Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: GROUP 61 AIR DEFENSE BI-WEEKLY, September 26, 1952

1.0 GENERAL

(D. R. Israel)

On Tuesday and Wednesday, September 16 and 17, Bob Wieser and I visited the Cornell Aeronautical Laboratory (CAL) at Buffalo, N.Y. The greater part of this visit was concerned with discussions of the studies which CAL has carried out in connection with Fleet Air Defense; in particular, we discussed considerations governing the choice of tactical doctrine in final-phase attacks. A group at CAL has been studying fighter-bomber engagements with various types of participating aircraft and weapons. The results of our discussion with this group will be the subject of a forthcoming M-note.

The people at CAL are very interested in the experimental results of our forthcoming final-phase tests, since these results can be compared to those obtained there by analytical studies. Discussions at CAL also pointed out the need for proper instrumentation to measure the final-phase separations of the tests. For this purpose movie cameras in both the target and interceptor aircraft may be used. A briefing of the pilots and observers of the Flight Test Squadron at Bedford will be held before the first of the final-phase interception tests.

While at CAL, we were briefed on two other pertinent projects. These were IKE, an analog computer to be used by a controller for carrying out interception computations in conjunction with analog TWS equipment and TEC, an equipment to be used as an aid in assigning carrier-based interceptors against bomber threats. Each of these equipments is in the construction stage.

On Thursday and Friday, September 18 and 19, Wieser and I visited the Control Systems Laboratory at the University of Illinois. That laboratory is engaged in studies involving the use of a digital computer for Tactical Air Command purposes. The computer which they will use, the second ORDVAC, has only recently been completed and they have as yet had only several opportunities to use it with their programs. At first they will employ only simulated radar data. Their preliminary experiments will

1.0 GENERAL (Continued)

(D. R. Israel) (Continued)

involve the control of friendly aircraft around a polygonal course; the control problem, as they are attacking it, is not that of guidance to a point (as it is with out interception or guidance runs) but is of "beam-riding" or guidance along a fixed path.

The only other problem which the group at the Control Systems Laboratory has as yet had an opportunity to study is that of the tracking of 100 aircraft. They have developed a correlation method and smoothing formulae, which are quite similar to our own.

The group engaged in studies relative to WWII is making progress, although not as rapidly as had been hoped; the chief difficulty is that the leaders of the group (Arnow, Walquist, and myself) have been forced to divert their attention to several other matters. Ways of handling and manipulating both the radar and track data have been studied and a list of all of the presently known correlation methods has been drawn up. Investigation of each of these methods will be undertaken during the coming bi-weekly period, as soon as some definite conclusions have been reached in connection with the problem of height. Present indications are that a three dimensional correlation scheme will be necessitated since we are considering short range radars with beams readhing elevation angles of 45° to 60°.

B-Box studies are nearing completion.

2.0 EQUIPMENT ENGINEERING

(N. Alperin)

A prototype light gun was delivered from the machine shop. It will soon be used during flight tests to see if it works satisfactorily under actual operating conditions.

The gun has two apertures, one for fine resolution and the other for general purpose work. A neon bulb in the back of the gun indicates when a target has been initiated upon.

(H. J. Kirshner)

The D.R.R. display 'scope has been afflicted by numerous troubles during the past few weeks but now appears to be operating normally.

Rockport and Scituate terminal equipments were checked prior to resumption of their operation with the computer. During the process of testing, approximately thirty 6AG7's were replaced. The major defect with these tubes was low emission and an autopsy performed in the tube shop showed that the cause was flaking of the cathode material.

2.0 EQUIPMENT ENGINEERING (Continued)

(H. J. Kirshner) (Continued)

Since the resumption of computer operations radar data from the Scituate and Halibut Point sites has not been available simultaneously for any worthwhile length of time. This was primarily due to completion of installation work at Halibut Point and the preparations for the demonstration at North Truro.

Negotations are underway to secure cross telling data from three G.C.I. stations in and bordering the Cape Cod System area. This information will be transmitted by teletype. Mr. Entichnop and Mr. Davis of Group 21 have been very helpful in assisting us to secure these facilities.

Since the last bi-weekly period the following new equipment has become available in Room 222:

1. Display #3
2. Indicator lights for flip-flop #2
3. Printer #1

Discussions are continuing with representatives of Ampex Electric Co. with regard to procuring a 14 track recorder. Informal specifications are now in the hands of Ampex and their comments are expected soon.

(B. Morriss)

The printer for Room 222 has now been installed. It responds to the si 216 (octal) order.

It was pointed out that the In-Out Delay Counter requires considerably longer to propagate a carry through all 14 digits than was assumed. This indicates the possibility of marginal operation at present and the necessity of changes in the block transfer orders. Timing is being measured to determine the extent of changes necessary.

The question of decimal indicators as a part of the In-Out System has continually come up. A cursory look at available equipment some time ago did not reveal anything which would not involve considerable equipment and without considerable high-speed storage be very slow from the computer's point of view. The use of the buffer drum for the storage has been suggested and G. Young and myself will continue to search for decimal display devices. It would be appreciated if anyone having knowledge of such devices would pass the information to us. It is impossible to intelligently investigate such systems without much better estimates as to the number which might be desired, and the approximate rate of change of data displayed in this manner.

2.0 **EQUIPMENT ENGINEERING** (Continued)

(G. F. Sandy)

The installation of racks in Room 156 seems to be slightly behind schedule. However, it is still hoped that they will be completely installed by October 10.

Most of the w res that run between test control and Room 156, test control and Room 041, and Room 156 and 041 have been cut and marked. The 4 x 4 wireways between Room 156 and Room 041 have been installed, except for the connections at the ends.

Last Tuesday morning, some modifications were made to the Power Supply Control Panel #1 in preparation for the tie-in with the Power Supply Control System #2. It is planned to complete these modifications next Tuesday morning.

Due to Alpha wire not meeting their expected delivery of #10 twisted pair cable, this cable has been ordered from Packard Electric. (Delivery in three to five weeks.) This is a critical item, since this wire must be sent to Gavitt Mfg. to be fabricated into cables for the rack power distribution.

(J. H. Newitt)

No further progress has been made during the subject period in the production of a frozen WWI equipment schedule. There are several key items upon which commitments have not been made. A strong effort will be made to resolve these items and to issue a frozen schedule before the end of the next period.

A contractor has been selected for the new WWI air conditioning work. Installation planning on this item is now underway. It is expected that this equipment will go in on schedule and be in proper operation prior to its actual need. Temporary heating arrangements may have to be made for Room 156 during late October and early November while installation of the air handling unit is progressing. The contractor has agreed to take care of this item at no charge to us.

(A. V. Shortell, Jr.)

Planning for the installation of the Teletalk Inter-communication System has been completed. Cabling for the master stations has been received as well as the metal junction boxes. Bill Carroll's crew has commenced work on running cables from master station locations to the central junction boxes which will be located in Room 226. The teletalk units, promised for September 25, have not been received as yet but are expected within a few days.

2.0 EQUIPMENT ENGINEERING (Continued)

(A. V. Shortell, Jr.) (Continued)

Photos of the video mapper and a mask of Scituate data were taken during this week. These photos are to be used in a Lincoln Summary Report.

(G. A. Young)

Engineering Note E-481, Toggle Switch Inputs and Indicator Light Outputs as External Units was issued this last bi-weekly period. The writing of test programs and procedures for testing the Auxiliary Drum was also started.

3.0 BEDFORD EXPERIMENTS

(D. R. Israel)

Pending satisfactory arrangements and more widespread acceptance of late night and early morning computer operation, the work in connection with the Bedford Radar (and presumably that of the other sections of Group 61) is suffering badly from a lack of computer time. At the present time there is not time between 8:00 and 5:00 for other than flight tests.

(M. Brand)

Final Phase Guidance

The Guidance Program T-2025-5 has worked successfully on recorded runs. A flight test on September 25, 1952 was not too successful due to faulty radar data and compiter trouble.

Beacon Response

Beacon Response Program T-2074 was written to work in conjunction with the Basic Two Aircraft Interception Program T-2061-4. This Beacon program uses registers 1433-1577 in T-2061-4. A new program using an averaging method for eliminating multiple displays has been written. This cuts the number of registers from 100 to 61. It has been written in relative address form pending a rewrite of T-2061-Y.

Aided Tracking

I have prepared an outline of the new Heading-Velocity Smoothing method.

One A/C Printing Analysis

This program is still being checked out.

3.0 BEDFORD EXPERIMENT

(P. O. Cioffi)

The basic 2 a/c tracking and interception program (T2061-4) has been brought to a point where only a minor change is required to put it in a final acceptable form; the only apparent error is in the scope display of the target's bearing angle. The program was used for a live test the last day of this period and the results were quite satisfactory. Some difficulty experienced in the initiation process is suspiciously attributable to the equipment.

I have resumed reading material in connection with air traffic and control in preparation for my early expected visit to the Air Traffic Control Center in Boston.

(F. W. Garth)

My project has been automatic initiation upon the interceptors, prepared to fit into the Basic Two Aircraft Interception and Display Program. With the help of Frank Heart I completed the programming and am waiting to try it on the computer.

Changes have been introduced into the automatic initiation from what was proposed two weeks ago. The program now uses FF3 as the switch selector of four modes: 1) an interceptor clear channel with display only of the target position; 2) the interceptor standing-by at Grenier Air Base; 3) the interceptor airborne at Grenier Air Base as determined by the control tower; and 4) normal tracking of both aircraft with all initiations controlled by the light gun.

(C. H. Gaudette)

The new basic two aircraft tracking program is now operating satisfactorily. The program is now being reorganized to accommodate the needs of the people who will use this program.

(C. C. Grandy)

I am working with Brand and Zraket and the final phase guidance program has been checked out and one flight test has been made. Work on the final phase interception is continuing with C. Zraket. We are including provisions in this program for selecting any one of several attack angles and also are using a final separation between the fighter and target, that is a time separation dependent on the relative velocities of the aircraft rather than just a distance separation.

3.0 BEDFORD EXPERIMENT (continued)

(Frank Heart)

Work has continued on elaborations of (1) the 16-aircraft program and (2) the single-pair interception program.

(1) It appears that major portions of the 16-aircraft program suggested by D. R. Israel are well in progress (Knapp, Ward and others). Height Finder and various display sections are being written and tested. Certain equipment changes may be required and these are being studied, as are further elaborations.

(2) a) It is hoped that the recently completed basic interception program can be combined with various other programs to obtain a sophisticated single-pair intercept program. In particular, it would be nice to include: Height Finder, Automatic Initiation, Beacon, Final Phase Calculation, and Anti-aircraft. Storage immediately becomes a problem. The approach presently being considered is revision of these various sub-programs to produce less sophisticated minimal-storage routines, including only those abilities really necessary for successful operation.

b) Some time was spent studying methods of "increasing" storage by use of magnetic tape. It was thought possible to have two sections of the program stored on magnetic tape. Then, for about two thirds of the 15-second scan, program A would operate, and at south, program B would be read in to storage, operate and be replaced again by program A. Assuming 600 registers for each block, it was found that read in of each block required, very approximately, two seconds. Assuming up to one second for operation of program B, this required about 5 seconds for insertion, operation, and replacement of program B.

Unfortunately it was also necessary to rewind the magnetic tape unit to the beginning of the two blocks in preparation for the next scan, and during this rewind the in-out switch is tied up and cannot be used for any other in-out operation (in particular, scope displays). Thus rewind is not feasible.

It was suggested that the two blocks be recorded redundantly for the entire length of the tape, eliminating rewind. One reel of tape would supply only approximately ten minutes running time. It was felt that alternate use of two entire magnetic tape units was too much of a brute force approach.

c) Some time was spent considering operating equipment requirements for this program.

3.0 BEDFORD EXPERIMENT (continued)

(S. C. Knapp)

The "Two on One" Interception Program has been checked out and a flight test using it will be held next week.

The Multiple Aircraft Tracking Program now works as far as tracking 16 aircraft is concerned, but program errors still exist in the Automatic Initiation section. A modification has been written to display the x, y, v, ψ, and height of any aircraft selected for this display by the light gun.

Due to lack of storage space, it has been decided to write the height finder section for manual height selection only, rather than an automatic scheme as previously planned. George Rawling is working on this modification for utilization of the height finder.

(G. A. Rawling)

Study of height phase of 16 a/c tracking program was continued.

(A. B. Ward)

A subroutine has been written which displays the decimal digits of a number in 4 x 7 form. It has been submitted to Bill Lone for inclusion into the subroutine library.

Indoctrination Problem #2 and a program written to test this subroutine were successfully run on the computer.

At present a subprogram to display letters as well as numbers is being worked on.

(C. R. Zraket)

The Basic 2 a/c Interception and Display Program, written with Cioffi and Gaudette, has been run successfully in a flight test. It is now contemplated that this program will be completely rewritten with the intent of conserving space by utilizing new orders such as "dm". Investigations are now being made to determine what is the optimum form for the program in order that such things as Height Finder Calculations, AAA, Automatic Initiation, Beacon, and Final-Phase

3.0 BEDFORD EXPERIMENT (continued)

(C. R. Zraket) (continued)

Calculations can later be fitted into the program with a minimum of effort.

The Final-Phase Interception Program has been written and checked and is now awaiting incorporation into the Basic 2 a/c Interception Program. It is hoped that an M-Note can be written on this subject as soon as operational results are in.

A Flight-TestSchedule for the month of October has been drawn up with C. Gaudette and will be available shortly from A. P. Hill.

A Final-Phase Guidance Test on September 25, conducted to check the rewritten program, gave poor results due to very spotty radar data and computer malfunctioning. The program itself operated correctly.

3.0 Bedford Experiment (continued)

(A. P. Hill)

The Flight Test Schedule from September 12 through September 26 is shown below.

Date	Scheduled Test	Tests Held	Reasons for Changes in Schedule
Sept. 17	1000-1100 (Gaudette) CALIBRATION 1100-1200 (Cahill) AAA GUIDANCE	Cancelled	Test Started - Radar Data Poor and Aircraft Returned to Base
Sept. 18	1000-1200 (Gaudette) TWO AIRCRAFT INTERCEPTS	Cancelled	Time Used for Testing Programs
Sept. 19	1000-1200 (Gaudette) THREE DIMENSIONAL INTERCEPTS With A1	Cancelled	All Available A/C Being Used for "Quick-Fix"
Sept. 22	1000-1200 (Gaudette) THREE DIMENSIONAL INTERCEPTS	Cancelled	Bedford MEW Inoperative
Sept. 23	1400-1800 (Brand & Webster) GROUND OBSERVER TEST	Cancelled	Weather
Sept. 24	1000-1200 (Brand) FINAL PHASE GUIDANCE 1400-1600 (Brand) BEACON TEST	Cancelled Cancelled	No Aircraft Available, "Quick-Fix" Test No Aircraft Available, "Quick-Fix" Test
Sept. 25	1000-1200 (Zraket) FINAL PHASE GUIDANCE 1400-1600 (Israel) JET COVERAGE	As Scheduled As Scheduled	
Sept. 26	1000-1200 (Gaudette) THREE DIMENSIONAL INTERCEPTS A1 RADAR	Did Not Use Height Finder, Rest as Scheduled	Height Finder Program Was Not Ready

Results of Flight Tests held:

Sept. 25, 1000-1200 Final Phase Guidance

An F-51 was used, starting at Concord, N. H., taking heading for Sanford Airport. Tracking was very poor on this run, came within three miles of Sanford. The next run started at Newburyport, heading for Sanford. Tracking was better but weather closed in and aircraft returned to base.

Sept. 25, 1400-1600 Jet Coverage Cape Cod Area

Bedford to Quonset Point - Altitude 8,000'- Good
Quonset Point to Otis Field - Altitude 10,000'- Good
Otis Field to Quonset Point - Altitude 12,000'- Good
Quonset Point to Otis Field - Altitude 14,000'- Very Good
Otis Field to Provincetown - Descending to 7,000'- Good
at all altitudes except 7,000'.

Sept. 26, 1000-1200 Two Aircraft Intercepts (A1)

Target (B-17) starting 15 miles east of Rockport
Interceptor (B-25) starting at Concord.

Run #1 - Target passed 1/4 mile ahead of interceptor.
A1 Radar "locked-on" at 9,000 yards.

Run #2 - Target passed 3,000' ahead of interceptor.
Radar "locked-on" at 6,000 yards.

Run #3 - Ten feet separation, radar "locked-on" at
10,000 yards.

4.0 DATA SCREENING

(R.L. Walquist)

Considerable time has been spent with other members of the data screening group in an attempt to specify the characteristics of Muldar Tracking Program #2 (MTP#2). Several of the more important characteristics of the program are listed below (a more detailed explanation of some of these is given by Attridge and Ishihara in their bi-weekly reports):

1. Acceptance of radar data from 1,2, or 3 radars comprising the Bedford, Rockport, and Scituate sites.

2. Correlation by breakdown of target tracks by quadrants of a radar set.

3. Tracking of both high-velocity and low-velocity targets; high-velocity targets tracked by non-linear smoothing; low-velocity targets tracked by positional tracking.

4. Automatic initiation from a selected area of the radar coverage (this area can be expanded to include all of the area of radar coverage).

5. A tracking method that allows for tracking twice as many low-velocity targets as high-velocity targets (5 storage registers used for low-velocity targets and 10 storage registers used for high-velocity targets).

6. A maximum tracking capacity of about 50 or 60 high-velocity targets.

7. Program instructions and radar data stored on computer-controlled magnetic tape units.

Several methods for automatic monitoring of the data screening program are being considered for the Cape Cod System. This automatic monitoring would consist of the computer (WWI) giving some form of warning when conditions deviate from normal. Three principal aspects of this problem are under study:

1. Fluctuations and/or errors in the input data from each radar set.

2. Program tracking capacity is exceeded.

3. Excessive target density in one particular area of the overall radar system.

4.0 DATA SCREENING (CONTINUED)

(R.L. Walquist) (Continued)

A memo is being prepared which discusses the reasons for carrying out this automatic monitoring and indicates various methods for accomplishing the desired results.

(W.S. Attridge, Jr.)

Methods of initiation for MTP #2 have been under consideration. Certain decisions have had to be made on the tracking methods to be used because of the close interrelationships of initiation and tracking. Furthermore, requirements of the correlation program have had to be considered.

New tracks are carried as five-register positional tracks. This type of tracking does not compute velocities, so as an additional feautre the initial position of the track is remembered, making possible a calculation of velocity during the initiation transient. The velocity can thus be determined after the initiation transient, and a decision can be made as to how the particular track should be carried henceforth in storage (e.g., poisitonal tracking or velocity tracking). The detection of noise can be accomplished by counting the misses during the initiation transient.

(P.R. Bagley)

I have begun again to think about the problems of simplified forms of tracking for slow-moving and stationary objects relevant to automatic initiation of targets into the system.

(D. Goldenberg)

1. The preliminary rough draft of the memo on the time analyses of various methods of sorting was completed and submitted for typing.

2. A method of computing the radius vector with a minimum accuracy of 0.75% was determined and programmed, using less orders and shorter time of operation than the existing methods. The method and subroutine have been turned over to W. Lone who will issue them along with other subroutines.

3. A method of computing the angle from the rectangular coordinates has been determined. Its accuracy will be better than 1 part in 256, but the exact degree of accuracy has not been determined. The subroutine of this method is shorter than the existing subroutines.

4. Work has been begun on combining the aforementioned subroutines in one. A saving of at least 25% of the orders and the time of operation is possible.

4.0 DATA SCREENING (CONTINUED)

(J. Ishihara)

Efforts are now being concentrated on coding the correlation section for MTP #2. Methods not incorporated in MTP #1 because of their complexity, but which experience has shown to be necessary, will be tried. The program will be so arranged that variations of one or more stages may be made without difficult program changes. Auxilliary sections to obtain useful information about the operation of the program will be added.

The following is an outline of the present plans for MTP #2 correlation. Track sort will be by radar set quadrants; i.e., once per set, tracks which may possibly give returns from this set will be separated by quadrants referred to the coordinates of the set. The actual correlation will be done in stages for each piece of information:

1) Conversion to (x,y) and determination of the quadrant in which the return falls.

2) Correlation with possible low-velocity tracks of this quadrant using a fixed search area. Further correlation will not be attempted after the first match.

3) A "best fit" of the piece of data with all high-velocity tracks of this quadrant, the information being associated with the correlated track having the smallest deviation. Any deviation smaller than that possibly introduced by quantization will be considered a "best fit" and the return stored with this track without further processing. Correlation will be carried out using first a large fixed search area before checking with the smaller variable search area associated with each track.

4) Information still not correlated will then be checked with those tracks initiated upon during recent scans, in a manner similar to that used with low-velocity tracks. If the return still fails to correlate, it will be initiated upon. Initiation will be done using a "selective initiation area"; i.e., only returns in a predetermined area will be considered for initiation.

The priorities for correlation of tracks were decided upon in an effort to accomplish the following:

4.0 DATA SCREENING (CONTINUED)

(J. Ishihara) (Continued)

1) Early removal of returns in areas of clutter. (High-velocity tracks will be dead-reckoned through such areas.)

2) "Best fit" of high-velocity tracks to avoid erroneous corrections due to overlapping search areas.

3) The initiated tracks are checked last to aboid stealing of returns from established tracks and multiple tracking of the same aircraft.

(J. Levenson)

At long last enough computer time was made available to complete the problem with necessary corrections introduced.

Some time has been spent studying the MTP #1 program, and I am now working on a correlation scheme in conjunction with the work done by Ishihara.

(H. Peterson)

A program to display data from three radars and if acceptable to store the data from any combination of the three in blocks on magnetic tape is about ready to be checked out on the computer. This program blocks out the Mt. Monadnock region and store only non-zero range returns from Bedford. The azimuth is stored in digits 0 through 7 and the range in digits 8 through 15 with a binary point understood between digits 14 and 15.

(N. Potter)

A program for the display of single numbers on a 3 x 5 grid with an arbitrary center and unspecified scope intensification line has been written.

At present work is in progress on a study of a variety of search areas, appropriate for use in a muldar system, which are functions of the immediately preceding history of misses.

(H.H. Seward)

Several methods of sorting tracks by radar sets and quadrants involving a code associated with each track were devised and evaluated under supervision of J. Ishihara.

5.0 TRACKING AND CONTROL

(J. Arnow)

An attempt was made to record data from the Halibut Point and Scituate radars during the past bi-weekly period. This effort was unsuccessful due to the fact that these sets were primarily being used in preparation for a demonstration to be held at North Truro. As a result we were unable to obtain good live data from both radars at the same time. A few programs were tried using test patterns which gave an indication of gross errors present in the programs. These are being corrected and will be tried during the next bi-weekly period.

(M. Frazier)

Progress continues on the Bedford-Rockport two-radar single-aircraft tracking program.

(J. Hayase)

I prepared a tape for the single-aircraft track-while-scan problem. The program will be run off as soon as computer time is obtained

(B. Lone)

Lack of computer time has prevented the testing of the TRASACT, times and positions averaged, program with simulated data.

A live data program utilizing the features of the above mentioned TRASACT program has been written. Tracking has not yet been possible, and at present it is unknown whether the fault lies in the program, incorrect scan times of the Rockport and Scituate radars, or improper coordinates of these sites.

(A. Mathiasen)

Program and tape errors have held up the computer testing of programs rewritten for the new In-Out System.

The two-radar tracking and printing program mentioned in the last bi-weekly has been completed.

The first week was spent on vacation.

(B. Stahl)

TRASACT, Best Fit, is still being written and ways are being considered of adapting it easily to live data as soon as it is working.

5.0 TRACKING AND CONTROL (CONTINUED)

(B. STAHL) (Continued)

The three-radar display program was checked out for the first time since having been adapted to the new In-Out System, and considerable time was spent in search of the cause for arithmetic overflow and a discontinuity in the test circle. The overflow was finally traced to a spurious piece of data, while the discontinuity is thought to be the result of a wrong constant in the sine-cosine conversion section of the program.

Computer time was not available to check out the other programs which have been written previously for checking of radar returns.

6.0 AIR DEFENSE CENTER OPERATIONS

(D.R. Israel)

On Tuesday, September 23, a visit was made to the Naval Research Laboratory (NRL) in Washington, D.C., where I spoke with people who participated in the evaluation of the British CDS equipment. The discussions centered chiefly on the types of display facilities which are practical and useful for monitoring and operating a system in which a large number of aircraft are tracked. The people at NRL were convinced of the need for displaying numbers and symbols on display scopes together with the actual aircraft positions. Their experience has also been that while automatic track-while-scan is a necessary feature, automatic initiation generally offers but little advantage over what a scope observer can do when provided with proper displays; for example, if a scope display were made of those radar echoes not correlating with previously established tracks, satisfactory initiation, they felt, could be accomplished manually up until a point is reached where one scope observer is asked to initiate on more than ten or so new tracks per scan.

The available CDS literature will be reviewed for more details on the symbolic displays used, and it is hoped that manpower will soon be available for investigations of automatic means -- such as that described by Fred Irish in his thesis -- for number and symbol generation in connection with the Cape Cod System.

A discussion of air traffic densities both at present and in the future was held under the auspices of the Weapons Systems Evaluation Group (WSEG) in Washington on Wednesday, September 24. At this meeting, the Airborne Instruments Laboratory (AIL) reported on a study which they made of military, commercial, and private traffic in various sections of the country on a typical day in the fall of 1951. For this study they selected eight representative areas throughout the U.S. and gathered the totals for the number of aircraft airborne during each hour of the day within a circle of 100 miles radius. For the circle centered at Hartford and including airports at Boston and New York City it was found that during either the peak hours of the morning and afternoon more than 500 aircraft would be in the air. The traffic seems to build up in the morning, take a dip at noon, peak again in the afternoon, and then fall off to almost nothing in the late evening and early morning hours. (A complete report of the study is now under preparation by AIL; copies of several of the more pertinent graphs are in the possession of D. Israel.)

At the WSEG meeting, representatives of the CAA reported on studies which they made of commercial and private flying in the same areas and a representative from Air Defense Command reported on a study made of the numbers of aircraft actually seen by the radars of the air defense network. The latter study is classified SECRET and did not correspond to the areas of the AIL study.

6.0 AIR DEFENSE CENTER OPERATIONS (Continued)

(D.R. Israel) (continued)

The data obtained by AIL includes that needed to compute the traffic to come under the coverage of the Cape God System, and that data has been made available to us. Peter Cioffi will undertake to utilize this data to determine the figures for the Cape Cod System.

(J.J. Cahill, Jr.)

The AA Guidance Georef Print-Out program, T2019M1, has been checked out, and is now available. The new Height-Finder program, T2083, for use with the Basic Two-Aircraft Tracking program, T2061M4, (C. Zraket, et al.) has not been checked out as yet. Two program errors have been found, and it is felt that the program will be operational very shortly.

Some progress has been made toward the Target-&-Battery Evaluation program and a simplified form for use with the proposed Single-Pair Interception program has been roughed out. In both cases, lack of storage space seems to be a stumbling block, but it seems reasonable to hope that the programs can be made to fit by giving up some of the desired AA features, at least for the duration of present storage limitations.

No AA Guidance tests were run during the past two weeks, since the Battery generally used is away from its position at present. It will return about October 15.

(F.A. Webster)

Work has been continued on the problem of tracking under a system (such as the Ground Observer System) where large variability and rough approximations characterize both the system itself and the data it uses.

7.0 ASSOCIATED STUDIES

(P.R. Bagley)

Programming for In-Out Units. I have written and published a memorandum entitled "Programming for In-Out Units" (Memorandum M-1623 and Supplement #1), containing all of the details concerned with in-out programming which programmers will normally need to know. This memo and the following publications together form a basic reference manual for programming:

Short Guide to Coding and WWI Operation Code, M-1624.

7.0 ASSOCIATED STUDIES (Continued)

(P.R. Bagley) (Continued)

Input Program, September 1952, E-473.

Basic Conversion Program, E-479.

Group 61 Subroutine Library, M-1631.

Security of Classified Programs. At a conference of C.W. Adams, J.C. Proctor, and myself, we concluded that it would not be feasible to arrange for the handling of confidential program sheets by the Tape Room. The consequence of this decision is that no one may submit to the Tape Room any material containing confidential notes or titles. Memorandum M-1642, "Security of Classified Programs of Group 61," discusses more fully the proper procedure for handling classified programs.

Storage Print-Out and Punch-Out Programs. I have brought the Four-Way Storage Print-Out Program up to date. It is now available as T-2066-2, and occupies registers 1340 to 2003 octal. A 556 Storage Punch-Out similar to the previous storage punch-out program is also completed. It is available as T-2071-0, and occupies registers 1713 to 2006 octal. The instructions for using both of these programs are posted on the bulletin board in the computer control room.

Indoctrination. Indoctrination of a new member of Group 61, William Wolf, has occupied a small amount of my time.

(W.A. Clark)

WWII Studies:

Committee meetings have consumed a large amount of time during the past biweekly period. These have essentially been devoted to the presentation and discussion of the concepts and parameters involved in the WWII specifications problem.

Time and storage analyses of indexing techniques used in Group 61 programs have continued.

(J. Hayase)

Analysed subroutines listed in W. Lone's Memo M-1631, and evaluated the number of data registers used, the number of relative addresses in the subprogram, and the number of data registers modified. Particular attention was given to the conversion of (x,y) to (R,A).

7.0 ASSOCIATED STUDIES (Continued)

(F. Heart)

Some time was spent assisting with Group 61 indoctrination. Two days were spent in assisting in the general laboratory one-week indoctrination program.

(G. Rawling)

Whirlwind II Associated Studies

The Non-linear Smoothing 2C Subprogram was evaluated in terms of access and program time used with respect to registers used, modified, readdressed, etc., for comparison with a similar program using a B-Box.

Two short informal notes were distributed; the first comprising remarks by B. Morriss on "Circulating Registers", the second, remarks by C. Adams on the "B-Box."

(W.I. Wells)

Work is continuing on the application of linear filters to the output of markoff chain processes. For a model problem, a filter was designed, which succeeded in reducing the mean square error of a signal plus noise input. The input was a signal having only discrete levels and the output, of course, had all possible levels. Thus, even though the mean square error was reduced, the filter actually was not useful. Actually, from the statistics of the input it could have been shown that no type of filter could remove any noise, for this particular problem. This just means that the mean square error criterion failed to yield significant results in this case.

8.0 COMPUTER OPERATION

(C.H. Gaudette)

During the period from September 14 to September 27 the assigned computer time was used as follows:

Equipment Characteristics	0.83 hours
MEW Tracking and Control	4.42 "
Data Screening	1.92 "
Multiple Radar Tracking and Control	1.50 "
Air Defense Center Operations	0.50 "
Indoctrination Programs	2.25 "
Miscellaneous	4.67 "
Sub Total	16.09 "

8.0 COMPUTER OPERATION (Continued)

(C.H. Gaudette) (Continued)

Flight Tests	4.00	hours
Calibration	.75	"
Equipment	1.00	"
Conversion	.67	"
Time Lost	2.16	"
Time not used	38.33	"
Total Assigned Time	63.00	"

9.0 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. "A Criterion for Assigning Targets to Batteries in an Antiaircraft System," J.J. Cahill, Jr., M-1625, September 11, 1952, pp. 1-8.
   CONFIDENTIAL

2. "WWII Meeting of September 12, 1952," N.H. Taylor, W.A. Hosier, K.H. Olsen, September 15, 1952, M-1640, pp. 1-2.
   CONFIDENTIAL

3. "Group 61 Bi-weekly Report, September 12, 1952," M-1641, pp. 1-15.
   CONFIDENTIAL

4. "Security of Classified Programs of Group 61," P.R. Bagley, September 16, 1952, M-1642, pp. 1-2.
   CONFIDENTIAL

TECHNICAL REPORTS

1. "A Wind-Tunnel Investigation at High-Subsonic and Low-Supersonic Mach Numbers on a Series of Wings with Various Sweepback, Taper, Aspect Ratio, and Thickness," W.G. Harris, Aircraft Laboratory, Wright Air Development Center, Dayton, Ohio, October 1951, Lib. No. 2071C.
   CONFIDENTIAL

2. "Echo-Box Pulse Doppler Radar," L.D. Smullin, R.H. Fox, Research Laboratory of Electronics and Lincoln Laboratory, M.I.T., May 6, 1952, Lib. No. 2075C.
   CONFIDENTIAL

3. "Theory of Errors in Automatic Navigation with Integrating Accelerometer Systems," The Rand Corporation, Santa Monica, California, May 5, 1952, Lib. No. 2080R.
   RESTRICTED

4. "Quarterly Progress Report, Division 4-Weapons, Division 3-Communications and Components," Lincoln Laboratory, M.I.T., July 1, 1952, Lib. No. 271/S.
   SECRET

9.0 PUBLICATIONS (Continued)

(M.R. Susskind) (Continued)

5. "Quarterly Progress Report, Division 2-Aircraft Control and Warning, Division 6-Digital Computer," Lincoln Laboratory, M.I.T., June 1, 1952, Lib. No. 272/S.

SECRET

6. "Multiplexing a Radio Teletype System Using a Random Carrier and Correlation Detection," Pankowski, B.J., Research Laboratory of Electronics and Lincoln Laboratory, M.I.T., May 16, 1952, Lib. No. 273/S.

SECRET

7. "TROUNCE Radar-Command Missile-Guidance System for SSG Submarines," Spilmer, B.H., Poirier, J.H., Kidd, E.C., Systems Division, U.S. Navy Electronics Laboratory, San Diego, California, July 17, 1952, Lib. No. 274/S.

SECRET

8. "Quarterly Progress Report, Project Lacrosse," Cornell Aeronautical Laboratory, Inc., Buffalo, N.Y., January-March 1951, Lib. No. 275/S.

SECRET