Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: GROUP 61 BIWEEKLY REPORT, DECEMBER 5, 1952

1.0 GENERAL

(P.R. Bagley)

Revision of Programming Memos. I have brought up-to-date M-1624 "Short Guide to Coding and Whirlwind I Operation Code," and M-1623, "Programming for In-Out Units." These memoranda will be distributed in the near future as M-1624-1 and M-1623-1.

Visitors. Lieutenant Colonels J.D. Prodgers and S.S. Hunn, Lieutenant T. O'Laughlin of AFCRC, and Major O. Cook of APGC, visited the Laboratory on December 5. They were given a briefing and witnessed a canned interception.

2.0 EQUIPMENT ENGINEERING

(H.J. Kirshner)

The H.F. radio communication link to Grenier Air Force Base has been checked and is now ready for operational use.

Members of the U.S. Navy flight test detachment attached to Project Lincoln will visit this laboratory for the purpose of briefing on the Cape Cod System. This naval detachment is equipped with two F3D all-weather fighters and two P2V patrol bombers which we may utilize in connection with our flight test activity.

A memo is being prepared relating to communication security and proper communication procedure. It is hoped that extracts from the "Brevity Code" (A.C.P. 1-65) will be available for inclusion in this memorandum.

(B. Morriss, G. Young)

Considerable time has been spent in discussing the present in-out system with the group from IBM. Most of the discussion was on the manner in which the buffer drum and its associated units will operate. Several meetings were attended in which methods of obtaining continuous scope displays using a magnetic drum were discussed. Some of these methods are being considered.

M-1733 A Word-by Word Mode of Operation for the Paper Tape Punch has been distributed. This note describes the use of the punch and the printers in the modes to be available after Monday, December 3.

Several people have asked about obtaining the original contents of the various registers of the computer after an alarm from the indicator light. It would probably be helpful if someone wrote a note describing how to do this for the various alarm conditions.

2.0 EQUIPMENT ENGINEERING (Continued)

(J. Newitt)

It has become desirable to extend the control of the air conditioning system for room #156 so that it will automatically adjust itself to the mode of equipment operation dictated by Test Control. During the past period, I have issued supplement #2 to M-1572 to outline the problem and to submit one possible solution. This data has been sent to the vendor and Minneapolis-Honeywell for incorporation into the installation plans. I have rejected the previous set of plans for technical reasons outlined in the subject memo. The vendor will resubmit plans next week for our approval. It is expected that the secondary air ducts will be installed in room #156 and that the air-handling unit for this room will be operative, within the next few weeks. In any case, I have made provisions for an emergency air supply for the drum equipment in case delay or difficulty arises with the present installation plans. Work on the penthouse (Barta) is expected to start soon and regrigeration equipment (now being held in warehouse storage) will then be installed. It is expected that present refrigeration equipment in use in Barta can be released by March at the very latest for use with MTC.

(F. Sandy)

Several Filament-Transformer panels have been received and installed. One Fuse-Indication and Rack-Interlock Panel has been received and installed. The other seven have been promised by December 15. Gavitt Mfg. delivered quite a few of the preformed cables for the power distribution in the MITE (multiple input terminal equipment) racks. These have been inspected and are being installed. The wireway out of the transformer room has been completed and power provided from the transformer room to room 156. Room 156 now has regulated and unregulated 115V.AC and lighting from this source.

Seven DC voltages are also available either from Whirlwind or laboratory supply.

The distribution of DC voltages to racks L1 and L15 have been checked and found to be correct.

20 plug-in mounting panels are due to arrive December 12.

(A.V. Shortell, Jr.)

The low-frequency sweep generator for simulating the azimuth sweep on the video mapper has been completed. In addition an intensification-gate amplifier has been built to obtain a variable-amplitude gate input for intensifying the Dumont scope. This amplifier will help in determining an optimum amplitude for intensifying the scope. During the next biweekly period I expect to design a Schmidt circuit for sharpening up the output pulses from the phototube.

2.0 EQUIPMENT ENGINEERING (Continued)

(A.V. Shortell) (Continued)

The junction boxes for the Teletalk installation have been wired and are being mounted on the wall in room 226. It is hoped that Bill Carroll's crew will be able to run most of the cables during the next biweekly period. Until more definite information is forthcoming on the location of master stations in room 222, we are planning to install two stations in the operation section of the room.

(C.W. Watt)

Delivery of Raytheon plug-in units has now passed the 300 mark. As yet, we have no mounting panels, but testing of the units is progressing well. Quality has improved greatly over the first few received. Raytheon now has a separate shop of about eleven or twelve wiremen working on this job; delivery will undoubtedly pick up sharply from now on.

3.0 BEDFORD EXPERIMENT

(D.R. Israel)

The Instrumentation Laboratory has conducted several flight tests involving automatic control of their F-94 (#486) with instructions relayed from a controller on the ground via the new AFCRC 16-digit data link. A test of the new data link equipment at the Barta Building will be made next week, following which a computer-controlled intercept with the F-94 will be attempted.

Qualitative results of a flight test involving an APN/19 beacon in an F-80 indicate satisfactory coverage out to the range limit (128 miles) of the MEW data link. Quantitative results, including blip-scan ratios and information on multiple returns, should be available in a week or so.

Arrangements are being made through the Navy Liaison Office at Lincoln to use several Navy aircraft in our flight tests. Of particular interest will be two F3D Navy two-place (side-by-side) jets now based at Quonset. A visit by the pilots of these aircraft is expected very shortly; use of the aircraft will begin immediately.

During the preparations for and execution of the visitor demonstration of December 1, the Final-Turn Interception Program, the Complete Intercept Program, and the Sixteen Aircraft Initiation and Tracking Program (MACT-16) were used with excellent results. A satisfactory "return-to-base" was accomplished with the Complete Intercept Program. The operation of the Sixteen Aircraft Program was very satisfactory, and it proved to be an extremely desirable demonstration program.

Preparation of material for the Summary Report is under way.

(F. Heart)

Much of the last biweekly period was spent assisting in the demonstration of December 1, 1952.

The Complete Intercept Program, T-2187-2, is operative. It includes Automatic Initiation, Return to Base, Height Finder display, and AA display.

Work on the four-pair interception program has been delayed.

3.0 BEDFORD EXPERIMENT (CONTINUED)

(F.M. Garth)

During the eventful Thanksgiving week I gave assistance to Charles Zraket in the preparation of his Identification Display Program. See his report for an explanation of this project.

More effort was devoted to improving the operation of the Basic Two Aircraft Tracking and Interception Program now combined with Height Finder. I prepared a report on the automatic initiation phase of this program.

At present I am devoting time to a display parameter to the Basic Two Aircraft Program. It is to select any combination of the 16 oscilloscope lines and display characters of different sizes and positions.

(C. Grandy)

Demonstration. Much of this last period was spent writing and checking out a simulated display program described elsewhere in this report.

Complete Intercept Program. Some time was spent on this program and several improvements were made in the programming. No further work has been done on the other projects outlined in the last biweekly report, other than writing a brief summary of reattack as material for the Summary Report.

(S. Knapp & A. Ward)

The Sixteen Aircraft Initiation and Tracking Program has been checked out and was shown at the demonstration on Monday, December 1. It is now being revised to include automatic sequencing of information displays and height-finder data.

(C. Zraket)

Two final-turn interceptions were conducted during the past biweekly period, one employing a head-on attack, the second a tail approach. In the future, no more final-turn interceptions will be conducted until cameras which will take pictures of the interception are installed in the interceptor aircraft.

For the present, further work in interception techniques will be confined to consolidating work done to date and to checking pertinent sections of the master Single-Pair Intercept Program.

4.0 DATA SCREENING

(D. Goldenberg)

R. Walquist made the suggestion that the switching time for the Buffer Drum might be reduced to about four seconds and that the last estimates of velocity and position be used to predict to the center of each four-second time sector. Smoothing would be done once every four time sectors, or about every sixteen seconds. I have been following up this suggestion and find that for tracking purposes, this method has the advantages of: a) reducing the search area and b) reducing the amount of work the program must do in order to time correct the data to some reference time within the switching sector.

Work is continuing on a logical approach to tracking around turns using two search areas about the predicted position. Results so far indicate that this logical sequence will increase the amount of storage, but it may be possible to shorten and/or improve the smoothing and prediction portion of the program. If a turn can be sensed by one part of the program, the smoothing portion need only deal with straight line flight. Non-linear smoothing and prediction will not be necessary; those people who have worked on smoothing techniques have said that better straight line fits are possible if turns need not be accounted for by the method.

(J. Levenson)

I am writing test programs for the various parts of MTP#2 which have now been completed and will be run during the next biweekly period.

(N.S. Potter)

I am continuing my work on assorted displays to be used in MTP#2. They will probably be run during the next biweekly period after which a definitive report will be available.

(H.H. Seward)

A parameter was made for checking Ishihara's track sorting section of Muldar Tracking Program #2. This section will be tested sometime during the next biweekly period.

5.0 TRACKING AND CONTROL

(M. Frazier)

Primary effort has centered on completing the "semi-real-time" program, since computer time was not available in the past biweekly period for checking other programs.

(J. Hayase)

Work is progressing on problem of tracking a single aircraft with two radars.

(A. Mathiasen)

The two radar tracking program failed to track an aircraft during a turn. This occurred mainly because of the small search circles used (1.75 and 3 miles radius for the small and large, respectively). These had been chosen as adequate from a study of tracking with simulated data for straight line flights of a medium speed aircraft. It was desired to have them small to avoid difficulties encountered when noise returns were selected as best fits. (See the biweekly of June 6.) Thus, a devil-and-the-deep-blue-sea situation has arisen. A satisfactory answer has not shown itself, but a larger size, yet smaller than originally used, will be tried.

(B.R. Stahl)

Most of this period was spent polishing up the three-radar selective display program for photographic purposes and other display. Some work was also done on Nolan's calibration program. Work on other current projects which had been temporarily abandoned for the period, has now been resumed.

6.0 AIR DEFENSE CENTER OPERATIONS

(D. R. Israel)

The majority of the past biweekly period was devoted to efforts in connection with the demonstration of December 1:

a) assisting in preparation of sketches and text for TM-20

b) drawing up of specifications for the four simulated programs

c) preparation of descriptive material for simulated and flight test programs

d) preparations for the flight tests

e) reorganization of equipment in Room 222

Together with Arnow, Walquist and Wieser, detailed consideration is being given to the type of demonstration which can be planned for September 1953 and which does not require the use of equipment, the availability of which is presently doubtful. The principal equipment in this category is the buffer storage drum.

A rough draft description of a more complete Cape Cod System, including a buffer drum and other new equipment is presently in the possession of the author. This draft, written before TM-20, is accompanied by sketches and room layouts.

A visit by several staff members to the "Quick-Fix" station at North Truro is being planned for the next biweekly period. This will serve to familiarize us with their identification procedures and permit us to make an active start toward assembling those facilities and equipments which we will need for the identification aspects of our September 1953 demonstration.

(R. L. Walquist, W. S. Attridge, J. Ishihara)

A program (Simulated Track Initiation Display) to demonstrate the use of a digital computer to carry out automatic initiation of tracks and the use of a man-machine combination to carry out manual initiation was conceived, written, rewritten, debugged, run and checked out during this last period.

The program's displays simulate the use of a magnetic drum and suitable control equipment in generating a flicker-free display of radar input data (the last four scans of radar data are cyclically displayed; the display of any one scan being repeated fast enough to be flicker-free).

6.0 AIR DEFENSE CENTER OPERATIONS (CONTINUED)

(R. L. Walquist, W. S. Attridge, J. Ishihara)

The initiation features (automatic and manual) were based upon past Muldar experience or were incorporated because they seemed desirable.

(M. I. Brand, A. B. Ward, C. A. Zraket)

The major portion of the past biweekly period was spent in writing a Simulated Identification Program to be used in demonstrations. In general, the program will generate, in time sequence, six unknown tracks represented by velocity vectors upon a map centered roughly at New York City and having a 250-mile radius. Upon initiation on any one of the vectors, all information correlating with this track, such as flight plans, GOC reports, etc., are displayed in a blown-up picture on another scope. The operator then has a choice of identifying the particular track in question as hostile or friendly, or he can defer judgment until later. Whatever identification is made is then printed on the main scope. Various refinements have been made to the program in order to bring about a "flicker-free" display of desired information and to concentrate certain desired blocks of information, such as all hostile aircraft, on one scope line.

(W. Lone, J. J. Cahill, C. C. Grandy)

We have written a Simulated Track Monitoring Program. Every time the program cycles through, the present position of each of seven tracks is displayed. The previous position is displayed every second; the position two scans ago is displayed every two seconds. Once each fifteen seconds the raw data and track numbers are displayed. Four "critical" situations arise during the course of the program: the crossing of two tracks, the landing of one, one flying through clutter while being tracked, and one dead reckoning through clutter. Shortly before these events occur, the quadrant concerned is blown up and displayed automatically on another scope. The track numbers are displayed continuously at this time on the main or supervisor's scope, and a bar above the number indicates the transfer to the monitoring scope. When the crisis is over, the continuous flashing of the track number ceases. Any quadrant can be blown up on the monitor's scope for inspection by selecting a point in the proper quadrant by means of the light gun. Likewise the monitor's scope can be erased by the light gun, with a different choice of digit.

(W. A. Clark, C. H. Gaudette, S. Knapp, G. A. Rawling)

The past period was devoted to the planning, programming, and testing of the Simulated Operations Center Display (Raid Assignment and Interceptions), which program demonstrates the control functions of supervisory personnel in an air defense system utilizing a high speed digital computer.

6.0 AIR DEFENSE CENTER OPERATIONS (CONTINUED)

(P. O. Cioffi)

Work on the radar track identification problem and the associated assignment at the Air Traffic Control Center was interrupted and delayed this period because of the recent effort accorded the Simulated GCI Operations Program. I assisted Zraket and Brand in the preparation of their program for the demonstration.

(J. J. Cahill, Jr.)

Most of the time during this period was spent preparing a Simulated Data Display Program for use during the demonstration of December 1. This program is described elsewhere in this report.

One AA Guidance flight test was attempted. Lack of aircraft , except for a fifteen-minute period, made results inconclusive.

There were some peculiarities in the Height Finder and AA Guidance program operation using T-2187 (Single Pair Interception Program) during this period. Some computer time was spent trying to discover the cause, but the program ran for nearly two hours without demonstrating the peculiarities noted in flight tests. As near as one can tell, the above-named sections of this program are working perfectly at this moment.

(F. E. Heart)

A communication link (radio) has been established to Grenier Airbase, and the first "more realistic" experiment in automatic initiation will be carried out next week.

Due to the recent demonstration, several desirable changes where made in Room 222. A new 16-inch scope was installed; the radio consoles (2) were physically separated so that two people may conveniently operate them; and the tables were generally arranged in a more convenient manner. A set of switches (previously called the Ground Observer Corps box) for remotely inserting information into FF's 3 and 4 was checked out, and labels for the switches (in the form of paper overlays) were drawn. These changes should simplify flight test operations during the next few months.

(F. A. Webster)

Further consideration has been given to the basic nature of operations carried out by human beings and automatic equipment in complex control applications.

6.0 AIR DEFENSE CENTER OPERATIONS (CONTINUED)

(F. A. Webster) (Continued)

In normal computer operation, the programmer sets the number of decisions the equipment can make while processing a given set of data. The number is not increased by the operation of the information-processing system. Another way of saying this is that the system does not have "information gain". The boundary between programmer and computer must, therefore, be such that inductive processes are entirely within the province of the programmer who generates the instructions and not within the province of the computer which carries them out.

Information gain by a system implies that the number of decisions it can make increases as a result of its operation. The information initially contained in a system can theoretically be measured by the number of design decisions built into it (cf. Ashby). For this quantity to increase automatically as a result of operation of the system, information must be drawn from the external data which the system processes; and the information must change the decision structure of the operating instructions in such a way as to permit an increase in the number of valid decisions possible.

The chief reason why inductive processes are performed by humans, rather than machine components, is because such processes are inefficient (in terms of operation required); and the inefficiency tends to increase with the lack of properly-stored data relevant to the problem in question. To state it in common language, since machines do not think, they cannot figure out meaningful solutions. Consequently they must determine a correct course of action by relatively crude and inefficient trial-and-error methods; they must ask a lot of questions to get one useful answer.

In complex control problems that involve a great deal of uncertainty, however, provision for all possible situations demands a large amount of "design time"; and it may call for partial control-action by human monitors, linked into the system. If the human linkages are too slow or have poor properties of information-transfer, the capacity of the system is restricted. One approach to the problem is to put certain low-level inductive processes into the machine. Before the implications of machine induction can be evaluated, it is necessary that the basic structure of inductive operation be made clear. Such analysis is being continued.

7.0 ASSOCIATED STUDIES

(E. J. Craig)

The past two-week period has been spent evaluating criteria for the convergence of iteration processes involving matrices of order n. No really simple result has appeared.

Time has been spent studying several iteration procedures especially those in connection with the theory of descent. The viewpoint taken is principally that of a systems engineer rather than mathematical. Some correlation between function space and system viewpoints may be in the offing.

(D. Goldenberg)

The correlation portion of the program for air defense consumes the greatest part of the time available for processing data. A little thought has been given to the following idea:

a) Store, in map form, all of the data from one scan on an electrostatic storage tube, or a magnetic drum, or a special tube with two guns located on opposite sides of the writing surface.

b) Read out with a beam deflected or gated by coincidence circuits to the predicted points for each of the tracks in storage.

c) The resulting data or no data read out will determine whether any of the data correlates with each track used to "read out".

Thinking has not been carried very much further because of my lack of engineering knowledge of storage tube and magnetic drum function and circuitry. But even if it is practical engineering-wise, it is not certain whether a significant saving of time can be effected without loss in accuracy of smoothing and prediction. Comments of others would be appreciated.

(W. K. Linvill)

Continued work on design procedure for Sampled-Data Control System.

(W. I. Wells)

An attempt was made to treat the problem of quantized data where the flight path is not straight. This work is done in one dimension only. A procedure has been worked out which handles the most recent four pieces of data. When turns are being considered, the usefulness

7.0 ASSOCIATED STUDIES (CONTINUED)

(W. I. Wells)

of past data diminishes rapidly. The next question to be investigated is the quality of smoothing that may be achieved by this procedure.

8.0 COMPUTER OPERATIONS

(M. I. Brand)

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

MEW Tracking and Control	
Flight Tests	3.00
Magnetic Tape	1.50
Data Screening	1.10
Multiple Radar Tracking and Control	1.40
Air Defense Center Operations	0.70
Indoctrination Programs	2.30
Calibration	0.50
Equipment	0.25
Preparation for Demonstrations	41.25
Demonstrations	15.00
Time Lost	15.00
Time not used	6.25
Total	88.25

DATE	TIME	SCHEDULED TEST A/C	SCHEDULED TEST Description	TEST ACTUALLY RUN A/C	TEST ACTUALLY RUN Description	REASONS FOR CHANGES OR COMMENTS
11/24	1400 1600	F80 F80	Jet Coverage: MEW	F80	Held with one aircraft	Only one jet available
11/25	1000 1200	B25 B25	Height-Finder	B25	Calibration: Rockport and Scituate	Preparation for "maximum effort" test
	1400 1600	B25	Coverage: Rockport and Scituate		Cancelled	No aircraft available
11/26	1000 1200	--	Maximum Effort - 17 aircraft		Cancelled	Weather
11/28	1000 1200	B25 B17	Final Turn Intercept	B25	Coverage: Rockport and Scituate	Preparation for demonstration
	1300* 1500	B25 B17	Final Turn Intercept	F51 B25	Held as planned	Preparation for demonstration
11/29	1330* 1530	F51 B25	Intercepts	F51 B25	Held as planned	Preparation for demonstration
	1530* 1630	B25	Coverage: Rockport, Scituate, MEW	B25	Held as planned	Preparation for demonstration
12/1	1030 1230	B25 B17	Demonstration	B25 C47	Held as planned	MEW failed towards end of test
	1400 1600	B25 B17	Demonstration		Cancelled	Not needed
12/2	1000 1200	B25	AAA Test	F80	Used F80 for only one hour 1100-1200	Only aircraft available
12/5	1000 1200	F51 B25	Three-Dimensional Intercept		Cancelled	Used recorded data for demonstration

Total Aircraft Hours Scheduled 71
Total Aircraft Hours Used 20

*Added to schedule during week of test.

9.0 FLIGHT TESTS (CONTINUED)

(A.P. Hill) (Continued)

Results of Flight Tests held:

Nov. 24 1000-1200 Jet Coverage
Jet (F-80) flew at 10,000' from Bedford-Quonset-Taunton-Otis-Scituate, back over the same course to Bedford. Data was poor from Bedford to Quonset, less than 40% coverage. The leg from Quonset to Taunton was fair. Tracking, with the best coverage from Scituate returning to Otis.

Nov. 25 1000-1200 Calibration, Rockport and Scituate
A slight error in azimuth was corrected at Scituate. Purpose of this test was the maximum effort test scheduled for the next day.

Nov. 28 1000-1200 Coverage, Rockport and Scituate
A B-17 was used flying in range of three radars; Rockport, Scituate, and Bedford.
The program worked successfully as the aircraft was tracked on all three sites.

1100-1200 Coverage - Jet with APN#19
With the use of the beacon mounted in an F-80, tracking was excellent at all altitudes from 5,000' over Concord to 17,000' over Portland. A blip-scan ratio will be made to determine the double azimuth codings.

1500-1530 Final-Phase Intercepts
One run was made using an F-51 as the interceptor starting over Concord at 8,500' IAS 260. The target (B-17) starting 15 miles east of Rockport 8,000' IAS 190, vectoring 345°. Fighter rolled out on heading of 165°, 12 miles ahead of target. Relative bearing at this point was 11 o'clock to the fighter aircraft. Interceptor remained on heading of 165° and passed 500 yards to the right of target.

Nov. 29 1330-1530 Intercepts
Run #1 - Fighter F-51 over Concord 8,000' IAS 225. Target B-17 15 miles east of Rockport 8,500' IAS 190. Final separation, fighter passed 1/4 mile ahead of target. The interceptor was vectored back to Grenier, and came in over the north end of the field.

Run #2 - This was a final-phase intercept, using the same aircraft and the same course as Run #1. The interceptor rolled out of his final turn on a heading of 345°; at this point the target was 7 miles at 12 o'clock.

1530-1630 Three Radar Coverage
Using a B-17 flying between Rockport and Scituate to test correlation of data from Rockport, Scituate, and Bedford.

9.0 FLIGHT TESTS (CONTINUED)

(A.P. Hill) (Continued)

Dec. 1 1030-1230 Demonstration Tests
Made one run using a B-25 with APG#33 as the interceptor, and a C-47 as the target. Bedford MEW data failed approximately 15 miles before the intercept; the computer dead reckoned the rest of the run. Final separation, target passed 1/4 mile ahead of fighter. AI picked up target at 6,000 yards.

Dec. 2 1000-1200 AAA Test
A B-26 was scheduled for this test; however, due to the cold weather the engines would not start - this left us with a jet for the test, only good for one hour flying time. The course flown was from Scituate to Rockport and return. The AAA battery picked the jet up at Scitaute and tracked to Rockport. A slight error in the readings sent from here to the AAA site was noted, probably due to the latest mod not being attached to the main program.

10.0 PUBLICATIONS

(M.R. Susskind)

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

LABORATORY REPORTS

1. "Summary of IBM-MIT Collaboration," October 27, 1952 to November 30, 1952 inclusive (FOR INTERNAL DISTRIBUTION ONLY), M-1739, A.P. Kromer December 3, 1952, pp. 1-2.
   CONFIDENTIAL

2. "Flight Test Schedule for Month of December," M-1731, A.P. Hill, November 25, 1952, pp. 1-2.
   CONFIDENTIAL

3. "Operations with the MPS-4 Nodding Beam Height Finder," M-1728, J.A. Arthur, J.J. Cahill, Jr., F. Heart, W.R. Martin, November 24, 1952, pp. 1-9.
   CONFIDENTIAL

4. "Time Analyses of Various Methods of Sorting Data," M-1680, D. Goldenberg, October 17, 1952, pp. 1-35.
   CONFIDENTIAL

TECHNICAL REPORTS

1. "Commercially Available General-Purpose Electronic Digital Computers of Moderate Price," a symposium, The Pentagon, Washington D.C., sponsored by The Navy Mathematical Computing Advisory Panel, May 14, 1952, Lib. No. 2058.
   UNCLASSIFIED

2. "Bomber Defense Missile, Quarterly Progress, Report No. 2, " BE-753-S-4, W.E. Crowell, Cornell Aeronautical Laboratory Inc., July-September, 1951, Lib. No. 2167C.
   CONFIDENTIAL

3. "Quarterly Progress Report, Division 6-Digital Computer," Lincoln Laboratory, M.I.T., September 15, 1952, Lib. No. 2154C.
   CONFIDENTIAL

4. "Simulation and Computing Techniques," Symposium II, Part I, Project Cyclone, Reeves Instrument Corporation, under sponsorship of the U.S. Navy Special Devices Center & U.S. Navy Bureau of Aeronautics, April 28-May 2, 1952, N.Y.C., Lib. No. 2156C.
   CONFIDENTIAL

10.0 PUBLICATIONS (CONTINUED)

(M.R. Susskind) (Continued)

5. "Steady State Deviation of a Star Ray Passing Through a Missile Window," MX-775, Northrop Aircraft, Inc., Hawthorne, California, December 1951, Lib. No. 2157C.

CONFIDENTIAL

6. "Three Dimensional Flight Table," Quarterly Progress Report No. 2, for period ending September 30, 1952, prepared for Special Devices Center, Office of Naval Research, Bendix Research Laboratories, Detroit, Michigan, Lib. No. 2158C.

CONFIDENTIAL

7. "Integrated Fire Control System for Terrier," Monthly Progress Reports for September, August, July, June, 1952, RCA Victor Division, Radio Corporation of America, Camden, New Jersey, Lib. No. 1951C.

CONFIDENTIAL

8. "The Integrated Electronic and Control System," Project MX-1179, Monthly Progress Newsletter Nos. 21-24, and 25, June 1-September 1, 1952, and October 1, 1952, Research and Development Laboratories, Hughes Aircraft Company, Lib. Nos. 279/S and 280/S.

SECRET

9. "Integrated Fire Control System for Terrier," Quarterly Engineering Reports, period covered February 9 to May 9, 1952, and May 9 to August 9, 1952, RCA Victor Division, Radio Corporation of America, Camden, New Jersey, Lib. Nos. 281/S and 282/S.

SECRET

10. "The Integrated Electronic and Control System," Project MX-1179, Monthly Progress Newsletter No. 26, November 1, 1952, Research and Development Laboratories, Hughes Aircraft Company, Lib. No. 286/S.

SECRET