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Memorandum M-1641

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Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

SUBJECT: GROUP 61 BI-WEEKLY REPORT, September 12, 1952

CLASSIFICATION CHANGED TO:
Auth: <i>DD 254</i>
By: <i>R. R. Everett</i>
Date: <i>2-1-60</i>

1.0 GENERAL

(C.R. Wieser)

A first draft of the Group 61 section of the Lincoln Summary Report has been completed.

On September 10 a talk and computer demonstration were given for the Air Force Scientific Advisory Board. Results of the demonstration were poor compared with what we have done in the past. We appear to have suffered from bad weather, marginal radar data, one computer error, and one human operator error. The marginal data may have been a result of the weather, which forced the aircraft to operate a higher than usual altitude above the radar beam. For further comments see Sections 2 and 3.

Work is now underway to assist in arriving at design specifications for Whirlwind II. This effort at present consists of programming studies to determine the saving in time and storage which would result from special features in WWII, such as an automatic correlation order, B-box, etc. Israel, Arnow, and Walquist will devote some of their time to getting the work started. Clark, Grandy, Hayase, Levenson, and Rawling will devote their efforts to the WWII planning studies. A group under the supervision of R.R. Everett is working to evaluate the cost in equipment of special features in WWII. The work of both groups should provide the information needed to decide -- and decide soon -- what special features should be designed into WWII.

2.0 EQUIPMENT ENGINEERING

(E.S. Rich)

Steve Dodd and I analyzed the numbers of each type of plug-in unit required for all of the WWI construction that is contemplated in the next year and broke these numbers down according to the dates when they should be available. These figures were used in determining the delivery schedule for plug-in unit construction. A discussion of the purchase order which has been placed with Raytheon for this construction is described in M-1627 from Chan Watt.

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2.0 EQUIPMENT ENGINEERING (CONTINUED)

(E.S. Rich) (Continued)

Negotiations for construction of a 14-channel magnetic tape recorder by Ampex Electric Corporation have been reopened. General requirements for this equipment have been discussed by Kirshner and me with Mr. Keene of the Radio Shack, who is going to visit Ampex next week and take up the subject with their engineers. It is expected that specifications for the unit will be worked out jointly with Ampex engineers and us.

(S.E. Desjardins & A.V. Shortell, Jr.)

Planning for the new Teletalk intercommunication system to be installed in the Barta Building has begun. Preliminary sketches for the voice and annunciator circuits have been prepared and a circuit diagram for the master stations has been drawn.

Installation of central junction boxes for voice and annunciator circuits will provide for ease of maintenance and flexible circuit interconnections.

Delivery of the Teletalk units is expected by the end of September. Additional material required for the junction boxes and for plug-in connections in Rooms 041, 156, and 263 is being estimated and will be ordered next week.

(H.J. Kirshner)

The demonstration given on September 10 was unsatisfactory primarily because of the inability of the MEW or DRR to provide sufficient target data. This lack of data was probably due to weather conditions which necessitated operating our aircraft at altitudes higher than normal and which also provided an abundance of cloud and rain clutter returns.

The most obvious defect, which actually caused trouble during only the last run, was the abnormal display observed at that time. This defect which first appeared intermittently early in the afternoon of the demonstration was traced by the Systems Group to a loose cable in the computer on the following day.

There was no malfunction of the DRR equipment at this end of the line which influenced the results of the flight tests. An intermittent developed in an amplifier of the DRR equipment about 1/2 hour prior to the scheduled starting time of the demonstration, but it was possible to keep the equipment operating during all the runs made.

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2.0 EQUIPMENT ENGINEERING (CONTINUED)

(B.E. Morriss)

A short note has been written on the changes to the magnetic tape units which will affect programming; this note is now being typed.

Up-to-date drawings of the Buffer Drum including additions necessary for operating slow inputs and outputs are being prepared. Several changes in the in-out block diagrams are necessary because of changes during installation.

Some time was spent working with Guy Young on various methods of installing indicator light registers and toggle switch inputs as a part of the In-Out System. No plans have yet been made actually to incorporate such units.

The typewriter in Room 222 which will respond to si 216 (octal) should be installed around the 19th of September.

(F. Sandy)

All power supply control panels for the Room 156 system are being built in the shop. These should be completed by October 10.

Next week, the two holes from the computer and test control rooms to Room 156 for the wireways for the power and power supply control wiring will be cut. The measuring, cutting, and marking of inter-panel wires will proceed starting next week.

Arlex will start installing the MITE equipment racks and wireways September 17 or 18. They have promised completion of the installation by October 10.

A meeting was held with Joe Gano, George Thomas, Chan Watt, and Ferrell Sandy participating, to arrange a time schedule for the work that must be done. Wiring between panels, contractors, and alternators will proceed immediately and should be completed by October 10. From October 10 to October 20 connections to the new panels will be made. A full day will probably be required for the switch-over of the alternators which should take place about October 21.

The tie-in between the WWI system and the Room 156 system should take place about October 28. The crucial point seems to be the delivery of the new alternator. If it does not come in on time, the rest of the schedule will be correspondingly late.

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2.0 EQUIPMENT ENGINEERING (CONTINUED)

(G.A. Young)

The last bi-weekly period was spent investigating possible methods of manual inputs to the computer and indicator light outputs from the computer. Time was also spent checking over A Proposal for Using the Buffer Drum with Slow Readers and Recorders by Ben Morriss.

3.0 BEDFORD EXPERIMENTS

(D.R. Israel)

A large amount of time during this period was devoted to preparations for the visits of the Scientific Advisory Board on Wednesday, September 10. Whereas it had originally been planned to spend the available computer time before the visit for preparations as well as for checking out revisions of old programs scheduled to be used in flight tests during September, delays both in obtaining useful computer time in checking out the demonstration programs have left us some ten days to two weeks behind where we had hoped to be at this date. The flight test schedule of M-1609 will be delayed for two weeks on this account.

The three demonstrations for the Scientific Advisory Board did not pass without difficulty. The first two demonstrations were not particularly successful, the difficulties seeming chiefly to be sub-normal radar data and an attempt by us to run an interception in an area in which aircraft or storm cloud echoes were rather dense. For the third demonstration an Ampex Tape recording was used, but even this show was marred by an error which initially caused the wrong recording to be used. The only bright notes in an otherwise unhappy day were several successful intercepts which were executed between demonstrations and the general convenience of conducting the tests from the new operations center in Room 222.

In addition to several successful intercepts completed in preparation for the demonstrations, a three-dimensional intercept was attempted and successfully completed (see remarks by A. Hill). Provisions for displaying incoming height information need to be formulated more carefully, but a reasonably satisfactory display was achieved through use of the Vu-Graph.

A good deal of effort during this bi-weekly period was devoted to reviewing and bringing up-to-date my year-old notes on the B-box. This work was done in conjunction with other studies relative to WWII and a future air defense system associated with it.

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3.0 BEDFORD EXPERIMENTS (CONTINUED)

(A.P. Hill)

From August 29 through September 12, a total of 39 aircraft hours were scheduled with a total of 24 aircraft hours actually flown. Reasons for change in schedule are outlined below:

DATE	SCHEDULED TEST	ACTUAL TEST HELD	REASONS FOR CHANGE IN SCHEDULE
Sept. 2	1400-1800 (Brand & Webster) Grounder Observer Test	one hour late	aircraft mechanical trouble
Sept. 4	1000-1200 (Gaudette) Intercepts Two Aircraft	cancelled	testing programs
Sept. 5	1000-1200 (Gaudette) Intercepts A.I. & H.F.	cancelled	testing programs
Sept. 8	1000-1100 (Cahill) Antiaircraft Guidance 1100-1200 (Gaudette) Intercepts (Maneuver) H.F.	cancelled test held from 1000-1200	testing programs
Sept. 9	1000-1200 (Gaudette) 2 A/C Intercepts, 1400-1600 (Gaudette) 2 A/C Intercepts, 1730-1930 (Brand & Webster) Ground Observer Test.	as scheduled as scheduled cancelled	no four engine a/c available
Sept. 10	1000-1200 (Brand) Final Phase Guidance 1400-1600 (Brand) Beacon Test	cancelled 1300-1700 2 Aircraft Intercepts	testing program for p.m. demonstration for demonstration
Sept. 11	1000-1100 (Gaudette) Intercepts A.I. 1100-1200 (Gaudette) Intercepts Jet, H.F.	cancelled cancelled	testing programs testing programs
Sept. 12	1000-1200 (Knapp) Two on one Intercepts	cancelled	testing programs
Note: Due to testing programs, the Flight Test Schedule outlined in Memorandum M-1609 will be moved up two weeks.			

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3.0 BEDFORD EXPERIMENTS (CONTINUED)

(A.P. Hill) (Continued)

Results of Flight Tests held:

- Sept. 2 1400-1800, Ground Observer Test
Using a B-17, the course flown was as follows: Bedford to Augusta, to Portland, to Newburyport, to Concord, N.H., to Portland, to Newburyport, to Fitchburg, to Nashua, to Laconia, to Portland, to Boston. For results of observer reports see report by M. Brand.
- Sept. 8 1000-1200, Two Aircraft Interception
Using an F-51 as the interceptor and a B-17 as the target, five runs were made.
Run #1 Interceptor passed one mile ahead of target.
Run #2 Interceptor passed one-quarter mile ahead of target.
Run #3 Interceptor passed one-quarter mile rear of target.
Run #4 Parity alarm, no interception.
Run #5 Interceptor passed 100 yds. rear of target.
- Sept. 9 1000-1200, Two Aircraft Interception
Two runs using an F-51 as the interceptor and a B-17 as the target were made.
Run #1 Interceptor passed two miles to rear of target.
Run #2 Final separation of 300 feet.
- 1400-1600, Three Dimensional Interception
Four runs with F-51 as interceptor and a B-26 as the target were made.
Runs #1,2,3 No interception due to wrong interceptor IAS being inserted into the computer.
Run #4 Final separation was one mile.
Note: Height-finder operation was good on all runs.
- Sept. 10 1300-1700, Two Aircraft Intercepts (Demonstration)
Using an F-51 as the interceptor and a B-26 as the target seven runs were attempted.
Run #1 Interceptor starting at Concord, target from Newburyport, north to Sanford. Final separation - 2000' ahead of target.
Run #2 Interceptor on same course with target starting at a point 15 miles east of Rockport, vectoring 345°; run cancelled because of poor radar data.
Run #3 Both aircraft on same course as Run #2; final separation one mile ahead of target.
Run #4 Same as Run #3.

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3.0 BEDFORD EXPERIMENT (CONTINUED)

(A.P. Hill) (Continued)

Run #5 Same course; final separation one-quarter mile ahead of target.

Run #6 Cancelled - parity alarm.

Run #7 Same course; passed 2000' rear of target.

Note: A storm frontal passage at the time of test caused a noticeable amount of cloud clutter making tracking difficult.

(M.I. Brand)

Final-Phase Guidance. Several attempts have been made to run this program but computer breakdowns and tape preparation errors have prevented any checking out of this program.

One Aircraft Printing Analysis. Lack of computer time has prevented checking of this program.

Beacon Response. I am still awaiting completion of the new basic two aircraft interception program for inclusion of the beacon subprogram.

Identification Methods. I have drawn a flow diagram which shows a possible method of identifying aircraft picked up by radar using GOC, flight plan data, and overlap reports in conjunction with any tracking or interception program and the GOC data input box.

(C. Gaudette)

C. Zraket, P. Cioffi, and I have rewritten the basic two-aircraft tracking and interception program. The program is fundamentally the same as the previous program (T 1000-5) with the following exceptions:

- a) All sections are in subroutine form.
- b) The IOR is used for initiation.
- c) The interception calculations are accomplished by a direct lead angle solution.
- d) When the target and interceptor are less than eight miles apart, the maximum search area size is one and one-half miles.
- e) The program uses an azimuth examiner.
- f) The frequency of the tracking display indicates whether the target was missed or picked up.
- g) The bearing angle is now displayed in "hour" notation.

The program should be operational by the end of the next period.

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3.0 BEDFORD EXPERIMENT (CONTINUED)

(P.O. Cioffi)

Continued work on the operational programs for use with the new In-Out System. This has been done in conjunction with Gaudette and Zraket.

(F.M. Garth)

A condition of the Single-Pair Intercept Program is that automatic initiation upon the interceptor occur as soon as it is officially declared airborne.

The fighter will "scramble" from Grenier Field which is almost due north from the Bedford MEW antenna. Therefore, as soon as the communication has been received in the operations room that the aircraft is airborne, a switch will be set which will automatically center the search area at north and set up the azimuth counter necessary for initiation.

Until the fighter has been picked up by the radar its path must be extrapolated. If the fighter has a slow rate of climb, this velocity can be used until an altitude of about 2000 feet has been reached when a return should have been received and normal tracking begun. Since the correlating and smoothing operations in the program provide for the change from extrapolation to tracking, the question whether a return from the interceptor has been received by the antenna need not be asked.

(F. Heart)

I began studying elaborations of 1) Single-Pair Interception Programs, and 2) Multiple Aircraft Tracking Programs.

(C. Grandy)

While waiting for computer time to complete the last of the indoctrination problems, I have continued working on the final-phase guidance and final-phase interception problems. Two trial runs were made with the guidance program but tape preparation errors and computer trouble prevented a satisfactory check of the program. A rough draft of the program for the final-phase interception has been started but still requires considerable work before it will be ready for a trial run. I also have spent some time working with the committee studying evaluation of computer devices for WWII. We (the committee) have completed a study of the B-box except for sampling existing subprograms and a memo on the results should appear in the near future.

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3.0 BEDFORD EXPERIMENTS (CONTINUED)

(S. Knapp)

Work on getting MACT-16 and the "Two on One" Interception program checked out has been held up because of faulty operation of the computer and of the equipment in Room 224. Some fairly encouraging results were obtained from the "Two on One" Interception but these results can be considered neither final nor completely reliable since the computer was not operating correctly.

In the meantime, thought is being given to incorporating some additional displays, height-finder data, etc., into MACT-16. I am currently trying to work out a new method for displaying decimal digits on the scope using a 4 x 7 array of dots.

(J. Nolan)

The old calibration program which was rewritten for the new In-Out System as well as a new calibration program have been checked out.

(G. Rawling)

1. Study in preparation for writing a height-finder utilization program for the Knapp Multiple Aircraft Program has been completed.

2. Examination of subroutines and "bookkeeping" orders for Be-box and WWII studies is in progress.

(A. Ward)

MACT-16 was studies and modifications were planned which will incorporate the information display suggested in a memo from Dave Israel.

(C.A. Zraket)

Some time was spent assisting members of the group in modifying operational programs to conform with the new In-Out System. Programs that were completely rewritten have not been checked out due to lack of computer time.

As much time as can be spared is being spent on the Basic Two Aircraft Tracking Program and the Final-Phase Interception Program. C. Grandy and F. Garth have been familiarized with the programs and are now continuing with some of the work.

Studies in connection with the thesis topic discussed in the previous bi-weekly are continuing.

One week of the past period was spent on vacation.

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4.0 DATA SCREENING

(W. S. Attridge and J. Ishihara)

Careful investigation of the applicability of B-box techniques has shown that a saving of 25% in operating time and 83 orders storage in MTP #1 is possible.

(W. A. Clark)

Greater emphasis is to be placed on operating-time in the re-written radar overlap program which is nearing completion. The earlier programs required as much as fifteen minutes of operating-time per set of parameters and it is hoped that this can be reduced to two or three minutes through the use of an additional stage of preliminary correlation. Parameters will be introduced from tape using Mann's read-in program.

(D. Goldenberg)

The memo on a time analysis of sorting processes is still in the process of being prepared.

(J. Ishihara)

Methods and programs for track pre-sort by overlapping "boxes" have been written and studied. In all these programs input data need only to be broken down into suitable non-overlapping "boxes" for the correlation process.

Walquist's suggestion to reverse the procedure, i.e. track-breakdown by non-overlapping boxes and using a radar return breakdown which overlap, seems promising and will receive attention in the near future.

Time has been spent in bringing up to date another member of the section and consolidating material for a report on Muldar Correlation work.

(J. Levenson)

Computer time is not yet available for indoctrination problems, so work on the last problem has come to a temporary halt. I have written and checked out a parameter which displays a grid on a scope and indexes a camera. Most of my time has been spent working with a committee evaluating programming devices for WWII. We are now studying the B-Box and preparing a memo which will measure the saving in storage and operation time, with actual figures from existing subprograms.

(H. Peterson)

I have finished the work I was to do on the effect of using slant range for true range. My indoctrination program has been rewritten.

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4.0 DATA SCREENING (Continued)

(N. S. Potter)

T 1290 which provides for magnetic tape recording of MEW data is in the process of being rewritten. The second half of the bi-weekly period was spent on vacation.

(H. Seward)

Returned from vacation September 9. Two days were spent on indoctrination tracking problem and two days on familiarization with the muldar tracking program.

5.0 TRACKING AND CONTROL

(J. Hayase)

Returned from vacation on Tuesday, September 9. A considerable amount of time was spent reading up on the notes that were taken at WWII Study Group meetings during my absence. Some literature on magnetic drums was read during this week.

Since computer time is available now, Indoctrination Problem #2 is being put in final form.

(M. Frazier)

Graphs of the data computed in the middle of the summer by the two-position tracking system (for two radars) show excellent smoothing -- most of the time. There are one or two cases of inexplicable wandering of the velocity, though.

Progress continues on the Bedford-Rockport tracking program. A rather elaborate series of displays is used as an aid in trouble shooting, which has proved difficult in the past because there are many possibilities of correct (and incorrect) operation, and it has been very hard to tell just what was going on.

(W. Lone)

Non-linear smoothing parameters 1, 2, 2b have been written into the TRASACT, times and positions averaged, program. Provisions have also been made to select a constant 13 sec. smoothing interval or to smooth at the end of the second search sector by proper setting of a flip-flop. Checking the print has revealed a tape preparation error. A tape preparation error has also been discovered in the parameter to A. Mathiasen's RPTR program which I have written.

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5.0 TRACKING AND CONTROL (Continued)

(A. Mathiasen)

A simulated data program for two-radar tracking which previously suffered conversion difficulties has been entirely rewritten.

A live-data program for two radars, which prints the r, θ of the best fit for each radar during available free time in the smoothing cycle, has been written in block form and remains to be transcribed to octal form.

Various errors have prevented other programs from being run as yet.

(B. Stahl)

The first five days of the period were spent on vacation.

Work has resumed on the TRASACT BF (Two Radar Single Aircraft Tracking, Best Fit) program, and this should be complete and working in the near future.

Most data plots of TRASACT tests from simulated data have now been completed and are now being classified by smoothing methods. This collection of plots will be added to in the future whenever any other tests (new parameters or programs) are run on the computer.

6.0 AIR DEFENSE CENTER OPERATIONS

(D. R. Israel)

The long-delayed section of the Lincoln Quarterly Report dealing with Air Defense Center Operations was completed in this period.

A descriptive outline of a proposed "Single-Pair Intercept" program was completed and will shortly be incorporated into a memo.

(M. Brand)

GOC Exercises. Memorandum M-1629 discusses the results of the 8/26/52 and 9/2/52 GOC exercises. During this last test a B-17 circled over Mass., New Hampshire, and Maine for two and one half hours including a run from Portland, Maine to Boston, Mass. In this period only three pertinent reports were received, one being badly in error.

(J. J. Cahill, Jr.)

Approximately 15 hrs. were spent in the computer room during the past two weeks, assisting at flight tests and checking out programs revised to conform with the new In-Out System. The Height-Finder Display Program, T 2024M1, has been checked out, and the AA Guidance Display Program, T2021 M1, is also operational.

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6.0 AIR DEFENSE CENTER OPERATIONS (Continued)

(J. J. Cahill, Jr.) (Continued)

A new height-finder routine, for use with the Basic 2-Aircraft Tracking Program, has been prepared, and will soon be tested. An AA Guidance Print-Out and Display Program is presently being written, which will also be used with the same basic program. It is hoped that this program will be used not just with a single battery, as is presently the case, but with all the gun batteries in the Boston area. Sub-routines are being prepared to evaluate battery-target combinations for up to 16 targets and 6 batteries. It is hoped that a way may be found to incorporate these in the multiple tracking program, MACT-16: T 2035, by S. Knapp.

(F. A. Webster)

Work has been continued on the theoretical issues raised in the report on manual tracking under the GOC system. Of particular interest is the problem of how such a system can be made most effectively to adapt to a variable set of conditions. This will be discussed in a separate memo.

Tests continue to indicate that under normal conditions the GOC net is very incomplete: only 3 out of a possible 75 reports were obtained during the last GOC test in the Manchester Area.

7.0 ASSOCIATED STUDIES

(W. A. Clark)

Together with Grandy, Hayase, Levenson, and Rawlings, a time and storage analysis has been completed of nineteen "bookkeeping" methods associated with data-handling subprograms along the lines begun by Israel some time ago. Results are of course dependent upon the manner in which data is stored and the total number of pieces of data, as well as the nature of data-address occurrences within a particular sub-program. Several Group 61 sub-programs will supply numerical values for the parameters of the analysis, which will be issued as a memorandum. The results should be of help in establishing the programming value of the "B-box" technique.

(W. Lone)

The unclassified portion of the library of subroutines has been completed and will be distributed shortly. Classified subroutines pertinent to the group are now being compiled.

(I. Mann)

The special input program, T 2000, has been checked out for the new In-Out System. It was used to set some pre-assigned variables of another program, and promises to be useful in the future.

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7.0 ASSOCIATED STUDIES (Continued)

(W. I. Wells)

During the last bi-weekly period, three days were spent on vacation. The remaining time was spent in the study of optimum linear filters for the output of Markoff chain processes. The auto-correlation function of these chains may be found and the optimum linear filters designed. There still remains the problem of finding the remaining mean square error of the output of the filter when the output is integrated. This work is hoped to form the basis for a solution to the correlation of data problems.

8.0 COMPUTER OPERATIONS

(C. H. Gaudette)

During the past bi-weekly period the computer was used by Group 61 as follows:

Equipment Characteristics	0.25 hours
MEW Tracking and Control	6.09
Data Screening	0.10
Multiple Radar Tracking & Control	0.33
Air Defense Center Operations	0.67
Miscellaneous	1.00
Sub-Total	8.44
Flight Tests	4.30
Visitors	8.00
Conversion	.60
Lost	20.16
Not Used	28.50
Extra time	8.50
Total	<u>78.50</u> hours

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9.0 PUBLICATIONS

(M.R. Susskind)

The following material has been received in the Library, Whittemore Building, and is available to Laboratory personnel:

LABORATORY REPORTS

1. "Tentative Flight Plan Schedule for Month of September," D.R. Israel, C. Zraket, M-1609, August 22, 1952, pp. 1-2.
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2. "Design of Receiving and Conversion Equipment for SDV Data," E.S. Rich, M-1630, September 8, 1952, pp. 1-3.
CONFIDENTIAL
3. "Group 61 Bi-Weekly Report, August 29, 1952," M-1638, pp. 1-13.
CONFIDENTIAL

TECHNICAL REPORTS

1. "Three Dimensional Flight Table," Quarterly Progress Report No. 1 for period ending June 30, 1952, Contract Nonr-321(01), Bendix Aviation Corporation, Detroit 1, Michigan, Lib. No. 2051.
2. "Computing Survival Probabilities of Targets With Multiply Vulnerable Components," Ballistic Research Laboratories, Aberdeen Proving Ground, Maryland, May 1952, Lib. No. 2055.
RESTRICTED
3. "Tests of a Ramjet Scoop Inlet Incorporating a Hemispherical Forebody," C. Pel, Project Meteor, United Aircraft Corporation, Research Dept., July 1952, Lib. No. 2059.
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4. "Quarterly Progress Report," Division 6-Digital Computer, Lincoln Laboratory, M.I.T., June 1, 1952, Lib. No. 2067.
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5. "Index of Missiles Division Reports, Research Memoranda, and Papers," RM-783-1, The Rand Corporation, March 3, 1952, revised July 1, 1952, Lib. No. 269.
SECRET
6. "Geodetic Research and the Compilation of Data for the Use of Guided Missiles, Artillery, and Radar," The Commanding Officer, Army Map Service, Washington, D.C., AMS Technical Report, No. 11, Progress Report as of June 30, 1952, Lib. No. 270.
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