Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: AIR DEFENSE BIWEEKLY REPORT, February 13, 1953

CAPE COD

1.0 GENERAL

(C.R. Wieser)

A brief supplement to the second draft of TM-20 has been prepared by the Lincoln Laboratory and now exists in rough draft form. In the supplement the names of some of the operating personnel and their exact duties have been changed. However, these changes have already been accounted for in the memoranda now being issued.

All memoranda concerning the demonstration next September should be issued according to instructions given in M-1815. All numbers of Groups 61 and 64 should read M-1815 carefully and handle all memos accordingly so that complete, up-to-date information on the progress of and specifications for the 1953 Cape Cod System will be available to all interested parties in a minimum of time. The routine distribution list given in M-1815 should be regarded as tentative, and people wishing to change it may do so by contacting me.

2.0 EQUIPMENT ENGINEERING

(E. Rich)

Harrington and Bevans of Group 24, and Dodd and Rich have been considering the alternatives for obtaining large size PPI displays of SDV data for use in radar mapping. To satisfy the needs of the Cape Cod demonstration by utilizing available military gear, it appeared that a 12" scope unit could be provided for the CPS-6B mapper and that 7" scopes could be furnished for the gap filler sets. Both of these types are ill-suited for the jobs; the first because it cannot be conveniently tilted to make the tube face horizontal, and the second because it is small. Both units contain considerable circuitry and hardware that is superfluous.

A more attractive solution to the problem of obtaining PPI displays is to purchase indicator units designed for the Pathfinder radar produced by Raytheon. These have 16" cathode-ray tubes with rotating yokes and can be relatively easily modified to make the tube face horizontal. The units have only a few circuits and are readily available from production. Group 24 plans to purchase one of these indicators and modify it for radar mapping purposes. If it proves satisfactory additional units probably will be obtained to serve as mappers for all Cape Cod radars. In the near future, Dodd and I will work out more specific plans and time schedules with Group 24 for the work they will undertake on these mappers.

2.0 EQUIPMENT ENGINEERING (CONTINUED)

(N. Alperin)

Work on light guns is progressing a little ahead of schedule. A new package has been decided upon -- Model III. Parts have been ordered and a prototype is being constructed by the shop. Model III differs from Model II in the position of the handle, the type sight, and the lens mounting.

(S.H. Dodd)

Terminal Equipment. A number of time schedules have been completed, indicating the design, construction, and installation of terminal equipment which is expected to be installed this spring. There are a few time schedules which are not yet complete because they are waiting for information on the required operating specifications.

These incomplete time schedules are not, however, a major part of the terminal equipment. All time schedules have been made up in great detail with check points located about every week so that it will be possible to find out if any time schedule is not being met; corrective measures can be taken immediately.

The terminal equipment should be operating by July 1, and, therefore, a target date of May 15 for completion of installation has been established to allow six weeks of systems testing. The schedules for drafting and shop time have been totaled and integrated with WWII and storage-tube schedules to make certain that adequate central service facilities are available.

(H.J. Kirshner)

A Navy type VE PPI repeater, supplied by Group 22, has been re-modified by Bill Karlsen and is now satisfactory for our use in displaying SDV data. We now have a total of two such units.

A sample of a new run of Audio Products magnetic recording tape has been given a cursory test on the Ampex recorder and appears to be of quality equal to that of the Scotch Telemetering Tape we now have on hand.

It appears that the installation of telephone lines to N. Truro will be delayed until the end of this month by the lack of sufficient local facilities. It is possible that an earlier installation date may be obtained by our relinquishing some of the data lines now routed to other sites.

There have been complaints concerning the DC resets on flip-flop registers to which the GOC box is connected. I have discovered no equipment malfunction and suspect that improper use of the equipment is the cause of the difficulty.

2.0 ENGINEERING EQUIPMENT (CONTINUED)

(B. Morriss)

A note has been prepared and should be distributed during the next period describing the operation of the MITE equipment to be installed for the N. Truro data as well as the equipment for two gap fillers.

The next two or three periods will be spent on the block diagrams for the tie in of indicator lights, intervention registers and a new display system with a vector and character generator. Comments on how the equipment should operate for ease of programming are invited.

A note containing a detailed description of the operation of the auxiliary storage drum, E-520, by J. Forgie has been issued.

(J.H. Newitt)

Scheduling for the September Cape Cod System is continuing. We are now in the process of schedule refinement after preparing summaries to show the loading of facilities. We have now predicted the time and magnitude of the drafting, shop and engineering loads. We have listed all items which should be made outside, and contact with vendors will be started in the forthcoming period. The design decisions on the 16" scope and console have been frozen; the order for 20 scopes will be placed within a few days and a metal console (prototype) will be designed (final form) soon. One potential source of trouble is in the procurement and handling of parts. We are planning to keep track of the critical items and perform special expediting or locate alternate sources of supply wherever necessary. Engineering is ahead of schedule at present but a pile-up of work seems evident in the installation and test phases of our program. We will try to plan for this contingency as soon as possible.

Outstanding items (unscheduled) at present are:

1. Expanded scope facilities
2. Communication between people in control room
3. Auxiliary scope specification
4. Tote boards
5. 2nd Bank ES.

(F. Sandy)

Modifications to Power Supply Control System, WWI. The Power Supply Control System for Whirlwind proper and for the MITE and drum equipment have been modified to provide a power failure interlock such that the system will lock out if power fails to the power supply control panel.

2.0 ENGINEERING EQUIPMENT (CONTINUED)

(N. Alperin, A.V. Shortell, Jr.)

Work on the video filter for the N. Truro set is proceeding slightly ahead of schedule. The scope cabinet and hood have been constructed. Al circuitry has been designed and constructed and will be tested during the next week. Delivery of the 16" scope is expected during the next week, and assembly of the filter and range gate equipment should be completed by the end of the next biweekly period.

The 5" breadboard filter was tried out with Scituate data one day this week and the results were very encouraging. Although the alignment problem was not investigated, the filter was able to eliminate data blanked by "grease pencil" yellow filter material and black tape and operated very consistently.

(C.W. Watt)

Detailed schedules for all equipment now contemplated for use with the Cape Cod System have been made up, and work to be done at outside vendors has been tentatively selected. It is possible to meet the May15 schedule for equipment completion if everybody does what he is supposed to do correctly the first time. There is very little rubber in the schedules to permit fumbling.

Production Control, Drafting, and Purchasing have been re-examining their procedures to see if any inefficiencies in these groups can be eliminated.

(G.A. Young)

Several routines have been written and used for checking the auxiliary drum. These routines have been placed on Tape 2327. The routines have been modified to bring out any errors detected.

Modifications of B-37345, "Block Diagram, Paper Tape Reader Control," and B-37316, "Block Diagram, IOS Paper Tape Unit Matrix," have been sent to L. Holmes. Two line diagrams of the Paper Tape Readers and Recorders have been sent to the Print Room and given sketch numbers SB-53900 and SB-53899. These will be drawn up as graded drawings in the Drafting Room.

3.0 BEDFORD EXPERIMENT

(D.R. Israel)

Procedures for the planning, scheduling, and execution of flight tests have been redefined in M-1835, "Flight Test Procedures."

In view of the large amount of work which must immediately be undertaken in connection with the Cape Cod Systems and in view of the scheduled removal of the MEW radar, an attempt has been made to list the programming work which

3.0 BEDFORD EXPERIMENT (CONTINUED)

(D.R. Israel) (Continued)

will be continued in connection with MEW activities. Programming work relative to the MEW will be restricted to the items listed below:

1) The Combined Interception Program will be modified to include the insertion and display of the target altitude.

2) The Combined Interception Program will be modified to give height-finder instructions relative to the N. Truro site.

3) A version of the Combined Interception Program will be modified to provide georef printing of the target track.

4) A version of the Combined Interception Program will be modified to include a geography display from the auxiliary drum.

5) After completion of the tests of the command tracking scheme, this feature will be put into a version of the Combined Interception Program.

6) The Sixteen Aircraft Program will be modified to accept and display height information.

7) Work will be continued on the Four-Aircraft Interception Program with whatever simple changes will make it consistent with the proposed procedures for the Cape Cod System.

8) The equipment test program being written by Garth and Lemnios will be completed.

(M. Brand)

Command Tracking. I have written a very complete flow diagram explaining in detail the method of tracking known as command tracking evolved by C.A. Zraket and myself. I have written a test program to test this new method. In this program each of the many "wiffle tree" paths of the flow diagram was assigned a number. The test program presents to the command tracking section two quantities, the time in minutes until the interception and the heading angle computed by the interception equations. From these two quantities the program eventually computes an angle to be used in the modified smoothing equations and an angle, if any, to be displayed for transmittal to the pilot. These quantities and several intermediate quantities are printed out by this test program along with the numbers indicating the logical path used by the program. The input data will be simulated and read in from a paper tape. The test program is completed. I am

3.0 BEDFORD EXPERIMENT (CONTINUED)

(M. Brand) (Continued)

presently working on the simulated data. I am trying to design this data so that it is consistent and yet insure that all the possible logical paths are used.

(C. Gaudette)

The multiple-return averaging program described in the previous biweekly has given satisfactory results. The initial operation of the program indicated that all the multiple returns were not being eliminated. S. Knapp and I wrote a new program to print out the (r,θ) coordinates of the clutter, which showed that in order to eliminate all multiple returns a multiple return must be defined as a return whose range differs from either of the last two returns (or both) by two nautical miles. S. Knapp is incorporating this method into the sixteen-aircraft tracking program.

C. Zraket, F. Heart, W. Lemnios, and I have completed a brief investigation of methods of calculating "out of the sun" interceptions. A table which gives this final attack angle for various hours of the day of any month is now being computed. C. Zraket will modify his Final Turn Program to include this method.

J. Cahill and I are attempting to record a good three dimensional interception which uses both height finders (MPS-4 and TPS-10), and which has the height finder information recorded on the Magnecorder. However, the Rockport MPS-4 has been inoperative recently, and the past few three-dimensional interceptions have used only the Scituate TPS-10. When a good interception with the two height finders has been recorded, the AAA will be introduced into the system, and its information will be recorded on the Magnecorder along with the height finder information.

(F. Garth)

William Lemnios and I have completed the first two main sections of our checkout program which are equipment checking and scope calibration. For the third section, radar calibration, I have prepared a parameter to examine Bedford radar data for 1) proper sequencing of azimuth and range, 2) azimuth discontinuity at north, 3) the correct differential between distinct consecutive azimuths. We have found confusion has arisen in keeping the three sections to this program separate so we are now writing a program which combines all parts.

3.0 BEDFORD EXPERIMENT (CONTINUED)

(F. Heart)

Occasionally a 5-5-6 paper tape has acquired so many modifications that its physical length introduces an additional hazard to correct read-in. One way to solve this problem is to punch out the contents of storage on a new 5--5-6 tape. In order to allow this, two short punch-out programs have been written and tested, (T-2295, T-2296). One is positioned in the "low end" of storage and the other in the "high end."

The auxiliary drum recently became available for limited use. Some time was spent checking the present status and availability of the drum.

As a first experiment in programmed real-time use of the drum, a geography display (the so-called "calibration" program) was stored on the drum and used in conjunction with the main two-aircraft interception program. As used, at an azimuth of west, a block of the interception program was read into the drum; the geography was read into ES from the drum, the geography display was operated in ES, the section of the interception program was read back into ES from the drum, and control was transferred to the main program. This first attempt was completely successful but rather crude, and a refined version will be prepared.

With S. Knapp, some time was spent testing the four-pair interception program on canned radar data. Results, though encouraging, are not yet satisfactory.

With Zraket, Gaudette, and Lemnios, an analysis was made of procedures for "out of the sun" interception maneuvers. A simple procedure was derived, involving simplifying assumptions, which should allow initial programming to be attempted. The analysis is available, as an interoffice memorandum, from Zraket or myself.

(S. Knapp)

The multiple-returns display program written with C. Gaudette showed that the method used to eliminate such returns is satisfactory and the method is now being incorporated into the Sixteen Aircraft Program.

Trouble with inaccuracies in velocity in both MACT-16 (Multiple Aircraft Tracking) and the Four-Pair Program has led to the conclusion that it is unsatisfactory to store both of these quantities in the same register, as has been done previously. Both of these programs are being modified to correct this.

The height section of MACT-16 has been completed, but due to tape preparation errors was not checked out.

3.0 BEDFORD EXPERIMENT (CONTINUED)

(S. Knapp) (Continued)

Other than the difficulty with the velocities, mentioned above, the Four-Pair Intercept Program seems to be working satisfactorily. The heading angles given are slightly inaccurate, but I think that more accurate velocities will correct this.

(W.Z. Lemnios)

The equipment checkout program was run on the computer with partial success. Trouble was encountered with the display portion of the program. The program worked well for the pieces of in-out equipment which do not depend on the scope displays. The program was extended so that now the scopes can be calibrated and the reliability of the radar data can be tested in addition to the checking of the in-out equipment.

Several conferences were held with C. Gaudette, F. Heart, and C. Zraket to discuss an out-of-the-sun interception. A solution was obtained which it is hoped will be incorporated shortly into the interception program.

Studies were begun of the effect of target maneuvering during the final phase approach of the interceptor. A mathematical analysis of this problem is being attempted and some calculations have been made. It is hoped that some results will be available in the near future.

(C.A. Zraket)

A flow diagram for a command tracking program has been completed and checked by C. Gaudette, M. Brand, and myself. M. Brand has written a program with simulated inputs to check all possible paths in the flow diagram. At the conclusion of this check, a command tracking program will be incorporated in the Combined Intercept Program for canned and live tests.

Discussions are being held with W. Lemnios in connection with an analysis he is making of our present final-phase techniques and procedures. It is desired to obtain the effect of target maneuvers during the final-turn approach of the interceptor. It appears that some kind of human monitoring and intervention must be provided for in order that the interception will not degrade completely. A quantitative analysis of different types of final approaches may be possible from the equations being derived.

3.0 BEDFORD EXPERIMENTS (CONTINUED)

(C. Zraket)

Gaudette, Heart, Lemnios, and I have completed an analysis of what information must be inserted into the computer in order to conduct an 'out-of-the-sun' interception. This analysis has been written up in an inter-office memo. The problem that arises when the interceptor must cross the target path in order to complete such an interception has not been analyzed as yet.

The present final-turn interception equations and program now being used are being written up in an inter-office memo.

4.0 DATA SCREENING

(R.L. Walquist)

A program has been written for checking the number of returns per azimuth for the data from the N. Truro set. The number of returns per azimuth are broken down into the categories:

$>10, 10, 9, 8 \ldots\ldots 2, 1.$

The total number of azimuths giving the corresponding number of returns are summed under each category and the results typed out. A computer-controlled range gate is also included for eliminating close-in returns from being considered.

The general layout for the track-while-scan (TWS) program for the fall demonstration is being studied. A master controlling program and a data collection program have been studied in some detail. Studies are being made of the necessary track data for the TWS function. The number of switches and indicator lights for the initiators and track monitors have been estimated along with the function of each switch. Storage studies indicate that 2 banks of ES are highly desirable in order to decrease program complexity and calculating time. All studies assume that 2 banks will be available.

(W.S. Attridge, Jr.)

Photographs of the data from the Maximum Effort Flight Test were unsatisfactory because of insufficient exposure and scratches on the film caused by the camera. Closer scrutiny of the above-mentioned data has revealed that it was of much better quality than had previously been thought. The Scituate data in particular showed numerous tracks in the vicinity of Squantum and Logan airports.

Data Screening Program #1 has been completed. Checking and testing of the program continues in anticipation of results soon.

Data input with azimuth occupying the left-hand part of a register and range, the right-hand part, result in a saving over input with range in the left and azimuth in the right in programming for the type of data conversion planned for the September System.

4.0 DATA SCREENING (CONTINUED)

(D. Goldenberg)

As a starting point in the problem of determining a reference plane and a system of projection of the earth onto this plane for a multiple radar system, a plane tangent to a spherical earth and a projection of the earth by radial lines onto the plane has been under investigation. In addition, a criterion of the suitability of a projection system has been defined to be a maximum error of 0.10 miles in the position as reported by any one radar.

An analysis of the assumed projection system has determined the form of the equations of the position of a target. Assume that the target's position has been reported by a radar located at latitude, L_r, and longitude, λ_r, and that the point of tangency of the reference plane is (L_0, λ_0). If the radar site is projected onto the plane, the coordinates of the projected point will be assumed to be x_0, y_0. The radar determines the slant range, S, and the azimuth, θ, from north and the height, H, of the target is known. The coordinates of the target in the reference plane are given by:

$$x = x_0 + F(S, H, \theta, L_R, L_0, \lambda_R, \lambda_0)$$

$$y = y_0 + G(S, H, \theta, L_R, L_0, \lambda_R, \lambda_0)$$

The functions F and G are complicated but sufficiently accurate approximations to them can be found. These are:

$$x = x_0 + (S^2 - H^2)^{1/2} \sin\left[\theta - (\lambda_R - \lambda_0) + F(S, H, \theta, L_R, L_0, \lambda_R, \lambda_0)\right]$$

$$y = y_0 + (S^2 - H^2)^{1/2} \cos\left[\theta - (\lambda_R - \lambda_0) + G(S, H, \theta, L_R, L_0, \lambda_R, \lambda_0)\right]$$

The functions F and G are far from negligible as compared to $(\lambda_R - \lambda_0)$ and must be accounted for in the calculations. If they are neglected, an error of the order of one mile may result at large ranges. The angle $\theta - (\lambda_R - \lambda_0)$ indicates that the zero azimuth direction of orientation of the radar should be parallel to the direction of north (the y axis) in the reference plane tangent at L_0, λ_0. The immediate point of investigation is to determine approximations to F and G preferably linear functions of θ which will minimize the errors in position.

In an effort to program this problem, it is certain that multiple length registers will be needed and that multiple length computation or representation of the trigonometric functions will be a considerable obstacle in achieving the accuracy desired. Programming will not be attempted until a clearer road to the solution is apparent.

4.0 DATA SCREENING (CONTINUED)

(J. Ishihara)

Parameters for Data Screening Program #1 (DSP #1) have been written so that tracking studies may be made using data from one, or any two, of the three radars used for the maximum effort flight test.

A test parameter to check operation of all subprograms of DSP #1 separately and in operational sequence has been completed.

(J. Levenson)

The test Track Monitor program has been completed and should be checked out within the next biweekly period. It is designed to monitor up to five situations causing tracking trouble and should give a more concrete idea of the requirements for efficient and fast monitoring by a human operator in conjunction with the computer.

I am eager to find out how easily and speedily the observer can reconstruct the tracking situation and identify the trouble when notified by the computer, and what types of displays facilitate this. At present I have chosen the following displays:

1. Present track position, a direction and velocity vector and identifying track number.
2. A letter to indicate the type of trouble the track is in.
3. Three past positions of a track, if desired.
4. One scan's worth of raw data.
5. A display expanded about any target which the operator chooses.

(H. Peterson)

I have written a parameter to my speed-up display program that was suggested by R. Walquist and which makes it possible to control the program from the G.O.C. box and to add 0 to 15 quarter-seconds between displays of data blocks if a slower display rate is desired. This parameter and a modification to assure that the program counts radar frames instead of data blocks have been checked out on the computer.

I have also written the section of the Data Screening Program which displays the grid, takes pictures, and prints out the number of velocity tracks in storage, those initiated on to date, those dropped along with the same information for positional tracks. I have also checked the smoothing and prediction section of the same program for W. Attridge.

4.0 DATA SCREENING (CONTINUED)

(H. Peterson) (Continued)

When we had the computer for the above mentioned check-out we also took pictures to determine if we could improve our exposure and eliminate the scratches we had on the first pictures we took of the data stored on magnetic tape of the recent multi-plane flight test.

(N.S. Potter)

The work on the proposed mode of handling altitude information in a muldar system mentioned in the previous biweekly is proceeding. I am now engaged in the numerical computations necessary for the preparation of graphs to display the distribution of the absolute error in the projected range. Though half the previous biweekly period was spent on vacation, the report should be finished this week.

(H.H. Seward)

A program has been written which converts and stores all returns from Bedford for the last four scans. The scans are then displayed successively in a blownup area with variable time increments between each scan and cycle of scans, the effect being a "moving picture" which should facilitate determining tracks for manual initiation. A similar program for Truro data using the past six scans stored on the auxiliary drum will be started next week.

(Wm. Wolf)

Three programs have been written to display returns from the Truro radar. Since the range is submitted in 1/2-mile increments there is a maximum possibility of 65,536 pieces of information per scan. Allowing 15 seconds per scan is equivalent to observing that the time between returns is 228 microseconds. This observation necessitates using test storage not only for display but for any efficient program since the comparatively slow time of electrostatic storage allows only one or two normal orders between quests for data.

The three programs written are as follows:

1) B scan - azimuth vs. range as x and y coordinates. This program displays each return as it is received.

2) PPI - One return is displayed per 14 "no returns", or 4,681 returns are displayed per scan, with certain restrictions.

3) PPI plus an added feature - One of the flip-flop registers is used as a counter to tell the programmer how many of the returns received are yet to be displayed. This program displays one return per 24 "no returns."

5.0 TRACKING AND CONTROL (CONTINUED)

(J.A. Arnow)

A meeting concerning aircraft requirements for the next two fiscal years was attended at ARDC in Baltimore. The significant feature of the meeting as pertains to Division 6 is that 14 F-89's, 1 F-86D, and 1 F-94 will probably be available for our use before next September.

(S. Best & Wm. Lone)

We are writing a program which will handle the track crossing problem, i.e., to keep fixed on an aircraft we are tracking when something else crosses its path. When a radar return in addition to that of the aircraft enters the search area, we propose to track both aircraft with the existing smoothed velocity for four scans and compare the velocities at the end of that time with those when double tracking was started, excepting the one which more nearly resembles that velocity as the aircraft we had been tracking prior to the interference.

(M. Frazier)

A scope calibration program for the Rockport & Scituate radars is available as T-2335, Mod. 1.

The program for studying the common velocity separate track method of smoothing for two radars has been modified for NLS-2. Present indications are that this type of data combination gives very smooth, but somewhat inaccurate velocities. The velocities tend to become accurate (with linear smoothing) after tracking has proceeded for about five minutes.

A program for tracking two aircraft using Bedford, Rockport, and Scituate data is in process of being written.

(A. Mathiasen)

Virtually all of the last biweekly period was spent calculating figures of merit for the various tracking methods tried with simulated data.

(H.D. Neumann)

The Bomarc mid-guidance program was modified, and 36 parameter tapes were prepared for a first trial of the program. More tapes will be written.

A new program is being prepared in an attempt to simplify and shorten the computations, using a table obtained from simulated data.

5.0 TRACKING AND CONTROL (CONTINUED)

(B. Stahl)

The two-radar tracking program described in recent biweekly reports now seems to be working. Some difficulty was encountered with the photoelectric tape reader which prevented the possibility of making a flat statement of success, but the program now will be checked out with several data tapes since it tracked reasonably well with linear smoothing.

No further work was done on the proposed three-radar revolution timing program.

6.0 AIR DEFENSE CENTER OPERATIONS

(D.R. Israel)

Plans for the 1953 Cape Cod System have been revised in accordance with the recently prepared supplement to TM-20. The major effect of these changes is outlined in M-1839 (see below).

Three memos relative to the organization and operation of the Cape Cod System have been written. The first of these memos (see below) outlines procedures to be used in issuing and distributing memos regarding the Cape Cod work.

M-1815: Memos Concerning the 1953 Cape Cod System

M-1839: Overall Organization of the Cape Cod Information and Direction Center.

M-1840: Preliminary Description of Duties and Equipment for Information and Direction Center Personnel

A proposal has been made for a simulated data program to be used in testing parts of the future Cape Cod program. Prior to complete formulation of plans for this program, investigations are being made into those overall programming details which effect the track-while-scan as well as the non-track-while-scan functions.

Drawing SC-53867 is a proposed floor plan for the Operations Rooms of the Cape Cod System. This drawing will be issued as a part of a forthcoming memo.

In conjunction with Conant and Webster, detailed investigations of the intercommunication requirements for the Cape Cod Operations Rooms have been undertaken. An inter-office memo describing some tentative requirements has been distributed to several people for their comments and suggestions. On the basis of these suggestions and the investigations carried out with Conant and Webster, it is expected that detail specifications for the intercommunication system will be issued prior to the end of the next biweekly period.

6.0 AIR DEFENSE CENTER OPERATIONS (CONTINUED)

(D.R. Israel) (Continued)

An inter-office memo containing a proposal for emergency operation of the Cape Cod System has been sent to several people for their criticism. This proposal is intended to handle situations in which the computer or drum is out of operation; the proposal displaying the N. Truro PPI picture directly on the 16-inch computer scopes. With this facility and the addition of several tote boards, under emergency operation the center could function, at reduced capacity, like a GCI station.

An adjustable cardboard mock-up of a new scope console design was prepared and was tested with the aid of a number of staff members. A set of measurements which satisfied a majority of those interested was obtained. These measurements form the basis for a wooden mock-up of the scope console which has been prepared under the direction of John Newitt.

Inquiries are being made in connection with the choice of two airfields for use in the Cape Cod System. The final choice will depend upon communications, operational suitability of the field, radar coverage, and other related factors. In conjunction with the choice of the fields, choices will shortly be made of those Cape Cod System radar sites which appear to be of most utility in the demonstration this fall.

Proposed tests concerning the use of flight plan data and use of the height information from the 6-B at N. Truro is awaiting the installation of necessary telephone lines.

(M.I. Brand)

Continued work on the Identification phase of the Cape Cod System. Worked out flow diagram for the Identification sections of the program. There will be four major sections to the programs:

1. Phone line recording and data preparation
2. Data processing
3. Flight plan tracking
4. Correlation and Display

Ann Ward is currently writing a program which will test out the flight plan tracking method currently envisioned.

A floor plan was desgined for the 9 x 12 area assigned for the Identification Room showing the position of the pre-plot board, scopes and switch consoles.

6.0 AIR DEFENSE CENTER OPERATIONS (CONTINUED)

(M.I. Brand)

A study of switch requirements for the switch consoles is underway. Phone line data sheets and data input cards have been designed for use with the system.

A work order was submitted to the Project Lincoln carpentry shop for the construction of the pre-plot board. This will be identical to the one now at the quick-fix station at N. Truro.

Work has continued in conjunction with C.H. Gaudette on the display of techniques program. This program is now virtually completed. The very few minor bugs remaining are expected to be ironed out during this biweekly period.

(J.J. Cahill)

During the past week an antiaircraft guidance flight test was run during which georef and other pertinent information on a tracked target was sent from Barta to the Antiaircraft Operations Center (AAOC). This information was in turn disseminated by the AAOC through operational channels to all batteries. Despite the fact that initial trouble at the MEW site limited the time available for the test, the result was a highly successful mission. The nearest battery to the target's line of approach to Boston "acquired" the target, solely on Whirlwind guidance, at its extreme range (60 miles).

The next step will be to have a target fly at an "unknown" altitude and have the nearest nodding-beam height-finder locate it and report altitude, which will then be passed to AAOC from Barta.

The previous week, an AA Guidance test was run using georef information, which was passed to a single battery (D Bty., 704 Bn.). Some correlation runs to compare Whirlwind information with the location of the target as found at the site were made. Results, in general, were good.

During the three-dimensional interceptions performed on February 6, the TPS-10 was consistently able to find the target altitude within 500 feet. On the three runs, the departure from the desired 500-foot separation (vertical) was -500 ft., 0, -300 ft. Visual contact was made well before interception in each case.

On Feb. 5, a flight test was run with the TPS-10 and MPS-4 using the computer in an effort to find combined coverage. The MPS-4 was operating poorly, and the TPS-10 found it difficult to locate the target, since it was flying at 2000 feet, and on a course tangential to the site. Other tests, run without the computer, but using axial courses with respect to the TPS-10 have proven more useful.

6.0 AIR DEFENSE CENTER OPERATIONS (CONTINUED)

(J.J. Cahill) (Continued)

Still another version of T-2187, Mod. 11, has been written. It will be circulated to those interested, but in general the new features will be:

1. Display of height-finder guidance information with respect to the N. Truro site.

2. Georef print-out and r,θ, and AA guidance display on the same program.

3. All height-finder and AA guidance information displayed in positions such that all may be shown at once on a single scope.

4. Insertion of altitude by means of the G.O.C. box, and display of some in thousands of feet.

5. Display of an "F" (for Fresh) in conjunction with altitude information less than 45-seconds old.

(P.O. Cioffi)

The identification data covering approximately a two-week period at Truro was analysed and plotted. The plot of this data indicates the areas of heavy traffic east and north of Truro for penetrating flights. It gives an estimate of the effectiveness of the quick fix group in terms of range and altitude of aircraft at identification position. It gives also an idea of the distribution of such flights over the day.

This result is written up and will be available early next period.

(O.T. Conant)

The communication problem in the September System is now being attacked on the basis of a breakdown of phone communication into direct line calls (high time priority), conference calls (common line among several individuals), and switchboard calls. A first determination of all direct line calls required, made in discussion with D. Israel, C. Zraket, and F. Webster, will be coordinated with the persons responsible for the various functions of the Center. Conference call requirements and means of implementation will also be studied.

6.0 AIR DEFENSE CENTER OPERATIONS (CONTINUED)

(M.A. Geraghty)

During the last period, I assisted J. Cahill in the running of two AA guidance flight tests and one height-finder test in a three-dimensional intercept.

In addition I have been trying to develop some simple means of approximating the coverage of the two height finders. In conjunction with Group 22, two tests have been run, the results of which point to a definite method of solution.

(F. Heart)

Efforts are continuing to obtain photographic recording of intercepts. The status of these efforts is as follows:

a) A request has been filed, by the 6520th Test Support Wing, with U.S.A.F. for aerial photographic equipment and a qualified photographer. No action has as yet taken place on this request.

b) At the convenience of the 6520th Wing a solid tripod mount for a 16mm sound movie camera will be installed in the nose of a B-25. We have agreed to wait until an appropriate aircraft is "down" for normal maintenance before this installation is made.

c) While waiting for one or both of the above to happen, some movies have been taken with a 16mm hand-held camera. For this purpose a camera equipped with a 6" telephoto lens was obtained from the Lincoln photographic laboratory (16mm, Bell & Howell). Several flights were made by Art Hill during which this camera was used. (A photographer from 6520th Wing accompanied Art Hill on these flights.) The results obtained to date are only fair, but further attempts will be made both with the above camera and with other hand-held 16mm cameras.

Arrangements have been made to systematize visits to the Laboratory of "sight-seeing" cleared personnel. It was decided that cleared personnel who were reasonably familiar with Group 61 activity, and who had already visited Barta one or more times, could, with a day's notice, watch any test at almost any time. It is assumed that little or no attention would be paid to such people and they would be permitted to stay in the background and observe. However, cleared personnel not familiar with Group 61 activity and thus requiring engineering time for a tour and a lecture, would only be permitted to visit on special days. In particular, alternate Tuesdays starting Tuesday, February 17 have been designated for such activity.

I gave an indoctrination lecture on Group 61 activities to about 30 pilots and crew members of the 6520th Wing at Bedford on Monday, February 9.

6.0 AIR DEFENSE CENTER OPERATIONS (CONTINUED)

(F.A. Webster)

A major difficulty in evaluating the details of information transfer between individuals in the September System is a lack of diagramatic representation of the communication channels and their interrelations. Two sets of diagrams are being prepared: 1) a general flow diagram which gives the major types and functional positions of channels between senders and receivers in the system; 2) diagrams which present the channels and message content from the point of view of a particular position or function. With the aid of these latter diagrams, preliminary analysis will be made of message content, message priority, and message loading as a function of the phase of an attack. Studies of actual message transfer in a simulated attack can then be undertaken.

(C.A. Zraket)

Following discussions with D. Israel, work will be started by Gaudette, Heart, and me on a simulated data program which will help to check out the non-track-while-scan functions of the 1953 Cape Cod System. The initial step will be to investigate various methods of storing the data and parameters of the system and obtaining access to this data. Following this, a flow diagram of the program will be drawn up.

7.0 ASSOCIATED STUDIES

(E.J. Craig)

The report on iteration procedures has been completed. It is now in the possession of Prof. W.K. Linvill, who is reviewing it.

The author has worked out a new method for solving sets of linear simultaneous equations. A method built along the lines of one by E. Stiefel (Zeitscrift für Angewandte Mathematik und Physik, Basel, Switz., Jan. 3, 1952, pp. 1-33) but essentially different has been evolved. In this manner the exact solution to n equations in n unknowns is determined in n steps of iteration. The only condition placed on the set of equations is that a unique solution exist.

8.0 COMPUTER OPERATIONS

(C.A. Zraket)

A canned demonstration was given for Gen. Seville on Tuesday, February 3. The following programs were shown:

1) Multiple Aircraft Tracking and Initiation, T-2109-15, Ampex 245.

2) Single-Pair Intercept Program. Use of automatic ground to air link, T-2187-9. Ampex 238.

3) Simulated Identification Program, T-2240-16.

Mr. R.D. Weber from the Office of Naval Research (ONR), London, visited Group 61 on Thursday, February 5. Group 61 activities were discussed and he observed a live demonstration of a two-on-one interception.

(M. Brand)

The following is a summary of scheduled computer time used by Group 61 during the last biweekly period:

MEW Tracking & Control

Flight Test	10 hrs 5 min
Magnetic Tape	3 hrs 50 min
Data Screening	5 hrs 25 min
Multiple Radar Tracking & Control	13 hrs 25 min
Air Defense Center Operations	3 hrs 25 min
Indoctrination Programs	1 hr 15 min
Conversion	25 min
Calibration	1 hr 25 min
Equipment Characteristics	5 hrs 15 min
Visitors & Demonstrations	3 hrs 0 min
Miscellaneous	20 min
Total Time Used	46 hrs 50 min
Time Lost to Computer (Parities, etc.)	2 hrs 25 min
Time Given to Magnetic Drum	14 hrs 45 min
Total Assigned Time	64 hrs 0 min
Percentage Assigned Time Used	73%
Percentage Available Time Used	100%

9.0 FLIGHT TESTS

(F. Heart)

A flight test schedule for February, 1953, was issued as M-1832. This schedule was delayed due to various shifts in computer scheduling.

A flight test activity report for January, 1953, was issued as M-1842.

(F. Heart & M. Brand)

The following statistics apply to the last biweekly period:

Computer hours scheduled for flight tests	26
Computer hours used for flight tests	10
Computer hours returned due to flight test cancellation	14*
Total aircraft hours flown	17.5
Aircraft hours flown by 6520th Wing at Bedford	11.5
Aircraft hours flown by M.I.T. Instrumentation Laboratory	3
Aircraft hours flown by Navy (Quonset-based Squadron)	3

* Two hours were kept by Group 61 despite cancellation of flight test.

DATE	TIME	SCHEDULED TEST A/C	SCHEDULED TEST Description	TEST ACTUALLY RUN A/C	TEST ACTUALLY RUN Description	REASONS FOR CHANGES OR COMMENTS
2/3	0900-1030	B-25	AAA Test	-	Cancelled	Weather
	1030-1200	B-25	2 Radar Calibration	-	Cancelled	Weather
	1330-1630	B-25 B-25	Auto. Intercepts with Height Finder	-	Cancelled	Weather
2/5	0900-1030	F-3D	Take-off Initiation	-	Cancelled	Aircraft mechanical
	0900-1200	B-26	AAA & Height Finder	B-26	As Scheduled	
	1330-1500	B-25 B-25 B-17	Two-on-One Intercepts	B-25 B-25 B-17	As Scheduled	
	1500-1600	B-25 B-25	Two Aircraft Tracking	B-25 B-25	As Scheduled	
2/6	0900-1200	B-25	Two Aircraft Intercepts, Data Link & Height Finder	B-25	As Scheduled without Data Link	Used Navy fighters; 6520th could not supply ship with data link
2/10	1000-1100	B-25	AAA Test	B-25	As Scheduled	
	1100-1200	B-25	3 Radar Coverage	-	Cancelled	High winds
	1400-1600	B-25 B-25	Automatic Intercepts with Height Finder	-	Cancelled	Unable to obtain suitable aircraft
2/12	1000-1200	B-25 B-26	Automatic Intercepts with Height Finder	-	Cancelled	Weather
2/13	1300-1430	B-25	AAA Test	-	Cancelled	Weather
	1430-1600	B-25 B-25	Two Aircraft Tracking	-	Cancelled	Weather

* Added to schedule during week of test

9.0 FLIGHT TESTS (CONTINUED)

(A.P. Hill) (Continued)

Results of flight tests held with the 6520th Flight Test Group:

Feb. 5 1330-1500 Two-on-One Intercepts
Using two B-25's as interceptors and a B-17 as the target, two runs were attempted.
Results: Run #1 was interrupted, the aircraft returned to holding positions.
Run #2, Fighter #1 passed two miles to the right of target, Fighter #2 passed 100 ft. ahead of target.

This test was the first attempt to take motion pictures with a Bell Howell hand-held 16mm camera. A. Hill rode in the nose of the target aircraft with an Air Force photographer. Two rolls of film were used. Results were very poor due to the wrong site setting, causing pictures to be off-center. Approximately 10% of the film was salvagable.

1500-1630 Two Aircraft Tracking
Two B-25's were used flying between Rockport and Scituate. Results were satisfactory.

(P.F. Dolan)

Results of flight test for U.S. Navy and M.I.T. Instrumentation Laboratory:

Feb. 5 0900-1200 Height Finder and AAA Tests (M.I.T. Instr. Lab.)
A B-26 #262 was used holding over Gloucester at 12,000 ft. Satisfactory results were obtained.

Feb. 6 0900-1200 Two Aircraft Intercepts with Height Finder (Navy)
An F-3D Navy Interceptor was used as fighter for first hour and a half, starting over Grenier Air Force Base at 8,000 ft., IAS 300 knots. The target aircraft was a B-25 from 6520th Wing.
Results: Fighter passed 1,000 ft. below and 500 yds. behind the target. Run #1 was only partially satisfactory because fighter IAS was not corrected for altitude causing heading angles to steadily increase as the interception progress. Height finder reports were very satisfactory.

9.0 FLIGHT TESTS (CONTINUED)

(P.F. Dolan) (Continued)

Run #2, the fighter passed 500 ft. below and 500 ft. behind the target. A replacement fighter was used, an AD-4, IAS 255 knots at 8,000 ft. The height finder reports were very satisfactory although the wrong aircraft was tracked at the beginning.

Run #3, the fighter passed 100 ft. above and 400 ft. ahead of target. Good run, good data, and fairly constant headings. Once more the height finder reports were very satisfactory. An attempt was made to take pictures from the target aircraft, but much the same results were attained as the last attempt on Feb. 5.

Feb. 10 1000-1100 AAA Test
A B-25 #423 was holding over Portland at 15,000 ft. vectoring to Boston. Satisfactory information was obtained from this test; only 15 minutes of data was obtained, however, due to radar trouble at Bedford.

WHIRLWIND II

(R.L. Best)

The following personnel assignments have been made for WWII basic circuits:

Pulse Logic

High-speed flip-flop - H.W. Boyd
High-speed flip-flop cathode follower - H.W. Boyd
Gate Tube - H.J. Platt
Buffer Amplifier - S. Bradspies
Pulse standardizer - H.E. Zieman
Pulse delay - J.I. Woolf

Diode Logic

Low-input impedance diode-driving flip-flop - H.W. Boyd
High-input impedance diode-driving flip-flop - B.R. Remis
Diode-driving cathode followers - B.R. Remis
Diode circuits - It is suggested that IBM do this; representative here will be B.R. Remis
Level inverter - J. Gilette
Level amplifier - C.D. Laspina
Level delay - H.J. Platt

Memory Circuits

X and Y plane driver - D. Shansky
Z plane driver - D. Shansky
Sensing amplifier - C.D. Laspina

In-Out

Scope deflection amplifier - H.E. Zieman
Single-pulse synchronizer - C.D. Laspina

Schedules have been made up for all the above items except diode circuits.

(H. Boyd)

High-speed flip-flop. Marginal checking data was taken on the 5965-gate-tube-driving flip-flop and tube and component tolerance data were collected.

Low input-impedance diode-driving flip-flop. A 5965 diode-gate-driving flip-flop was designed and constructed, although as yet no tests have been made on it. In principle the two flip-flops are alike. An added restriction was placed on the diode-gate-driving flip-flop, however, inasmuch as the output levels have to be held within certain tight limits.

WHIRLWIND II (CONTINUED)

(S. Bradspies)

The design of a buffer amplifier has been started.

(W.A. Clark)

On February 3 a meeting was held with E.H. Goldman and W.E. Triest of Project High and was attended by Don McCann and Ben Morriss as well as by the WWII people of Group 61. Output display generation was discussed at some length and the subject was narrowed down to three modes of implementation:

1) Display line technique as used in WWI,
2) Coincidence selection as described in Project High Report IM-11,
3) Display assignment representing a combination of 1) and 3) in which requests for particular displays are processed by the computer program rather than by external equipment.

Method 3) appears to require a large amount of machine time and this may disqualify it. Method 1), which is acceptable for something the size of the Cape Cod System, may well be too "noisy" for the Transition System. The coincidence scheme 2) seems to be the most promising but costs a lot of equipment, although the amount of equipment may be greatly reduced at the expense of scope console standardization and generality.

Estimates of the number of bits per track in drum storage have been examined carefully, and it may be possible to revise these totals downward. TM-20 suggests 250-300 bits per track while the new estimate is about 200. (As Hayase points out in his report, the situation is complicated by the fact that computer-controlled aircraft or missiles require considerably more information than other aircraft.) A list of the items included in this new estimate is available for comment. Although it will almost certainly be extended by new programming and systems requirements, it is felt that this compilation contains items which are at least believable.

(J.S. Gilette)

The design of a slow-speed level inverter has been started. The inverter will use one 5965 tube and two crystal clippers.

(C. Grandy)

A description of the operation of the Track Supervision Room for the proposed Transition Air Defense System has been written. This description includes the duties of the various personnel in the Track Supervision Room, the displays they receive and various ways of implementing the displays. Two problems under consideration are 1) the method of sorting, storing and displaying track history of hostiles, and 2) the method for displaying the most recent four scans of uncorrelated radar data to achieve the effect of moving tracks. A similar description of the Identification Room is pending.

WHIRLWIND II (CONTINUED)

(C. Grandy) (Continued)

Two methods of providing a display by height selection in a coincidence display system have been examined in some detail with W. Clark and B. Morriss. Notes on these methods are being distributed and copies sent to the IBM Project High engineers. A similar investigation of methods to select by speed will be undertaken.

Exploratory programming with the new WWII order code has been postponed in order to concentrate more effort on the display system.

(J. Hayase)

The study of displays in the transition air defense center is being continued. Based on this study, categories required in the coincidence display system to obtain various displays have been established. It has been noted that most of the aircraft being tracked have common categories with the exception of the manned and unmanned interceptors. For both manned and unmanned interceptors, the category "assigned raid no." takes up to 9 or 12 binary digits.

A preliminary listing of various items to be included as track information for the unmanned interceptor has also been made up based on G. Rawling's Bomarc flow sheet. Track information needed for the effective launching and guidance of unmanned interceptors under computer control requires information not needed for tracking and control of manned interceptors. This indicates that the storage of track information on the auxiliary drum for interceptors should be handled differently from the other aircraft being tracked.

(J.F. Jacobs, R.C. Jeffrey)

We have completed a survey of operation times and equipment complexity for 10 arithmetic elements as possibilities for WWII.

A summary of the results has been prepared, and is available on request.

(H.J. Platt)

The standard gate tube circuit used in WWI and MTC is being investigated for sensitivity to parameters as a function of some marginal checking voltage. Curves of component variation versus marginal checking voltage will be made. It is expected that the full behavior of the circuit will be revealed.

A discussion of the type of testing to be done will be found in M-1828.

WHIRLWIND II (CONTINUED)

(G. Rawling)

Various reports* of interest to the transition phase of the air defense system have been studied and pertinent information added to the chronological flow sheets illustrating weapon employment.

Some subjects discussed in these publications included IFF systems and displays; ground and airborne radar systems and moving target indicator, types, limitations and interference; control, types, and geometry of interceptions; communication channels and data transmission links; navigation aids and systems both for long range and landing; airborne fire control systems and weapon sights; the operational use of long range missiles, with their limitations, functional organization of their ground control systems, and allied topics.

A first-draft chronological flow sheet indicating factors to be considered by the computer in recommending weapon assignments has been completed. The preliminary considerations are broad, and include considerations for choice of ground interceptor or orbiting fighter or missile; with such factors as availability, weapon stockage, minimum time for interception, location of interception point included; geographical, aerological, and communicational limitations and restrictions (which must be augmented); and displays of weapon bases and associated interception points either in sequence or as optimum choice in each weapon type category selected by the computer.

Future work will include the preparation of flow sheets illustrating communication channels and transmitters assignment, (and control), and point defense by ground weapons.

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* 1) "The Integrated Electronic and Control System", Proj. MX-1179, Hughes Aircraft, March 1952.
2) "Future Requirements for AI in Fleet Air Defense," Operations Evaluation Group Report 61.
3) "F99 (Bomarc) Concept of Operations," Headquarters, ADC, Colorado Springs, Colorado.
4) "Digital Course Computer for Ground Bomarc System," WRRC, U. of Mich., October 1951.
5) "Design Principles and Description of the Tactical F99 Ground Control Networks," WRRC, U. of Mich., July-October 1952.
6) "Function and Equipment Specification for the Engineering Model of the F99 Ground Control Network," WRRC, U. of Mich., October 1952.

WHIRLWIND II (CONTINUED)

(H.K. Rising, G.R. Briggs)

Study of the X-Y conversion problem is continuing. M. Epstein is investigating sequential sine-cosine methods further with the help of WWI, to determine the effect of round-off errors. We are extending the method discussed in the last biweekly to calculate sine and cosine to greater accuracy than six bits, since this accuracy is not sufficient for the computer or probably for the radar mapping scopes either. Methods of obtaining the increments for the X-Y conversion other than obtaining them from the radar are under investigation also.

(D. Shansky)

An investigation of the address selection and memory core driver circuitry for use in the proposed 64 x 64 x 32 magnetic core memory in WWII has begun. A possibility exists for the use of an Olsen magnetic matrix switch (see R-211) as the address selection device, this switch being used to control vacuum tube current drivers which will furnish the Read-Write pulses in the memory. An experimental 16 x 16 switch suitable for this application is now in the process of construction by A. Katz, while I am engaged in the design of the current stabilized core drivers.

(H.E. Zieman)

Some difficulty has been experienced in the decoding output amplifier with stability, causing a random motion of the scope spot. A preliminary investigation seems to indicate that a variation in the DC supply, such as induced pulses, is causing the trouble. It is felt that a push-pull amplifier throughout might cure this difficulty. Further filtering of the DC supplier within the amplifier may also help with regard to induced pulses but will not help any drift conditions in the supply.

The present deflection amplifier in the 16 inch display scopes has been redesigned. By using a push-pull feedback system, the phase inverter stage has been eliminated, two tubes have been eliminated, and a troublesome VR coupling tube became unnecessary. Only a buffer amplifier and the final stage remain, reducing the circuit complexity from seven tubes to five tubes. An extra tube was added as a voltage stabilizer for the position control.

The circuit has been designed and built and is now being tested.

10.0 PUBLICATIONS

(M.R. Susskind)

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

LABORATORY REPORTS

1. SUMMARY OF IBM - MIT COLLABORATION, December 1, 1952 to December 31, 1952 inclusive , M-1780, A.P. Kromer, January 5, 1953, pp. 1-2. (For Internal Distribution)

CONFIDENTIAL

. MEMOS CONCERNING THE 1953 CAPE COD SYSTEM, M-1815, D.R. Israel, February 5, 1953, pp. 1-5.

CONFIDENTIAL

3. REVISED OPERATIONS WITH THE MPS-4 NODDING BEAM HEIGHT FINDER, M-1816, J.J. Cahill, Jr., February 2, 1953, pp. 1-5.

CONFIDENTIAL

4. SUMMARY OF IBM - MIT COLLABORATION, January 1, 1953 to January 31, 1953 inclusive, M-1817, A.P. Kromer, February 3, 1953, pp. 1-2. (For Internal Distribution)

CONFIDENTIAL

5. LINCOLN DIVISION 6 GROUP ORGANIZATION LIST, M-1825, February 9, 1953, pp. 1-13.

RESTRICTED

6. AIR DEFENSE BIWEEKLY, January 30, 1953, M-1826, pp. 1-25.

CONFIDENTIAL

7. FEBRUARY FLIGHT TEST SCHEDULE, M-1832, A. Hill, P. Dolan, F. Heart, February 5, 1953, pp. 1-2.

CONFIDENTIAL

8. FLIGHT TEST PROCEDURES, M-1835, D.R. Israel, February 10, 1953, pp. 1-2.

CONFIDENTIAL

9. OVERALL ORGANIZATION OF THE CAPE COD INFORMATION AND DIRECTION CENTER (Supplement to M-1815: 1953 Cape Cod System), M-1839, D.R. Israel, February 11, 1953, pp. 1-5.

CONFIDENTIAL

10. PRELIMINARY DESCRIPTIONS OF DUTIES AND EQUIPMENT FOR INFORMATION AND DIRECTION CENTER PERSONNEL (Supplement to M-1815), M-1840, D.R. Israel, February 12, 1953, pp. 1-21.

CONFIDENTIAL

11. FLIGHT TEST ACTIVITY REPORT FOR JANUARY, 1953, M-1842, A. Hill, F. Heart, pp. 1-2.

CONFIDENTIAL

10.0 PUBLICATIONS (CONTINUED)

(M.R. Susskind)

TECHNICAL REPORTS

1. "Index of Air Force Electronic Components Under Development," Wright-Patterson Air Force Base, Ohio, 1 November 1952, Lib. No. 1245R.

RESTRICTED

2. "The Aerodynamic Characteristics of Fin-Stabilized Rocket Models With Oversized Heads," NAVORD Report, Part 3. MACH Number 1.86, & Part 4. MACH Number 2.87, 17 October 1952, China Lake, California, Lib. No. 2043R.

RESTRICTED

3. Radar Interceptor, Monthly Newsletter, Research & Development Laboratories, Hughes Aircraft Company, January 1, 1953, Lib. No. 1763C.

CONFIDENTIAL

4. "Three Dimensional Flight Table, Device No. 24-X-5," Quarterly Progress Report No. 3 for period ending December 31, 1952, Bendix Research Laboratories, Detroit 1, Michigan, Lib. No. 2158C.

CONFIDENTIAL

5. "Progress Report on Reliability of Electronic Equipment, Vols. I & II," prepared by Ad Hoc Group on Reliability of Electronic Equipment, Research & Development Board, Dept. of Defense, February 18, 1952, Lib. No. 2261C.

CONFIDENTIAL

6. "Study of Materials for Jet Vanes in the Bomber Defense Missile," Report No. BE-753-S-8, Cornell Aeronautical Laboratory, Inc., October 31, 1952, Lib. No. 2266C.

CONFIDENTIAL

7. "Jet Vane Controlled Bomber Defense Missile," Quarterly Progress Report No. 4, BE-753-S-6, Cornell Aeronautical Laboratory Inc., January-March 1952, Lib. No. 2267C.

CONFIDENTIAL

8. "Progress Report for December 1952," Control Systems Laboratory, University of Illinois, Urbana, Lib. No. 296/S.

SECRET

9. "A Non-Coherent Doppler Automatic Tracking Airborne Radr for Use On Moving Ground Targets," R-31, 26 November 1952, Control Systems Laboratory, Univ. of Illinois, Lib. No. 297/S.

SECRET

10. "Progress Report for November 1952," Control Systems Laboratory, University of Illinois, Lib. No. 298/S.

SECRET