

ARLINGTON HALL STATION

Date _____

TO

FROM

Commanding Officer
 Asst. Commandant
 Dir. of Com. Research
 Executive Officer
 Asst. Executive Officer
 Adjutant
 Asst. Adjutant
 Coordination Section
 Chief, Headquarters Branch
 Chief, A Branch
 Chief, B Branch
 Chief, C Branch
 Chief, D Branch
 Chief, E Branch
 Chief, F Branch
 Dir. of Training
 C. O. of Troops
 Property Officer
 Personnel Officer
 Provost Marshal
 Classified Mail Room
 Secretary to C. O.
 General Files
 201 Files

Comments and Return
 Recommendations
 Information
 Information and Return
 Inf. and Forwarding
 Your Information and File
 Signature, if approved
 See Note on Back
 As Requested
 As Discussed
 Your Action

Ito, Redick & Dress will
 probably be interested
 in this. Maybe they can
 give some helpful
 comments.

J.

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Chief, Army Communications Service 4D216 Pentagon

Processing of messages through War Department Code Center

SPSIS-3

Col. Corderman

1 September 1943

Signal Security Branch

30340

8129

1. During the past several years, on the theory that existing cryptographic apparatus is too slow, various agencies have been urging the Signal Security Agency to modify existing or to develop new apparatus which might speed up the cryptographic processing of messages at large signal centers. Developments such as the 131 set for enciphering teletype transmissions, Converter M-228, and the so-called "Autocaba" are examples of what has been done in an attempt to meet desires along these lines. The results thus far obtained have been only partially satisfactory.

2. At a recent conference between War Department Signal Center and NSA personnel it was suggested that there was reason to believe (1) that the cryptographic operations might really play only a relatively minor part in the time taken to process messages through this and other signal centers; (2) that there might be several relatively long delays intervening between successive operations; and (3) that steps should be taken to reduce or eliminate all unnecessary delays before further efforts are made to speed up the cryptographic operations.

3. It was then agreed that a time study be made of the processing of messages through the War Department Code Center with a view to ascertaining the length of time required for each of the operations involved therein, so as to have some logical basis for future steps to be taken to improve the overall efficiency.

4. With the wholehearted cooperation of personnel in the War Department Code Center a preliminary study was made. For a number of days, accurate and detailed account was kept of the time required to process the messages handled by the fastest means now available, viz.: Converter M-1340 (Sigaba) and Converter M-228. Job tickets were prepared on mimeographed forms (see Exhibits A, B, and C) and a ticket was attached to each message upon its arrival in the code section. After each operation

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Processing of messages through War Department Code Center

was performed the clerk filled in the hour and minute of completion in the column marked "TIME (EWT)" and forwarded the message, with its job ticket, for the next operation. The number of messages studied in this way comprised the following:

1800 Converter M-134C (Sigaba) incoming messages.
 1000 Converter M-134C (Sigaba) outgoing messages.
 200 Room-circuit operated Converter M-228 incoming messages.

No attempt was made to isolate the messages into the various categories of priority, urgent, ordinary, and deferred.

5. These job tickets were then turned over to SSA for statistical analysis. The time intervals for the successive processes were tabulated and statistical modes and means ascertained. The results of these preliminary studies have been reduced to graphic form and are contained in Exhibits D-K.

6. Exhibit D depicts graphically the time now required for the various operations involved in processing incoming Sigaba messages. It is based upon modes, that is, it shows what was most typical or most often happened in the 1800 messages studied. It shows that most often it took 50 minutes to process an incoming Sigaba message; most often the actual deciphering operation, however, took only 7 minutes and accounted for only 14% of the time required; most often the necessary correlated operations (such as registering the message on its receipt in the code section, pasting up the printed slip as it comes out of the Sigaba, typing the message on the regular message form, editing and proofreading it) took a total of 11 minutes and accounted for 22% of the time; and most often all the rest of the time (32 minutes), amounting to 64% of the total time required to process the message, was spent in baskets, waiting for the next operation.

7. Exhibit E depicts graphically the time required for the various operations involved in processing the outgoing Sigaba messages studied. It is also based upon modes calculated

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from a study of 1000 outgoing messages. It shows that most often it took an hour and 16 minutes to process an outgoing Sigaba message; most often the actual enciphering operation, however, took only 5 minutes and accounted for only 6.6% of the time required; most often the necessary correlated operations (similar to those mentioned above) took only 7 minutes and accounted for only 9.2% of the time required; and most often all the rest of the time (64 minutes), amounting to 84.2% of the total time required to process the message, was spent in baskets, waiting for the next operation.

6. In some quarters it has been thought that by providing a more nearly automatic means for cryptographic intercommunication, such as the Converter M-228, certain operations could be eliminated, with a consequent increase in speed. Exhibit F depicts graphically the time required for the various operations involved in processing a typical incoming message on the room-circuit operated Converter M-228. In this system, designated as "228-Q", the incoming message is received in the form of a perforated tape which is then passed through a transmitter-distributor to operate Converter M-228, the latter then producing on the teletype printer the deciphered message. Exhibit F is also based upon notes calculated from a study of 200 such messages. It shows that most often it took an hour and 40 minutes to process a typical incoming 228-Q message; most often the actual deciphering operation, however, required only 4 minutes and accounted for only 4% of the time required; most often the necessary correlated operations took only 9 1/2 minutes and accounted for 9.4% of the time required; and most often all the rest of the time (86 3/4 minutes), amounting to 86.6% of the total time required to process the message, was spent in baskets, waiting for the next operation.

5. Exhibits G, H, and I are similar to Exhibits D, E, and F, except that they are based upon means and not modes. That is, the former set depict what happened in most cases; the latter set what happened in the cases taken as a whole. The mode is considered a better statistic for this study than the

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mean because a few messages have very long delay-intervals intervening between consecutive operations and therefore the mean has a value which is not typical of its group. However, a side-by-side comparison of modes and means may be useful:

	Sigaba				228-Q	
	Incoming		Outgoing		Incoming	
	Mode	Mean	Mode	Mean	Mode	Mean
Basic cryptographic operations.....	14%	6.2%	6.6%	2.3%	4.0%	5.1%
Essential correlated operations.....	22%	11.4%	9.2%	7.4%	9.4%	10.7%
Waiting for next operation.....	64%	82.4%	84.2%	90.3%	86.6%	84.2%
	100%	100.0%	100.0%	100.0%	100.0%	100.0%

While the mean in the case of Sigaba itself, as a cryptographic instrument, is more favorable than the mode, as regards basic cryptographic operations and essential correlated operations, in the case of 228-Q the mode is less favorable than the mean. However, the most striking feature of the foregoing tabulation is that the delay time (merely waiting for the next operation to take place) seems to be by far the most important element in the present situation.

10. Exhibit J depicts the situation as regards the foregoing delays, or "waiting-in-basket times", in sequential order. The graphs are based on the modes. The horizontal line at the bottom of the graph represents the instant the message arrived in the Code Center; the horizontal line at the top represents the instant the message left the Code Center to go to the Classified Message Center or to the Signal Center. On arrival at the Code Center an outgoing Sigaba message is registered and this is represented by the cross-hatching at the base of the first column. This most often took 4% of the time. Then there is a delay, most often amounting to 9.2%, waiting after registration to go to the decoding section. On arrival at the code section, most

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often it waited 32.9% of the total processing time to be picked up by the code clerk who was to encipher the message. Most often the actual encipherment took only 6.6% of the total time. Then followed the essential subsidiary operations, with slight intervening delays. Finally, there was a long delay, most often 39.5% of the total processing time, while the completed message was waiting to be picked up to go to the Signal Center. The other two columns in this same diagram are similar to the first column and are self-explanatory. It is to be noted how relatively small a portion of the total time was required for actual cryptographic and necessary subsidiary operations, and how relatively large a portion of the total time was "waiting-in-baskets" time.

11. Exhibit J also gives indications that there is probably a fallacy in thinking that the use of more nearly entirely automatic apparatus, such as Converter M-228, will speed up communications to a significant or important degree. Emphasis in this regard is to be made in connection with any thought that by developing "Autoaba" machines the overall speed in communication will be materially improved.

12. A separate tabulation was made of reports on 1630 outgoing Sigaba messages, merely to find the average time required to encipher them. The results obtained indicate that the average time is only 5 minutes. Yet the present study appears to indicate that generally it takes over an hour to get an outgoing Sigaba message through the War Department Code Center.

13. Exhibit K is also interesting. For this chart the data were broken down into groups of 5% and shows how many minutes it took to perform basic cryptographic and necessary subsidiary operations, and how many minutes were occupied by each group in "waiting in baskets". It shows that in the case of incoming Sigaba messages only 5% of the messages got through editing, typing, and proofreading in 2½ minutes; deciphering and pasting in 3 minutes; and suffered only a delay ("waiting-in-baskets") of 6½ minutes; another 5% got through editing, typing, and

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proofreading in 4 minutes; deciphering and pasting in 5 minutes; and suffered only a delay ("waiting-in-baskets") of 14 $\frac{1}{2}$ minutes; and so on. There were, as shown by the right-hand side of the curves, some messages which (1) required an hour and 10 minutes for editing, typing, and proofreading; (2) required one hour and 25 minutes for deciphering and pasting; and (3) suffered a delay ("waiting-in-baskets") of more than 10 hours. No doubt some of these were deferred messages, which had to wait until priority messages had been processed and some had to wait until services were received to correct errors that could not be straightened out locally. It is hard to imagine that any of them were ordinary or priority messages which were delayed that long awaiting handling. However, in the vicinity of the middle of the curves, undoubtedly the "waiting-in-basket" time accounts for a very considerable amount of the delay in communication.

14. Obviously this study would have been more useful if it had taken into consideration the transmission classifications (precedence) of the messages involved. However, Exhibit K shows quite clearly that even in the case of the 5% of the messages that were processed the most expeditiously, 50% of this time was spent in the Code Center waiting for successive operations to be applied; and in the case of the messages that were processed the least expeditiously (no doubt deferred messages) no appreciable saving in time through the Code Center would be experienced even if the cryptographic time were reduced practically to zero.

15. These studies are merely presented as tentative and preliminary. They should not be taken as proof of anything but merely as possible indications of where difficulties may be involved and where improvement may be made. It is therefore suggested that the War Department Signal Center engage competent communications personnel to undertake detailed studies

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of this kind. It is obvious that if the delays which these tentative studies appear to disclose are real and apply to ordinary and priority traffic as well as to other types the causes of these delays should first be eliminated and then only after this step and only if the speed of cryptographic communication is still unsatisfactory should further attempts be made to develop more rapid cryptographic apparatus for use in large code centers.

W. Preston Corderman
Colonel, Signal Corps
Chief, Signal Security Branch

Attchd:
Exhibits A-K

A - Applies only to SIGFIP

B - Applies to SIGABA and TYPE X

SIGABA

SIGFIP

TYPE X

	TIME (EWT)	ELAPSED INTERVAL (MIN)
REC'D IN CODE CENTER	<u>0018</u>	XXXXXX
1 REC'D IN DECODING SECTION	<u>0030</u>	:12
2 CODE CLERK TAKES MSG.	<u>0216</u>	:40
3 A - END TAPE CUTTING		
4 END DECODING	<u>0215</u>	:05
5 B - FINISH PASTING	<u>0218</u>	:03
6 START EDITING	<u>0226</u>	:02
7 END EDITING	<u>0222</u>	:02
8 START TYPING	<u>0331</u>	:09 *
9 END TYPING	<u>0335</u>	:04
10 START PROOFREADING	<u>0355</u>	:20 *
11 FINISH PROOFREADING	<u>0359</u>	:04
12 TO C M C	3 hr. 4 min. <u>24</u>	

Handwritten notes: 4 3, 2 1, 2

SIGABA

SIGFIP

TYPE X

	TIME (EWT) WAR DEPT.	INTERVAL IN MIN.
REC'D IN CODE CENTER	162230	0.2 XXXXXX
REC'D IN CODING SECTION	170139	3 00
END CODING	170300	1 30
A-- END PASTING	170320	20
START PROOFREADING BY CODE CLERK		
B - END CHECK BACK OF ENC. TAPE	170321	1
END PROOFREADING BY CODE CLERK	170322	1
B - END STAPLING COPIES TO WORKSHEET		
START PROOFREADING	170328	6
END PROOFREADING	170330	2
TO SIG CENTER		19

0349
2230/19
5

5 total 9 min

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RECEIVED MSG.

GR.

74

Q 640

Q

A- Applies only to 131

 131 (A)266-4 228

	TIME (EWT)	INTERVAL (MIN)
RECEIVED IN CODE CENTER	<u>0652</u>	XXXXX
(A) RECEIVED IN DECODING SECTION	<u>0652</u>	<u> </u>
(A) CODE CLERK TAKES MSG.	<u>0920</u>	<u>2:28</u>
CODE CLERK FINISHES DECODING	<u>0923</u>	<u>:03</u>
END STAPLING COPIES TO WORKSHEET	<u>0923</u>	<u> </u>
START EDITING	<u>0938</u>	<u>:15</u>
END EDITING	<u>0943</u>	<u>:05</u>
START TYPING	<u>1000</u>	<u>:17</u>
END TYPING	<u>1004</u>	<u>:04</u>
START PROOF READING	<u>1014</u>	<u>:10</u>
END PROOF READING	<u>1015</u>	<u>:01</u>
TO C M C	<u>1027</u>	<u>:12</u>

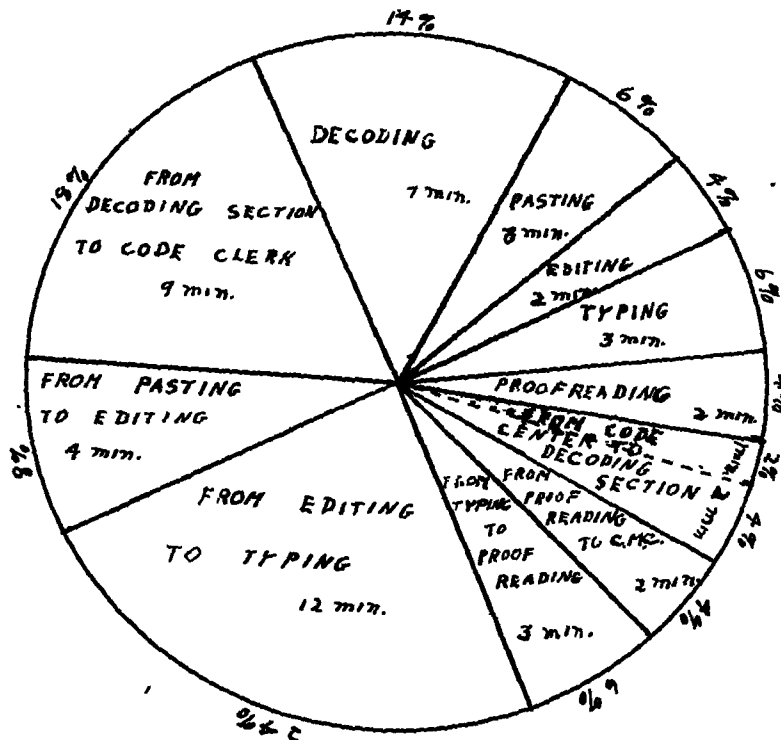
(EXPLAIN LONG INTERVAL ON REVERSE)

3 hr. 35 min

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PROCESS TIME OF A TYPICAL RECEIVED SIGABA MESSAGE



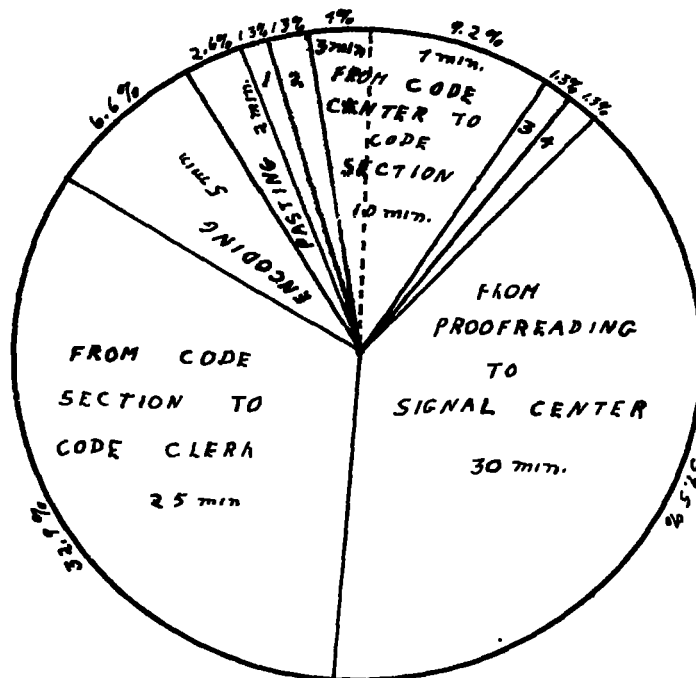
Based on approximate modes derived from
A study of 1800 messages

SUMMARY

Basic cryptographic operations.....	14%
Essential correlated operations.....	22%
Waiting for next operation.....	64%
	<u>100%</u>

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PROCESS TIME ON A SIGABA MESSAGE SENT



From a study of 1000 messages Based
On the mode

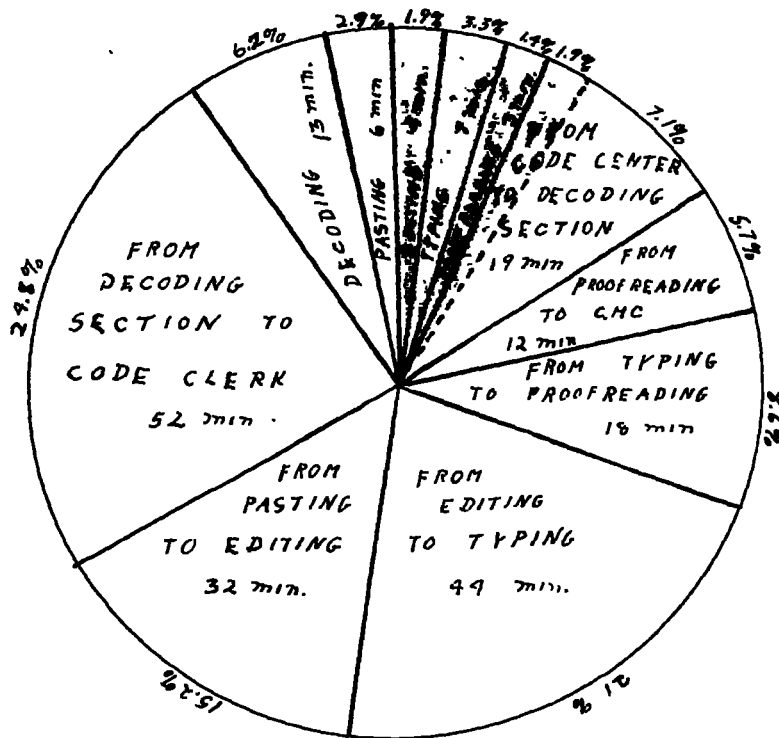
- | | |
|---|--------|
| 1. Proofreading by code clerk | 1 min. |
| 2. Proofreading | 1 min. |
| 3. From pasting to proof reading
by code clerk | 1 min. |
| 4. From code section to proof-
reader | 1 min. |

SUMMARY

Basic cryptographic operations.....	6.6%
Essential correlated operations.....	9.2%
Waiting for next operation.....	84.2%
	<u>100.0%</u>

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PROCESS TIME OF A TYPICAL RECEIVED SIGABA MESSAGE



From a study of 1800 messages
Based upon the means

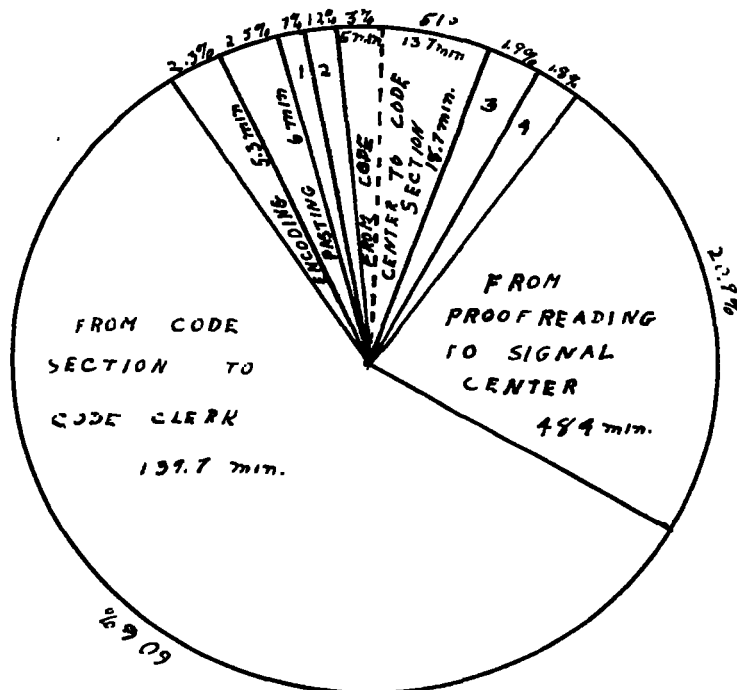
SUMMARY

Basic cryptographic operations.....	6.2%
Essential correlated operations.....	11.4%
Waiting for next operation.....	82.4%
	<u>100.0%</u>

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PROCESS TIME ON A SIGABA MESSAGE SENT



From a study of 1000 messages
Based on the mean

- | | |
|---|----------|
| 1. Proofreading by code clerk | 1.6 min. |
| 2. Proofreading | 2.8 min. |
| 3. From pasting to proofreading by code clerk | 4.6 min. |
| 4. From code section to proof-reader | 4.3 min. |

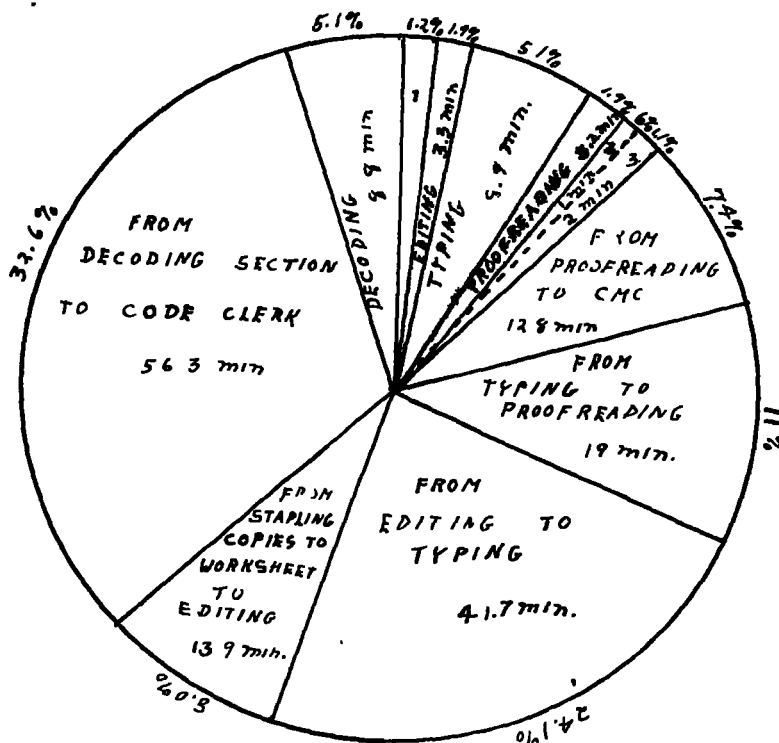
SUMMARY

Basic cryptographic operations.....	2.3%
Essential correlated operations.....	7.4%
Waiting for next operation.....	90.3%
	100.0%

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PROCESS TIME ON A TYPICAL RECEIVED 228-Q MESSAGE



From a study of 200 messages
Based on the means

- | | |
|-------------------------------------|--------|
| 1. Stapling copies to worksheet | 2 min. |
| 2 & 3. From code center to decoding | 3 min. |

SUMMARY

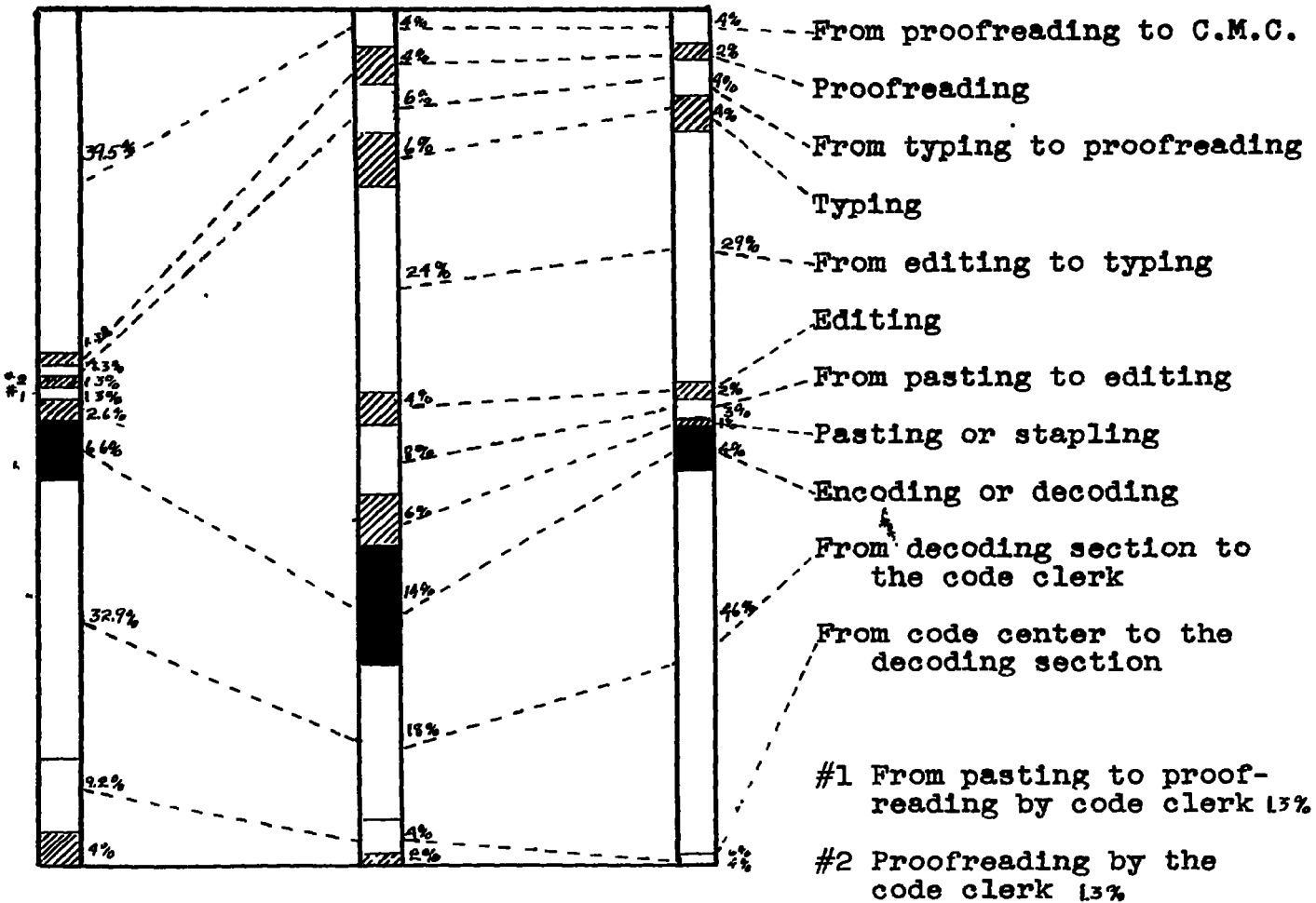
Basic cryptographic operations.....	5.1%
Essential correlated operations.....	10.7%
Waiting for next operation.....	84.2%
	<u>100.0%</u>

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SIGABA
SENT

SIGABA
RECEIVED

228-Q
RECEIVED



SUMMARY

OPERATIONS	MEANS		
	SIGABA		228Q
	SENT	RECEIVED	RECEIVED
Basic cryptographic operations.....	6.6%	14.0%	9.4%
Essential correlated operations....	9.2%	22.0%	4.0%
Waiting for next operation.....	84.2%	64.0%	86.6%
	100.0%	100.0%	100.0%

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