless, except for historical purposes, the encipherment must be removed with the highest possible speed.

Removal of the encipherment, however, is of little use unless the location of the observer is known. The time is usually in the clear. Since the location is indicated normally by a number which may frequently be changed, its identity is determined from the continuity of weather types and by cryptanalytic means. Radiogoniometry has not proved satisfactory for this purpose, particularly when, in dealing with a collective, its use could reveal at most the location of the central bureau transmitting the collective. Solution of the reports requires a much higher percentage of intercept coverage than is necessary for ordinary diplomatic traffic, and the coverage must represent not a single station but all stations. Because these reports are broadcast at regular intervals rather than throughout the day, it is necessary that many intercept facilities be assigned weather missions at the proper times. A further difficulty is that the reports are broadcast without regard for atmospheric disturbances, and the text

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of the intercepts is frequently imperfect. Diplomatic traffic, on the other hand, may be broadcast when the operators find conditions satisfactory.

B. The Organization

On 7 May 1942 the Weather Unit was formed for the solution of enemy meteorological traffic and weather reports and placed under the direction of a Reserve officer, Captain Ulrich S. Lyons, who, in civilian life, had been an astronomer attached for many years to the Naval Observatory in Washington. He was, however, transferred to other duties on 15 August 1942 and was succeeded by Captain Edward J. Wrigley, who in turn was replaced in July 1943 by the present Officer in Charge of the solution of weather reports, Captain William H. Hezlep.

As technical expert Captain Lyons had with him Mr. John Hyman, and Lieutenants Clinton C. Swears and James R. Thompson. During the first week, which, for purposes of orientation, was spent at the Weather Bureau in Washington, the Unit was joined by Captain Wrigley, and on 5 July 1942 it was moved from the Munitions Building to Arlington Hall Station. Shortly afterward several young women were added who soon made substantial contributions to the work of the group.[2]

On 1 September 1942, the staff was further enlarged by seven

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2. Misses Keturah McDonald, Mildred Erskine, Virginia Brainerd, Mary Donahue, and Louise Gordon.

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enlisted men.[3] All of these men afterwards became expert at the solution of weather traffic, and five of them were assigned to units operating in two different theaters, one in the charge of Lieutenant Pfeiffer, the other under Sergeant Myers. The same month also brought to the Weather Unit two other persons who did exceptionally fine work on the cryptanalysis of weather traffic. Miss Belinda Snow was responsible, without assistance, for the solution of the Vichy French traffic. Miss Marcella Davis remained with the unit until the summer of 1944, when she was transferred to another section. Somewhat later Lieutenant Richard W. Stowbridge, who was the first to examine the Japanese weather reports, joined the unit but left for the China-Burma-India Theater in January 1945. Captain Hezlep became a part of the unit on 13 December 1942. In 1943 three other persons were added: Lieutenant William Fleischman, who remained for a year beginning in July 1943; Lieutenant Clifford J. Maloney, who came shortly after Lieutenant Fleischman and still remains; and Mr. Hyman Shapiro, who remained until February 1944. The last named had previously served with the Air Corps as a meteorologist at Tyndall Field, Florida. Mr. Shapiro's extensive experience as a meteorological observer proved invaluable in the cryptanalysis of the Japanese problems.

In addition to the persons named, the Weather Unit made use of

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3. Paul N. Pfeiffer, Edwin Marton, Hugh Myers, Richard Friendlich, William Morris, Robert Y. Austin, and George Northern.

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the services of a large number of clerks. By 21 December 1942 the original strength of four had grown to 16; the maximum strength of 80 persons was reached on 23 July 1943. There was a general decline in number of personnel in 1944. Captain Hezlep now spends part of his time on research and liaison with the field, in addition to serving as Officer in Charge of the Miscellaneous Diplomatic Section, while Lieutenant Maloney carries the now extensive liaison with the Navy. Other than the work done by these two officers, all activity on weather traffic is now being carried on in the field.

C. Training

In connection with the training program of the Unit, three groups of enlisted men as well as one group of officers were trained for the field.[4] These officers never reached the field, however, as the plan was changed. The first group of enlisted men was trained in September and October 1943 and consisted of seven men assigned to the Weather Unit for training and three of the enlisted men already named, Sergeants Friendlich, Marton, and Northern. They were sent first to the North African Theater, later to the Mediterranean Theater, where they were under the charge of Captain Pfeiffer. The second group, under the charge of Sergeant Myers, was trained in the fall of 1943 and is now in the India-Burma Theater. The third group, trained in the summer

4. Lieutenants Joseph R. Salem, Theodore F. DeGomar, Benson K. Buffham, Edward C. Kalb, and Sidney Jaffe.

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and autumn of 1944, consisted of 17 enlisted men destined for overseas. This last group was trained partly at Arlington Hall Station and partly at Vint Hill Farms Station; the instructors were Captain Hezlep, Lieutenant Kalb, and Lieutenant Buffham.

D. Coverage and Traffic Handling

At first coverage was far from satisfactory and frequent liaison with the intercept units of the Communications Branch was necessary. In 1942 and in early 1943 adequate facilities for interception were not assigned to this traffic. For example, on 2 May 1943 a report stated that at that time the British had 40 receivers and 176 operators at work on the weather problem, while for the same period the Signal Security Agency had only four receivers in operation, and these were not used exclusively for the purpose. Furthermore, intercepts were at times received with no indication of the time or station and were consequently of no value.

In addition, the location of the Weather Unit created problems which gradually had to be overcome. In the first period, when the Unit worked in the Munitions Building, and even later, when it had moved to Arlington Hall, traffic had to be obtained first at the Weather Bureau in Washington and later at the Army Weather Central in the Pentagon, by members of the Unit, using private automobiles, and after the encipherment had been removed, the unenciphered traffic had to be delivered by the same means to the Army Weather Central.

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Later, teletype facilities were made available, but still not all the problems were solved. When in May 1943 the Unit was moved from Operations A Building to Operations B Building, a serious time lag took place. Traffic had to be carried from the teletype machines in A Building to the Weather Unit in B Building, and, in the case of the German traffic, after rapid editing, it had to be taken once more to A Building for punching by IBM; finally the cards had to be taken once more to B Building for sorting and printing. The problem was further complicated by the fact that at this time Post Regulations made it necessary to use only commissioned officers for carrying this classified material from one building to another. In the early period the problem of transportation was so acute that current traffic was not received during the first hour of business and work on the analysis had to be stopped an hour before the close of business so that the results could be transported to the Army Weather Central in time to be of use. The result was that the working day was in effect shortened to six hours of intensive activity.

E. Solutions

The constantly increasing need for personnel to process the growing amount of traffic impeded the work in the early period. The fact that the traffic of five different governments was studied, however, did not necessitate experts in the languages of those governments, since the International Meteorological Code or its Japanese counterpart was used.

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At the outset, through the study of text books on the subject and of plain-text weather reports which had been intercepted, Captain Lyons gave his group an acquaintance with the basic science of climatology. A week was spent in a course of training given at the United States Weather Bureau in Washington. No traffic, however, was received until about 9 June 1942, when some Russian weather reports became available. The problem was attacked both by the probable word method (that is, likely weather conditions at the time and place of the message) and by frequencies and superimposition of messages. When German traffic was being studied, arrangements were made to use IBM methods for computing the frequencies. These methods could be used in the case of weather reports on the traffic of a single day. For successful solution, about 250 collectives were needed.

During the summer of 1942 chief emphasis was on Russian traffic, studied for training purposes, but early in September French traffic was also received. Miss Snow turned her attention to the new problem and by the end of the month had solved some messages. French traffic continued to be received until the day of the North African landings, when it stopped at all stations except Dakar. The danger to Allied security was at once apparent, and, at the initiative of the Signal Security Agency, diplomatic pressure was brought to bear on the Vichy government to stop the Dakar traffic. After about 10 days the Dakar station ceased broadcasting these reports.

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In September 1942 the Weather Unit was visited by a British cryptanalyst, Dr. George C. McVittie, a distinguished astronomer, who remained at Arlington Hall Station for about two months. The experience of the British on weather traffic was thus made available; Dr. McVittie's chief contribution was the demonstration of the main features of the Italian weather system then current. Italian reports, however, could not be read at once, but with sufficient coverage the additive keys used for messages could, after some study, be recovered.

Italian reports were of all types: land, ship, "raob," and "pibal." The basic synoptic used consisted of 25 digits, but a special 30-digit synoptic was used by coastal stations. Since the numbers indicating the observation stations were not those used in peace times, these numbers were known by the technical term "war indicatives." They changed approximately every 90 days. The code was enciphered by a running additive key, taken from a table valid for periods of 72 hours. Since the key indicators were unenciphered, overlapping was possible to a considerable depth, enabling the first solutions to be effected in December 1942. On the 21st of that month the progress report mentioned that an average of 2,000 lines of weather traffic had been solved and deciphered each day of the preceding week. On 11 January 1943 the corresponding figure was 4,600 lines. From that time on, Italian traffic was readable as long as it was received. For some reason never understood here, this traffic stopped suddenly

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on 19 July 1943, to be resumed, but in very small volume, for a short time thereafter. In September 1944, with the capitulation of Italy, it ceased entirely.

After the text of the messages was reduced to the basic plain code, it was transmitted to the Army Weather Central in the Pentagon and, from 22 February 1943, directly by teletype from Arlington Hall to Pasadena, California. For a short period the additive keys solved at Arlington Hall were transmitted regularly to the North African Theater, where the Signal Corps personnel were thus able to process new traffic as it appeared. The Weather Unit here functioned as a cryptanalytic staff for operations in North Africa. By 15 March 1943 the strength of the Unit had grown to 50 persons, who worked in three shifts. On 25 April 1943, however, when a decided drop in traffic was reported, it was possible to transfer 10 of the 57 members then in the Unit elsewhere without loss to production.

German traffic was next studied. Although Dr. McVittie during his visit had expressed skepticism concerning the possibilities of solving these messages, Miss Davis spent most of her time on German traffic after September 1942; and in January 1943 Sergeant Friendlich turned his attention to the German problem. At the end of the month progress was reported as very satisfactory. It was found that the Germans were actually broadcasting from their station in Rome reports on weather conditions in Italy which had already been sent out in

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the Italian system. They also were broadcasting reports on Spanish weather conditions which the Spaniards had previously broadcast. Consequently, the Italian messages, which were by this time readable, and the Spanish messages, which were in the clear, supplied cribs for the unreadable German messages. This entering wedge made possible by the end of February 1943 the solution of the German system.

Though the traffic was transmitted in groups of six digits, these were in reality encipherments of five-digit groups. The central digit of the group was enciphered by substitution of two digits which, when added together by non-carrying arithmetic, would equal that digit. This in itself provided no great security, but the group thus expanded was broken into two equal parts, each three digits being enciphered by substitution from a table containing a thousand three-digit groups, valid for a five-day period. There were 12 of these tables, six being reciprocal to the other six. When the six-digit enciphered groups had been reduced to five-digit unenciphered form, a sequence of five of them would constitute a synoptic. The problem of solution was rendered somewhat easier because the Germans used the basic IMC synoptic, a practice which they continued, in spite of its insecurity, to the end of the war.

On 21 August 1943 the regular progress report stated that during the preceding week 7,100 lines of weather reports had been processed, of which 661 were current; on 3 September 1943 the corresponding

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figures were 3,549 as a total and 2,967 current. Both Italian and German traffic was included in these figures. The traffic which was not current represented the work of the historical group, which worked on old messages. Normally, this traffic has no value, but in July 1943 the Army Weather Central in the Pentagon had begun to make extensive efforts to prepare tables of probable weather on the basis of the averages of observed weather over a period of years. For such tables older reports were not only useful but even necessary. German traffic so processed was received mainly from the British, who had a greater coverage (approximately 90 per cent) of all the messages broadcast.

Intercepts of Japanese weather reports had been received from time to time, and on 25 January 1943 Miss Snow began to examine it. Traffic was too light, however, for active work until July 1943, when a group within the Weather Section was organized under Lieutenant Fleischmann to make the first intensive study of the available messages. After that the Japanese systems were emphasized more and more, and during 1944 they formed the bulk of the studies carried on by the Section. In the case of the systems used by the European governments, large quantities of plain-text weather reports and much climatological information were available from the beginning but when the Japanese systems were first studied very little assistance of this kind was to be had. All material available at the Weather Bureau library was secured, but the Japanese had apparently for many years deliberately

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concealed from other governments their activity in meteorology. At international meteorological conferences the Japanese delegations had proved very uncooperative, giving their main attention to matters of protocol. In one instance they had even tried to get special weather concessions in the Netherlands East Indies.

Furthermore, the Japanese do not use the International Meteorological Code, but employ synoptic forms quite different from those of western nations. This difference is illustrated in the following presentation of the IMC and the Japanese equivalent form:

IMC

$$III\ C_L\ C_M\ w\ w\ V\ h\ N_h\ D\ D\ F\ F\ N\ P\ P\ P\ T\ T\ U\ C_H\ a\ p\ p$$

Japanese Long Form

$$(GG)\ III\ D\ D\ F\ F\ w\ w\ P\ P\ P\ T\ T\ t\ t\ R\ R\ N\ C_{L/M}\ N_h\ C_L\ h\ D_L\ C_l\ C_l\ V$$

$$C_2\ C_2\ f\ (EE)$$

Accordingly, climatological data had to be gathered from many sources. Early in 1942, however, the secret code, weather report forms, and the key book then currently used for encipherment by the Japanese Admiralty were captured, and they proved of great help.

The Japanese were using, when study began, an unknown number of weather systems. One of these, a naval system known as JN-36, was used for reporting weather observations made at outlying points. These were sent to the Japanese Weather Centrals at Tokyo and other necessary points by relays. Some work was done on JN-36, but insufficient

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coverage and the fact that the Navy was already reading it led to concentration on another system, JN-37, the main inter-service collective system in which the reports already enciphered by JN-36 are repeated, including JN-36 reports which may never have been intercepted because of the difficulty of hearing remote and isolated stations.

Reports sent in JN-37 consist of a collective message containing from 1 to 250 synoptics either in the long form (32 digits) or the short form (14 digits). Broadcasts conform to a regular schedule; in addition certain special reports are broadcast anywhere from two hours to two days late and are designated therefore as "retards" or "delayed reports." Coverage of JN-37 traffic was sufficient in July 1943 to permit the beginning of solution and it improved in 1944 to such an extent that about 400 messages were received daily. The bulk of these intercepts come from United States Army stations; the remainder are derived from United States Naval and Canadian stations. The broadcasting schedules maintained by the Japanese have been fully worked out in the case of 16 transmitters, which supply 60 per cent of the bulk of the traffic broadcast. Coverage of station TOYOHATA is most complete; traffic from certain other stations is intercepted in insufficient volume to permit the reconstruction of the entire schedule. The station ERIKO in Saigon is one such station, the study of which would probably be profitable if intercepts from foreign sources were obtainable.

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The basic feature of the JN-37 encipherment is additive taken from a key book of 1,000 pages, each containing 100 lines of 36 digits printed in nine four-digit groups. The point at which the key begins is shown by an indicator. Key Books 1 to 5 were captured in 1944 or earlier; Key Book 6 has not been captured; Key Book 7 was never used by the Japanese; Key Book 8 has been captured, and Key Book 9, which is in current use, is now in process of recovery. The point of attack is the use of limitations of plain values in the synoptic and characteristic frequencies. By these means messages can be placed in depth, and solution is therefore possible. IBM methods are not practical for such purposes and have never been used on Japanese traffic. Experiments have been conducted to see whether high-speed RAM methods may be used to locate messages enciphered in the same key. These experiments have not proven very successful, nor have attempts at solution of the indicator system. Recent developments in the study of the indicators have shown that they are vulnerable in the following respects:

1. The starting points in the additive key sequences used with the delayed messages are chosen carelessly.

2. Both the text and indicators of JN-36 messages have been enciphered by the same line of additive taken from the JN-37 key book. This permits the solution of the indicator when the additive key has been previously recovered.

Late in 1943 and in 1944 the Japanese used three other systems for weather reports, though the exact dates of introduction are unknown. These are: JWE-24, a system used for reporting weather ob-

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servations to Tokyo; JWE-3, an encipherment by simple additive, solved by the British; and JWE-5, a system about which little is known, but which is thought to be enciphered by a one-time pad. Only one or two messages are received each day in JWE-5. In the same period the Japanese have also used language codes for reporting weather observations. A one-part code of the type usually found in diplomatic systems (i.e., a code group of three digits with plain equivalent representing actual Japanese words) has been enciphered by the keys taken from the JN-37 key book. Earlier forms of the code were captured in the field and later editions were recovered here.

Captured material in the form of code books, pro forma sheets, pages of keys for minor systems, complete copies of the JN-36 and JN-37 key books, and other cryptographic material has been received from other agencies at various times. Some of the pro forma sheets had been used, and were therefore valuable in showing the operations performed by the Japanese code clerks. Complete and technical liaison with the Navy is now carried on by Lieutenant Maloney. Traffic in low-echelon systems solved by the field unit in the China-Burma-India Theater is received by mail but, being delayed, the information to be obtained generally is of reduced value. The United States Weather Bureau, the Army Weather Central, and several American universities have been conducting extensive climatological studies covering the Far East.

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CHAPTER XIV. THE SPECIAL EXAMINATION UNIT[1]

The Special Examination Unit (now a part of B-III-d-1) has had during its history three distinct functions: (1) the reading and transcribing of stenographic documents; (2) the processing of documents suspected of containing open code; and (3) the transcribing and translation of radiotelephone conversations intercepted by electric means. Work on stenographic documents ceased after September 1943 owing to lack of material, and the volume of open-code problems sharply declined after July 1944, with the result that the processing of the recordings of telephone conversations, which began to be received in July 1943, has now become the chief activity of the Unit. By 31 June 1944 only two persons remained in the Unit, and language specialists were called in for particular jobs. After the surrender of Germany most of the conversations were in Japanese, and the men at Vint Hill Station worked on these.

None of these functions were being carried on at the time the Unit was organized in February 1943, though in an earlier period (January to August 1942) the Office of Censorship had from time to time submitted specimens of intercepted mail in the Spanish language suspected of containing hidden messages. These were then processed

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1. The statements made in this section are based chiefly on the progress reports of Captain Edward J. Vogel from 5 February 1943 to July 1944, and also on interviews with Mrs. Jean Hitch Banks, Mrs. Dorothy K. Watson, and Lieutenant L. Clark Keating.

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by the South American Section under the direction of Lieutenant (now Major) Leroy M. Glodell,[2] but after the dissolution of that Section, in August 1942, this feature of the work was dropped.[3]

The first head of the Special Examination Unit was Captain Edward J. Vogel,[4] who was directed to form a new unit (B-I-s) for the processing of two kinds of documents: (1) stenographic documents captured in the field; and (2) documents suspected of containing open codes. Captain Vogel at first worked alone, but after a month was given the assistance of another officer[5] and in the summer of 1943 the staff was enlarged by a number of persons.[6]

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2. See chapter VIII, page 150.

3. Some time in 1943 Lieutenant (now Major) Raymond R. McCurdy is known to have worked on press dispatches from New York to Madrid to see whether they might contain open code, but the results were negative.

4. Captain Vogel was one of four persons who served in cryptological units in World War I and also in the Signal Security Agency in World War II. He was an Army Field Clerk in the Radio Intelligence Section, General Staff, in France, in 1918. As a civilian he was engaged in the business of court reporting and was one of the country's leading experts in stenography.

5. Lieutenant Charles E. Lloyd, succeeded on 23 July 1943 by Mrs. Marion Hazard. Lieutenant (now Captain) L. Clark Keating assisted Captain Vogel in his spare time from September 1943 to May 1944.

6. Misses Dorothy M. Presnell, Annette K. Robinette (Mrs. Herther), Nell McMillan, Cordelia Greene, Jean Hitch (Mrs. Banks), Jacqueline Fowlkes, Virginia V. Summey, Mary G. Murray, Kathleen Pearce, Eleanor P. Horsay, and Dorothy Jarmon.

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At the outset Captain Vogel familiarized himself with a collection of shorthand text books in English, German, French, Spanish, Italian, Japanese, Greek, Hungarian, Turkish, Serbian, and Croatian, which had been the property of the Shorthand Subsection of MI-8 in World War I, and constructed a file of extracts from these text books to serve in the ready identification of stenographic systems in the major European languages and even in Esperanto. On 11 February 1943 the first material arrived: a quantity of German stenographic documents including three personal diaries, six small notebooks, and 58 loose sheets, captured in North Africa on 7 November 1942. This material, forming the bulk of the stenographic material received by Captain Vogel, proved to contain much intelligence concerning the German occupation of North Africa and French armies and materiel in Morocco. There was the day-by-day diary of a German officer from his induction in Germany to the time when he was a member of the Armistice Commission in North Africa, with such items as information concerning his pay, the morale of the troops, the treatment of the French, and observations on the terrain, the population, and the customs of the country. Two lengthy reports on this material were prepared on 25 March and 3 June 1943. Some idea of the nature and difficulty of the work may be derived from a quotation taken from Captain Vogel's progress reported dated 1 June 1943.

> Reading shorthand notes, especially in a foreign language, is a slow process, and by the time they are translated and typed, and enough gathered together to warrant making a report, a considerable period may elapse. Then it is naturally somewhat

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> discouraging when that material turns out not to be of any great moment. It should be obvious that any shorthand notes seized from the hands of the enemy, or of a suspicious kind, should be deciphered, because their contents cannot be even surmised until that is done. And once they have been read and translated, even though a great deal of the subject matters appears to be of an irrelevant nature, the translation might as well be forwarded to G-2 for them to get whatever intelligence they can out of it. The reading of an enemy officer's correspondence and diaries certainly ought to produce some information of value, even if only historical.

It was intended from the beginning that the Special Examination Unit should process documents suspected of containing open code, and the first two plain-text messages were received from the Office of Censorship on 23 February 1943. The first successful solution of an open code was reported on 9 March 1943. Not many documents were received, usually not more than five or six a week. The following list, taken from a special report dated 14 May 1943, shows the sort of material upon which the Unit worked:

> letters or documents passing through the Military Censorship;
> suspicious documents found in the baggage of enemy agents;
> suspicious document found in a defense plant;
> suspicious document found near an alien detention camp;
> radio broadcasts;
> press releases;
> cablegrams and telegrams;
> newspaper articles;
> letters of Japanese and Italian prisoners of war; and
> letters from civilians to the War Department with reference to codes and ciphers.

The work on this material was, in Captain Vogel's words, "a court in which many are accused but few are convicted." A huge amount of

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drudgery is involved in the examination of this material which for the most part produces negative results. Negative reports, however, are not without considerable interest, particularly when they clear the writers of the documents from suspicion; and on those occasions when positive results are obtained, the information derived is often highly useful.

In order to shorten the processes of testing suspected documents for open code, a set of 130 operations was derived and systematically applied to each document. For example, operation No. 98 was to read every eleventh letter starting with the sixth letter. After operations Nos. 1 to 97 had been applied to a certain document, operation No. 98 was applied and produced the following sequence:

RASPIHSOGRACWENROBRAHEDISNI

Since each sequence was read both forwards and backwards, the hidden message appeared:

INSIDE HARBOR NEW CARGO SHIPS, etc.

To apply all of these operations to a message was a laborious task. Accordingly, a method of speeding the process was devised. It was now necessary only to copy the message a few times on cross-section paper of the same scale as especially prepared grilles, which made possible the rapid reading of the text in every position. Using these one person could process from 10 to 12 ordinary plain-text messages in a single day.

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On 16 June 1943 the Unit was presented with its first extensive problem in open code, a task which engaged the major portion of the Unit until January 1944. The suspension of cryptographed communications between Axis governments and their representatives in Buenos Aires made it seem likely that these governments would attempt to use open code in place of the former secret communications. It was therefore planned to route all plain-text messages in the traffic to and from Buenos Aires through Captain Vogel's office. The messages were first read by persons in the appropriate language units, and certain messages were selected for processing: messages not entirely intelligible, messages between suspect correspondents, or messages having any unusual character. Some idea of the magnitude of this task may be gained from the totals of messages received. On three days in July 1943 (the second, third, and fifth), the totals were: English 253; German 282; Spanish 275; Italian 105; French 56; Japanese 2; Portuguese 8. For the week ending 29 October 1943 the totals were English 644; German 275; Spanish 1163; Italian 20; French 121; Japanese 0; Portuguese 6. In January 1944, when this work ended, about 2,000 messages were being processed each week. The results of all this work were entirely negative, as were similar attempts carried on in GCCS. There was, however, a large amount of clandestine traffic. On 8 September 1943 the Germans were reported to have sent 182 permitted messages to Buenos Aires and 58 clandestine; from

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Buenos Aires, the totals were respectively 52 and 438. As long as the transmission of clandestine traffic was possible, the Germans probably did not need to resort to the extensive use of open code. There were, however, in traffic intercepted in other systems a number of indications that open-code messages were being used, for the Japanese referred on one or two occasions to information received "in plain text" from their agents in Argentina. If these statements are bona fide, then the messages referred to were not found by the Signal Security Agency. But it should be pointed out that in one type of open-code message, when, for example, correspondents have previously agreed that they will send a message merely acknowledging receipt of a message, and the addressee will then understand that some totally different plain equivalent is meant, it is practically impossible to detect such a message short of capture of the system. Similar tests were also made in August 1943 on Domei broadcasts suspected of containing open-code messages to Japanese in Argentina, but with negative results.

A second problem, on which work was done between 9 July and 10 September 1943, involved the testing of 840 messages sent by officials of the Philips Export Company. The volume of traffic sent by these officials drew the attention of the FBI to this company. Accordingly, the 840 messages were tested by the Special Examination Unit, and in this case positive results were obtained which were helpful to the

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FBI in handling the case.

Another interesting problem was the so-called Friedman Secret Writing Case. In all, there were 20 letters, dating from the period 17 November 1941 to 13 November 1943, which were sent from the United States to correspondents in South America. Each of the messages contained a cover letter in English and a letter written with secret ink. The secret text was in a variety of languages and consisted of plain text mixed with cipher. The cipher, which was solved in several of the instances by Captain Vogel, was based on a key taken from a pocket volume on the opera and from other books not identified. The Special Examination Unit contributed substantially to the solution of these letters and enabled the FBI to close the case.

The Unit also made substantial contributions to the case of Mrs. Velvalee Dickinson, the proprietress of a doll shop in New York City, who was in 1943 convicted of espionage. Among the more amusing problems was a letter sent on 22 November 1943 by an anonymous citizen of Somerville, Massachusetts, to the "Department of Military Intelligence, Washington, D. C." The writer challenged the experts to decipher a message prepared in what proved to be a fairly simple system. The plain text was: "There comes a time in the life of every intelligent man when he realizes how dumb he is." See Tab 25.

About the first of August 1943 work began on the third function of the Special Examination Unit, the processing of radio-telephonic

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conversations.[7] By 9 September 1943 the Unit had listened to 377 sides of these recordings, with about 200 more awaiting processing at that date, and 169 reports had been prepared. Each record required about 45 minutes merely to listen to one side, to say nothing of transcribing it on paper. Moreover, since many of these converaations were in foreign languages, personnel peculiarly qualified to listen had to be recruited. For this work Mr. Angus McCoy was assigned on loan by the Language Branch to the Special Examination Unit on 27 August 1943; he has since given his full time to the work. For about two months (December 1943 to February 1944) Mr. Henry Sauerwein worked on the German recordings, and other members of the German Unit helped out from time to time. Late in 1943 two small rooms were prepared as audition chambers. In the early period many technical difficulties were encountered. Different systems of recording were tried out with varying degrees of success, and unsatisfactory methods were discarded.

In July 1944 when Captain Vogel was sent on detached service, the direction of the Unit was turned over to Mrs. Dorothy K. Watson. The Special Examination Unit itself, which began as a part of B-I, had been, since the summer of 1943, one of the subsections of B-III. It was now incorporated for administrative purposes into the German Unit (B-III-d-1). The present activity consists almost exclusively of processing telephone conversations, but occasionally open-code problems are still being received.

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7. The conversations occasionally took place in offices, hotel-rooms, and the like and were intercepted clandestinely.

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CHAPTER XV. TRAFFIC IN COMMERCIAL CODES[1]

The mission of the Agency implies that some attention will be given commercial codes, which are intended chiefly to reduce costs of transmission. Their publication has been extensive: about 300 of them are now available in the files of the Signal Security Agency and presumably there are others not yet on hand.

A large volume of commercial traffic, transmitted by stations in countries over which the United Nations do not exercise full control, is worth processing since, even when the transactions discussed are not hostile to the interests of the Allies, information is found concerning the economic situation in enemy and occupied lands which is frequently of value to the Military Intelligence Service.

The processing of commercial traffic has been performed by two separate units, one successor to the other and composed of entirely different personnel. The history of the earlier unit, organized in February 1943, exhibits many changes in personnel and even more frequent changes in the officers in charge.[2] The initial task of the unit was the isolation of various types of commercial code traffic and the solution of the system indicators, if any, used in the messages. During

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1. The statements in this section are based on interviews with Mrs. Marvin Prather, Miss Maude Devenney, Mr. William D. Coffee, and Captain Benson K. Buffham.

2. Captain William F. Edgerton was succeeded in May 1943 by Captain Franklin F. Russell. The original staff consisted of four civilians; by May two more had been added.

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this period the unit read and translated a few German and Spanish texts, but the great bulk of the traffic then being received (more than 91 per cent) was in English codes, in spite of the fact that it originated predominantly in Spanish-speaking countries. Another feature of the work was that from time to time bits of information derived from the commercial traffic would be coordinated with data available from other sources which would lead to solution in the crypt-analytic sections.

For a period of about three weeks in August 1943 the Officer in Charge was Lieutenant John C. Apollony, but when he left, the unit, which had up to this point been a part of the Romance Language Code Recovery Unit (then B-2-a, now B-3-a), was transferred to the Cipher Section.

From August to December 1943 the unit was successively in the charge of three different officers, each of whom spent most of his time with other units, so that the person actually directing operations was Miss Devenny.[3] The strength of the unit in this period, exclusive of the Officer in Charge, was reduced to about four, and by December 1943 so little commercial traffic was being received that the unit was disbanded, and the personnel transferred elsewhere.

After an interval of a few weeks during which nothing was done

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3. These officers were Captain William S. Smith, next Lieutenant J. C. O'Neill, and finally Lieutenant Walter J. Fried.

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with commercial traffic, it was decided to set up a new unit with the same function but with entirely new personnel, all Negro civilians, including the supervisor. For administrative purposes only, this group was, however, placed under a white officer in charge.[4] The supervisor has, throughout the history of the unit, been Mr. William D. Coffee. Until 15 November 1944 the unit was officially attached to the Administrative offices of the old B Branch and later to the Intelligence Division; it is now B-III-b.

At first Mr. Coffee worked alone, but on 25 February 1944 Mrs. Annie H. Briggs became his assistant, and soon the unit had grown to a strength of 20.[5]

As the work began in January 1944 the greatest problem was to be found in the identification of the code used when the preamble contained no discriminant; but as time passed, it was discovered that of the 300 odd codes on file not more than about 15 were in current use. Procedure now begins with an examination of a new message in comparison with the tables of permutations printed in most of the codes. If the

4. In succession the following officers were in charge: Lieutenant John V. Frank, Lieutenant L. Clark Keating, Captain Francis E. Maloney, and, at present, Captain Benson K. Buffham.

5. Of these, Mr. Herman W. Phynes and Miss Naomi K. McElwaine engaged principally in an attempt to solve encipherments, and Miss Aubrey V. Fox, Mrs. Ethel H. Just, and Miss Eloise E. Daniels do the translating of messages in foreign languages. The others perform the operations of code identification, decoding, transcribing of the text of English messages, typing, and filing.

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first few groups are not to be found in the permutation table of a given code, that code may at once be eliminated from consideration. It is no longer necessary to test the message by actually looking up the groups in the code. Whenever this procedure fails to identify the code, then frequency studies are made of the letters appearing in the different positions of the group and compared with similar frequency studies of the various codes on hand. An elaborate cross-reference filing system has been instituted so that the information derived from previous messages may be immediately available to all personnel.

The mission of B-III-b, since its organization as a separate section of the General Cryptanalytic Branch, has been the exploitation of the commercial codes (all known as QAA) used by commercial houses of Australia, Great Britain, Spain, Portugal, Bulgaria, Turkey, Afghanistan, Russia, China, Indo-China, Thailand, Japan, Egypt, South Africa, and several countries of South America. Germany was included in this list until V-E Day, when all QAA traffic in and out of that country stopped. Of the traffic examined during the past year about ten per cent contained diplomatic and military information. Of the remainder about 40 per cent was sent to the Military Intelligence Service for forwarding to the Foreign Economic Administration.

Since 14 November 1944 the Commercial Traffic Section has had the additional assignment of sorting and routing all plain-text

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traffic (QAZ), a task formerly performed by the Traffic Coordination Section. The traffic, which in a given month may range from 175,000 to 200,000 messages, is sorted into the following categories:

1. Commercial plain text (identified by the address or signature);
2. Plain text dealing with commercial matters but bearing a diplomatic heading;
3. Plain text in the Romance languages and German;
4. Plain text in other languages;
5. Diplomatic plain text;
6. Red Cross plain text (QGA);
7. Commercial Code traffic (QAA).

The languages of the Commercial traffic may be classified as follows:

English	75 per cent
French	10 per cent
German	10 per cent
Spanish	2 per cent approximately
Portuguese	2 per cent approximately

In April 1945 the government systems of four countries were transferred to the Commercial Traffic Section from B-III-a for exploitation. They are those of Belgium (BEA, BEB, BEC, BED, BEE, and BEZ), Haiti (HTA, HTB, and HTZ), Liberia (LBA, LBB, and LBZ), and Luxembourg (LUA and LUZ). Several of these diplomatic systems are now in research. The Section has had considerable success in solving such systems as BED and HTB, and has contributed much to the exploitation of JAH, a Japanese commercial system.

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CHAPTER XVI. THE MACHINE CIPHER SECTION[1]

Until the spring of 1942 the Japanese diplomatic Red and Purple machines[2] were the only cipher machines studied by Army cryptanalysts.[3] In that year, however, lectures were given by Lieutenant (now Lieutenant Colonel) Frank B. Rowlett on the IT&T machine and on the Commercial Enigma machine. Captain (now Colonel)Solomon Kullback, upon his return from a visit to GCCS in the summer of 1942, gave lectures to a small group of experienced cryptanalysts on the German Abwehr Enigma (GEQ), German Military Enigma (GEU), and the German Teleprinter ciphers (GES, GET). Research and some work on solution was then done on GEQ.[4] Methods of solution for the Analin Fabrik Commercial Enigma traffic and the

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1. The statements in this chapter are based on interviews with Major E. Dale Marston, Miss Gertrude Ullman, Mr. Alfred Hesse, and Miss Nancy McWhorter, and on the following documents: Cipher Teleprinter Regulations (SFV) for the Wehrmacht after 1 December 1942 (IL 4040); Major Roy D. Johnson, Cryptanalytic Report Number Two; German Permutation Cipher Teleprinter, Type 52b (IL 3883); A Method for the Solution of the GEQ Indicator System (IL 3296); William F. Friedman, Preliminary Historical Report on the Solution of the "B" Machine; An RAM Procedure for Placing Cribs in a De-Chi; A Statistical Method for Analyzing Certain Types of Flags Applicable to Tunny and Hagelin; Statistical Solution of Messages Enciphered by the Tunny Machine; Synopsis of Cryptanalytic Machines (IL 3988); SZD, A Swiss Machine Cipher (IL 3846). Discussion of Hagelin problems will be discussed in a later chapter.

2. On these machines, see chapter II. Also see volume IX.

3. The SIS had studied other machines but only in test messages.

4. By Lieutenant Herbert H. Maass and Sergeant Arthur Lewis.

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German Kryha machine were developed.[5] A portion of this traffic was subjected to solution and processed for translations.[6] At this time analysis of the Finnish Hagelin machine was in progress and a separate section was formed to handle all Hagelin problems.

In November 1942, when the cryptanalytic units then known as B Branch, were moved from Headquarters Building, Arlington Hall Station, to the new Operations A Building, there was only one section which concentrated on the cryptanalysis of machine ciphers other than the Hagelin machine. This section, directed by Lieutenant (now Major) E. Dale Marston, consisted of a small group who confined their activities to the solution and reading of messages enciphered by the Japanese Purple machine (JAA).[7] At this time, however, attempts were being made to intercept German Army and Air Force traffic, and it was decided that an intensive course in machine cryptanalysis should be given to a group of cryptanalysts who would ultimately be assigned to the German Enigma problem. The instructors were Mr. Ferner, Miss Grotjan, Mr. Small, Mr. Levine, Lieutenant Maass, Lieutenant Morris R. Collins, Sergeant Lewis, Mr. Maurice Waltz, and Sergeant Hyman. The students in this course, selected from the various units in the Cipher Section

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5. By Miss Genevieve Grotjahn (Mrs. Feinstein), and Messrs Robert O. Ferner, Albert W. Small, and John Hyman.

6. By Mr. Jack Levine and Mr. Frank Lewis.

7. See chapter II, section C.

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(B-III), were given the instruction in two groups.[8]

After all students in the first group had completed the courses in Military Cryptanalysis, they studied some machine ciphers: Wheatstone, ITT, Commercial Enigma, Swiss (SZD), German Abwehr Enigma (GEQ), German Military Enigma (GEU), German Teleprinter ciphers (GES, GET), Japanese Red and Purple machines (JAA), Hebern machine, Hagelin machine, and the German Kryha (GEH). When Major Roy D. Johnson returned from England in April 1943, he gave a series of lectures on cryptanalytic procedures used at GCCS in connection with the German Military Enigma machine. Until his arrival, the Section was under the direction of Captain (now Major) John N. Seaman, Officer in Charge of the Cipher Section (B-III), and Mr. Robert O. Ferner, who were sent to GCCS in April to study procedures in Enigma cryptanalysis. Two identical electromechanical machines ("003") of great size and complexity were being installed in the basement of Operations B Building for this purpose. (Tab 28). These machines were officially turned over to B Branch on 16 October 1943.[9] Unfortunately,

8. The first group: Miss (now Lieutenant) Mary Charlotte Lane, Misses Betty Scherer, Jeanette Early, Marjorie MacLeod (Mrs. Max-Muller), Isabel Murdock, Sergeants Frederick McComas and Everett R. Dawson, and Lieutenant (now Major) William P. Bundy. The second group: Misses Gertrude Ullman, Nancy McWhorter, Alice Joys, Dr. Albert H. Carter, Lieutenant (now Major) Charles J. Donahue, Dr. Martin Joos, Dr. Ray W. Pettengill, Sergeant (now Lieutenant) Burrows Hunt, Mr. Alfred Hesse, Dr. Frederick Klemm, Dr. Robert Weidman, Dr. Karl Klitzke, Mrs. Hunt, Lieutenant Richard Hallock, Sergeant George Vergine, Sergeant Ernest Goldstein, Sergeant George Hurley, and Sergeant Daniel M. Dribin.

9. For further details and illustration of the 003, see volume IX.

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efforts to obtain traffic and procedure data for this project were entirely unsuccessful, so that use of the equipment has been confined to research and the solution of special jobs sent from GCCS. For further details, see chapter XVIII.

During the summer of 1943 a large number of personnel were assigned to the operation of the 003 to establish procedures for clerical personnel as soon as they could be procured. Maintenance of the 003 was undertaken by the Development Branch. In September 1943 two sections under Captain Marston were established to carry out these functions: B-III-c-4 (Operation and Control of the 003) under Lieutenant (now Captain) C. P. Collins; B-III-c-5 (Maintenance and Repair of the 003) under Lieutenant (now Captain) J. E. Bates. The cryptanalytic personnel were then returned to the Machine Cipher Section (B-III-c-2) for work on problems other than the German Military Enigma. During the summer cryptanalytic personnel of the Machine Cipher Section, except those assigned to the 003, concentrated on other cipher machine problems. Messages enciphered by the Swiss Enigma (SZD), which differs from the Military Enigma in that it has no endplate plugging, were currently read. Work on this system first began in December 1942, and the first translation was processed in July 1943. The stations using this system include: Bern, Washington, London, and Rome. The purpose of exploitation was not primarily the intelligence value of the decipherments but the maintenance of cryptanalytic continuity and the training of new personnel

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in methods of Enigma cryptanalysis.

Also during the summer the German Abwehr (GEQ) Enigma was studied, but no solutions were obtained because of faulty intercept copies and out-of-date cribs. This Enigma machine differs from other German models in that it has no endplate plugging and from the Swiss Enigma in having a different wheel-turnover pattern. Each wheel has a number of notches which govern the turnover of adjacent wheels. The number of notches varies with each wheel so that the turnover is irregular.

At this time work was resumed on the Commercial Enigma machine, which has none of the complexities of the other Enigma types. Traffic between the Chemnyco Company in New York, which had been forced to close, and the Analin Fabrik, Ludwigshafen, Germany, was seized in New York by the FBI and forwarded to the Signal Security Agency for cryptanalysis.[10]

An extensive study of the German high-grade teleprinter cipher (GET) was initiated under Captain Maass. This system, called Tunny by the British, is entirely different from the Enigma machines. It involves a complex teleprinter machine using non-Morse transmission in the Baudot alphabet. As this traffic was not intercepted by the Signal Security Agency, material was sent from GCCS for research purposes. New methods of solution were devised and special emphasis was placed upon the

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10. The remaining traffic on hand was read by Miss Gertrude Ullman, Miss Nancy McWhorter, Sergeant George Hurley, Mr. Alfred Hesse, and Lieutenant Richard Hallock.

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the application of RAM[11] to this problem. A new method of flag analysis was developed for the solution of this traffic, and many technical reports were written on the basis of research conducted at the Signal Security Agency. In the autumn of 1943 all members of the Section were given training in this problem under the direction of Captain Maass and Sergeant Jack Levine. More advanced courses were planned, and new cryptanalytic attacks were tried out. The Dragon machine, (Tab 31) a mechanical means of sliding a crib against intermediate cipher text to determine [redacted] was constructed and delivered to GCCS in the autumn of 1944, where it has been used operationally with considerable success and has been the prototype of new machines. Concentrating principally on research, the Section was currently informed of operational procedures developed at GCCS by the American Liaison Officer stationed there. At that time, another machine (later known as the 5202) was designed for the purpose of setting certain other wheels (those not set by the Dragon machine) in Tunny machine problems. Certain units of the machine were designed to photograph data on specially prepared films, which were later subjected to a rapid comparison. The entire process was similar to the operation performed by the British machine known as the Colossus.

EO 3.3b(6)
PL 86-36/50 USC 3605
EO 3.3(h)(2)

After Major Johnson left the Machine Cipher Section for GCCS,

11. See chapter XVIII.

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Captain William S. Smith became head of B-III-c-2 for a short time. Captain Walter Fried then took over the Section until he was appointed Liaison Officer at GCCS. Captain Herbert Maass succeeded him until he too was ordered overseas in the autumn of 1944. Since then the Section has been directed by Mr. Alfred Hesse.

In the early spring of 1944, the space allotted to B-III-c-2 was taken over for the exhibition of B-III cryptanalytic activities. See Tabs 18 to 25. During the two weeks that the exhibition was in progress, members of the Machine Cipher Section were assigned to other sections. Miss Ullman, Miss McWhorter, and Miss Rosebro studied in the Hagelin Section. Mr. Alfred Hesse, Sergeant Goldstein, and Mrs. Max-Muller wrote a report on the solution of the GEQ indicator system and studied the German Teleprinter ciphers GES and GET. Mrs. Dora Ralph and Miss Virginia Roberts maintained current solution of SZD traffic, and the remainder of the Section analyzed the "19 Kana Nigori" (the machine-cipher system employed by the Japanese Army) for B-II. Solution was not possible at this time because of lack of sufficient traffic.

One of the contributions of the Machine Cipher Section has been the extensive analysis of the German Abwehr Enigma (CEQ, formerly called Orange). Attention was first directed to this system in July 1942 upon the return of Captain Kullback from England. Captain Kullback brought with him messages, cribs, and work sheets, and organized a class of 12 cryptanalysts to study this among other machine ciphers.

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No solution work was carried on by this group, but they in turn instructed others in the methods of Enigma cryptanalysis. Interest in the system was revived in the summer of 1943, when Major Johnson brought back additional material from England. A unit of four people (later expanded to nine) was formed to study the GEQ traffic on hand. Reference catalogs were compiled and processed by IBM, and statistical studies were made. Because of the faulty intercept copies and inadequate cribs, little progress was made on the actual solution of the system; but the work did provide excellent training for a large number of people, who later were able to solve the traffic currently. In October 1943 a complete list of keys was received from the British for the traffic of April to September 1943. The back traffic was then deciphered, and crib sheets were prepared and studied for the best points of attack. Work was concentrated on the "A" net (Berlin, Madrid, Bordeaux, Paris, Rome, Merano, Lake Garda, Lisbon), which had much the best coverage. About 60 per cent of the Berlin-Lisbon traffic was covered at this time. The unit, which had shrunk to two people (Lieutenant Hunt and Sergeant Goldstein), was increased to four by the addition of Mr. Alfred Hesse and Miss Betty Scherer on 2 November 1943. Miss Ullman and Miss McWhorter followed within a week. The first solution of current traffic was effected on 12 November 1943. From then on, with the improvement in interception and the training of additional personnel (the unit numbered 21 at its peak), key recovery progressed

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to the point where 24 of the 31 daily keys for December were solved and messages were processed upon receipt. Methods of analysis using the 003 were developed for these messages so that very rapid solution was possible. The first "D" net (Berlin, Istanbul, Ankara) message was solved on 1 January 1944. On 15 January 1944 cryptographic changes were introduced into the system which prevented further key recovery with the methods in use. The unit was working on a new method of solution when new keys and a description of the changes which were already known in the unit arrived from the British. A method of solving the indicator system was devised,[12] and an elaborate catalog, consisting of an index of the development produced by the reflector and two adjacent wheels for all possible wheel motions, was compiled. The index, a new type of Eggs Catalog, was constructed by IBM methods. Attempts were made to record the data on IC plates and also on RAM tape, but IBM proved to be the most convenient medium. Solution, however, of the current messages was considered impractical because of inadequate interception and lack of cribs. But because the system was used on clandestine circuits which were covered by the United States Coast Guard, all cryptanalytic materials were turned over to the Coast Guard in June 1944 for further analysis.

When, during the spring of 1944, the use of the pluggable

12. See A Method for the Solution of the GEQ Indicator System, IL 3296.

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reflector threatened to become widespread in the Enigma communications of the German Army and Air Force (GEU), the Signal Security Agency was asked to assist GCCS in the hand recovery of the reflector and the endplate plugging by a method known as scritching. Traffic and cribs for this purpose were received from GCCS, and the efforts of the entire Cipher Section were devoted for several weeks to scritching. Many shortcuts and minor improvements on the procedures were developed; but the hand method of solution, impractical because of the time and number of high-grade personnel involved, was afterwards superseded by an electrical means of scritching developed in connection with the 003 to handle this problem. This machine, known as the Autoscritcher (Tab 30), was designed by members of the Research Group and the Machine Cipher Section and constructed by the Development Branch.

On several occasions the Section has contributed to cryptanalytic problems located outside of B-III-c. In the spring and summer of 1944 a small group, under the direction of Captain Herbert Maass and Mr. Samuel S. Snyder, undertook the cryptanalysis of JBH, a Japanese commercial system. Solution was accomplished with the cooperation of GCCS, and the messages were found to contain important economic information. The system proved to be a complex kana transposition and substitution with auto-key. In November 1944 the recovery was attempted of the current JEV (Japanese Army) conversion squares. Solution of the first set of squares was completed on 23 January 1945. At the

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same time other members of the Machine Cipher Section were assigned to the GEE (German one-time pad) system[13] in B-III-d. Cryptanalytic activities there were directed by Mr. Robert Ferner, Captain Walter Fried, and other members of the Research Group. After the nature of the machine which generated the additives was determined, the problem was returned to B-III-d for further exploitation. Problems relating to the security of our own communications have been analyzed from time to time by this group. Other systems which have been studied by the Machine Cipher Section during the winter 1944-45 are: GEV (German Military Attaché); GEX (Tokyo-Berlin German letter traffic); GEW (German Shanghai letter traffic); and FWA (French military B211).

Research of the GEV system was carried out by Miss Wilma J. Lambert and Miss Mary Neely Rosebro. From frequency distributions it was determined that an Enigma machine had been used in encipherment. Messages as far back as 1939 found to be in possible depth with current traffic indicated that no basic change in the machine had taken place since that time. Current cribs from Naval attaché systems were tested without success. Several attempts with the 003 were made, assuming the wheel wiring of the military Enigma. The exact nature of the machine (number of wheels, presence of endplate plugging, wheel break pattern) is not known. The six-letter indicator,

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13. See chapter IV, section C, page 88. See also volume IX.

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as in the German Abwehr and Armistice Commission Enigmas, points to a setting of three wheels, but since no mention of the nature of the machine has been made in other German systems, no other proof has been found. Work on GEV was continued, and results of the research were sent to GCCS, where a section was organized to continue the work on this problem.

Analysis of GEX (Tokyo-Berlin German letter traffic) has progressed under the direction of Major Marston, Mr. Alfred Hesse, and Dr. Ray Pettengill; but only about 75 messages were received, and traffic ceased entirely at the end of December 1944. The nature of the machine has not yet been determined, but frequencies show that an Enigma machine is probably not involved. Several long messages have been tested statistically for Hagelin characteristics but without success.

The French military machine cipher, FWA, has been analyzed recently by members of B-III-c-2. It is a fractionating cipher and the basic machine is the Swedish Hagelin B-211, which was fully described by Colonels Rowlett, Kullback, and Sinkov in 1939, under the direction of Mr. William F. Friedman. The French, however, have further complicated the action of the machine by the addition of four wheels between the original fractionating device and the printing mechanism. The indicator system has been solved, but the wiring and exact function of the wheels are still unknown.

Traffic for 1943 and 1944 in the GEW system, letter traffic between the Berlin Foreign Office and the German Consulate in Shanghai,

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was available for study. A cipher-text frequency was made on approximately 24,000 letters taken from messages after 12 July 1944. This distribution revealed that some type of Enigma machine had been used. Some compromised plain texts of messages were available, and although the corresponding cipher text was not on hand, cribs from these messages were tried on at least 18 cipher messages with no success. It was assumed that the wheel wiring was identical with that used in GEQ (German Abwehr Enigma) but several jobs were tried on the 003 without obtaining a solution. Some of the messages had sections of transposed plain text which were studied in the Machine Cipher Section. The traffic from Berlin was sent over clandestine channels and the intelligence was the same as that found in systems analyzed by the United States Coast Guard. Accordingly, work was abandoned on GEW at the Signal Security Agency and the traffic and work sheets were turned over to the Coast Guard.

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CHAPTER XVII. THE HAGELIN SECTION[1]

No date for the establishment of the Hagelin Section (now B-III-c-3) can be given. At first this machine was studied in connection with exploratory work carried on by the Administrative Office of B Branch. Considerable time was given to the problem in the spring of 1942 by Lieutenant (later Major) John N. Seaman, who had been a member of the French Section, but, because of his knowledge of Swedish and Finnish, was directed in May 1942 to study the solution of the Hagelin C-38 and Finnish and Swedish plain-text messages. The state of Hagelin studies at this time was hardly more than that presented in a manual prepared by Captain (now Major) G. W. Morgan of GCCS on the Theory and Analysis of a Letter-Subtractor Machine.[2] Techniques

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1. The name "Hagelin Section" relates to the fact that the cipher machine in question was invented, developed, and produced for commercial sale by the Swedish engineer, Boris C. W. Hagelin, of Stockholm. His original five-wheel model (C-36) was improved by him as a result of certain suggestions by the Signal Intelligence Service in its studies of the possibilities of the C-36 as a small cipher machine for field use. The Hagelin Model C-38 was the result. The United States Army Converter M-209 is a C-38 Hagelin machine without the "slide" and with certain other minor changes. The C-38 machine was sold by Hagelin to a number of governments, the Swedish, Finnish, Dutch, French, Italian, and Portuguese. Hagelin was not, however, successful in interesting the German or British Governments in his machine, although the Germans copied certain features of it in one of their later developments (C-41). See chapter XXI, page 303. Throughout this chapter the name "Hagelin Machine" will refer to the C-38 model. It must not be confused with another Hagelin machine, Model B-211, altogether different in nature. An extensive bibliography on Hagelin solution now exists: see appendix at end of this chapter.

2. SSA Document No. 13.

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subsequently developed in the Signal Security Agency show an enormous advance measurable both by the volume of Hagelin traffic solved and the publication of a number of technical studies.

Lieutenant Seaman began by making a careful study of the Swedish plain text, and to good advantage, for he was able to solve two Swedish messages by means of phrases common in the plain text and ship names, notably the probable word KOOKABURA. Mr. Robert O. Ferner had found these messages and the method of

[redacted] In order to solve the problem presented by this fact, Lieutenant (now Lieutenant Colonel) Frank B. Rowlett examined [redacted]

EO 3.3b(6)
PL 86-36/50 USC 3605
EO 3.3(h)(2)

In this period work on the Hagelin problem was advanced by the assistance of a number of other persons,[3] but the group itself possessed

3. Captain (now Lieutenant Colonel) Perry Molstad, Lieutenant (now Major) Charles J. Donahue, Lieutenant (now Captain) Cyrus H. Gordon, Lieutenant (now Major) Stephen Dunwell, Lieutenant (now Lieutenant Colonel) James B. Greene, Mr. Robert O. Ferner, Mr. John Hyman, Miss Genevieve Grotjan (Mrs. Feinstein), and Sergeant Earl M. Ratser.

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only four persons regularly assigned to it.[4] When the Signal Intelligence Service moved to Arlington Hall Station in July 1942, there was a further increase. About this time a series of Swedish cipher tables was received, and to decryptograph a large body of accumulated traffic a number of clerks were added.[5] A method of extending the compromised Swedish tables to other circuits, based on relationships among them discovered by Captain Rowlett, was evolved.

The first entry into Finnish systems came in September. Only a single fragment of information about the Finnish use of the cryptograph was available,[6] but soon methods of solution were developed.

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EO 3.3(h)(2)

.....

[redacted]

4. Lieutenants Seaman, Donahue, and Gordon, and Captain Molstad.

5. Translations were made by Captain Molstad, Lieutenants Donahue and Gordon, and Dr. Martin Joos. Dr. A. H. Carter was assigned to the task of studying Finnish plain text in order to discover probable words, and to recognize and translate Finnish, should it ever be recovered.

6. This had been learned accidentally during a visit to the Signal Security Agency of Brigadier Tiltman of the British Army. He had used the term "finnery" in a totally different connection, and upon inquiry explained that the British had read a day or so of Finnish traffic and had labeled cyclic interruption there discovered "finnery."

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[redacted]

On 17 December 1942, when Captain Seaman became Officer in Charge of the Cipher Section (B-III), Dr. A. H. Carter took over the leadership of the Hagelin Section, but continued to concentrate his efforts on the task of translation, for although experts in Finnish were now available,[8] cryptanalytic production, which was by January 1943 on a

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7. New members of the Hagelin Section included Private (later Lieutenant) Burrowes Hunt, Miss Dudley Scovil (Mrs. Hunt), and Lieutenants Arnold I. Dumey and Walter J. Fried. Lieutenants Dumey and Fried had successfully analyzed the Hagelin machine while engaged in the practice of law.

8. Mr. John Kepke, one of the country's leading experts on Finno-Ugrian languages, and Dr. Reino Virtanen.

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current basis, outran linguistic production.[9] The first language study in Finnish was prepared about this time.[10]

By February the Hagelin Section had grown to some 50 people, and it was regarded as a training ground for machine cryptanalysis. On 12 February the first solution of a Hagelin cryptogram was accomplished.[11] The translation of volumes of correspondence, cryptographic materials, and records of all sorts in a very short time created a task of enormous proportions.

EO 3.3b(6)
PL 86-36/50 USC 3605
EO 3.3(h)(2)

9. At this period Sergeant Vergine was in charge of statistical analysis, Lieutenants Dumey and Fried, Sergeant Goldstein, and Captain C. A. Rupp were in charge of research. Mr. (now Sergeant) Walter Jacobs was added to the staff in March 1943.

10. A "language study" in this sense is a statistical analysis, usually by IBM methods, of the frequencies of individual letters, groups of letters, and words in a representative sample of plain text.

11. In March Dr. Carter was transferred to the Research Group working on special problems and machine ciphers, and Lieutenant (now Major) William P. Bundy took charge.

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messages.[12]

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Some of these solutions were achieved through adaptations and refinements of the

[redacted] was especially the work of Miss Oriole Gidlof, who worked out many methods for the speedy

12. At the time of the final negotiations between the two countries the Section was on a 24-hour basis, and several members were more than once summoned from bed.

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PL 86-36/50 USC 3605
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..... [redacted] As for the non-Hagelin systems,[13] Mr. (now Sergeant) Robert Brumbaugh, and Lieutenant Vilar Kelley solved the transposition system FIG. Dr. Reino Virtanen, Dr. Leslie Rutledge, Lieutenant Richard Hallock, and Dr. Carter were responsible for the entry into FIB. Dr. Virtanen, Captain Paavo Carlson, and Mr. Kepke are to be credited for their work on the running-key system. Reconstruction of the FIE system (substitution with disguised running key) is one of the landmarks in cryptanalytic history in B-III: the plain text was known but not the relationship of plain to cipher text. Once this was found after many tedious hours, it could be tested only by examining the resultant key, which had approximately the same frequency characteristics as English. This key in turn had to be anagrammed in such a way that fragments of English plain text appeared. From such a fragment "---isati---" it was believed that the key book was an English book published on the Continent: the spelling "(civil)isati(on)" was the clue. From such reconstructions the key book was located in a single day's search. When the key book changed and the supply of captured plain text was exhausted, by dint of sustained patience and effort two fragments of running key were reconstructed--a sequence of trigraphs and one of pentagraphs taken from the margin of a book by a route transposition--which made possible

13. The Hagelin Section also studied systems not using the C-38 machine because it had the personnel qualified to work in Finnish and Scandinavian languages, who were required for this work.

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the discovery of the key book after a search of five days in libraries in the New York area. The key book for FIF also gave an exciting chase. At one point, through an unfortunate slip in liaison, the Library of Congress actually requested it of the Finnish Legation! But it was found in the New York Public Library after a series of searches by several agencies here and abroad. Later, Dr. Virtanen inspected the libraries in the foremost Finnish-speaking communities in the United States, where he obtained[14] the key book used in the Buenos Aires version of the FIA systems.

Lieutenant Bundy was relieved by Lieutenant Fried in June 1943, and he by Lieutenant Dumey in December 1943. At about the same time, the exploitation of the Portuguese Hagelin (POV and POW) systems was undertaken, based on keys supplied by GCCS. In February 1944 the problem of the Netherlands Hagelin NEA system arose. The current solution of most of this traffic owes much to new techniques of aligning messages.

Among the major achievements of B-III-c-3, aside from the great production maintained in the Section, must be counted: recommendations to the Cryptographic Branch for the protection of our own systems,

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14. Search in public libraries and Finnish book stores was unavailing, but Dr. Virtanen read in the files of a Finnish newspaper in New York that the publisher of the book (assumed but not known to be the key book desired) had donated copies of books to the library of a Finnish college in Michigan. Dr. Virtanen went to this college and found and surreptitiously appropriated the book, which proved to be the correct one.

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the justification of warnings issued by the cryptanalysts after the reading of a message picked up by the Security Branch on a routine inspection of the Code Room of the Office of War Information, the several technical papers, and the interchange of technical information with GCCS and OP-20-G.

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EO 3.3b(6)
PL 86-36/50 USC 3605
EO 3.3(h)(2)

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CHAPTER XVIII. THE YELLOW PROJECT[1]

Knowledge of the German Enigma problem and some details of operational procedure were first brought to the United States by Captain (now Colonel) Abraham Sinkov and Lieutenant (now Lieutenant Colonel) Leo Rosen in the spring of 1941 when they returned from a study of the problem at GCCS.

The cryptanalysis of the German Army and Air Force traffic was first considered by the Signal Intelligence Service in the early spring of 1942. The methods of Enigma cryptanalysis used by the Navy (OP-20-G) and at GCCS had been examined, and it was decided to abandon the rotary type Bombe used at these centers in favor of a relay switching system which could be developed at the Bell Telephone Laboratories in New York. It was felt that research could be undertaken with more profitable results with this type of equipment. Accordingly, a meeting was held at the Bell Laboratories in New York on 30 September 1942.[2] The

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1. The statements in this chapter are based on interviews with Mr. William F. Friedman, Lieutenant Colonel Frank B. Rowlett, Colonel Earle F. Cook, Major Lewis W. Gammell, Captain C. P. Collins, Major E. Dale Marston, Captain Joseph E. Bates, and Lieutenant Margaret Baker, and upon the following documents: The Arlington Dudbuster (IL 4099); Bell Laboratories Project File (Secret Switching System Project X68003); Contract File (SPSIF); File on the 003 in SPSIB-3; Semimonthly reports of B-III-c-4; Cryptanalytic report No. 2, by Major Roy D. Johnson.

2. Those present were Colonel Frank W. Bullock, then Officer in Charge of the Signal Intelligence Service; Captain Leo Rosen, now Chief, Equipment Branch, SSA, who was charged with the responsibility of the engineering on this problem; Mr. William F. Friedman, Director of Communications Research, SSA; Messrs Williams, Mertz and Stibitz, who originally designed the switching system, and Mr. A. B. Clarke, all of the Bell Laboratories.

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details of the cryptanalytic problem were presented by the representatives of the Signal Intelligence Service, and the discussions resulted in the decision to construct, at the Bell Laboratories, an experimental Enigma frame which would duplicate in effect the motion of a three-wheel Enigma machine with fixed reflector and pluggable end-plate. A letter of intent was sent to the Bell Laboratories on 16 October 1942 authorizing the expenditure of $30,000 for the construction of one Enigma frame to be known as Secret Project X68009. On 3 November plans were drawn up for the development of an electronic model. An engineering survey was made (X68007), but after the expenditure of $2,000 in experimentation, this project was abandoned because the time and cost involved did not warrant further development. The original experimental relay frame was completed and demonstrated to Mr. Friedman and Captain Rosen on 22 November 1942. Another successful demonstration was given on 9 December in the presence of Captain (now Lieutenant Colonel) Frank B. Rowlett, present Chief, General Cryptanalytic Branch, Signal Security Agency, then attached to the Office of Director of Communications Research, and Captain (now Major) L. W. Gammell, who, under Captain Rosen, was to be responsible for the maintenance and mechanical functions of the Bombe. Since the performance of X68009 was excellent, plans were made for the construction of a unit containing 144 frames and a recording apparatus, to be installed at the Signal Intelligence Service. Half of the frames were scheduled for completion by 1 April 1943 and the remainder by the following August.

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Developments were made on the recording apparatus and other features. An A-1 priority was placed upon the construction of the first 72 frames, and the project was designated as X68003. On 5 February 1943 representatives of the British Government, Mr. Turing, and Major G. G. Stevens, then British Liaison Officer at the Signal Security Agency, were given a demonstration of the X68009. They were favorably impressed with the departure from the rotary bombe technique, which had been replaced by a new stepping apparatus controlled by switches.

During the early part of February steps were taken to obtain German Army and Air Force traffic and intercept data which were desperately needed for this project. A small amount of traffic was currently received from stations at Vint Hill Farms, Newfoundland, and Iceland, but, because of geographical location, they could never provide adequate intercept material. In addition to intercept data, information on cryptanalytic procedures was extremely important, if not vital, for efficient exploitation of the traffic. This information could be obtained only from GCCS, however, and Brigadier Tiltman had indicated that, for reasons of security, the British Government would be most unwilling to allow such information to leave England. Consequently, liaison concerning this matter had to be conducted on the highest level. A letter to the late Field Marshal Sir John Dill was prepared in February 1943 for the signature of General George C. Marshall, Chief of Staff, requesting all pertinent information needed for the exploitation of German Army and Air Force traffic by the

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United States Government. The reasons for the request were stated as follows:

1. In all probability the Signal Security Agency could make important contributions in respect to the type of machinery employed because of the new design, which gives greater flexibility; but only practical operation on actual traffic could establish this point.

2. It was desired to supplement British interception of this traffic in order that as complete coverage as possible of German cryptonets could be maintained.

3. American coverage of areas applicable to Allied operations in North Africa would release British intercept sets and personnel for other assignments pertinent to British rather than to American operations.

4. If the Germans should introduce a fourth wheel into the Army and Air Force Traffic, as they had done in the Naval Enigma, the Signal Security Agency would be in a position to assist materially in solution.

5. It was felt that actual operation of the relay bombe would afford the best training for cryptanalytic personnel, so that, in the event that American forces should operate in areas of primary interest to the United States, exploitation of the traffic might be carried on by the Signal Security Agency personnel without burdening GCCS.

6. Indications that the Japanese might adopt the Enigma machine had been noticed in Japanese Military Attache messages. If this should happen, the Signal Security Agency had to be in a position to solve the traffic.

7. It seemed wise to provide against the contingency of the wholesale destruction of equipment and specially qualified personnel in England, which at that time, shortly after the Battle of Britain, was entirely possible.

Whether this letter ever reached General Marshall or Sir John Dill is not known, but Mr. W. G. Welchman, in charge of Enigma operations at GCCS, came to the Signal Security Agency in April 1943 to

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present the British point of view and to arrange a working plan of operation between the Signal Security Agency and GCCS on this problem. Agreement was reached on 17 May 1943.

During January 1943 personnel were selected from various sections of B Branch for special training on machine ciphers in preparation for Enigma cryptanalysis, as has been described in chapter XVI, page 235.

In April Major Roy D. Johnson, who had spent several months in the Engima Section of GCCS, returned to the Signal Security Agency to organize, under Lieutenant Colonel Rowlett, the Enigma Cryptanalytic Section here. Lectures on methods and procedures employed at GCCS were given to the personnel of the Machine Cipher Section (B-III-b), and its subsections were planned according to the British method of operation. None of these subsections functioned according to the original plan, except the Translation and Intelligence Unit under Captain (now Major) Charles Donahue, Dr. Ray W. Pettengill, and Dr. A. H. Carter, because sufficient traffic was never available for traffic analysis or cryptanalysis. Several attempts were made to expedite the interception of more traffic during the spring and summer of 1943 without success. Research on discriminants and unsuccessful attempts to isolate crib messages from the available traffic were carried on by Captain Roy D. Solomon and Mrs. Marjory Max-Muller; the remainder of the Section at that time concentrated on other problems, except for the Information Section, under Dr. Carter, which analyzed reports from intercept centers in order to direct

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intercept activity towards particular cryptonets which would offer crib material. It was soon discovered that the system of allocating discriminants had changed since Major Johnson had studied it at GCCS and that the new system could not be accurately determined from the small amount of traffic at the Signal Security Agency. The few cribs on hand were out of date and could not be applied with any hope of success to current traffic. Jobs on current traffic were submitted to the bombe, and approximately 1000 machine hours were consumed without a single solution. Liaison with B Branch, which then was responsible for the traffic analysis, was conducted with Lieutenant Richard Farricker, who headed the group of traffic analysts assigned to this problem. When all attempts at cryptanalysis were abandoned in October 1943, the Section was disbanded and the personnel were assigned elsewhere. In August 1943 work on current traffic was temporarily abandoned until information regarding cribs and discriminants could be obtained from the British, or the interception of traffic greatly increased.

Installation of the Bombe 003 began 1 April 1943, but it was not until 1 June of that year that test jobs from B Branch could be submitted. These test jobs, actual menus received from the British, proved that considerably more work had to be done on the 003 before any operations could be considered. It was not until 23 July 1943 that the 003 was functioning with a degree of accuracy sufficient to warrant operational work. Enigma cryptanalysis at this time was

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devoted primarily to research, and all activities connected with it were known as the Yellow Project. By arrangement with Commander Sir Edward Travis and Mr. Welchman, operational jobs were regularly sent to the Signal Security Agency from GCCS. Special communication channels were set up between the two centers to insure speedy exchange of jobs and solutions, and the section at the Signal Security Agency actually functioned as a subsection of the British unit.

Sections to handle these problems were organized so that the cryptanalytic group checking the runs were separated physically from the bombe operators and maintenance crew, because several Bell Telephone personnel were included in the latter group. Three control officers were selected to direct the activities of both groups.[3] After Major Johnson received orders to go to England, Lieutenant Morris Collins was put in charge of all Yellow operations until Major Marston could relieve him. Because of the shortage of clerical personnel, the delayed WAC program, and the security problem involved, it was necessary to assign highly trained cryptanalytic personnel, during the experimental period, to the jobs of turret operation and run checking so that they could train others at a later date.[4]

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3. At the beginning of operations these officers were Lieutenants (now Captains) C. P. Collins, Robert Masenga, and Vilar Kelley.

4. The personnel then included Misses Gertrude Ullman, Betty Scherer, Jeannette Early, Elizabeth Page, Wilma J. Lambert, Nancy McWhorter, Mary Neely Rosebro, Margaret Smith, Evelyn Burch, Alma Earle Parker, and Marjory Max-Muller.

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The run-checking job consisted of examining all stops from the Bombe with a celluloid mask grille for contradictions in endplate plugging. If no contradiction occurred, the menu had to be further tested on a hand model (Tab 27) of the Enigma machine for a possible solution. Solutions were actually deciphered on a captured machine before the wheel setting and endplate plugging were sent to GCCS. This group developed rapid methods of checking and hand testing as well as methods for making menus, so that less highly trained personnel were able to take over the job later in November when they were made available to the Section. Operations in the turret room included plugging menus to the Bombe, adjusting wheel-setting keys, operating and adjusting the recording apparatus, and routing maintenance of the frames. This is now done largely by enlisted personnel.

In October 1943 Major Johnson left for England to head the Beechnut Project, and responsibility for the Yellow Project was assumed by Captain E. Dale Marston, effective 15 October 1943. Under him Captain J. E. Bates from the Development Branch took charge of the maintenance of the 003, which was completed and turned over to B Branch on 16 October 1943. Lieutenant Charles P. Collins headed the cryptanalytic group in charge of Bombe operations. The second set of 72 frames was completed on 2 October, and acceptance tests were conducted immediately afterwards, so that the entire unit was functioning on an operational basis by 16 October. Further attempts to work on current traffic were made after the receipt of a discriminant list from Colonel George Bicher

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at ETOUSA and of information about the solution of the new discriminant allocation system. Traffic could then be sorted according to the various cryptonets, but the lack of cribs, together with the fact that the volume of traffic was decreasing, prevented success in solution. All work on current traffic, including interception of the traffic, was officially abandoned on 15 October 1943 and has not been resumed.

At this time, October 1943, successful tests were made on two attachments to the 003 (projects X68128 and X68129). The first of these attachments (known as "the machine gun" because of its noise) was designed to cut down the number of stops on a run by means of a mechanism which prevents the 003 from recording a stop when there are conflicts in the endplate plugging. Therefore, only the stops which must be hand tested are recorded. The other attachment allows two small related menus to be tested simultaneously (the double input method). The construction of these attachments brought the total cost of the 003 equipment to $944,101.10.

When only 72 frames were functioning, it was possible to handle an average of 10 jobs a week, which made necessary about 30 separate runs on the 003 to cover all possibilities of wheel turnover. After 16 October, when all 144 frames were operating, 12 menus could be handled every 24 hours, using only 75 per cent of the total capacity and leaving 36 frames for research activities. Actual operation time per job ranged from three to 36 hours. Jobs of high priority were processed with all possible speed, and in some cases answers were

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cabled to GCCS within three hours of the receipt of the message at Arlington Hall Station. The time involved in the case of dud solutions was even less.

Early in September 1943 plans were made for the construction of a machine to solve messages for which all elements of the key except the setting of the wheels at the beginning of the encipherment are known. The first model of such a machine, the Dudbuster, consisted of 36 Enigma frames; this number, one-fourth of the 003 capacity, seriously hampered the production of regular jobs. Dud solution by this method was soon abandoned in favor of a single-frame model (Tab 29), which handled, from the date of its completion in October 1944 to 15 May 1945 when traffic ceased with the cessation of German military activities, an average of 10 dud messages each day. The record number of solutions in any one day was 12, and the maximum daily capacity for the machine was 30. In two cases solutions for high priority duds were sent to the British within one hour after the receipt of the message at Arlington Hall. Often as much as 10 per cent of the total daily traffic, or 40 per cent of the traffic on a single cryptonet, was intercepted with faulty or garbled indicators, and the Arlington Dudbuster was able to contribute to the solution of messages for which British personnel had neither the time nor the equipment to divert from regular solution.

In September 1944 a Dudbuster of a different type was developed. This new machine consisted of a specially designed camera connected to

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an Enigma frame. The generatrices of high-frequency letters, with a given endplate plugging, generated by an Enigma frame, clip setting, and wheel order, were recorded on film. Films made of cipher texts were then compared, by RAM, with the generatrices, the largest number of coincidences indicating the correct stops.

In January 1944 half of the 003 frames were rewired to make possible the solution of messages enciphered with a new reflector which the Germans had introduced into some cryptonets. At the same time the British recommended that Enigma research be concentrated on three problems:

1. The quick solution of dud messages.
2. The solution of two-period cillies.[5]
3. The simultaneous recovery of endplate plugging and reflector wiring.[6]

Study of all of these problems was undertaken by the Research Group, and the sections concerned with the operation of the 003 (B-III-c-4 and B-III-c-5). The Arlington Dudbuster was the answer to the first problem. As for the second problem, a method was devised

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5. A cilli occurs when the setting of a message part can be derived from the assumption that the operator has failed to move the wheels since the encipherment of the last message before enciphering the indicator of the next message part; if the wheel setting so derived is recognized by comparison with settings commonly used, deductions as to wheel order can be made and the setting used as an indicator crib.

6. In certain Army cryptonets the Germans had introduced a pluggable reflector on which the plugging changed every 10 days, so that regular Bombe methods of solution were impossible without prior recovery of the reflector wiring.

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for adapting the 003 to the analysis of two-period cillies. The British then sent all problems of this type to the Signal Security Agency for solution. The third problem, simultaneous recovery of two series of plugging, one at the endplate and another at the reflector, at first appeared invulnerable to machine attack. But cryptanalysts at GCCS, OP-20-G, and the Signal Security Agency have, after one year of experimentation, succeeded in finding three different answers to the problem. Hand solution was begun immediately on a large scale at GCCS. It was greatly feared, from the reading of messages dealing with code instructions, that the enemy would soon introduce the pluggable reflector into all cryptonets; therefore rapid methods of solution were badly needed. The Signal Security Agency was asked to assist in hand methods. About 20 persons were trained in this long tedious job which the British termed "scritching" and which the Americans called "Bingo". This method involved the assumption of one pairing in the endplate plugging and the examination by eye of the implications in the reflector for a series of constatations until a contradiction or confirmation was found. Fortunately, the enemy was slow in spreading the use of the pluggable reflector; hence the hand method could be abandoned in favor of the development of machine methods. Plans were drawn up and submitted to the Development Branch for a mechanical means of scritching; these resulted in the construction of the Arlington

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Autoscritcher.[7] First, experiments were made on the 003 by running all of the 144 frames in combination, using only two wires in each reflector. On the strength of this experiment the British constructed a machine similar in theory known as the "Giant." The Navy, working on a different theory, constructed a machine known as the "Duenna," which was successful in later Enigma operations. The Autoscritcher, constructed from 003 equipment by the Development Branch, accomplishes solution according to the same principles as hand scritching but does the job in a fraction of the time. It can test all possible constatations in a problem in about two weeks, depending on the length of the crib. This time is equivalent to that required by the Giant and, with a long crib, half that required by the Duenna; with a short crib the time might be twice that required by the Duenna. Preliminary tests were successful and actual operations began 25 December 1944.

For the most part, the unit working at the Yellow Project functioned as an operational subsection of GCCS, sharing the burden of routine Enigma Solution. From 23 July 1943 to 30 January 1945 the number of jobs received and solutions obtained were:

	Received	Solutions
Jobs	1,375	413
Cillies	71	21
Duds	714	499

7. The problem was outlined by Mr. Albert W. Small and Mr. Robert A. Ferner, and the Autoscritcher, the Army's answer to the problem, was designed by Captain C. R. Deeter and constructed by the engineers of the Development Branch.

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Development of the Arlington Dudbuster and the Autoscritcher have been important contributions of the Signal Security Agency. A Superscritcher, suggested by members of the General Cryptanalytic Branch and designed and constructed by the Development Branch, was prepared to go into operation in the summer of 1945. This is an electronic machine, capable of accomplishing in 12 hours an amount of work that required two weeks on the Autoscritcher.

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CHAPTER XIX. THE RAM SECTION

Rapid analytical machinery (RAM) was first developed for cryptanalytic purposes by the Navy (OP-20-G). The machinery was designed along general lines and not for specific problems. Thus, the application of existing machinery to actual problems was at first very limited, but it offered a wide field for research and development.

The term RAM, as used within the Signal Security Agency, is limited to high-speed cryptanalytic equipment using the photoelectric principle of evaluation, though it is not impossible that in future other techniques may be developed and then be included within the term. Included in this category are index of coincidence (IC) comparators, the Tetragraph Tester, the 70-mm Comparator, the 5202, and others. Each machine is constructed for certain specific types of tests: the IC will give an index of coincidence between two bodies of text 600 by 26 units maximum with a margin of error of approximately 1 per cent for all positions. The Tetratester will recognize coincidences of predetermined pattern between the messages for a length of 30 letters or the exact number of coincidences in any position of the 30 letters. The 70-mm Comparator will tabulate exactly the number of coincidences (monographic, digraphic, trigraphic, etc.) for two lengths of text up to 1,800 letters, or longer with modification, for all juxtapositions.

A request for this machinery was initiated by B Branch on 7 January 1943. Subsequent negotiations were carried on between the

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Equipment Branch (then called the Development Branch), which had recently been established, and the Bureau of Ships, Navy Department. Allotments of $100,000 and $77,000 were made to the Bureau of Ships for the purpose of buying RAM equipment. They in turn negotiated research contracts with the Eastman Kodak Company, the National Cash Register Company, the Grey Manufacturing Company, and the International Business Machines Company (IBM). Aside from the RAM, the contracts included certain other items: 6 additive machines, hand operated by the cryptanalyst; 20 robot heads for use in the Development Branch (solenoid banks for remote operation of Electromatic typewriters); Special IBM teletypewriter tape equipment used in connection with RAM.

The complete list of equipment on order and installed by February 1944 was:

1. From the IBM Company: 15 tape readers, 8 tape punches, 7 punch controls (SMFSA),[1] 1 copy machine (SFMSA), 7 regenerating units (SMFSA), and 20 robot heads.

2. From the Eastman Kodak Company: 1 Tetragraph Tester (including projector), 4 IC cameras, and 5 projectors.

3. From the National Cash Register Company: 6 additive machines, 1 70-mm Counter Printer, 1 70-mm Relay Control.

4. From the Grey Manufacturing Company: 1 70-mm Comparator, 2 70-mm punches.

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1. A Navy term for "Special Machinery for Security Applications."

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In January 1943 personnel were assigned to special study of RAM equipment. Lieutenants LeRoy Wheatly and William Moran studied the operation and maintenance of the machinery at Rochester, New York under the supervision of the experts at the Eastman Kodak Company. After the delivery of the IC equipment to the Signal Security Agency in July 1943, tests were made on it by using three sample messages from the text of Military Cryptanalysis, Part III. These tests were so successful that, as soon as the personnel became familiar with the operation and theory of the machinery, actual operations were begun 7 July 1943 on Swedish diplomatic Hagelin (SWA) messages. Following that, 124 messages enciphered by the German clandestine Enigma machine (the GEQ system) were compared for coincidences. Special projects for the Equipment Branch for the security of our own communications were also accomplished.

During the summer and autumn of 1943 the RAM Section (then designated B-III-c-1), under Captain E. Dale Marston, included Lieutenant William Sprengle, assisted by 2 enlisted men, 1 enlisted woman, and 14 civilians.

Among the early operational work was an IC count of sample messages submitted to test the security of some American machines, a project that would have taken at least a month by hand methods but which required only two days by RAM. The IC machinery was also used for a study of Japanese meteorological systems by RAM. But on 19 November

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1943, when the Tetragraph Tester was in operation, the comparison of Japanese meteorological systems was transferred to this equipment. In January 1944 a method was devised to determine the dimensions of a transposition matrix by means of the Tetragraph Tester. The regular jobs done by the RAM Section at this time included pattern searches of JBD (Japanese diplomatic), overlapping of FIR (Finnish) messages, which involved 1800 separate comparisons at all possible positions of each message, and the comparison of JAM (Japanese diplomatic) messages to establish overlaps. To speed up this job one IC projector was remodeled to handle film in place of the glass plates. On 10 November 1943 the first Tetragraph Tester projector and camera were delivered. The IC Projector had measured only the index of coincidence, was hand-operated, and was capable of testing only two messages at a time; but the Tetragraph Tester could search for patterns of any complexity up to 30 positions, was motor-driven, and could compare 40,000 characters in a single position. This was possible because the Tetragraph Tester used 35-mm film rather than plates.

At the same time as the Tetragraph Tester, another piece of RAM equipment, capable of extremely high-speed coincidence counting, was developed and put into operational use. This was the 70-mm Comparator, capable of performing any task in which counting coincidences was necessary and of recording in written form the results of coincidence tests. It was with this unit that the first electronic

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counter was successfully used. Its weak points were that only 10 characters could be examined at one time, and the difficulty of producing 70-mm punched tape.

The theory of multiple exposures, or the comparison of more than one character at a time, was explored and was applied to a new Tetragraph Tester camera. This proved to be one of the most valuable modifications of RAM equipment because it made possible the comparison of long stretches of key with many variants and the search for repetitions in text using the same key. This modification made possible the first of a long series of successes with Japanese Army problems.

On 14 September 1944 a new Tetragraph Tester camera incorporating many changes in design, including the use of lucite rods, was delivered. At this time an IC Film Projector equipped with an electronic counter to count coincidences was also received. With this equipment the subsection developed methods for solving enciphered messages with the same transposition key of the IC film projector. Techniques for comparing partially recovered lines of enciphering squares for contradictions and confirmations and for comparing long stretches of key with variants with cipher or plain text were developed in a search for repetitions.

With the arrival of the multiple-exposure Tetragraph Tester camera, searches could be made for repetitions within key with variant possibilities. Such a search was first successfully accomplished on

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JEP (Japanese Army) messages. The RAM Subsection devised methods of using film projectors to search long stretches of cipher text for cribs for which there were multiple possibilities on coincidence and successfully applied them to JEQ and JEM (Japanese Army) traffic.

Upon the arrival of the 70-mm Comparator unit, work was begun on the setting of the patterns of the cyclic wheels in GET (German teletypewriter cipher) messages. This was possible with only a small modification of the equipment and proved that high-speed electronic counting could be done with little difficulty. At this time a 70-mm tape 108 feet long was used operationally for the first time. The tape was over four times as long as that originally designed.

The Index of Coincidence Plate Projector was modified so that it could utilize the film produced by the camera of the Tetragraph Tester. This was accomplished by changing the plate gate of the (IC) projector and substituting double film gates in which as many films as desired could be inserted at one time. A motor-driven version of this modification is planned for the future.[2]

A further development along this line, the 5202 (Tabs 32,33), when tested, was taken to England and installed. Three characteristics set

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2. On 15 May 1944 Lieutenant Robert Masenga took charge of the Section, replacing Lieutenant Wheatley. The Section continued to expand, and in October it was decided that additions would be limited to enlisted women. On 15 February 1945 Lieutenant George Dixon, a radar and electronics engineer, was added to the staff.

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it apart from other IC machines: it can scan a large body of text (40,000 elements), it can compare two different sets of textual data simultaneously and can thus make use of principles of positive and negative weighting, and it can count the coincidences at specified positions with almost 100 per cent accuracy. Accordingly, though it was designed for a specific cryptanalytic problem it is a general cryptanalytic tool which can be adapted to the solution of many types of ciphers. This machine is a landmark in RAM development.

Another machine, the Dragon, used in the solution of the German teletypewriter cipher, was constructed by the Equipment Branch with the advice of the Subsection. In the autumn of 1944 it too was delivered to GCCS, and it has been used successfully in operations at GCCS since that time.

More recently, RAM proved useful at a time of crisis in the solution of JAA (Japanese diplomatic Purple machine) messages. When, in March 1945, far-reaching changes took place in Japanese cryptography, new machine methods were needed to maintain the important flow of Purple intelligence. An IBM card reproducer was connected in record time to the analog of the Purple machine constructed in the Signal Security Agency, and the reproduction on cards of the entire development of the Purple machine was completed in one day. Thus, the testing of all starting points with a crib for JAA messages in 15 minutes was for the first time possible, whereas hand testing had formerly

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required about a week. During one two-week period some 50 messages were read by the application of 150 cribs.

Another significant development in the application of RAM was the recovery of the JAS Conversion Square No. 28 in the J-period. This analysis, done on the 70-mm Comparator, provided overlaps which made possible the reconstruction of segments of the square. The limitations of Square No. 28 were ascertained through the juxtaposition of the cipher text of a number of messages and the plain text known to underlie them recovered from messages of the readable I period. The study of these messages by RAM provided a means of attack on Square No. 28 as well as on the indicator keys of the J-period key book.

RAM is at the service of all the sections of the Branch and of other branches with suitable problems. It has not only saved untold hours of work and made feasible projects that otherwise would have been too costly in time, but it has also eliminated the inescapable inaccuracies that void much of the work done by hand. The flexibility of RAM appears in the variety of systems it has analyzed: polyalphabetic substitution, additive encipherment, encipherment with running key and random cipher square, machine ciphers, and unknown systems.

RAM and accessory equipment in use at the Signal Security Agency on 15 March 1945 included the following: IBM letter writing (teletypewriter tape) equipment: 20 readers, 9 punches, 5 punch

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controls (digit), 2 regeneration machines (32-character), and 5 regeneration machines (standard); 70-mm equipment: 2 comparators, 2 control units, and 2 counting and printing units (each counting unit containing 5 counters); 35-mm film equipment: 2 Tetragraph Tester projectors, 3 IC film projectors, 2 Tetragraph Tester cameras, and 1 special camera (with lucite rods); IC plate equipment: 3 IC plate cameras, and 2 IC plate projectors.

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CHAPTER XX. THE TECHNICAL STAFFS AND SERVICE UNITS

The General Cryptanalytic Branch has included in its organization for a large part of the duration of the War a number of small units which are not assigned to the task of cryptanalyzing the traffic of specific countries and types of communication, but which perform a variety of services which are used by most, if not all, of the operating sections of the Branch. These units range in character from the Research Section, which provides expert cryptanalysts for the most difficult problems encountered by the operating sections, to the Document Section, the duty of which is to catalog, distribute, and account for all documents belonging to the Branch. In the present chapter the story of each of these units will be presented in turn.

A. The Research Section

The Research Section was organized on 1 July 1943, with Mr. Albert W. Small serving as acting head until Mr. Robert O. Ferner's return from England. The original personnel of this Section (Mr. Small, Mrs. Genevieve G. Feinstein, Mr. Martin Joos, and Sergeant Walter Jacobs) were all research specialists of the Cipher Machine Section and had indeed had experience with many, if not all, of the systems studied in B-III. These four cryptanalysts had given assistance in the study of the SIGCUM cipher teletypewriter and after a month's study had been able to increase the security of the machine. Upon the conclusion of this special assignment, it was decided to maintain the group to handle other special problems and to assist

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and advise the operating sections of the Branch on new problems, difficult and time-consuming for the operating sections. From the beginning the policy of the Research Section has been to rotate personnel. New personnel were brought in from time to time and others were on indefinite loan to the operating sections where need for them existed. Thus, specialists in various phases of the work of the Branch were brought together to foster an exchange of ideas and to engage in profitable study. They maintained constant close contact with operations and, for the most part, concentrated on operational activities.

In addition, constant informal liaison was carried on with the Cryptographic Materiel Branch and the Equipment Branch. Members of the Section were consulted regarding the security of systems, including ciphony and cifax. One of the early members of the Section, Dr. Martin Joos, was eventually transferred to F Branch to continue his specialized research.

The personnel for the Section was chosen originally to concentrate on cipher-machine analysis (Mrs. Feinstein; Dr. Joos; Sergeants Dribin, Levine, and Jacobs; and later Dr. Getchell, and Mr. Lipsky). Soon, however, specialists in various other fields, for example, transposition and additive, were brought in (Mr. Bryan, Mrs. Siegel, and Mr. Snyder).

The principal contributions of the Section lay in solutions, advancement of cryptanalytics, especially in the field of machine-cipher analysis, and recommendations for new cryptographic machinery

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and cryptanalytic mechanized procedures. The activities of the group ranged from the analysis of machines used by the United States to cryptanalytic attacks on high-grade German and Japanese machine-cipher systems.

The lessons learned from attacks upon enemy systems have been applied to the analysis of our own systems in order to increase their security, as in the case of the M-228, M-325, and M-409 machines. As for the M-228, it was recommended, even after improvements had been made by the Research staff, that the device be abandoned for secret communications since it was possible to read any two messages enciphered with the same indicators without any knowledge of the key-generating unit. Pluggable endplates were suggested for the M-325 and M-409, and the vulnerability of machines without such pluggings was demonstrated. A further protection was obtained by the incorporation of additional notches to the rotors, so that all rotors must step more often, eliminating the possibility of solving the rotors one at a time. To the M-409 a second continuously moving wheel was added, which prevented solution even with the use of a long plain-text crib. Moreover, a new type of circuit known as the "reflexing circuit" was designed to repeat a variable number of times the encipherment of individual letters. In conjunction with the Security Division and OP-20-G, the group, after extensive study of a certain combined-operations cipher machine, was able to improve its security by changing the indicator system.

Important contributions in a different field may be noted in the

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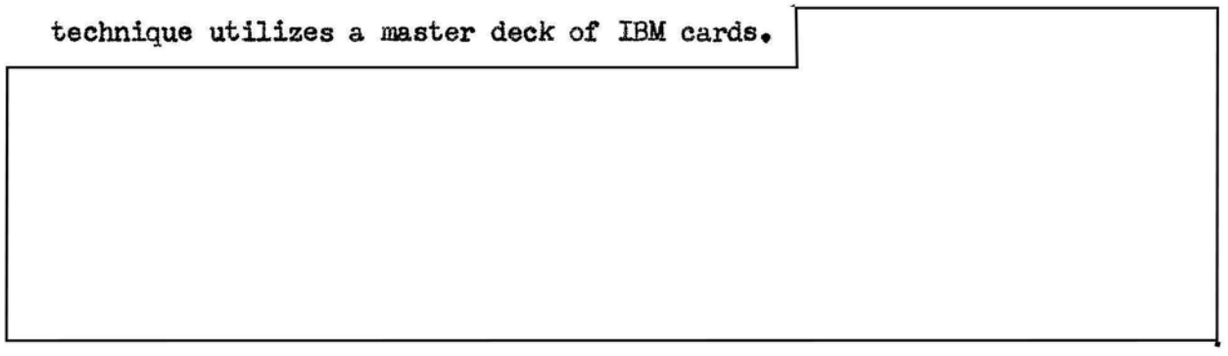
original solutions of certain Japanese diplomatic enciphered code systems. JBA, a transposition system of a degree of security second only to the Purple machine-cipher system (JAA), was solved by statistical methods within six weeks. This solution is believed to be the first instance of the recovery of an unknown transposition of an unknown code by purely statistical means. Beginning groups, and later, code groups within the body of the text were found by matching stretches of cipher text from several messages with the same indicator. Frequent digraphs were recorded, and eventually the transposition patterns and tetragraphic code groups were recovered despite the presence of occasional trigraphic groups, the use of blanks in the matrix, and the use of the letters of the signature as nulls throughout the message.

The Research Section also made contributions to the theory of additive recovery. Studies of the problems of additive recovery led to the development of new techniques, especially statistical approaches to the determination of relative probability involving logarithmic weighting. In addition, the group proposed designs for RAM equipment to effect additive recovery on purely statistical bases. One technique utilizes a master deck of IBM cards.



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EO 3.3b(6)
PL 86-36/50 USC 3605
EO 3.3(h)(2)

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EO 3.3b(3)
EO 3.3(h)(2)
PL 86-36/50 USC 3605

[redacted]

This method has been successfully applied to several of the Japanese diplomatic systems and has contributed to the exploitation of the JE group of Japanese Army codes.

In the field of enemy machine ciphers the staff has also made contributions, especially in designs for cryptanalytic machinery, such as the Autoscritcher and the 5202, designed to overcome many of the obstacles to solution of such machine ciphers as the Enigma and the teletypewriter systems. The captured Japanese Army Green Machine was examined and analyzed jointly by the Military Cryptanalytic Branch and the Research staff of the General Cryptanalytic Branch. Confronted with the problems of a general solution, they were able to devise a hand method and an IBM method as well as a relay device for the process of solution. In connection with the study of the Green Machine, the principle of the setting rotor was discovered; this principle in addition to providing a comparatively rapid method of solution for the Green Machine, was applicable also to the Purple Machine problem and is expected to provide a much speedier method of solution than the present one. Moreover, the group prepared instructional materials used in courses designed to prepare cryptanalysts against the possibility that the Japanese might use the machine even though it had been captured. In another Japanese military field "The Mathematical Theory

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of Related Cipher Alphabets," a research paper prepared by Sergeant Jacobs primarily to clarify the analysis of cipher machines with Hebern-type rotors, was unexpectedly applied successfully to the recovery of a basic square used in a Japanese Army double additive encipherment system.

One of the most important problems studied by the Research Section was GEE, the German one-time pad system. After the initial break into the system by the German Diplomatic Section (B-III-d-1), the entire Research staff was assigned for some months to assist in the exploitation of the system and to speed the reconstruction and the reading of the pads. Their assistance made it possible to supply a great amount of useful intelligence before V-E Day as well as afterwards.

Thus, through their original solutions, their recommendations for more effective procedures, their inventions of accurate and time-saving cryptanalytic machines, and their specialized training courses, the Research staff made available a great amount of intelligence from many different sources. Working together as a group, the Section has advanced the science of cryptanalytics and increased the security of our own systems.

B. The Recorder's Group

On 12 August 1943 a committee of the General Cryptanalytic Branch recommended the establishment of the Recorder's Group for the purpose of composing and publishing technical papers dealing with cryptanalysis and various other activities. During the two years of its existence,

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the group expanded in number from one to ten. Dr. Albert Howard Carter, who was in charge of the group from the beginning, conceived the need of permanent records of the valuable cryptanalytic work of the General Cryptanalytic Branch for present and future use.

The Group prepared many kinds of papers. The first category describes the nature of the traffic in various cryptographic systems, the history and methods of the cryptanalysis of the systems, their cryptanalytic relations with other systems, and the cryptanalytic and cryptographic materials necessary to their solution. Papers have been written describing 50 such systems. To a second category belong technical papers dealing with the theory and application of cryptanalytic methods. They are theoretical contributions to cryptanalytics rather than descriptions of specific aspects of the cryptanalysis of a particular system. Since the organization of the group, 12 of these have been printed and several more prepared in typescript. A third category includes miscellaneous writings, such as surveys, summaries of cryptanalytic work done, progress reports, indexes, staff studies, and other such reports for which a need arises in the administration, operation, or liaison of B-III. The progress reports include the Daily Information Bulletin (published since 5 September 1944), which contains a summary of news from all sections of the Branch. This bulletin covers mainly cryptanalytic data, but also intelligence which keeps higher authority and operating sections promptly informed of important developments. The Semimonthly Report

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comments on the progress of solution and the administrative problems of the Branch. The Annual Report for the Fiscal Year relates to the achievements of B-III and forms the basis of that part of the Summary Annual Report of the Army Security Agency dealing with general cryptanalytic problems. The Branch history presents a report of the achievements and policies of B-III.

In general, such papers were prepared by the Recorder's Group as permanent records of the achievements and failures of the Signal Security Agency. They were sent to the cryptanalysts in the various sections and branches of the Agency for their information and use, to the Navy for the furtherance of their work, to our Allies, and to the Vault for preservation. In the writing of these papers, accuracy, completeness, and clarity, including the use of standard nomenclature, have been the goals.

The Recorder's Group has also been responsible for recording the proceedings of the Committee on Terminology. The preparation of a prescriptive glossary, necessitating constant research in the literature of cryptology and personal contact with key members of the Signal Security Agency and other centers, has also been part of the contributions of the Recorder's Group. One tentative edition of approximately 234 copies has been published by the Post Committee on Terminology. This manual contains definitions of terms dealing with signal security and intelligence. At the request of the Office of the

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Director of Military Training, Army Service Forces, the Committee on Terminology during the past year was engaged in the preparation of a change to A Dictionary of United States Army Terms (TM 20-205) to deal with all terms falling within the province of the Signal Security Agency. In addition, the Recorder appointed the Signal Security Agency member of the working committee of the Army-Navy Communications Intelligence Coordinating Committee on the preparation of a dictionary of cryptographic terms.

Another work of the Recorder's Group is that dealing with the liaison reports between the Signal Security Agency and GCCS and other cooperating centers. These reports have been fully studied and indexed. In 1945, as directed by the Commanding General for his information, a monthly report was prepared on the Status of Liaison between the Signal Security Agency and the London Offices of GCCS.

Through this group a high level of consistency has been maintained in the written production of the Branch and an important body of cryptanalytic literature has been compiled.

C. The Planning and Priorities Unit[1]

The small unit now known as the Planning and Priorities Unit of the General Cryptanalytic Branch came into formal existence on 31 August 1944 but was an outgrowth of an earlier unit known as the

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1. Statements made in this section are based chiefly on interviews with Captains Francis E. Maloney and Benson K. Buffham, and with Miss Margaret Hancock and Mrs. Nelle Smithson.

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Contol Unit of B-III, of which Lieutenant (now Captain) Francis E. Maloney was the Officer in Charge. Lieutenant Maloney also served as Traffic and Systems Coordinator as well as the Executive Officer of B-III. He had one civilian assistant for this work. In October 1944 he was succeeded by Lieutenant (now Captain) Benson K. Buffham.

The principal contribution of the Planning and Priorities Unit has been the daily dissemination of information, usually concerning the description of systems, to the several cryptanalytic units, together with continuous research into the nature of new traffic for the purpose of allocating responsibility and of routing. Its services have covered a wide range of activity from routine affairs to its special projects: contact with cryptanalytic units, liaison with GCCS and EU, assignment of priority to systems, assignment of short titles, maintenance of the list of short titles, and compilation of the System Identification Book.

Constant contact with the cryptanalytic units was maintained in order to find out what intelligence may be of value to them and to bring to the attention of all units any operations performed elsewhere which might help them increase their efficiency. Material collected and sent to the Communications Branch has constituted an important contribution. This work involves informing the Records and Distribution Unit of the external characteristics of systems and the circuits over which they travel and checking the work of the Records and Distribution Unit on this

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phase of traffic processing. The Planning and Priorities Unit studied all mistakes in routing or identification to determine the probable cause for the error in order to avoid similar mistakes in the future. A report on the relative coverage of traffic sources over point-to-point circuits was submitted monthly to the Military Traffic Analysis Branch.

Exchange of information with GCCS and EU was another profitable phase of the work of the Unit. Requests were prepared by this office both for traffic desired by B-III units and for specific information not of a technical cryptanalytic nature but necessary to the performance of services. Information in response to requests from GCCS and EU was collected from the cryptanalytic sections of B-III and forwarded.

General supervision of the distribution and indexing of traffic in B-III has been another responsibility of the Planning and Priorities Unit, which also assigned priority to intercepted traffic. Such factors as the overall priority of the traffic of a given government, the readability and intelligence value of the system, and the need for speed in handling were examined to provide a basis for the assignment of the priority. Thus, during the San Francisco Conference, the Unit established temporary priorities for the 24-hour working day of some of the units. Further, a month-by-month evaluation of the relative priority of all diplomatic systems has been maintained together with a list showing current priorities of the systems.

A number of miscellaneous services were also performed by this

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Unit during the past year. One copy of cryptographic information messages concerning all systems except those of the Japanese Army was filed and one copy of all messages dealing with radio communications was sent to the Communications Branch. Radio service messages were examined and the information contained placed at the disposal of the various cryptanalytic units of the Branch.

A special project was the assignment of short titles in the form of trigraphic designations to systems and the preparation and maintenance of a list of short titles for all foreign cryptographic systems except those of the Japanese Army. The list is arranged systematically by short title; two annual lists have been published to date, the first appearing in February 1944 and the most recent in January 1945. The task of compiling this list involved determining the existence of new traffic, assigning new short titles to the traffic, and collecting as much data on each system, together with a sample message, as necessary to make identification possible.

The System Identification Book is a permanent record in convenient form of all types of traffic received in B-III. Containing data used in identifying more than 500 systems, it is arranged alphabetically according to short titles. Material was compiled from study of traffic to determine the identifying characteristics of each system, such as the preamble, call signs, signature, indicators, and the circuits used; sample messages were included for each system.

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D. Documents Section

A rapid accumulation of documentary material concerned mainly with the activities of the representatives of the Signal Security Agency at GCCS, needing immediate methods of identification, prompted the Administrative Office of B-III to create a separate unit for this purpose. In November 1943 Mrs. Julia Martin began setting up a system for indexing and cross-indexing this material. The necessity for routing, accounting for, and expediting such records to the sections of B-III for their information, as well as to other outside branches, made the main purpose of the Documents Section that of identification. Registration of these documents was a laborious assignment, involving a backlog of as many as 58 reports from the American Liaison Officer in GCCS. Well over 7000 cards comprise the files of the liaison reports. Continuous dissemination of material required an elaborate system of handling and checking, so that a record of those signed out to any person in the Branch could be seen at a glance.

E. The Decryptographing Unit[2]

From September 1942 to September 1943, a Decryptographing Unit (B-I-c) contributed to the operations of the Branch. Its function was the decryptographing of all messages sent in systems not involving further cryptanalytic work. Such systems were of three types:

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2. The statements made in this section are based upon interviews with Miss Katharine L. Swift, Mrs. Betty Moulton Leonard, and Mrs. Olive Mickle, a diary kept by Miss Swift from 16 October 1942 to the present, and a report by Lieutenant James C. Taylor on the personnel of this Unit (11 November 1942).

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compromised, completely solved, and reconstructed to a point where translations could be prepared with little or no cryptanalysis, although some of the codes required additional recovery. The Unit was organized to relieve the cryptanalytic units of purely mechanical tasks.

For a time Mrs. Jean Reischauer was the supervisor, but by 11 November 1942 Lieutenant James C. Taylor had become Officer in Charge. The latter continued in this post until just before the abandonment of the Unit in 1943, when Captain Carlisle C. Taylor succeeded him temporarily. On 11 November 1942 the 26 civilians and 3 enlisted men under Lieutenant Taylor processed four Japanese systems, three weather systems, four systems using Spanish, and four using French.

As time went on the Unit tended to specialize more and more until it was divided into a French group, a Spanish group, and a Japanese group.[3] The Japanese group, under the direction of Mrs. Evalyn McGee, processed traffic in JAE, JAI, JAH, JAJ, and JAK. The premium on a knowledge of Japanese prevented the assignment to this group of any person who could read the message decoded.

The French group, which at first included only Mrs. Helen Siegel and Mrs. Ruth Cherniss, was expanded on 16 October 1942 by the addition of Miss Katharine L. Swift, who, after December 1942, was the supervisor and continued to supervise French decoding even after her group

3. No group, apparently, was formed for weather traffic, which had ceased to be processed in this Unit before the specialization.

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was absorbed on 21 September 1943 by the French Section (B-III-d). Two French systems (FBT and FBU) and, by September 1943, eight others (FAC, FAD, FAE, FAG, FAH, FAM, FAN, and FAV) were processed. Unlike the Japanese group, the French group was laregly able to read the traffic. Moreover, in this unit certain features of encipherment and some previously unidentified code groups were recovered, so that in actual practice the French group accomplished somewhat more than its assignment. In the spring of 1943 when traffic in one Italian system (ITD) was heavy, this unit assisted the Italian Section in decoding the messages.

The supervisor of the Spanish group was Miss Betty Moulton (Mrs. Leonard). Most of the group could read Spanish, with consequent profit to the work. Systems processed by this group included the following: ARB, CLA, CUA, MXA, MXB, SPB, and VZA. Toward the end of their work, the unit worked on some of the Portuguese systems also.

Because the cryptanalytic units were deprived of data made available by exploitation and the decryptographers were deprived of cryptanalytic aid, the Decryptographing Unit was abandoned and its personnel and functions were reassigned to the respective language units.

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CHAPTER XXI. ASSISTANCE FROM ESPIONAGE

Before leaving the subject of the cryptanalytic activities of the General Cryptanalytic Branch and passing on (in volume III) to the story of similar activities on a specific class of systems, namely, those of the Japanese Army, it will be well to consider one phase of the work which in the preceding chapters has been mentioned briefly on some occasions but not discussed adequately. This was the assistance given to cryptanalysts by the efforts of espionage agents assigned to the task of obtaining information concerning foreign cryptographic systems.

As will shortly be made clear, much information of this type was received by the Signal Security Agency and was, in most cases, highly valuable in cryptanalytic operations. The reader of the foregoing chapters will have been impressed by the fact that, given the modern techniques of cryptanalysis, it appears to be possible to solve even the most secure cryptographic systems purely as the result of cryptanalysis. An illuminating example of this kind is provided by the solution of the Japanese Purple Machine described above in chapter II, an instance in which no compromised material was received.

Though it may be theoretically possible to solve any type of system without assistance from espionage, it is a fact that even a small amount of information at once greatly increases the probability of successful solution and lessens the expenditure of time, effort, and funds necessary to achieve solution. On many occasions success

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in reading messages would probably not have been achieved at all had not some ulterior assistance been received, since a cryptographic system involving the principle of a truly random one-time pad would, so far as present knowledge is concerned, be absolutely impregnable to cryptanalytic attack.[1] If, therefore, it is possible to obtain by means of what are colloquially known as "second-story methods" a photograph of the one-time pad itself, the extracting of intelligence becomes possible. Similarly, in the case of less secure systems, the possession, for example, of a photograph of the basic code book used in an enciphered code system greatly reduces the time and effort needed for solution, even though success might be achieved without it.

Furthermore, one of the aims of the more astute cryptographers is to prepare systems in sufficient numbers so that only a small volume of traffic will pass in any one system. For this reason, it is frequently true that very little traffic can be intercepted in systems intrinsically not of the highest security but safe enough when insufficient traffic is available for study. A case in point is the sort of system provided by many governments for temporary use during an international conference: the small volume of traffic passing at such time may be entirely insufficient for solution while the importance of the traffic is even greater than normally.

For these reasons the mature cryptanalyst will be grateful for

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1. GEE proved not to be a random one-time pad. See chapter IV, section C, pages 89, 90.

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any assistance that comes to him from the outside. Not only this, but he may even himself initiate steps to gain such help. In the case of military systems, particularly those used by echelons low enough to be subject to capture, the receipt of captured cryptographic documents becomes more frequent in proportion to the progress made by the armed forces of the United States and decreases in the same proportion as these forces are thrown back. Naturally, cryptographic personnel attempt to destroy material of this kind to avoid its capture but there will always be instances in which attack is so swift that destruction cannot be accomplished, and, as a result, cryptographic documents are made available for the study of the cryptanalysts.

Diplomatic systems, however, are not subject to this kind of capture. They are normally distributed in sealed diplomatic pouches. They are to be presumed to be kept under lock and key or in combination safes at all times. To photograph them without detection by their holders is a task that obviously requires the most careful and astute work on the part of those assigned to this activity. Only when the work is done without detection is it of any value at all, for, if suspicion is aroused, the presumption is that the users will at once change as many elements in the cryptographic systems that have been compromised as the difficulties of distribution under current conditions permit them to effect. If such changes are possible, it may well be that the value of the compromised documents is much less than the fresh obstacles created by the change. In many instances it is

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therefore better to continue without such assistance than to run the risk of forcing a change.

For this reason the Signal Security Agency did not initiate extensive operations of this kind. Of the two alternatives, it preferred to depend more upon analysis and less upon ulterior assistance, and this preference rose less from confidence in its powers to perform successful analysis than from fear that clumsy attempts at theft of cryptographic documents might reveal to the government concerned the fact that compromises had been made. Nevertheless, the fact remains that much valuable assistance of this kind was received, together with some useless material.

The earliest example on record of compromise attempts through "second-story work" concerns the photographing of the diplomatic and consular code used by a Spanish official in Panama during World War I.[2] This attempt was actually instigated by the Chief of the Cipher Bureau, Captain Herbert O. Yardley,[3] who sent an agent provided, so it is said, with $20,000 for the purpose. What actually happened was that this agent was so clumsy and indiscreet that his mission became known to representatives of the Intelligence Officer on duty in Panama, and

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2. See Historical Background of the Signal Security Agency, volume Two, p. 91. The information about what happened in Panama was given by one of the participating agents to Mr. William F. Friedman and is on file in the Office of the Director of Communications Research.

3. This statement is based on Yardley's book, The American Black Chamber, pp. 172-186. The account there differs from that of the agent, and the story of the appropriation of $20,000 for this purpose in particular is seriously open to question.

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he was told that if he would be patient these representatives would obtain what he wanted. The Intelligence agents made use of the fact that the Spaniard had a son whose thirst for strong drink had forced the father to limit his allowance to such a point that the son was easily induced to go on a wild party, the funds for which were supplied by the agents. Choosing a night when it was known that the official himself would be absent from home, the boy was made drunk through the help of two prostitutes. His key ring was abstracted from his trousers and an impression made of the safe key which he carried. Using this impression, another key was at once made, and with this the agents were able to open the safe and remove the code. This was photographed, but a single page failed to be photographed well, and the whole proceedings had to be repeated. Neither the Consul himself nor his son were aware that the code had been compromised, but the photograph became very useful in the solution of all the Spanish government codes, even though it was not the basis for many of the diplomatic systems. This story has been told in detail because it will serve as a useful illustration of the undercover method involved. The Signal Security Agency was not itself informed of the means used in the attempts at compromise which were successful, since the security of espionage agents depends on keeping their methods as secret as possible.

The following review of benefits to the General Cryptanalytic Branch from direct action of the kind described is based on a document

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in the Branch files dated 17 February 1945:[4]

1. Finnish.—In 1943 the FBI was successful in procuring photographic copies of cryptographic materials in the Finnish Embassy at Washington. While some cryptanalytic success had been attained previously, this effort permitted the exploitation of all Finnish machine cipher systems the traffic of which was then available. Cribs,[5] keys, work sheets, and library references were obtained. Not only was a new source of intelligence developed over night, but insight into the techniques employed by Finnish cryptographers was a tremendous aid to our own research work. It would have been virtually impossible to read these systems through cryptanalysis in their later stages if it had not been for this "break." At the present time little Finnish traffic is being received. The military attaché in Rio is one important source of raw traffic; however, this traffic is sporadic and incomplete. It is extremely doubtful if the traffic could now be read without the background provided by the compromised material. See also footnote 14, page 254.

2. German.—Wolff, a German agent, was intercepted in the Canal Zone by the FBI in 1940, and the Signal Security Agency was provided with cryptographic materials which had been intended for distribution in South America. The immediate value of this compromise[6] can best be understood in relation to the cryptanalysis of GEC.[6] At that time, not only was it necessary for the cryptanalysts to recover the keys and the method of their application to the basic code, but it was also necessary to recover the basic code book of 100,000 possible groups. Among the materials Dr. Wolff carried was a copy of this basic code, and its possession eliminated the complex and infinitely meticulous task of a simultaneous recovery of both related elements, the code book and the additive used with it. Also among these materials were sheets of one-time pad (GEE) which enabled the analysts to determine the pad patterns leading to important discoveries in this system. Without photographic copies of these pads the characteristics of their reconstruction would not have been evident. More recently, the OSS has been able to provide German Foreign Office copies of messages in the latter quarters of 1944 (known as the "Boston Series").

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4. Lieutenant Colonel Frank B. Rowlett to Colonel Harold G. Hayes, Subject: Assistance to Cryptanalysis, 17 February 1945, filed in WDGAS-90.

5. That is, messages containing wholly or in part the same plain text as that contained in messages sent in other systems or keys.

6. On this, see chapter IV, section B, page 83.

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These have been used to generate provisional additive to determine patterns, which can be correlated with those already produced in GEE. This fact, coupled with translations of GEC messages, has confirmed the authenticity of the "Boston Series." Thus, the value of the "Boston Series" to the cryptanalysts has been considerable. The FBI has several times submitted copies of cipher mail originating from German sources in Argentina, which, in some cases, the German Section has been successful in reading. This traffic would not have been available to the Signal Security Agency through regular channels, and the intelligence contained in it would have been lost.

3. Yugoslav.—An example of the value of the actual code book to cryptanalysis can be demonstrated in a consideration of the Yugoslav YOA book. An old version, picked up by the British[7] and forwarded to the Signal Security Agency, has been subsequently employed through repagination as the basic book in new systems. Despite the difficulties of reconstructing a repagination of a known book, the task of reconstruction without the book would be immeasurably more difficult, especially in considering the scarcity of able linguists in the Balkan Section and the paucity of traffic available for study.

4. Greek.—A copy of the GRB code book was received from the FBI in 1942. This permitted immediate exploitation of the system and saved the time of a number of personnel who would otherwise have been required for code reconstruction. In addition, a study of the format of the book was instrumental in demonstrating Greek cryptographic methods as well as the inflection principle used by the Greeks.[8]

5. Iran.—The British sent photographic copies of the Iranian diplomatic systems IRA, IRB, and IRC. At the time, the Near East Section had been painfully attempting to reconstruct

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7. The British have had considerable success through the utilization of the direct method: "Photographs or actual copies of such cryptographic devices as keys, cribs, code books, cipher machine and indicator lists received from GCCS speak eloquently for the proficiency of the British Secret Service." (Quoted from the report cited in footnote 4 above).

8. The fact that some foreign languages employ highly inflected forms to express grammatical relationships produces characteristic frequencies which may become useful tools.

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the IRA book and had not even begun to think of further projects.[9] This piece of "practical cryptanalysis" permitted the complete exploitation of Iranian systems with a considerable saving of personnel and time.

6. Turkish.—The same is true of the Turkish systems TUA and TUE, in which actual copies of the code books were received. This aided key recovery considerably and permitted immediate exploitation of the message when the keys were solved. In addition, valuable linguistic personnel was freed from the code-recovery problems and became available both for translation purposes and cryptanalytic requirements.

7. Spanish.—Without direct aid the SPA tape system could not have been read since it is a one-time system. Regularly the keys for various circuits are received through the FBI, permitting direct exploitation of the system without delay. The British are also able to obtain these keys on the Continent, another indication of the development which their organization has attained. The [redacted] in South America have been instrumental in obtaining copies of raw traffic sent out by Spanish emissaries, which has allowed further development of this intelligence source. This traffic is not normally available through our intercept sources since it never goes on the air.

EO 3.3b(6)
PL 86-36/50 USC 3605
EO 3.3(h)(2)

8. French.—The French Section has been the recipient of more compromised material than any other language group. The following photographed code books are in the Section: CTX (used in FMH and FMS); PC-148 (FAV); PC-146 (FAH); PC-155 (FAD); CGX (FCB tables); DN-1 (FAP); X-37 (FAM); X-38 (FAN); and PC-152 (FAC). These have been extremely valuable not only for exploitation but also in the research on unknown systems. Since the French frequently make use of variations of formerly used cryptographic materials, it has been possible to achieve solutions where some of the elements (i.e., the old material used in new systems) were available. The linguistic problem of code reconstruction of these codes through cryptanalysis would have required many more translators than have ever been available.

9. Portuguese.—Possession of the "Diccionario do Cifra de Ministerio dos Negocios Estrangeiros," Lisbon, 1910, 4th edition,

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9. It should be pointed out that no one in the Section had ever had more than a smattering of Persian.

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has enabled the Section to read POA, POB, and POR; the 6th edition of this same book (1937), gave the basic code for POF, POH, POI, POJ, and POK; the 7th edition made possible the solution of POC, POD, POE, and POL. POM was made readable through the 8th and 10th editions of "Diccionario Cryptographico," while the 2nd edition of the Mascotte commercial code (1930) is used in PPD and BZE. The latter is a commercial code as is "Guedes", the code book used for PON, which was obtained from the Library of Congress. It should be stated that, while most if not all of these systems could have been read by pure analysis alone, to do so would have involved a huge amount of labor and time.

10. South American.--The Peruvian code book PEA was compromised at the Consulate in San Francisco in March 1943. It has been useful in solving PEB, which employed a code book constructed along similar lines. Other South American code books now in use which were received, presumable from the FBI, are: the"Solar" code book (CLA), "Clave Telegrafica" (ARB), and the books used in PAA and CUA.

These examples have shown the direct benefits to cryptanalysis, but other contributions have been just as useful, although their results are not immediate. For example, the OSS recently forwarded some German Hagelin machine directions to the Military Intelligence Service. From a study of the instructions contained in this material, it was possible for the analysts to develop a solution for a new and highly complex type of indicator system. It was valuable again in that it clearly illustrated the cryptographic lines along which the Germans were proceeding. This is a factor which cannot be overemphasized: regardless of the immediate value of any material received as a source of intelligence, another use, namely, that of accurately gauging the state of the art of cryptography in foreign countries, is realized as well. For this reason, too, all compromised cryptographic material, regardless of its immediate bearing, should be received at the Signal Security Agency for study.

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EO 3.3b(3)
EO 3.3(h)(2)
PL 86-36/50 USC 3605

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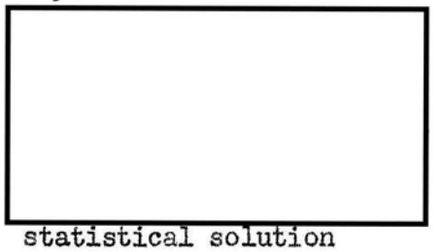

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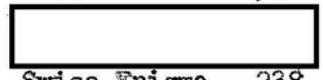

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APPENDICES

Doc ID: 6554247

TOP SECRET CREAM

EVOLUTION OF THE GENERAL CRYPTANALYTIC BRANCH

In 1941 the cryptanalysis of all foreign systems other than those of the Japanese Army was carried on in various parts of the Signal Intelligence Service. There was a J (Japanese) Section, directed by Mr. F. B. Rowlett; a G (German) Section, directed by Dr. Kullback; an I (Italian) Section, directed by Captain Sinkov; an M (Mexican) Section, directed by Mr. Frank Bearce; a school under Sergeant Kretlow; a Machine Section, under Mr. Kropfl; and a Bulletin and Distribution Section under Miss Louise Prather. This organization was not rigid, for the top cryptanalysts freely consulted among themselves and worked together on problems as the need arose. Indeed, as late as August 1942 the table of organization of what was then called B Branch existed only in slips pinned to a bulletin board in Major Boud's office in the Munitions Building. The organization was then much the same as that of 1941, except that Lieutenant Bearce was now in charge of the French Section and a "South-of-the-Border" section had been formed under Lieutenant Glodell. When the Signal Intelligence Service moved early in July 1942 to Arlington Hall, B Branch already existed as such, but included: B-1, an amorphous section those principal job was the translation of the production of the two cryptanalytic units, the publication and distribution of the Bulletin, instruction in Japanese, and information; B-2, which was charged with code recovery and the solution of additive encipherments of code; B-3, whose mission was the solution of ciphers and code encipherments other than additive; and B-4, the IBM unit. The main problems of B-2 were Italian, Spanish, (including Spanish American), Portuguese (including Brazilian), German, and French.

Serious effort had also begun on Japanese Military Attache systems and by June 1942 the problem of meteorological encipherments was undertaken. In B-3 the main problems were the famous J-19 transposed code, Hagelin encipherments, and the Japanese Purple Machine ciphers. The organization of B-3 in January 1943 is presented in Tab 4. Captain John N. Seaman had been attached to Colonel Boud's office in the summer of 1942 and had more recently been in charge of the group working on Hagelin problems; when Captain Frank B. Rowlett went to the Training Branch in 1942, Captain Seaman became OIC of B-3.

On 1 September 1943 the organization of B Branch was completely revised; B-2 was set up to deal exclusively with the Japanese Army systems and B-3 undertook the mission which it has had ever since. The organization at that time is shown in Tab 7.

More recent changes in organization are revealed in the Annual Report, Signal Security Division, Fiscal Year 1943; the Annual Report Signal Security Agency, Fiscal Year 1944; and the Summary Annual Report, Signal Security Agency, Fiscal Year 1945.

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PLAN OF ORGANIZATION

SIGNAL INTELLIGENCE SERVICE

1 March 1942

SECRET

OIC
Lt. Col. Harold Boud

TECHNICAL ASSISTANT
1st Lt. Frank B. Rowlett

B-1
JAPANESE
Major L. H. F. Svensson

B-2
GERMAN
Captain Solomon Kullback

B-3
ITALIAN DIPLOMATIC
Major Abraham Sinkov

B-4
FRENCH
Lieutenant H. . . Pearce

B-5
STENOGRAPHIC
Miss Louise Prather

B-6
TRAFFIC
Major A. L. Schukraft

B-7
SOUTH AMERICAN
Lieutenant L. L. Glodell

B-8
ITALIAN
Lieutenant Robert H. Adams

SECRET

2

354247

WORK SCHEDULE MAY 18- MAY 30 1942

(THIS SUPERCEDES PREVIOUS SCHEDULE ISSUED MAY 13th)

Beginning Monday May 18 and until further notice the following Schedule will be in effect for the Japanese Army Codes Section:

Day Shift:	Night Shift:
Mary Joseph DUNNING	Lt. Elbert MOSES
Lt. Charles FERGUSON	
PFC. James FULD	Pvt. David AVRACH
Lt. Rodger HARRISON	Pfc. Morton BARROW
Lt. John C MERRITT	Miss Jean COCROFT
Mr. Franklin PORTER	Pfc. William FLEISCHMAN
Lt. Chester RAY	Sgt. James GUSTON
Lt. Morris SEIBERT	Pfc. Cameron HOSMER
Mrs. Delia SINKOV	Miss Louise LEWIS
Mr. A.W. SMALL	Pfc. Victor ROSE
Mr. Maurice WALTZ	Sgt. Paul SEBESTYEN
Miss Harryet WILLIS	Pfc. Rubin WEISS
Lt. Victor YOUNG	
Hours: 8:15-5:00	Hours: 4:30-12:30
Lunch: 45 min.	Supper: 30 min.
	Saturday: 1:00 PM- 9:00.

* *

The above shift in plans is made necessary by the rapid expansion of the section. It is hoped to switch shifts at the end of two weeks.

* *

✓ Japanese lectures will start promptly at 4:30 each day, so the night shift is asked to be here promptly.

* *

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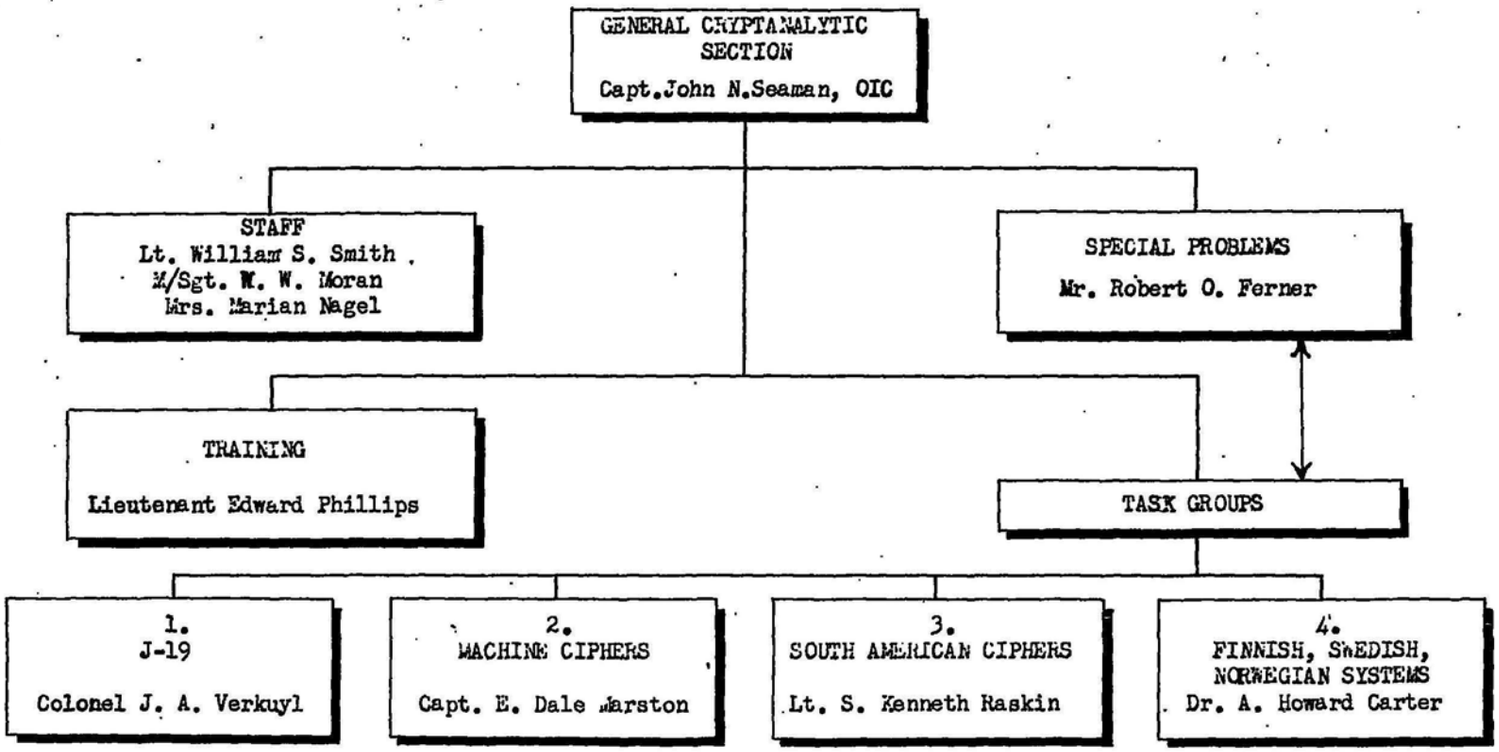
PLAN OF ORGANIZATION
General Cryptanalytic Section, B-3
January 1943



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IN REPLY REFER TO

WAR DEPARTMENT
OFFICE OF THE CHIEF SIGNAL OFFICER
WASHINGTON

SPSIS-2

5

February 17, 1943.

MEMORANDUM TO: Mr. Friedman.

In connection with our conversation of the other day, the following is submitted as a statement of the functions and organization of B Section:

1. The solution of all military and diplomatic and certain specified commercial codes and ciphers and the translation of the messages written therein of all actual and potential enemy governments and such governments as directed. Also the solution of all open codes and any other visible forms of secret writing including shorthand submitted to it by other agencies of the army. The operation of an IBM service for SSB.

2. The organization of B Section is as indicated by the accompanying chart.

3. The functions of the subsections of B Section are as follows:

(a) B-I. The recording and indexing of all messages received from E Section; the decryptographing of all messages in known systems; the translation of all decryptographed messages; the reading and study of all shorthand and open code material submitted by other agencies of the army; the preparation of a daily bulletin of solved and translated messages and its delivery to G-2 and the Navy; the operation of a library and a collateral information service; the recording, accounting for and proper dissemination of all classified collateral information in documentary form; and the operation of a Japanese language school for translators.

(b) B-II. The solution of all codes indicated in paragraph 1 including additive enciphered codes but excluding codes enciphered by means other than additive.

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IN REPLY REFER TO

WAR DEPARTMENT
OFFICE OF THE CHIEF SIGNAL OFFICER
WASHINGTON

(c) B-III. The solution of all ciphers indicated in paragraph 1 including codes enciphered by means other than additive.

(d) B-IV. The operation of the IBM service indicated in paragraph 1.

4. The functions of the Technical Committee, consisting of the subsection heads and other selected persons, are to study the over-all operation of the section and make appropriate recommendations to the Officer in Charge of B Section.

5. The functions of the Coordinators, one for each government whose codes and ciphers are under study, are to coordinate the activities of the various language groups where they cross subsection lines and make appropriate recommendations to the Officer in Charge of B Section.

6., In connection with all of its functions and as part of the execution thereof, B Section conducts in-service training for its personnel in accordance with its requirements.

Harold Doud,
Lt. Col., Signal Corps.

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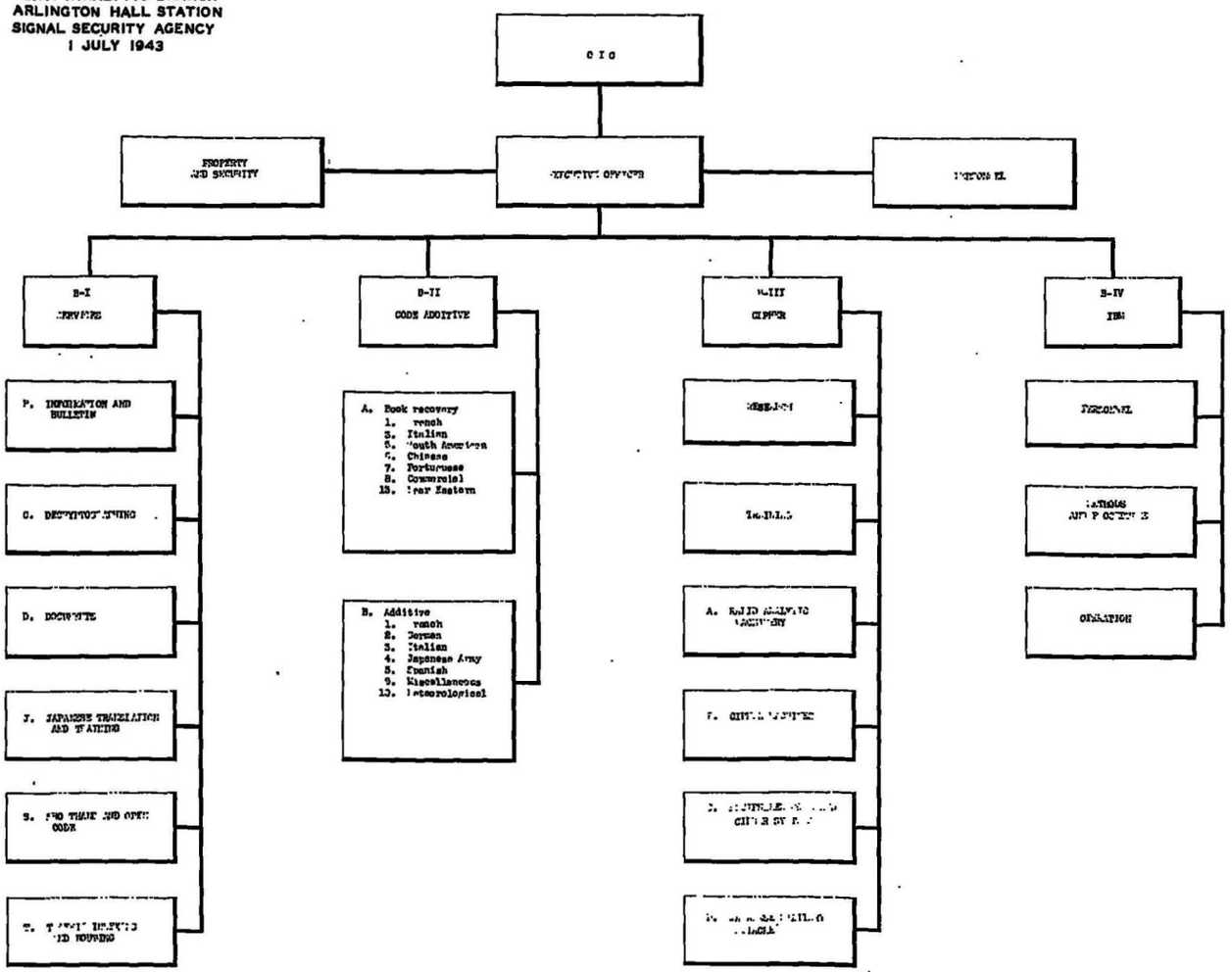
B
CRYPTANALYTIC BRANCH
ARLINGTON HALL STATION
SIGNAL SECURITY AGENCY
1 JULY 1943



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PLAN OF ORGANIZATION
CENTRAL CRYPTANALYTIC BRANCH
B-III

GENERAL CRYPTANALYTIC SECTION
Major Frank B. Rowlett

SEPTEMBER 1945

ADMINISTRATIVE

TRAINING: Lt/Col Daniel M. Corbin

RECORDER: Dr. Albert Howard Carter

RESEARCH: Mr. Robert O. Ferner, CIC

SPECIAL EXAMINATION: Captain E. J. Vogel

B-3-a
Major Gordon T. Fish

1. ITALIAN
   Capt. F. Duke
2. SPANISH-PORTUGUESE
   Lt. J. V. Haggard
3. CHINESE-THAI
   Lt. L. P. Roberts
4. PLAIN TEXT
   Lt. J. J. Apollony
5. NEAR EASTERN
   Lt. J. A. Salem
6. SPECIAL PROBLEMS
   Lt.G. E. McCracken

B-3-b
Major E. J. Wrigley

2. GERMAN
   Lt. Leonard J. Seidenglanz
9. SPECIAL PROBLEMS
   Lt. F. L. Coudert
10. WEATHER
    Lt. William H. Hezlep

B-3-c
Captain E. Dale Marston

1. RAM
   Captain E. Dale Marston
   a. OPERATIONS
      Lt. L. Wheatley
   b. MAINTENANCE
      Lt. L. W. Moran
2. MACHINE CIPHERS
   Capt. Ray Johnson
3. MISCELLANEOUS CIPHERS
   Lt. James C. O'Neill
4. JAPANESE DIPLOMATIC AND JAPANESE MILITARY ATTACHE
   Mr. Samuel B. Snyder
   c. CODES — Miss Elizabeth Stephens
   d. ADDITIVE — Lt. Karl Elmquist
   t. TRAFFIC — Sgt. John Richardson
   a. JMA — Lt. Donald McCown
   b. PURPLE — Lt. L. Phelps

B-3-d
Major William Edgerton

1. ADDITIVES
   Captain J. J. Carroll
2. SWISS AND BELGIAN CODES
   Capt. Thomas H. Glenn
3. OTHER ENCIPHERED CODES
   Lt. Elwood Hill
4. TRAFFIC
   Miss Ruth Adams
5. DECRYPTOGRAPHING
   Miss Katharine L. Swift

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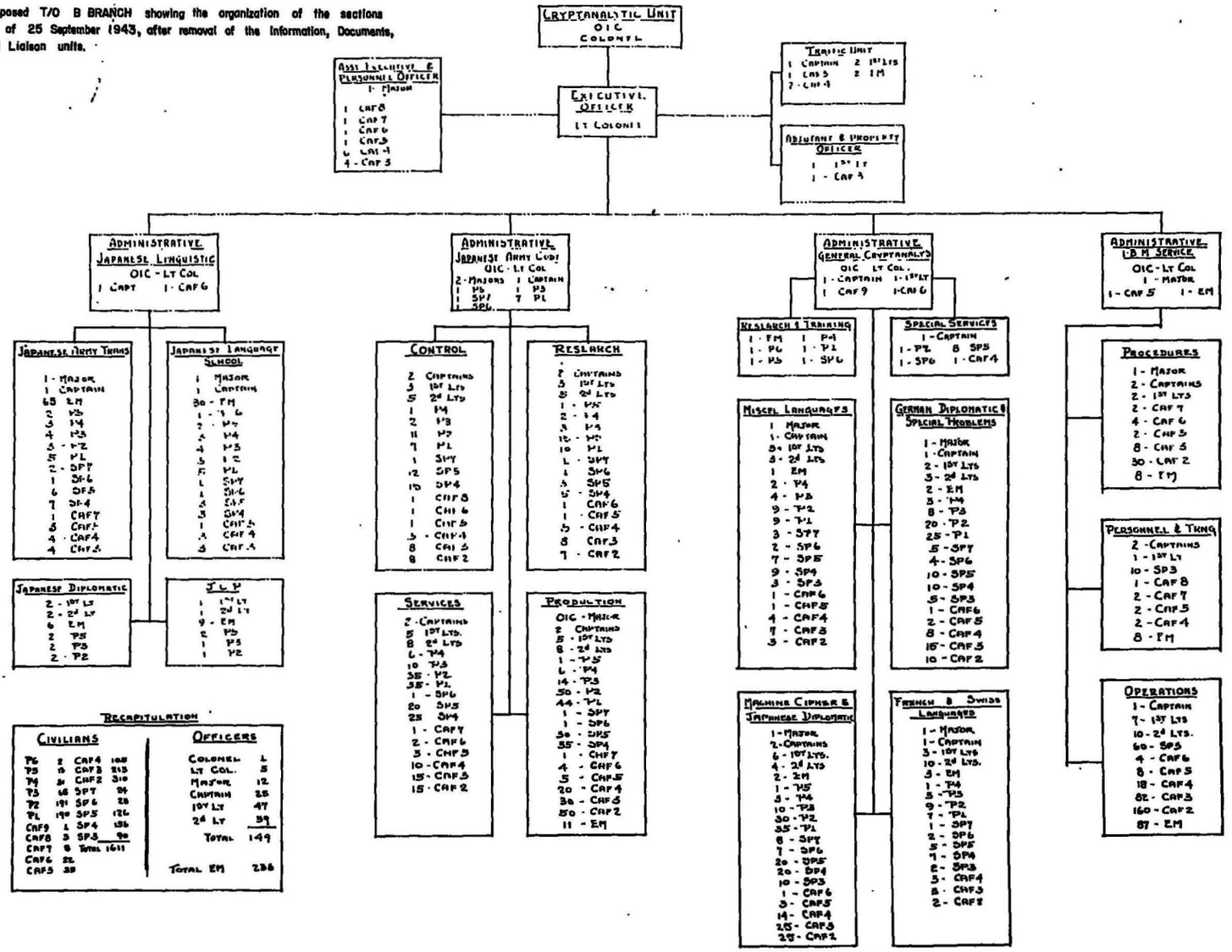
Proposed T/O B BRANCH showing the organization of the sections as of 25 September 1943, after removal of the Information, Documents, and Liaison units.



RECAPITULATION

CIVILIANS				OFFICERS	
P6	2	CAF 4	108	COLONEL	1
P5	10	CAF 3	213	LT COL.	3
P4	31	CAF 2	310	MAJOR	12
P3	68	SPT	94	CAPTAIN	25
P2	191	SP6	28	1ST LT	47
P1	192	SP5	126	2D LT	39
CAF 9	1	SP4	136	TOTAL	149
CAF 8	3	SP3	90		
CAF 7	8	TOTAL 1611			
CAF 6	22				
CAF 5	38			TOTAL EM	236

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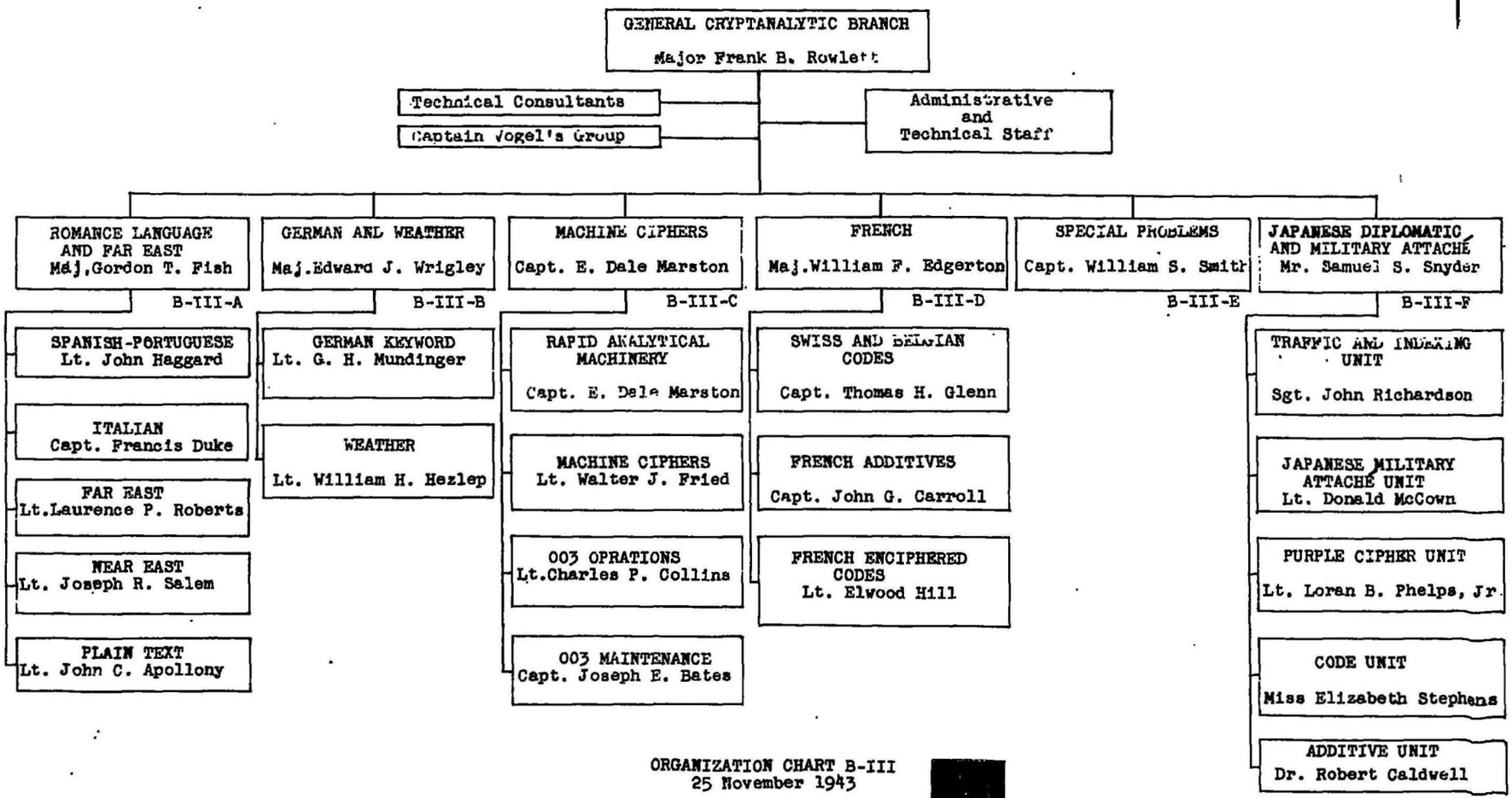

ORGANIZATION CHART B-III
25 November 1943

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B
CRYPTANALYTIC BRANCH
ARLINGTON HALL STATION
SIGNAL SECURITY AGENCY
17 APRIL 1944

APPROVED:
W. Preston Corderman
W. PRESTON CORDERMAN
COLONEL, SIGNAL CORPS
COMMANDING

ADMINISTRATIVE

1 Colonel	1 CnF-14
1 Lt. Col.	2 CnF-9
1 Major	1 CnF-8
1 Captain	1 CnF-7
3 1st Lts.	2 CnF-6
4 2nd Lts.	10 CnF-5
11 Officers	14 CnF-4
	14 CnF-3
12 Enlisted	46 Civilians
Total Personnel	69

B-I

1 Lt. Col.	2 P-6
1 Major	8 P-5
8 Captains	25 P-4
30 1st Lts.	35 P-3
46 2nd Lts.	35 P-2
	30 P-1
86 Officers	1 SP-8
	23 SP-7
	32 SP-6
	50 SP-5
	50 SP-4
	1 CnF-13
	1 CnF-9
	2 CnF-8
	2 CnF-7
	3 CnF-6
	15 CnF-5
	5 CnF-4
	15 CnF-3
254 Enlisted	387 Civilians
Total Personnel	641

B-II

1 Colonel	3 P-6
1 Lt. Col.	8 P-5
2 Majors	55 P-4
15 Captains	80 P-3
31 1st Lts.	100 P-2
40 2nd Lts.	110 P-1
90 Officers	8 SP-8
	100 SP-7
	100 SP-6
	250 SP-5
	125 SP-4
	1 CnF-14
	4 CnF-9
	4 CnF-8
	4 CnF-7
	4 CnF-6
	845 CnF-5
	80 CnF-4
	150 CnF-3
80 Enlisted	1306 Civilians
Total Personnel	1444

B-III

1 Lt. Col.	1 P-7
4 Majors	3 P-6
9 Captains	6 P-5
16 1st Lts.	45 P-4
20 2nd Lts.	50 P-3
	50 P-2
50 Officers	65 P-1
	2 SP-8
	10 SP-7
	15 SP-6
	8 SP-5
	110 SP-4
	4 CnF-14
	1 CnF-13
	3 CnF-9
	3 CnF-8
	3 CnF-7
	3 CnF-6
	155 CnF-5
	30 CnF-4
	80 CnF-3
65 Enlisted	781 Civilians
Total Personnel	896

B-IV

1 Lt. Col.	3 P-6
1 Major	12 P-5
4 Captains	15 P-4
18 1st Lts.	30 P-3
18 2nd Lts.	33 P-2
	1 SP-8
42 Officers	25 SP-7
	20 SP-6
	20 SP-5
	25 SP-4
	1 CnF-13
	1 CnF-9
	2 CnF-8
	2 CnF-7
	2 CnF-6
	134 CnF-5
	18 CnF-4
	20 CnF-3
13 Enlisted	466 Civilians
Total Personnel	523

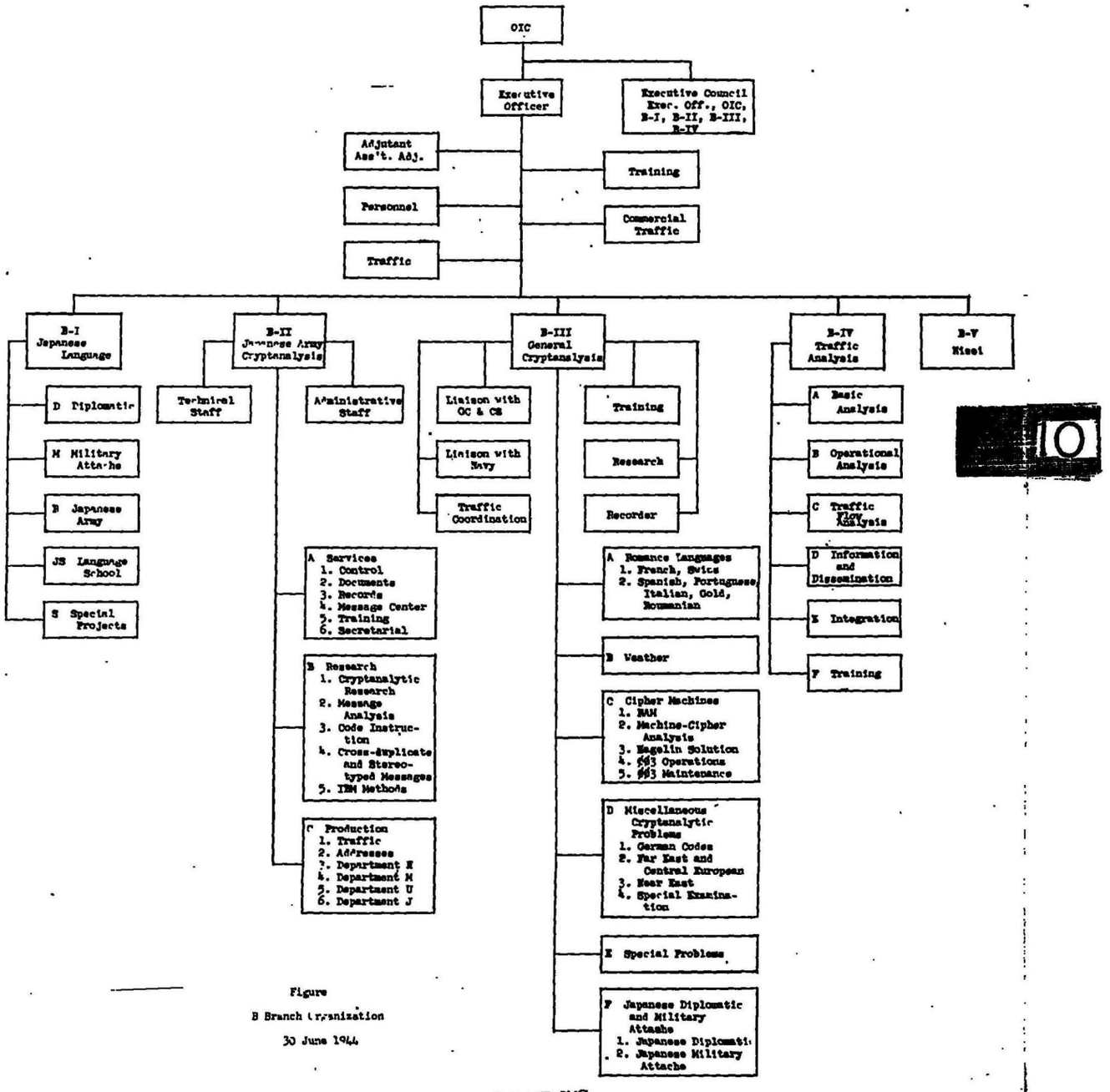
B-V

1 Major	
1 Captain	
2 1st Lts.	
4 Officers	
*	
Total Personnel	4

RECAPITULATION

MILITARY	CIVILIAN
2 Colonels	1 P-7
5 Lt. Cols.	8 P-6
10 Majors	28 P-5
36 Captains	118 P-4
130 1st Lts.	141 P-3
161 2nd Lts.	240 P-2
	220 P-1
343 Officers	13 SP-8
	178 SP-7
	220 SP-6
	283 SP-5
	411 SP-4
	3 CnF-14
	2 CnF-13
	11 CnF-9
	12 CnF-8
	12 CnF-7
	12 CnF-6
	484 CnF-5
	128 CnF-4
	324 CnF-3
369 Enlisted	3488 Civilians
Total Personnel	4234

* 43 Enlisted Personnel from B-I located at Vint Hill and assigned to that Station.



Figure

B Branch Organization

30 June 1944

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B-III

Lt. Colonel Rowlett

19 August 1944

Reorganization

1. In accordance with a directive from the Commanding Officer, Signal Security Agency, a reorganization of the Agency will become effective 21 August 1944.

2. On the above date the undersigned becomes Chief of the Intelligence Division.

3. Effective the 21 August 1944 and until further notice, the Intelligence Division will consist of five branches. A brief description of these five branches follows:

a. Japanese Language Branch, abbreviated title, B I. Officer in Charge:- Lt. Colonel Verner C. Aurell. Composition:- This branch will consist of the present Section B I plus the present Section B V.

b. Military Cryptanalytic Branch, abbreviated title, B II. Officer in Charge:- Lt. Colonel S. Kullback. Composition:- The present Section B II.

c. General Cryptanalytic Branch, abbreviated title, B III. Officer in Charge:- Lt. Colonel Frank B. Rowlett. Composition:- The present Section B III.

d. Traffic Analysis and Control Branch, abbreviated title, B IV. Officer in charge:- Major Robert T. Walker. Composition:- The present Section B IV plus the Control Section of the present E Branch.

e. Information and Liaison Branch, abbreviated title, I & L. Officer in Charge:- Major J. H. Frier. Composition:- The present Information and Liaison Branch less the Production Trends Section.

4. Under the new organization the office of the Division Chief is not an office of record and, consequently, many of the functions now performed by the Office of the Chief of B Branch will devolve upon chiefs of the five branches set up as above. These functions will include personnel and supply.

5. The branch chiefs will be authorized direct correspondence

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on technical matters with other branches of SSA or offices within SSA and with field signal intelligence establishments. They will be authorized to authenticate their own telegrams and correspondence.

6. On the other hand, all matters involving policy, new procedures, the transfer of personnel, and matters which require coordination between other branches of the Intelligence Division, or with other branches and offices of the SSA will be authorized only by the Division Chief. In such cases, the coordination will be secured by the branch of origin and will bear on the face of the document a written indication of the concurrence of the other branch or branches concerned prior to submission to the Chief, Intelligence Division.

7. The sole purpose of this reorganization is to increase the efficiency of the derivation of intelligence from radio intercept by avoiding any possible duplication of effort by bringing closer together all activities concerned with the production of signal intelligence. In accomplishing this end, it is desired that there be no interruption in existing procedures, that there be no movement of personnel or equipment, and that within branches there be as few changes as possible in the responsibilities and duties of the branch personnel. Certain changes will of necessity have to be made if the full benefit of the reorganization are to be realized but these changes will be made slowly, based upon the experience of the new alignment and with a minimum of interruption to existing procedures.

8. The organization described above will be tried out for a period of approximately six weeks upon the conclusion of which recommendations will be made by the Chief, Intelligence Division to the Commanding Officer, Signal Security Agency concerning any changes which it may be desired to incorporate in the permanent reorganization. It is desired that all five branch chiefs keep this in mind during the entire period and that they submit to me not later than 12 September their comments and recommendations concerning the new organization.

/s/ Harold G. Hayes

Harold G. Hayes
Colonel, Signal Corps
SPSIB, Ext. 311

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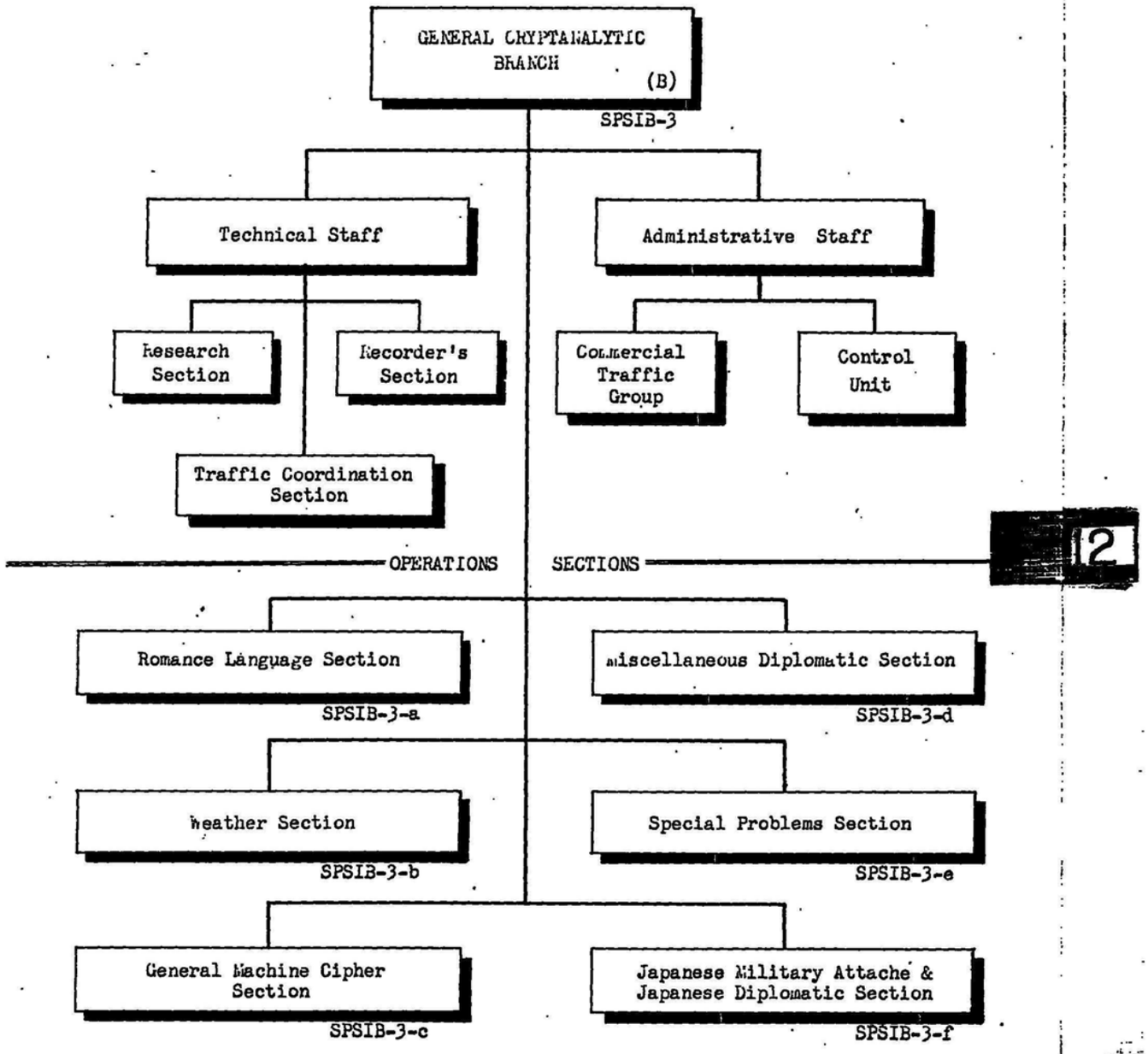
ORGANIZATION OF GENERAL CRYPTANALYTIC BRANCH

21 August 1944



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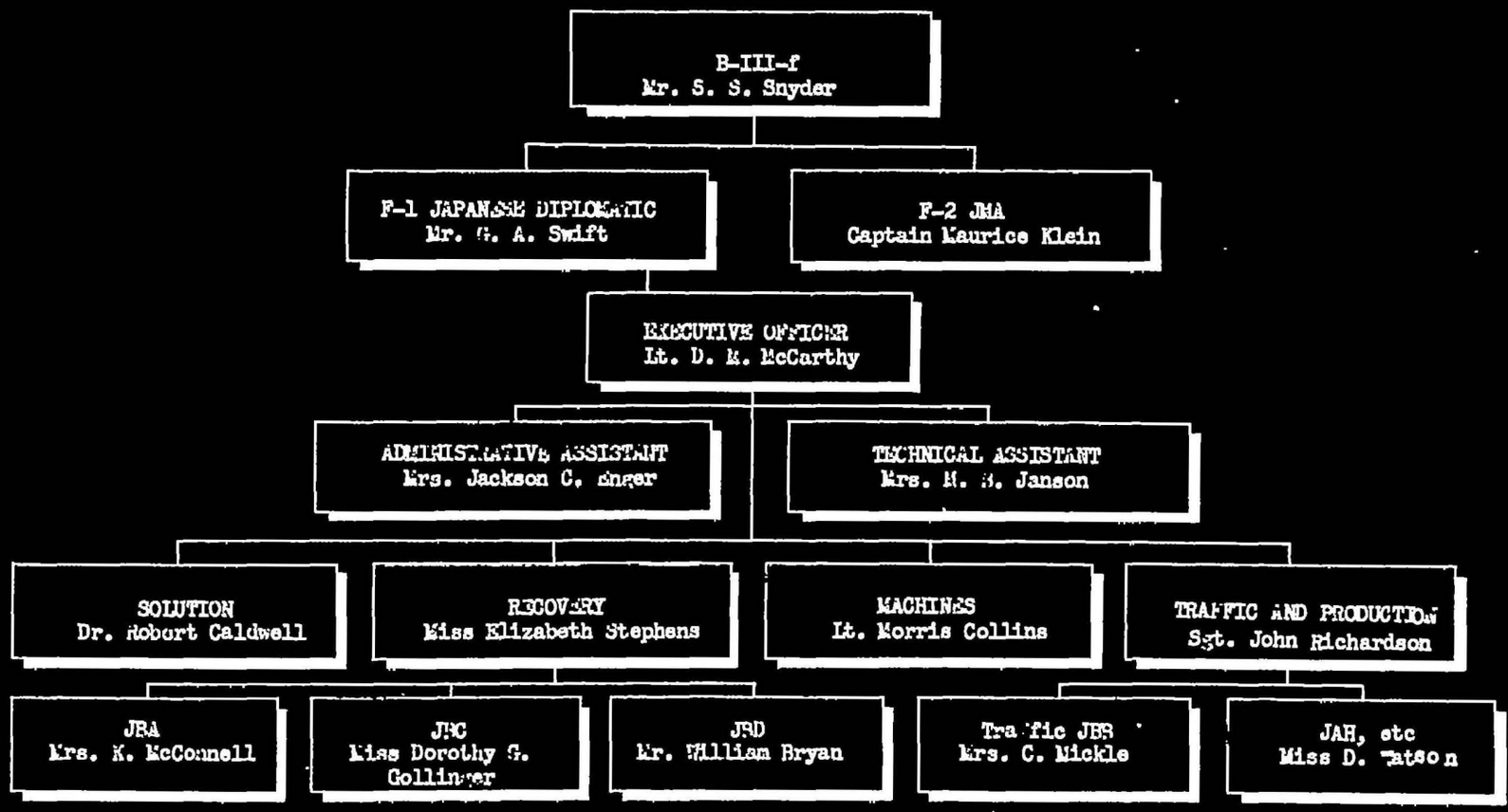
PLAN OF ORGANIZATION

JAPANESE DIPLOMATIC SECTION

Spring 1944



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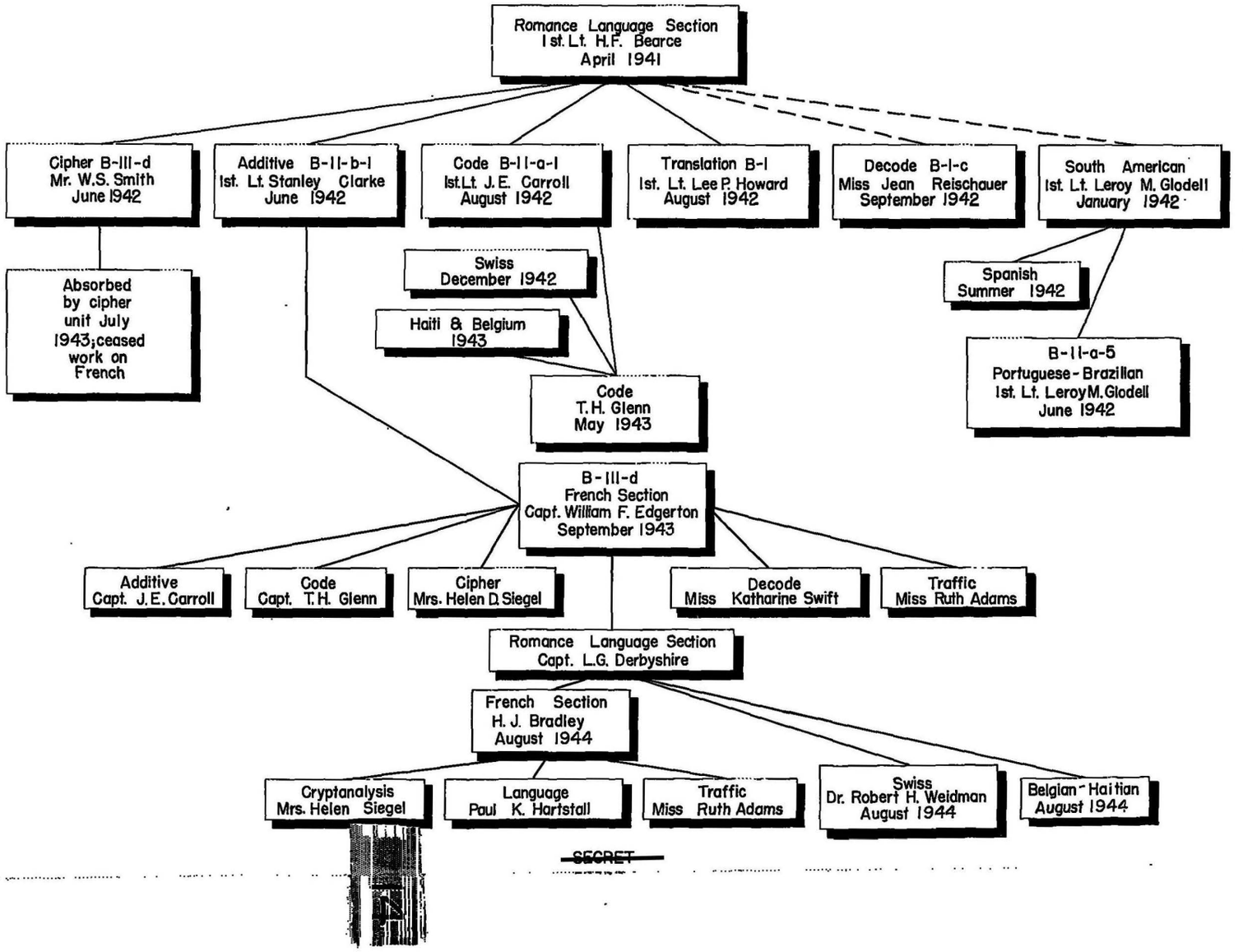
EVOLUTION OF THE ROMANCE LANGUAGE SECTION
1941 TO 1944



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COUNTRY	July Rec.	July Pub.	August Rec.	August Pub.	September Rec.	September Pub.	October Rec.	October Pub.	November Rec.	November Pub.	December Rec.	December Pub.	January Rec.	January Pub.	February Rec.	February Pub.	March Rec.	March Pub.	April Rec.	April Pub.	May Rec.	May Pub.	June Rec.	June Pub.	Total Rec.	Total Pub.
Afghanistan	66	$	66	$	$	$	$	$	$	$	$	$	63	$	80	$	64	$	49	$	65	6	76	5	593	11
Albania	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	1	$	2	$	3	1
Argentina	see South America				187	74	116	56	67	37	49	12	132	53	188	69	468	96	821	94	749	89	581	68	3404	642
Belgium	437	7	587	66	328	82	223	114	288	18	$	$	$	$	$	3	261	6	341	$	537	2	1883	$	3953	225
Bolivia	see South America				23	14	32	3	48	7	42	2	186	51	66	11	121	21	295	47	293	7	413	15	1429	178
Brazil	see South America				516	69	544	68	584	22	596	21	914	32	945	49	925	35	1693	36	1668	33	1171	28	8876	379
Bulgaria	167	$	196	$	8	$	$	$	$	$	$	$	$	$	$	$	$	$	243	$	382	$	423	1	976	1
Burma	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	1	$	$	2	$
Chile	see South America				429	339	442	164	413	162	377	47	665	116	577	113	819	147	1845	128	826	114	968	154	6341	1418
China (combined)	$	46	$	232																						
Chungking	see China (combined)				2521	112	2146	82	2404	77	1628	76	961	82	849	53	1488	73	1862	98	1984	161	2298	74	17559	838
Nanking	see China (combined)				$	$	$	$	$	$	$	$	14	$	187	$	455	$	1128	3	1812	$	1869	$	5873	$
Colombia	see South America				22	2	67	6	68	3	56	7	148	15	142	29	583	28	859	36	769	15	938	78	3374	249
Costa Rica	see South America				$	$	$	$	$	$	$	$	$	$	$	$	$	$	243	4	313	1	295	$	854	5
Croatia	13	$	37	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	31	$	81	$
Cuba	see South America				34	21	41	3	34	7	36	1	32	7	36	8	619	17	1147	17	1267	13	1146	9	4386	103
Czechoslovakia	226	$	449	$	$	$	148	$	$	$	$	$	$	$	$	$	$	$	134	$	49	$	132	$	463	$
Denmark	363	$	287	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	119	$	128	$	125	$	372	$
Dominican Republic	see South America				118	78	158	85	141	45	75	24	118	36	84	12	327	21	335	11	451	28	853	45	2668	363
Ecuador	see South America				293	88	146	2	148	5	122	1	292	7	422	9	521	2	587	12	721	18	833	58	3995	194
Egypt	78	$	112	$	8	$	8	$	4	4	5	$	3	$	16	$	163	1	132	1	282	4	118	$	595	16
Esthonia	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	2	$	1	$	$	$	3	$
Ethiopia	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	17	$	9	$	24	$	79	$
Finland	476	343	638	156	265	129	182	39	221	18	118	185	224	82	486	61	833	134	462	77	598	83	394	68	5843	1796
France	6362	586	8838	742	3674	586	3679	1697	3934	1194	3585	1295	6818	1391	8395	1246	14428	1588	12615	1665	11978	2368	9954	2632	74972	15596
Germany	8969	2265	8328	2741	2415	3685	11592	1661	3162	1613	2664	1698	21857	547	24747	992	24421	655	21885	739	18751	421	13632	474	144246	11798
Greece	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	698	8	486	15	336	32	1672	75
Greenland	22	$	46	$	38	$	$	1	$	$	$	$	$	$	$	$	$	$	148	$	183	$	114	$	393	1
Guatemala	see South America				6	$	12	$	2	$	3	$	2	$	$	$	$	$	56	$	94	3	288	$	586	3
Haiti	see South America				$	$	$	$	165	$	$	$	$	$	$	$	$	$	77	3	187	3	87	1	487	11	483	18
Honduras	see South America				$	$	$	$	$	$	$	$	$	$	$	$	$	$	43	$	23	1	74	$	178	1
Hungary	175	$	196	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	181	$	386	11	695	6	1822	17
Iberia	2865	276	2782	1251	see Spain and Portugal																					
Iceland	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	487	$	588	$	429	$	1424	$
Iran	174	14	229	26	116	73	91	71	133	124	138	133	175	89	253	$	446	4	391	1	352	94	477	73	2474	542
Iraq	16	4	45	3	11	8	12	14	13	23	4	2	6	3	89	$	69	$	57	$	62	$	112	$	373	78
Ireland	161	$	327	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	254	$	228	$	216	$	684	$
Italy (including Badoglio)	2718	215	2828	413	526	148	98	37	93	28	79	29	158	26	116	21	374	143	124	48	133	66	237	185	1938	643
New Mussolini govt.	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	224	136	398	178	296	227	916	535
Japanese	185693	4222	147385	7478	6546	3672	16841	3463	8789	3498	13478	3554	16147	3896	18437	4419	23422	3972	24915	4699	31465	6242	26678	3925	169918	44538
Latvia	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	8	$	18	$	1	$	19	$
Liberia	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	21	$	13	$	14	$	48	$
Lithuania	$	$	$	$	6	$	$	$	$	$	$	$	$	$	$	$	$	$	2	$	2	$	6	$	16	$
Luxembourg	$	$	$	$	8	2	$	$	$	$	$	$	5	1	15	3	21	3	21	2	15	$	55	1	149	12
Mexico	see South America				366	263	322	114	383	83	358	54	628	146	473	182	1891	142	1857	143	1968	169	1993	173	11397	1449
Netherlands	2571	$	2582	$	$	$	$	$	$	$	$	$	$	$	$	$	1539	$	1977	963	1289	1662	1733	1443	6118	3468
Nicaragua	see South America				31	$	$	$	4	$	$	$	8	$	5	$	161	3	244	1	363	1	281	3	1639	34
Norway	$	$	$	$	$	$	$	$	$	$	258	$	217	$	237	$	238	$	536	1	639	2	363	$	2679	$
Panama	see South America				18	18	$	$	11	4	8	$	35	13	36	12	67	16	299	1	23	7	631	8	1431	74
Paraguay	see South America				$	$	$	$	$	$	$	$	14	$	8	$	45	2	68	$	85	2	49	2	261	6
Peru	see South America				112	51	114	22	99	25	186	44	244	79	238	77	466	84	634	153	548	94	548	138	3181	729
Philippines	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	19	$	1	$	22	$
Poland	733	4	965	6	$	$	$	$	$	$	$	$	28	$	4	$	$	$	565	18	836	$	462	$	1827	18
Portugal	see Iberia				468	42	489	306	521	149	473	117	1666	138	1229	121	1276	223	2368	298	1669	292	1566	163	14373	1743
Rumania	378	$	354	4	126	$	$	1	$	$	$	$	$	$	$	$	$	$	83	$	46	1	$	$	633	2
Salvador	see South America				$	$	$	$	1	$	$	$	$	$	3	$	165	11	159	$	172	8	179	2	679	21
Saudi Arabia	1	$	$	$	2	$	67	63	44	34	9	$	$	$	2	$	3	$	1	$	2	$	$	$	136	99
Slovakia	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	11	$	98	$	15	13	124	13
South America	4657	396	5511	997	see the several countries																					
Spain	see Iberia				339	167	497	164	398	153	525	163	866	179	1694	137	2663	891	1821	283	1853	172	1249	164	14257	1797
Sweden	1338	12	2482	1	399	$	515	$	723	$	642	$	1877	$	1353	$	1272	$	2517	$	2598	$	2378	3	13436	3
Switzerland	1878	335	2242	457	961	439	814	562	1138	376	1158	152	1482	135	1451	183	2119	174	2695	185	2615	254	2381	281	16664	2617
Thailand	$	$	$	11	65	5	164	26	116	21	157	2	291	14	224	55	289	97	217	74	187	188	292	11	1897	433
Turkey	732	12	684	39	321	44	446	74	351	169	279	155	383	78	899	8	1267	16	1284	13	1558	76	1953	68	8661	677
Uruguay	see South America				38	29	18	2	33	1	13	$	64	3	39	5	97	$	168	1	139	6	169	3	762	58
Venezuela	see South America				92	98	127	12	84	12	183	6	287	52	189	55	1117	38	1817	85	1226	63	1338	97	5272	452
Yugoslavia	322	17	518	37	21	288	718	$	$	$	189	$	$	$	$	9	$	1	459	$	418	$	312	2	2921	212
Total	221829	8776	188989	14614	21863	14829	33886	8535	24171	7832	27225	7844	55316	7191	63432	7934	84866	8827	92698	9771	94116	11997	85791	16696	576966	89467

Figure . The production of B-III throughout the year, showing the number of messages received and the number published for each government or governmental group. The figures do not include a great number of messages decryptographed but not published. The totals given in the column farthest to the right are for the ten months from September through June because of the new system of accounting inaugurated in September. Further, the great rise in figures for April is largely due to the fact that plain text was systematically counted for the first time in that month. The figures become increasingly more accurate as the system of accounting was perfected; those for the first six months of 1944 are far more reliable than those for 1943.

*The figures given are totals for the several French governmental groups (Vichy, Giraudist, etc.), whose systems sometimes overlay. **The figures for Japan include Army traffic for July and August of 1943, the province of B-I and B-II. In the later period also, they reflect the contribution of B-I in translation and code reconstruction.

SECRET

554247

TOP SECRET

PROCESSING OF DIPLOMATIC TRAFFIC

TOP SECRET

Doc ID: 6554247

TOP SECRET

PROCESSING OF DIPLOMATIC TRAFFIC
40 GROUP UNITS

September 1944

SECTION AND NATIONAL GROUP	NO. TRIS.	TOTAL RECEIVED	DUPLICATES	ORIGINALS	NOT PROCESSED AT ALL	NOT DECIPHERED OR DECODED						DECODED OR DECIPHERED	NOT TRANSLATED OR SUMMARIZED						TRANSLATED OR SUMMARIZED
						Total	System Unsolved	Book key or indicator incompletely solved	Text Incomplete	Backlog	Lack of Personnel		Total	Low Intelligence	Held for Parts	Held for British Translation	Lack of Personnel	Backlog	Incomplete Text	
B III-A																				
Spain	3	2,981	1,276	1,765	-	1,115	28	1,685	2	-	-	596	40	33	-	7	-	-	-	556
Argentina	4	760	344	416	-	30	-	4	-	26	-	386	172	172	-	-	-	-	-	214
Bolivia	2	162	32	130	-	75	3	72	-	-	-	55	-	-	-	-	-	-	-	55
Chile	2	814	305	505	-	70	35	-	-	35	-	435	270	270	-	-	-	-	-	165
Colombia	2	538	225	313	-	34	-	34	-	-	-	279	98	98	-	-	-	-	-	181
Cuba	3	32	-	33	-	1	1	-	-	-	-	32	29	29	-	-	-	-	-	3
Dominican Republic	1	239	22	217	-	28	-	28	-	-	-	189	141	141	-	-	-	-	-	48
Ecuador	4	571	250	321	104	33	3	26	1	3	-	184	109	109	-	-	-	-	-	75
Guatemala	1	31	4	27	-	27	27	-	-	-	-	-	-	-	-	-	-	-	-	-
Haiti	1	37	2	35	-	-	-	-	-	-	-	35	25	20	-	-	-	5	-	10
Mexico	8	724	155	569	-	172	43	76	-	53	-	397	169	169	-	-	-	-	-	228
Nicaragua	2	4	1	3	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Peru	2	402	103	299	-	1	-	-	-	1	-	298	143	143	-	-	-	-	-	155
Panama	1	39	-	39	-	-	-	-	-	-	-	39	39	39	-	-	-	-	-	-
Paraguay	1	3	-	3	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Uruguay	3	70	12	58	-	2	2	-	-	-	-	56	37	37	-	-	-	-	-	19
San Salvador	1	1	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Venezuela	2	258	97	161	-	1	-	1	-	-	-	160	97	97	-	-	-	-	-	63
Tot. Span. Lang.	43	7,663	2,828	4,835	104	1,596	148	1,327	3	118	-	3,135	1,369	1,357	-	7	-	5	-	1,766
Portugal	17	2,649	1,325	1,324	-	321	30	1	1	143	146	1,003	507	404	-	3	2	98	-	496
Brazil	7	1,625	668	957	-	438	1	322	-	-	115	519	342	261	-	-	-	81	-	177
France	32	19,037	10,476	8,561	-	2,574	1,953	616	1	4	-	5,987	1,660	1,589	37	-	2	1	31	4,327
Belgium	3	574	32	542	-	294	196	-	-	-	98	248	165	165	-	-	-	-	-	83
Switzerland	15	7,335	3,716	3,619	-	1,961	26	1,734	7	193	1	1,658	311	126	1	-	184	-	-	1,347
Italy	8	940	493	447	158	137	-	14	-	123	-	152	18	18	-	-	-	-	-	134
Luxembourg	1	5	-	5	-	-	-	-	-	-	-	5	3	3	-	-	-	-	-	2
Rumania	6	1,526	216	1,310	-	1,310	1,310	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL B III-A	132	41,354	19,754	21,600	262	8,631	3,664	4,014	12	581	360	12,707	4,375	3,923	38	10	188	185	31	8,332
B III-C																				
Finland	3	345	174	171	-	171	171	-	-	-	-	-	-	-	-	-	-	-	-	-
Netherlands	2	1,557	298	1,259	-	826	99	727	-	-	-	433	-	-	-	-	-	-	-	433
Norway	1	720	-	720	720	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sweden	2	2,024	825	1,199	-	1,199	1,199	-	-	-	-	-	-	-	-	-	-	-	-	-
Germany	2	1,136	498	638	-	638	638	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL B III-C	10	5,782	1,795	3,987	720	2,834	2,107	727	-	-	-	433	-	-	-	-	-	-	-	433
B III-D																				
Germany	4	39,135	6,809	32,326	30,180	47	-	47	-	-	-	2,099	506	182	-	-	-	324	-	1,593
Hungary	1	1,059	453	606	-	588	582	6	-	-	-	18	-	-	-	-	-	-	-	18
Total B III-D-1	5	40,194	7,262	32,932	30,180	635	582	53	-	-	-	2,117	506	182	-	-	-	324	-	1,611
Bulgaria	2	1,151	622	529	-	273	273	-	-	-	-	256	228	-	-	54	-	174	-	28
China	18	4,696	909	3,787	2,844	196	115	53	5	23	-	747	560	552	8	-	-	-	-	187
Croatia	2	82	25	57	-	57	57	-	-	-	-	-	-	-	-	-	-	-	-	-
Czechoslovakia	3	495	25	470	-	359	299	60	-	-	-	111	96	96	-	-	-	-	-	15
Greece	3	1,333	826	507	80	-	-	-	-	-	-	427	10	5	-	5	-	-	-	417
Philippines	1	4	-	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Poland	6	1,221	227	994	-	925	452	473	-	-	-	69	1	1	-	-	-	-	-	68
Slovakia	1	30	3	27	-	27	27	-	-	-	-	-	-	-	-	-	-	-	-	-
Thailand	1	279	50	229	-	3	-	3	-	-	-	226	60	52	-	-	-	8	-	166
Yugoslavia	2	189	41	148	-	137	69	68	-	-	-	11	-	-	-	-	-	-	-	11
Total B III-D-2	39	9,480	2,728	6,752	2,928	1,977	1,252	657	5	23	-	1,847	955	706	8	59	-	182	-	892
Afghanistan	1	51	14	37	-	18	-	18	-	-	-	19	13	6	-	-	7	-	-	6
Egypt	1	40	8	32	-	8	-	8	-	-	-	24	7	7	-	-	-	-	-	17
Ethiopia	2	25	-	25	-	15	-	15	-	-	-	10	4	4	-	-	-	-	-	6
Ireland	2	44	3	41	-	41	33	8	-	-	-	-	-	-	-	-	-	-	-	-
Iraq	3	46	14	32	-	1	-	-	1	-	-	31	8	8	-	-	-	-	-	23
Iran	1	626	275	351	-	39	-	29	10	-	-	312	189	90	-	88	11	-	-	123
Saudi Arabia	2	41	4	37	-	37	1	36	-	-	-	-	-	-	-	-	-	-	-	-
Turkey	8	2,758	1,135	1,623	-	109	14	8	87	-	-	1,514	720	717	3	-	-	-	-	794
Total B III-D-3	20	3,631	1,453	2,178	-	268	48	122	98	-	-	1,910	941	832	3	88	18	-	-	969
TOTAL B III-D	64	53,305	11,443	41,862	33,108	2,880	1,922	832	103	23	-	5,874	2,402	1,720	11	147	18	506	-	3,472
B III-F - Jap. Dip.	22	51,178	32,451	18,727	-	3,132	2,323	618	128	63	-	15,595	6,555	1,600	321	800	2,561	1,273	-	9,040
B. Adm. T.																				
Denmark	1	25	18	7	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Greenland	2	15	-	15	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iceland	2	9	1	8	8	-	-	-	-	-	-	31	20	20	-	-	-	-	-	11
Ireland	1	34	3	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Liberia	1	18	1	17	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lithuania	1	4	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL B. Admin.T	8	105	25	80	49	-	-	-	-	-	-	31	20	20	-	-	-	-	-	11
Special																				
KI	5	1,365	609	756	159	-	-	-	-	-	-	597	412	412	-	-	-	-	-	185
ZY	10	14,399	885	13,514	-	13,514	13,514	-	-	-	-	-	-	-	-	-	-	-	-	-
ZZ	6	18,267	5,174	13,093	-	13,093	13,093	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL SPECIAL	21	34,031	6,668	27,363	159	26,607	26,607	-	-	-	-	597	412	412	-	-	-	-	-	185
Totals B III Sect.																				
B III-A	132	41,354	19,754	21,600	262	8,631	3,664	4,014	12	581	360	12,707	4,375	3,923	38	10	188	185	31	8,332
B III-C	10	5,782	1,795	3,987	720	2,834	2,107	727	-	-	-	433	-	-	-	-	-	-	-	433
B III-D	64	53,305	11,443	41,862	33,108	2,880	1,922	832	103	23	-	5,874	2,402	1,720	11	147	18	506	-	3,472
B III-F	22	51,178	32,451	18,727	-	3,132	2,323	618	128	63	-	15,595	6,555	1,600	321	800	2,561	1,273	-	9,040
B. Admin. T	8	105	25	80	49	-	-	-	-	-	-	31	20	20	-	-	-	-	-	11
Special	21	34,031	6,668	27,363	159	26,607	26,607	-	-	-	-	597	412	412	-	-	-	-	-	185
GRAND TOTAL	257	185,755	72,136	113,619	34,297	44,084	36,623	6,191	243	667	360	35,237	13,764	7,675	370	957	2,767	1,954	31	21,473
% of Intercepts		100.00	38.81	61.17	18.46	23.7	19.7	3.3	0.13	0.35	0.18	18.9	7.4	4.1	0.20	0.52	1.5	1.05	0.02	11.5
% of Originals	-	-	-	100.00	30.19	38.8	32.2	5.4	0.21	0.59	0.32	31.01	12.11	6.76	0.32	0.84	2.44	1.72	0.0	18.88
PLAIN TEXT	-	21,916	1,697	20,219	-	-	-	-	-	-	-	-	20,275	20,265	-	-	-	-	-	24

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TOP SECRET CREAM

THE FIRST TRANSLATION OF A B-MACHINE MESSAGE

Except in cases of great emergency, it is not until the cryptanalysts realize that a basic system is on the way to solution that they venture translations in that system. The reason this three-part message, translated 14 June 1940, could be submitted several months before the so-called first "Purple" Machine messages of 27 September 1940, was that the system began to break down at the moment of this translation. At this point, it was realized beyond a doubt that, in a matter of a few months, all the messages in this system could be read. The solution of this message might be said to be somewhat forced in that several obvious letters of the text were assumed.

TOP SECRET CREAM

From: Rome (Japanese Ambassador)
To: London
June 6, 1940.

Received from Berlin as #95.

Rela to London as #71. Sent to Tokyo as #328 (?), May 30th.

Part 1 of 3.

* * * The Foreign Minister of the Netherlands formally stated to the Japanese Minister ~~at~~ The Hague that the Netherlands Government would ~~(could ?)~~ not see as acceptable any country's protection of the Netherlands East Indies and that the Netherlands Government were determined to refuse any offer of protection or intervention of any kind or which may be made by any country.

The Japanese Government believes that the Netherlands Government is determined to remain true to the above quoted statement in spite of the * * * for which the Japanese Government cannot help feeling deepest sympathy. But it must, however, be appreciated by the Japanese Government that * * *. The Japanese Minister at The Hague under instructions from his government proposed to the Foreign Minister of the Netherlands that the matters to be discussed * * *. The Japanese Government is anxious to be informed as soon as possible ~~of the~~ (that ?) Netherlands Government * * * in the response to the proposal and * * * to make these instructions known and to propose that the complete negotiations should be conducted in Batavia and that the East Indies Government be instructed to that effect by the Netherlands Government.

#7610

Trans. 6/14/40 (7)

From: Rome (Japanese Ambassador)
To: London
June 6, 1940.

Received from Berlin as #95.

Relay to London as #71. Sent to Tokyo as #328 (?), May 30th.

Part 2 of 3.

* * * between Japan and the East Indies in the matters of trade enterprises, * * * the traditional friendship between the two * * * public opinion of both countries * * * by situations which bring calumny and propaganda * * * international relations * * *. The Japanese Government is only too anxious * * * the questions between * * * of the East Indies * * *. The Japanese Government shares with the Netherlands Government. * * * feel that the proposal of the Japanese Government * * * initiative for these proposals on the questions of trade enterprises underway. * * * to the effect that the Netherlands Government would not adopt any change in the measures of the export to Japan of all the East Indies products needed in Japan.

#7611

Trans. 6/14/40 (7)

From: Roma (Japanese Ambassador)
To: London
June 6, 1940.

Received from Berlin as #95.

Relay to London as #71. Sent to Tokyo as #[illegible]8 (?), May [illegible]th.

Part 1 of 2.

[illegible] to the promotion of friendly sentiment between * * * Firm in the belief that the Netherlands Government shares with the Japanese Government the desire not only to keep this fostered friendship undisturbed under any circumstances but also to continue increasing friendly relations between them, the Japanese Government proposes to the Netherlands Government * * * permit within the limits of the present emergency the trade between Japan and the East Indies * * * the Netherlands Government be good enough to give the Japanese Government an answering Japanese memorandum above answer * * * continuing the export to Japan of the undermentioned products and goods of the East Indies and to instruct the government there * * * to act accordingly:

Rubber	Scrap Iron
Mineral Oil	Chrome Ore
Bauxite	Lead
Nickel Ore	Cinchona
Manganese Ore	Molybdenum
Wolfram Ore	

Note: This is the first translation of "B" machine messages.

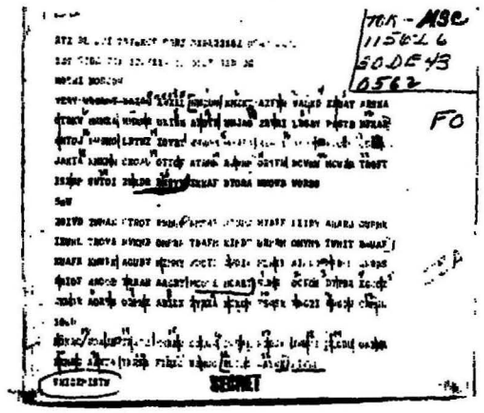
7612

Trans. 6/14/40 (7)

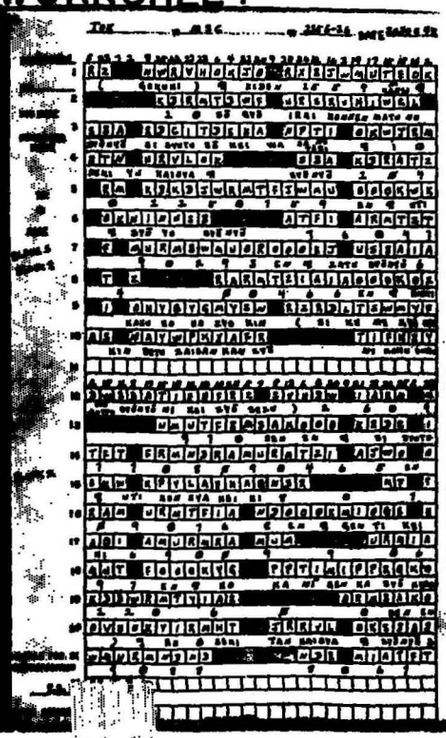
INTERCEPT

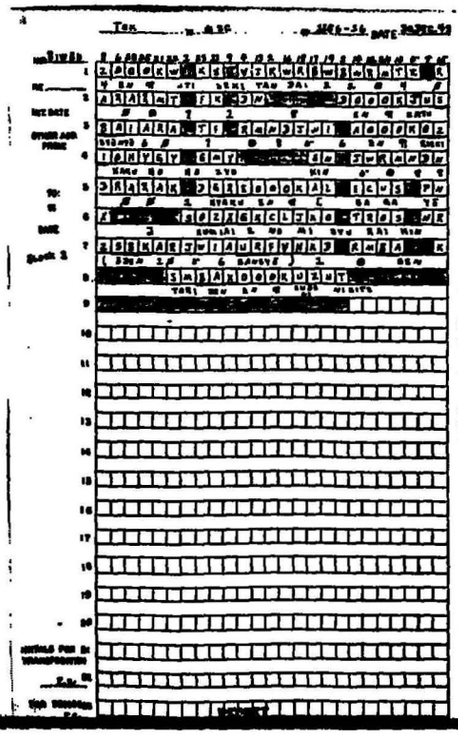
5. The JAA process.--The JAA operation is summarized in the following illustrations. The first series shows the cryptanalysis of the messages: the matrix with its blocks, the decodement, and translation; the rules for the use of blanks in the two types of encipherment; and the digraph-to-code chart. The second series illustrates problems of key recovery.

The top photograph shows an intercepted JAA message. The traffic unit has designated the serial and worksheet numbers, the date, and the origin and destination. (The message is sent ready to be transposed and decoded.) The message is marked into groups of forty (JAA letters), which constitute a block. A full block is rectangular in form, 25 cells wide, and 16 deep. Each block has a different numerical key. The message is written into the matrix and the plain is obtained from values on the digraph and trigraph charts. Finally, the translated message is shown on the last photograph on the page.

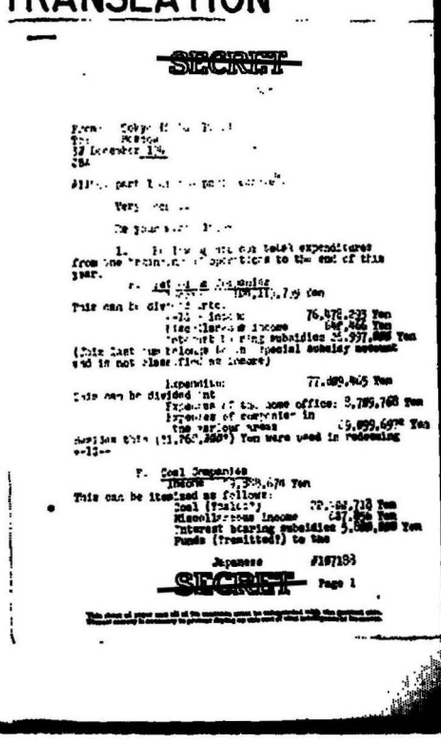


WORKSHEET





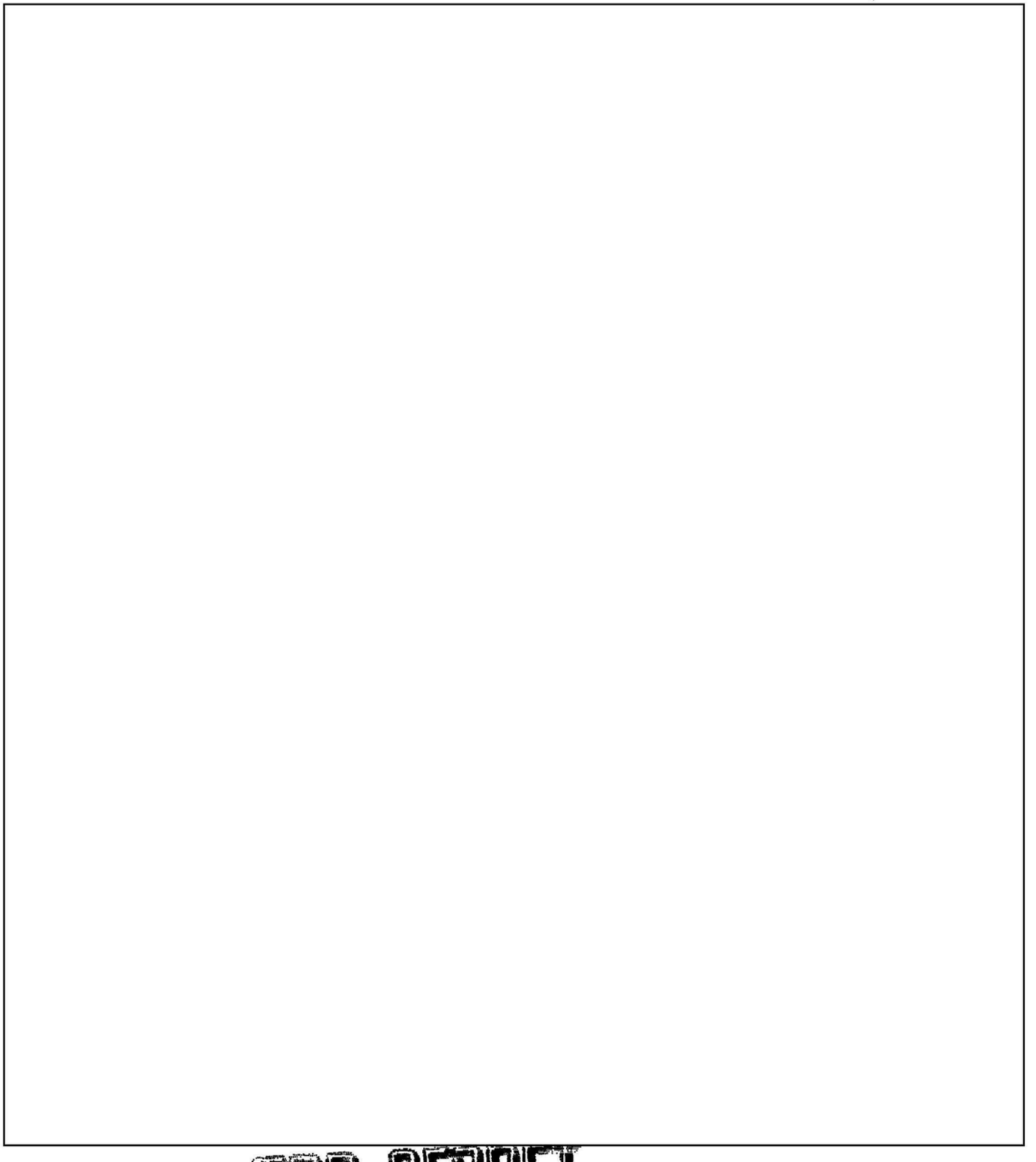
TRANSLATION



Doc ID: 6554247

EO 3.3b(6)
PL 86-36/50 USC 3605
EO 3.3(h)(2)

THE JSC PROCESS FROM INTERCEPT TO TRANSLATION



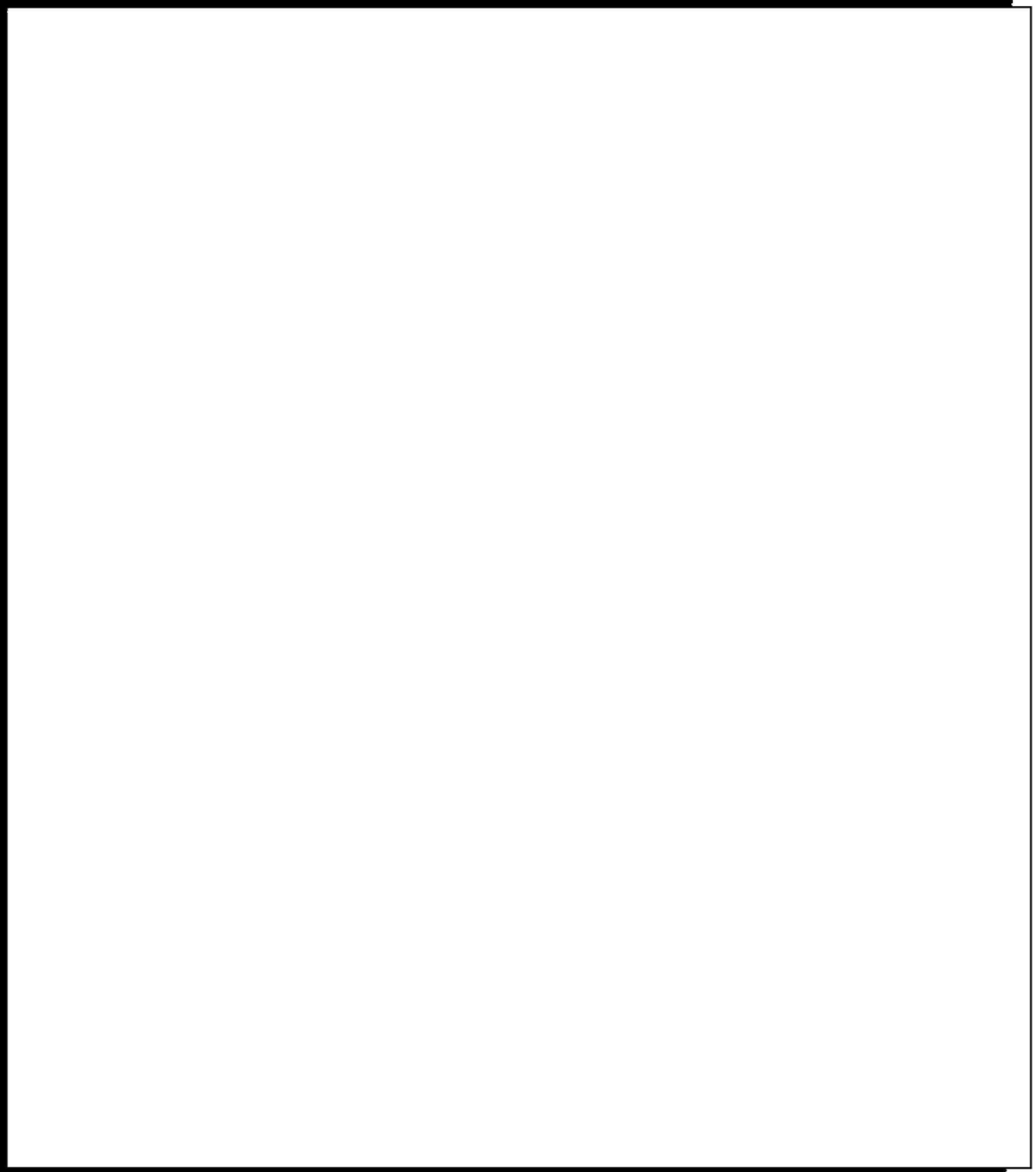
EO 3.3b(6)
PL 86-36/50 USC 3605
EO 3.3(h)(2)

[redacted]

[redacted]

[redacted]

EO 3.3b(3)
EO 3.3(h)(2)
PL 86-36/50 USC 3605



EO 3.3b(6)
PL 86-36/50 USC 3605
EO 3.3(h)(2)

Doc ID: 6554247

~~SECRET~~

PERSIAN ENCIPHERED CODE PROCESSING

~~SECRET~~

~~SECRET~~

PERSIAN

FROM: NEW YORK (DOCTOR NASSR)

TO: TEHERAN (FINANCE MINISTRY)

MSG.NO.: 1173

1. Message as received:

ENPPE LNIIK EZEJX KTSRF XUOHI NXVGC BXOYX FXFYK ZYYZU UBEGL XQIDP

ELMUO TUOUJ TQPRD BSUYO QIDHL PNKAM XKVHB PLTFMZ

2. The same message as above divided into tri-literal code groups and showing decipherment (purple color) and decodement (orange color). Plain text (orange) is Persian plain-text in English script.

ENP	PEL	NIL	KEZ	EJX	KTS	RFX	UOH
RBX	XRP	BLP	YRA	RED	YQZ	VND	IMN
KMP'NY	NFT	'ST'ND'R-Y	V'	KV	V	MYHV'HND	ÇN'NÇH
INX	VGC	BKO	YXE	XFY	KZY	YZU	UBE
LBZ	SGU	FDM	TDH	DHT	YAT	TAI	IFR
DVLT 'YR'N	M'YL'ST	BH	MΔ'KRH	D'ŞD	NM'YNDH	MNṢVṢ-Y	JHT
GIX	QID	PEL	MUO	TUO	UJT	QPR	DBS
GPD	CLJ	XRP	KIM	QIM	CEQ	CxV	JFZ
THṢYL	'MTY'Z-Y	NFT	DR	QSMTN'Y	'Q'MH D=VY	'YR'N-Y	H'RJ'Z
UYO	QID	HIP	NKA	MXK	VHB	PLT	FMZ
ITM	CLJ	NPX ŞRKT NFT	BYO 'GZ'MY	KDY	SNF	XPQ	HKA TLGR'F
HDVD	'MTY'Z-Y	'YR'N V 'NCLYS		D'RD	MTMNY'ST	NZRYH	NM''YD

[redacted]

~~SECRET~~

~~SECRET~~

3. Transliteration into Persian script:

کمپانی نفت استاندار واکووم میخواهند چنانچه دولت ایران مایل است به مذاکره با نماینده منصوص جهت تحصیل امتیاز نفت در قسمتهای خارج از حدود امتیاز شرکت نفت ایران و انگلیس اعزام دارد مقتضی است نظریه تلگراف نمائید

4. Translation:

The SOCONY-VACUUM OIL COMPANY wishes, if the Iranian Government is so inclined, to confer with its special representative with the view to obtaining an oil concession outside the limits of the ANGLO-PERSIAN OIL COMPANY's concession. Please wire your opinion.

~~SECRET~~

Doc ID: 6554247

TURKISH ENCIPHERED-CODE PROCESSING

Doc ID: 6554247

SECRET

TURKISH

FROM: WASHINGTON (TURKISH AMBASSADOR, MUNIR ERTEGUN)

TO: ANKARA (HARICIYE)

MSG. NO.: 47

1.

01115 15493 27024 61965 07881 68189 32544 34452 31842 11237 54431 76137 90585

49683 85086 94171 85638 48092 87039 14106 22847 76557 52212 39360 50495 34472

35500 08352 80381 68189 32164 06245 09587 82042 55113 95732 72897 33229 70437

97171 06941 61705 76481 62554 44780 35780 09090 34428 58845

2.

4653	8297	6534	5971	8765	2456	9345	8745	3638	7564
0111	5154	9327	0246	1965	0789	1681	8932	5443	4452
4764	3341	5851	5117	9620	2134	0926	6677	8071	1916
14	ŞUBAT	TARIH	VE	#24	N.T.	DA	ile	TÜRKİYE	BUGÜN
3184	2112	3754	4317	6137	9058	5496	8365	0869	4171
7737	0309	9288	9288	4892	1404	4731	6000	3497	1635
BU	BARIN-DAN	HEMEN	HEMEN	HARB	E	HAZIR	//	NUSHA	SINDAN
8563	8480	9287	0391	4106	2284	7765	5752	2123	9360
2116	6677	5711	5262	2861	4630	6000	3497	5751	6824
GEÇILEN	ile	HAFTA	LARCA	SÜRME	SI	//	NÜSHA	SINA	KADAR
5049	5344	7235	6000	8352	8033	1681	8932	1640	6245
9692	3531	3769	1971	6017	0489	0926	6677	4278	3709
OLAN	GRUP	LAR	OLUP	DAHA	AŞAĞI	DA	ile	MÜNA KAŞA	LAR
0958	7920	4255	1139	5732	7289	7332	2970	4379	7171
4601	5117	0789	6000	3497	9635	6677	0615	7907	4635
EVVELCE	VE	AHIREM	//	NUSHA	SINDAN	//	SAFHA	YA	INTIKAL
0694	1617	0576	4816	2554	4478	0357	8009	0903	4428
4247	9804	6000	9787	0219	6824	9692	6744	3531	1982
ETTIRIL	MIŞ	//	NÜSHALARINA	KADAR	OLAN	#6	GRUP	RICA	EDERIM

5864
9437
#47

TURKISH-ENCIPHERED-CODE PROCESSING

SECRET

SECRET

1. Section one represents the message as received.

2. Section two is the same message in enciphered four-digit code groups (black); and the basic four-digit code groups (red), derived by the application of the forty-digit additive (green). The plain component is Turkish plain-text (blue).

3. Turkish plain-text:

Ondört Şubat tarih ve yirmidört numerali telgrafta "Türkiye bugün bakim hemen-hemen harbe hazir" nushasindan geçilen "haftalarca sürmesi" nushasina kadar olan gruplar olup daha aşagida "münakaşalar evvelce ve ahirem" nushasindan "safhaya intikal ettirilmiş" nushalarina kadar olan alti grup ricaederim kirkyedi

4. Translation:

I request the (code) groups in your message number twenty-four, dated fourteen February, beginning with the text, "Türkiye bugün bakim hemen-hemen harbe hazir" as far as the text, "haftalarca sürmesi"; and further on, the six groups beginning with "münakaşalar evvelce ve ahirem" up to the text "safhaya intikal ettirilmiş", forty-seven.

SECRET

Doc ID: 6554247

~~SECRET~~

24

ARABIC CODE AND CIPHER PROCESSING

~~SECRET~~

Doc ID: 6554247

~~SECRET~~

ARABIC

FROM : WASHINGTON (IRAQIYAH)

TO : BAGHDAD (KHARIJIYAH)

MSG. NO. : 11

1.

DDCUN CSSGP ZUNCP SSIPN LEXXL HZCJS HWDLU HCVEE XHBMZ NHKEE AHHVP ZEHXL KFBRU

CUZUN NULUW GMMCK CDKAH WXZLE PZWYH ZBFVK HWULH WVLCW VUEHP ZALKX LFIML NLXFX

LNSEM KOHAH LAFHH VSDLF NGHFH HKPZE HXLLX BRFPW ULHAP UZJOK SPZWC ASUPF KPNLX

JSUNB KNGHF HHKWH CLEVM WBUEP EHXCZ LONSF VKHFM FWBRF ZLAOF KSFDC WCASU PAHKU

PVKHW ETMJV UEHFP ZNLKL XFNLE KWCAS UPFKP EXOAW HZCZN LXLCS ONHXV KHSUN BKWNG

HFNHC LEVLW BUEPC VFMLX UHCZL AKFWD FZMDX DLXEN GNCLL NSUBX LEEUN HSEXL WCUNC

SEXJS GZASI PZLUA LKEUN HLSWH YBAPW ULHAP UZJOK SPZWH PGGDH HVCXN EKYBA HLSEL

UJFOH WETMW VUEHF ZCXNE KWCDL KAWSY UHVHF LBSDL DLVKH LVCLK WAFHZ XHHXP

2.

CIPHER: DDC UNC SSG P Z UNC P SSI P NLEXXL HZC SSH WDLUH CV KKX HHM ZNHK EEA HHV P

PLAIN : BRQX/TYNA | RQM | ∧ | W RQM | / | Q>BLN> | YMM | 9 | LT>RY | MS | N>>B | M>SR | WKYL | HAR-JYN | AMY-RKA |

ZEHXL KF BRU CUZU WNULU WCNMC KCDKAH WXZLE P ZWYHZB P VKH WULH WVLC WVUEH

WBYN> | LH | HTR | MRWR | LQR>R | LMQ3M | LMJLSY | LNW>B | W>LSYWM | SLY | LR>Y | LS>M | LSRBY |

ZALKXLF LML NLX FXLN SEXK OH AHLAF HHV SDLF NGHF HHK P ZEHXL LX BRF P WULHA

WS>LN>H | >3> | K>N | HH>K | TBDL | FY | SY>SH | AMY-RKA | TS>H | QBYM | FLS-TYN | WBYN> | >M | HTH | LR>YS |

P UZJOKS P Z WCASU P FK P NLXS JUNB KNGHF HHK WH CL EVM WBUE P EHX CZLONSF

RWZFLT | W >LMSTR | HL | K>NT | TRKH | LQBYM | FLS-TYN | >LY | M> | BSJ | >LHRB | BYN | MW>FQTH |

VKH FMF WBRF ZLAOF KSFDC WCASU P AHKU P VKH WEDM WVUEHF P Z NLK LXF NLEK WCASU

SLY | HBH | >LHTH | M>SFH | LTHJM | >LMSTR | SYLR | SLY | >LBDX | >LSRBYH | W Q>L | >NN | Q>BL | >LMSTR |

FK P EXOA WEZC Z NLXL CSONHX VKH SUN BK WNGHF WH CL EVM WBUE P CV FML XUH

HL | BNFS | >LYNM | W K>N> | MTFQYN | SLY | TRK | HL | LQBYH | >LY | M> | BSJ | >LHRB | MS | HB> | NRY |

CZLAKF WDFZM CX DLXENC NCL LNSUBXL EEUNHSHXL WCUNCSHX SSG Z SSI P Z LUALK

MW>SLH | >LTHWJ | MH | J>NBKM | KM> | >QTRHN> | BBRQYYYN> | >LMRQMTYN | ∧ | W | 1· | W >RS>L |

EUNHLS WH YBA P WULHA P UZJOKS P Z WH P GGD HHV CX NEK YBAHLS KLUJF OH WETM

BRQY>T | >LY | SNS | >LR>YS | RWZFLT | W >LY | HKW-MN | AMRI-KA | MH | QBL | SNSY>T | B>RZH | FY | >LBL>B |

WVUEHF Z CX NEK WCDLKA WSYUHVHF LBSDLDL VKH LVCLK WAFHZXHHX P

>LSRBYH W HM QBL >LMB>LS >LTSRYSYH >HTJ>J> SLY >SM>L >LSHYWHYYN

~~SECRET~~

~~SECRET~~

1. Section one represents message as received.

2. Section two is the same message showing the segregation of code groups (red underscore) from the cipher text. Plain component (orange color) is Arabic plain-text in English script.

3. Transliteration into Arabic script:

برقيتينا رقم ٨ ورقم ١٠ / قابلنا يوم ٩ الجاري مع نائب
مصر وكيل الخارجية الاميركية وبينا له خطر مرور القرار
المقدم لمجلسي النواب والشيوخ على الراي العام العربي
وسألناه اذا كان هناك تبدل في سياسة اميركا تجاه قضية
فلسطين / وبينا ان خطة الرئيس روزفلت والمستر هل
كانت ترك حل قضية فلسطين الى ما بعد الحرب /
بين موافقته على هذه الخطة واصفة لتهجم المستر سيلر
على البلاد العربية / وقال انه قابل المستر هل بنفس
اليوم وكانا متفقين على ترك حل القضية الى ما بعد الحرب
مع هذا نري مواصلة الجهود من جانبكم كما اقترحنا
ببرقيتينا المرقمتين ٨ و ١٠ / وارسال برقيات الى شخ
الرئيس روزفلت والى حكومة الاميركية من قبل

~~SECRET~~

شخصيات بارزة في البلاد العربية ومن قبل المجالس
التشريعية احتجاجاً على اعمال الصهيونيين

4. Translation:

Reference our telegrams No. 8 and No. 10:
On the 9th. instant the Egyptian minister and I called on the United States Undersecretary of State. We explained to him the dangers attached to the passing of the resolution presented to the House of Representatives and the Senate as regards Arab public opinion, and we asked him whether this meant a change in American policy on the Palestine question. We explained that the plan of President Roosevelt and Mr. Hull had been to leave the solution of the Palestine question until after the war. He expressed his agreement with this plan and his regrets at the attack of Mr. Celler on the Arab countries. He said that he had called on Mr. Hull on that very day, and that they had agreed on leaving the solution of the problem until after the war. In spite of this, we think it advisable to pursue the efforts to be made on your part, as we suggested in our telegrams No.. 8 and No. 10, in person; and to despatch telegrams to President Roosevelt and the American Government from prominent personalities in the Arab countries and from legislative assemblies, protesting against the activities of the Zionists.

ARABIC CODE AND CIPHER PROCESSING

Doc ID: 6554247

RESTRICTED

A TYPICAL PROBLEM ROUTED TO THE

SPECIAL EXAMINATION UNIT

A COMBINATION CIPHER AND PLAIN TEXT COMMUNICATION ADDRESSED TO "DEPARTMENT OF MILITARY INTELLIGENCE, WASHINGTON, D. C. " FROM SOMERVILLE, MASSACHUSETTS. SOLUTION READS:

"THERE COMES A TIME IN THE LIFE OF EVERY INTELLIGENT MAN WHEN HE REALIZES HOW DUMB HE IS."

RESTRICTED

SOMERVILLE, MASS.
NOV 22
11—PM
1943

BUY
WAR SAV
BONDS AND S

25

Dept of Military Intelligence
Washington D.C.

new code

4875

The funny qualities of this code
make it extremly difficult
To decipher without the key
with the accompanying translation
Can you reconstruct the key?
or read the following message?

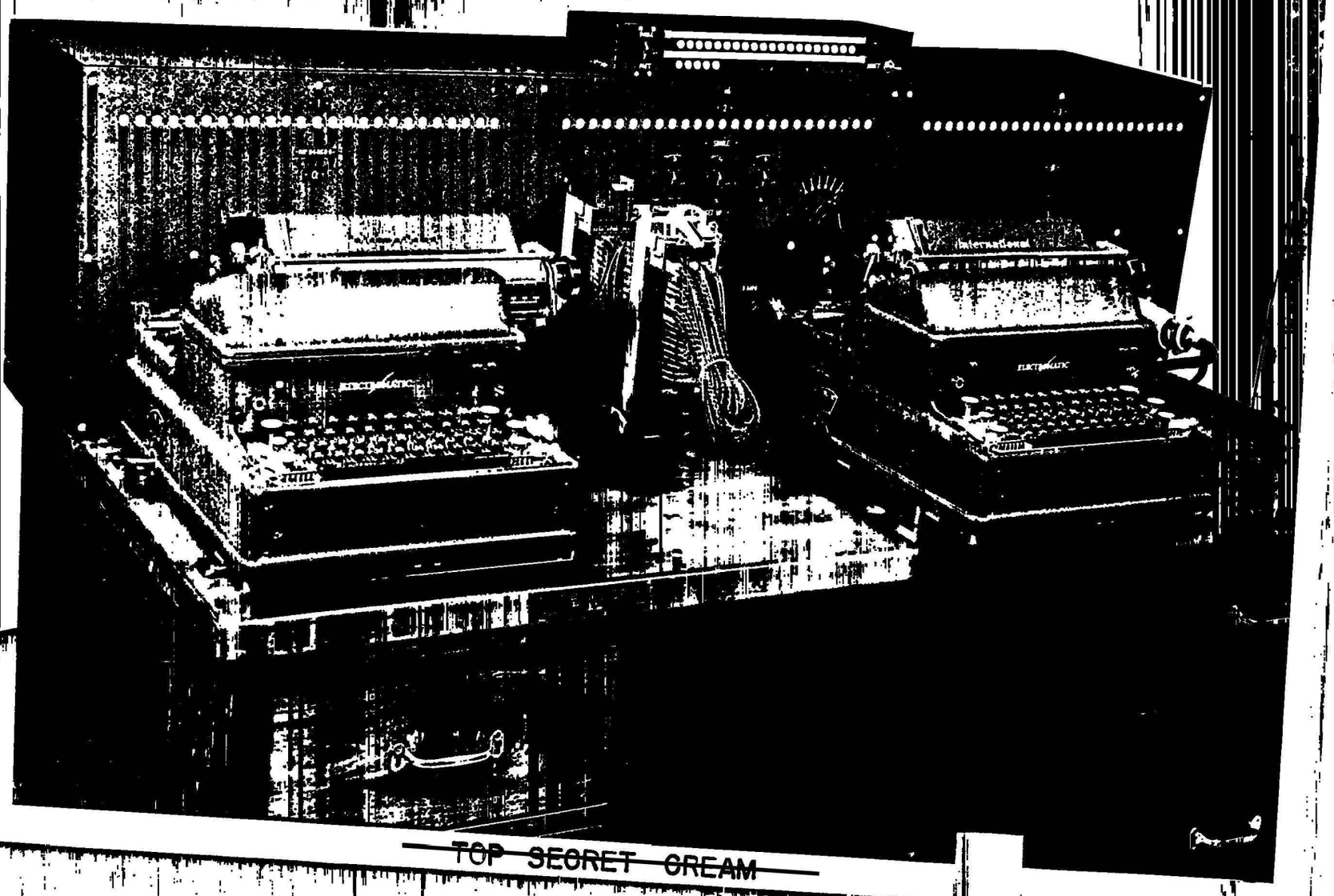
Doc ID: 6554247

TOP SECRET CREAM

ANALOGUE OF THE PURPLE MACHINE

Although the cryptanalysts had never seen the Japanese cipher machine used for secret diplomatic messages, they were able to duplicate the operation of the Japanese machine in the analogue pictured here. The design and construction of the analogue was based on the cryptographic principles established by the cryptanalysts in their solution of the system and carried out by the engineering staff.

TOP SECRET CREAM


International
ELECTROMATIC

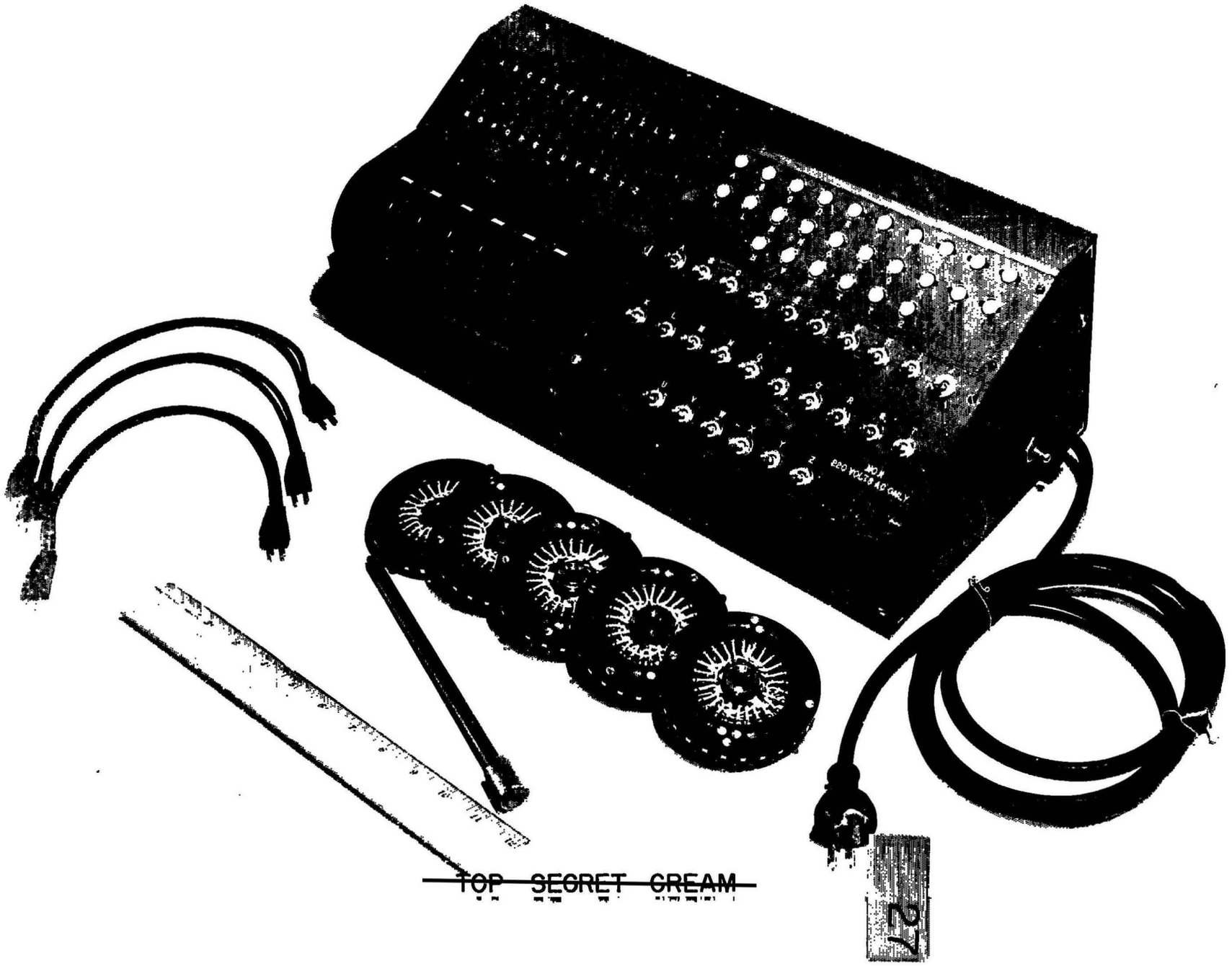
Doc ID: 6554247

TOP SECRET CREAM

ENIGMA REPLICA

This useful gadget for testing further by hand the several likely settings after other methods had eliminated most settings was often called the "Handtester."

TOP SECRET CREAM



Doc ID: 6554247

TOP SECRET CREAM

THE "003"

The Cryptanalytic machine, called for convenience and security the "003" (from the project number X68003), was designed to test rapidly the many assumptions required in the solution activities of messages enciphered by a cipher machine of the Enigma type. The innovation of a relay switching system, a departure from the rotary type of construction usually found in this kind of equipment, provided greater flexibility in the use of the equipment.

TOP SECRET CREAM

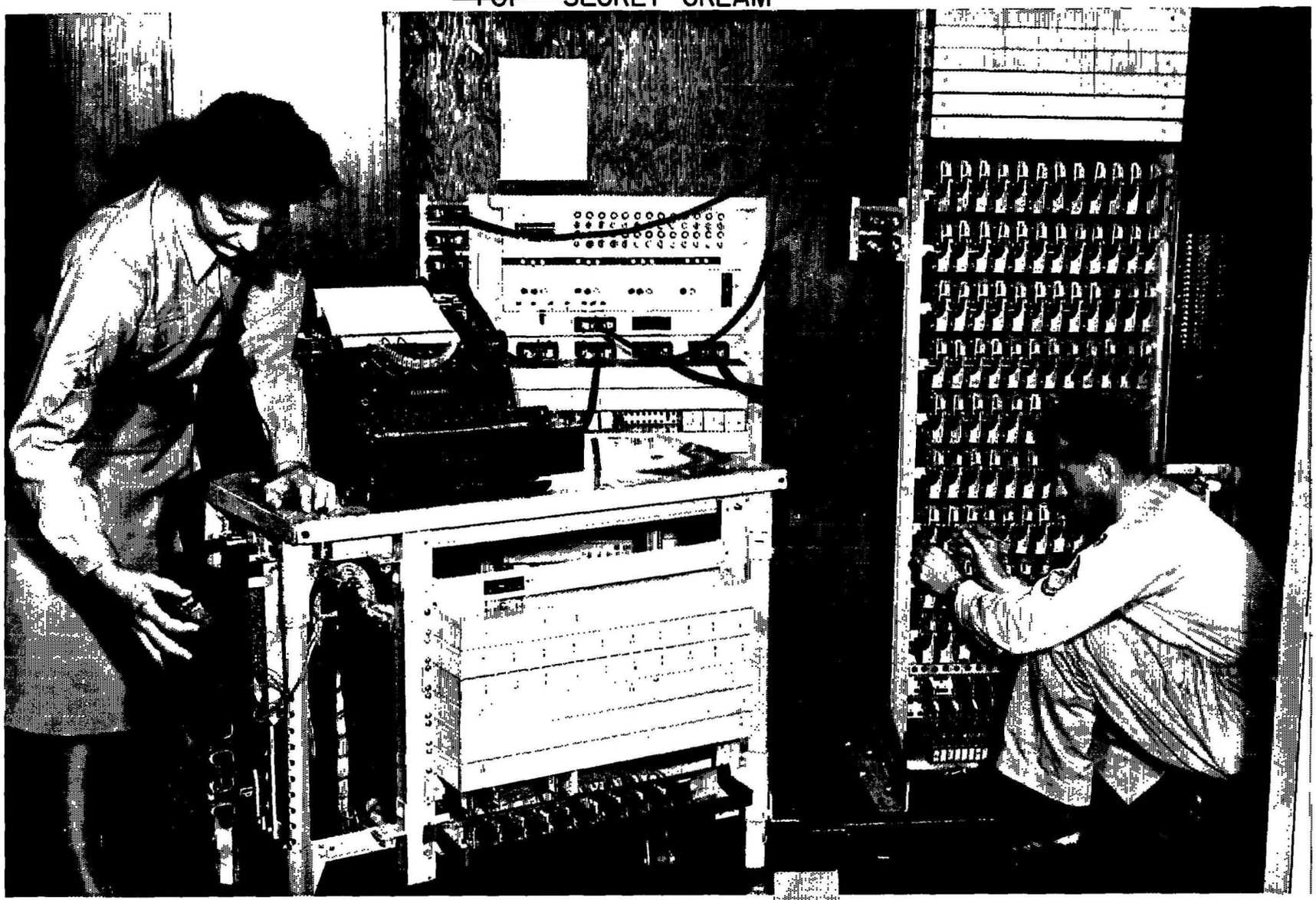
Doc ID: 6554247

TOP SECRET CREAM

THE "ARLINGTON DUDBUSTER"

Designed to speed the solution of a special class of messages with faulty indicators, termed "dud messages" and in conjunction with the 003, the "Dudbuster" piled up a notable record of solutions.

TOP SECRET CREAM



Doc ID: 6554247

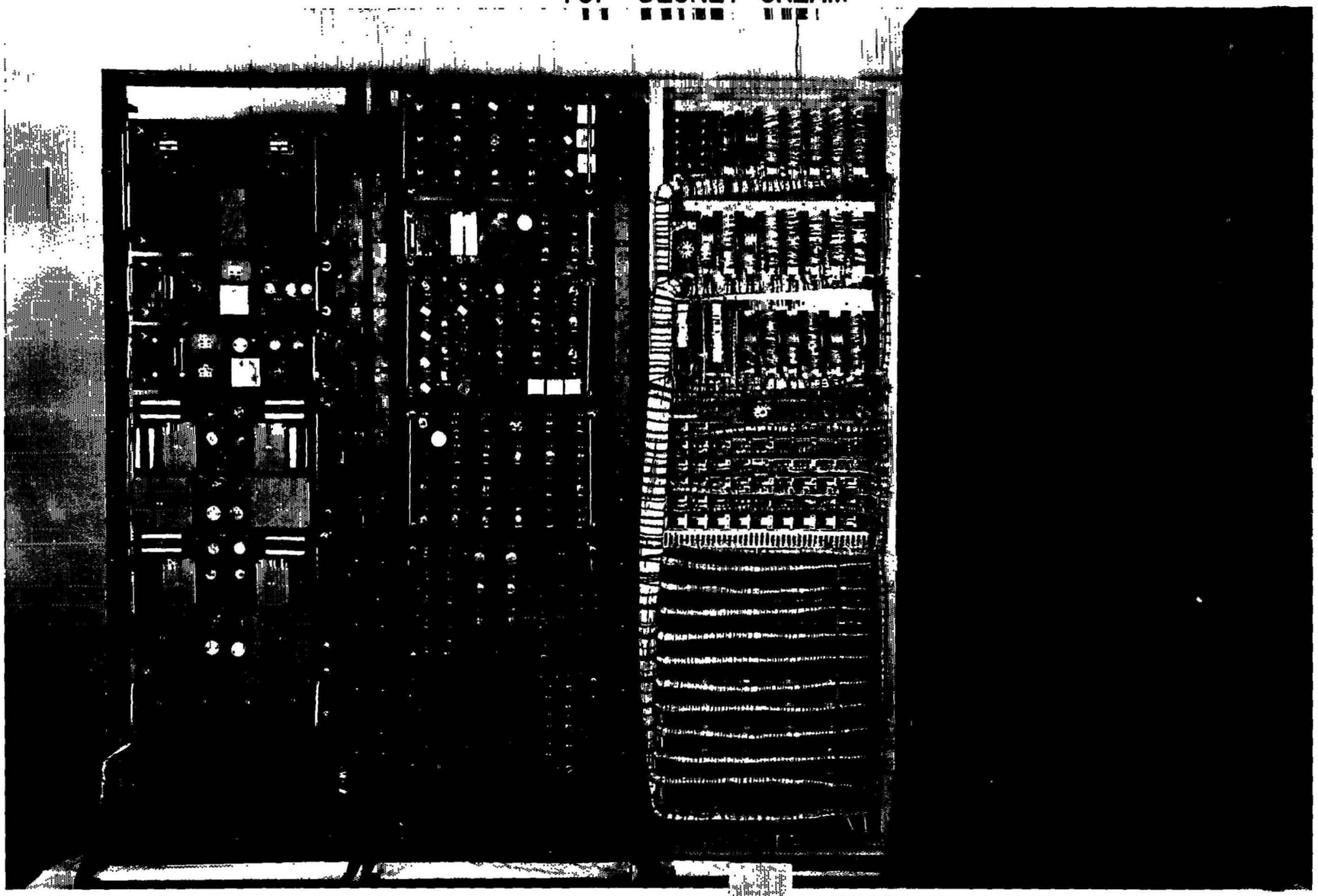
TOP SECRET CREAM

THE "AUTO[illegible]"

VIEWED FROM THE REAR

In order to perform the millions of tests necessary for solution, diverse elements (relays, electronic tubes, selectors, rotors, plugs, and jacks) were combined in an intricate wiring system.

TOP SECRET CREAM



Doc ID: 6554247

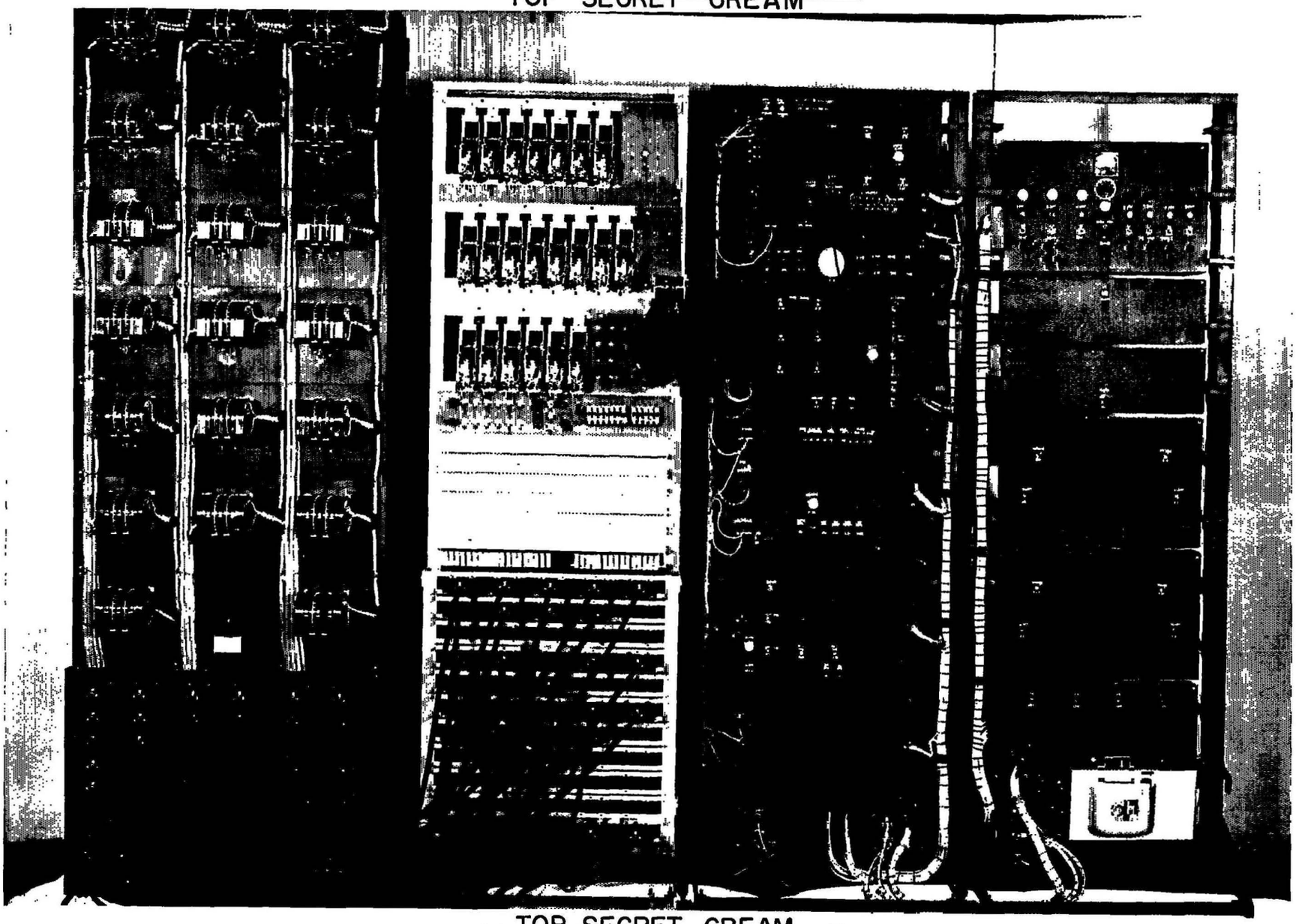
TOP SECRET CREAM

THE "AUTOSCRITCHER"

VIEWED FROM THE FRONT

When changes in systems required new techniques for solution, new machinery was needed to perform tirelessly the new and lengthy processes. The "autoscritcher" was designed to take care of the superhuman task of solution involving pluggable reflectors.

TOP SECRET CREAM



Doc ID: 6554247

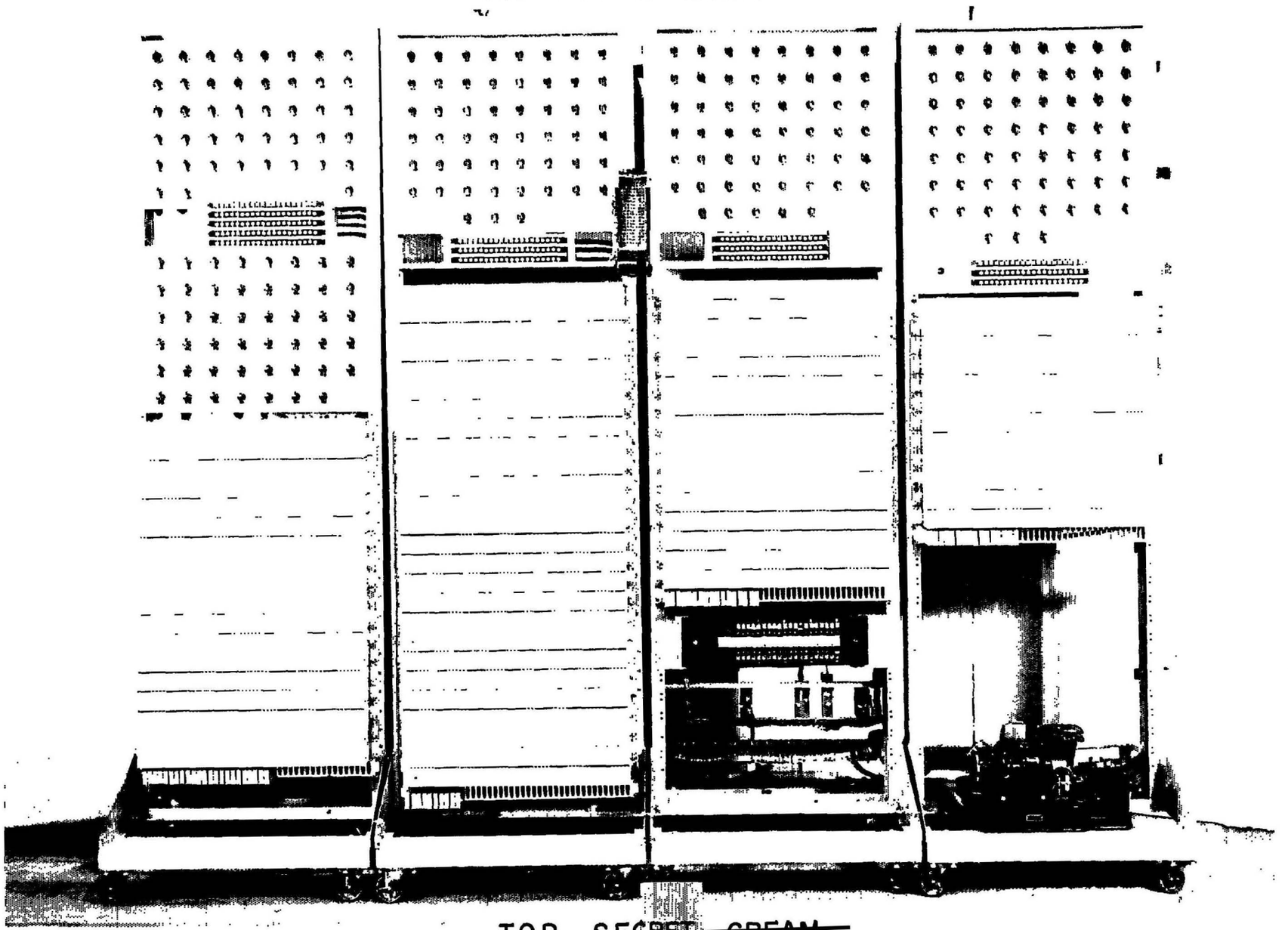
TOP SECRET CREAM

THE DRAGON

Solution of teletypewriter cipher systems was aided by the specially designed RAM equipment, the Dragon, which "dragged" cribs through messages.

TOP SECRET CREAM

TOP SECRET CREAM



TOP SECRET CREAM

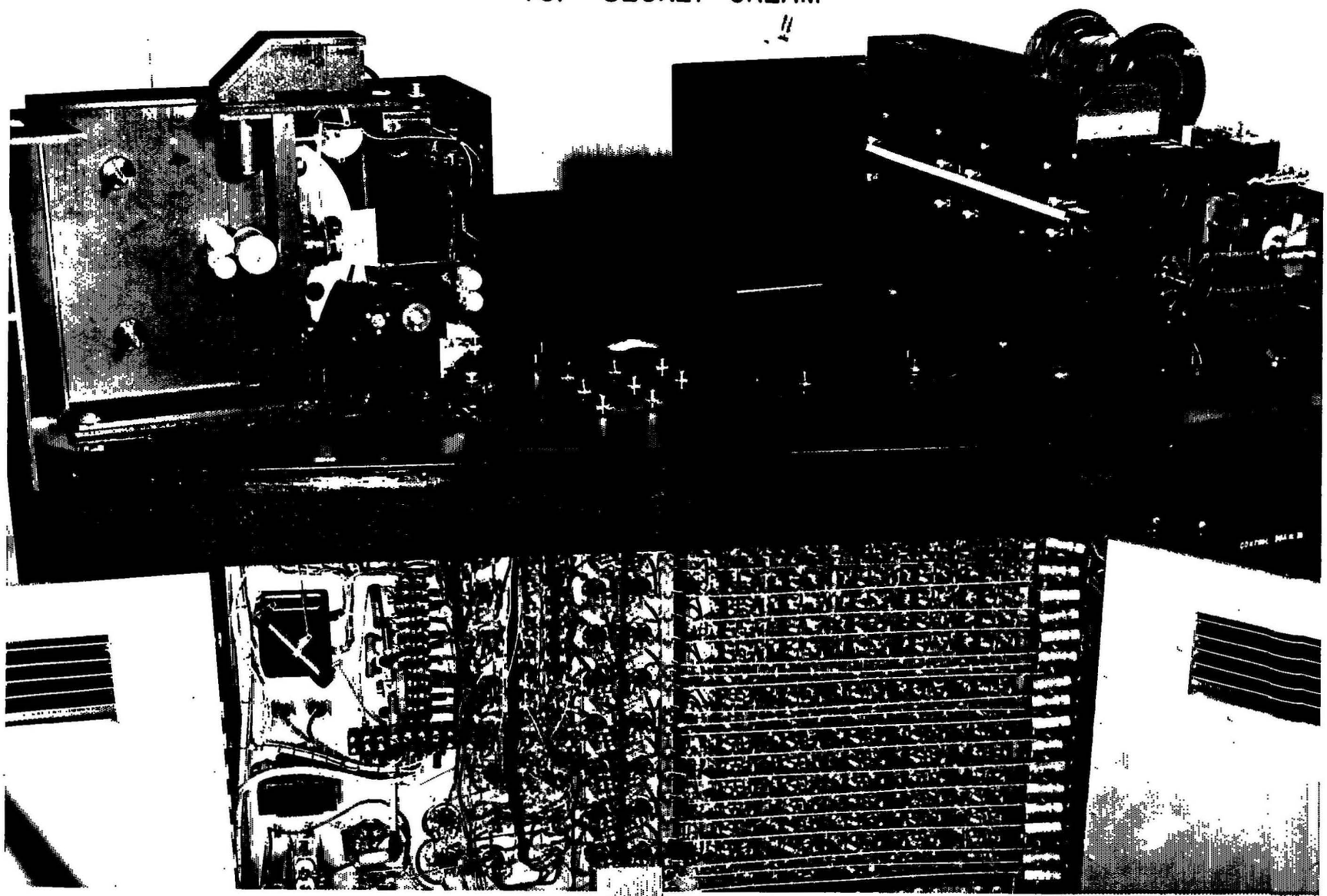
Doc ID: 6554247

TOP SECRET CREAM

THE 5202 CAMERA, TARGET, AND GENERATOR

The high-speed camera of the RAM equipment, the 5202, photographed the sequences of impulses produced by the generator. The speed, the accuracy, the number of characters it records, and the smallness of the space which this record occupies on the film are noteworthy characteristics of the 5202.

TOP SECRET CREAM



Doc ID: 6554247

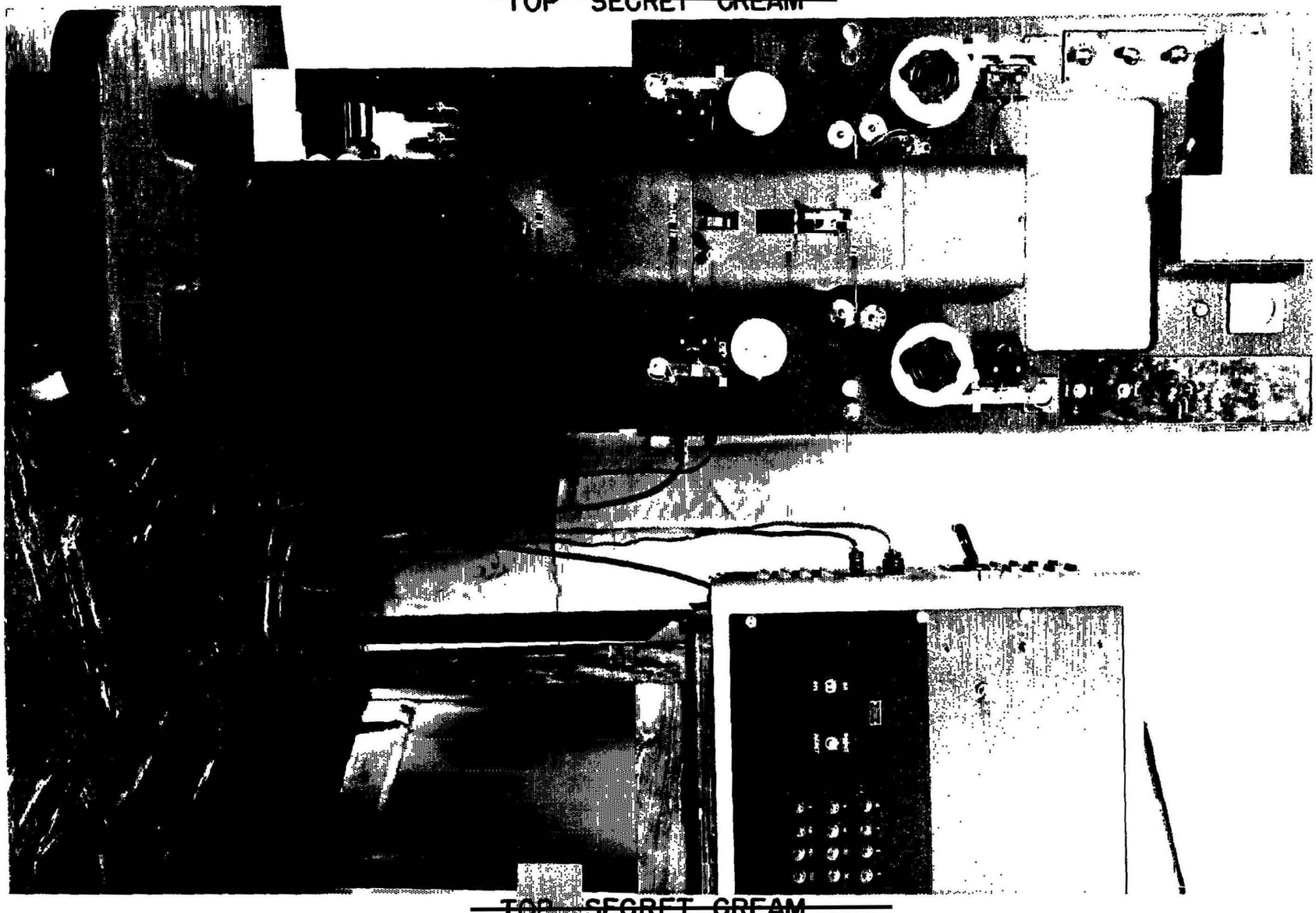
TOP SECRET CREAM

THE 5202 COMPARATOR AND COUNTER

The Comparator measures the coincidence between the texts recorded on film, identifies the juxtaposition where given degrees of coincidence occur, and displays the nature of the coincidence. The Counter, an electronic device, counts the number of coincidences.

TOP SECRET CREAM

Doc ID: 6554247



Doc ID: 6554247

AHA
119