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Memorandum 6M-3457

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Division 6 - Lincoln Laboratory  
Massachusetts Institute of Technology  
Lexington 73, Massachusetts

SUBJECT: BIWEEKLY REPORT FOR 11 MARCH 1955  
To: Jay W. Forrester  
From: Division 6 Staff

CLASSIFICATION CHANGED TO:  
Auth: DD 254  
By: XKE  
Date: 3-21-60

COVER SHEET

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Massachusetts Institute of Technology  
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To: Jay W. Forrester

From: Division 6 Staff

Approved: John B. Bennett  
John B. Bennett

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INTRODUCTION

Laboratory Personnel Training

(J. B. Goodenough) (UNCLASSIFIED)

A preliminary report has been prepared summarizing the general educational needs and various educational activities of the Laboratory under five categories: advanced-degree requirements, technician training, orientation, technical specialization, and nontechnical specialties.

College Recruiting Program

(R. J. Horn, Jr., W. Ogden, Jr.) (UNCLASSIFIED)

The following is a list of trips made during the last biweekly period:

<u>Representative</u>	<u>College</u>	<u>Date</u>
R. Walquist, F. Heart	California Tech	25 Feb.
R. Walquist, R. Mitchell	UCLA	1 Mar.
	Stanford	3 Mar.

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<u>Representative</u>	<u>College</u>	<u>Date</u>
H. Peterson	Arizona U. Colorado A&M U. of New Mexico	3, 4 Mar. 8, 9 Mar. 10, 11 Mar.
F. Irish	U. of Kentucky	4 Mar.
E. Wolf	U. of Tennessee	7, 8 Mar.
W. Papian	Polytech of Brooklyn	8 Mar.
W. Attridge, S. Manber	Mount Holyoke Smith	10 Mar. 11 Mar.

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## I - SYSTEM TEST &amp; PLANNING

1.1 Air Defense1.1.2 Cape Cod System Operation

(C. A. Zraket) (CONFIDENTIAL)

Members of the Group have initiated a study to determine the frame time for the proposed computer program for SAGE. All of the 1954 Cape Cod System programs have undergone a series of measurements under various conditions in addition to detailed analyses made by the responsible programmers. These results have been compared and extrapolated to the SAGE System program. Results of this study will be forthcoming by 18 March.

Successful intercept and tracking-accuracy tests were conducted during the past week. Results of the tests will not be known until the data recorded on magnetic tape is analyzed by programs currently being written. Data on all live tests will continue to be recorded on magnetic tape during operations.

Radar and Mark X data for the Cape Cod System continues to be usable. Initial transmission of FGD from S. Truro to the Direction Center will commence on 16 March for checkout by Groups 22 and 64.

Memorandum 6M-3422, "Status of SDV Data Collection For Noise Studies," 7 March 1955, has been issued.

Documentation of 1954 Cape Cod System programs, flow diagrams, status forms, etc., being done by Benington, Chandler, Ishihara, Latimer, and Manber, will be completed by 18 March. This will provide a complete record of Cape Cod programs.

(A. E. Budd) (CONFIDENTIAL)

I am preparing flow charts for a subroutine to read data recorded during operation of the 1954 CCS and to reconstruct and store it in core storage by track channel number. This is the first step of a program to sort and compare the tracking process of the 1954 CCS with Raydist tracking.

(R. Davis, A. Smalley, P. Dolan) (CONFIDENTIAL)

Test Coordination Sub-Section scheduled four Raydist orientation, two accuracy-training, and two track-accuracy evaluation tests.

Of the four Raydist, three were cancelled because of aircraft unavailability, one because of weather.

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One accuracy-training test was conducted as scheduled, the other cancelled because of weather, with a simulated training mission substituted.

Two tracking-accuracy evaluation tests were conducted as scheduled and as defined by Group 61 Operations Plan 30. Winds of 125 knots and computer-program malfunctions precluded usable computer data from the first test. Raydist data was nearly perfect. Data recorded during the second test appears to be complete, but its quality will not be known until a preliminary analysis is made.

(H. Frachtman) (CONFIDENTIAL)

The structure and specifications for the data-generation program are undergoing vigorous discussion with members of the Group.

Memorandum 6M-3408, "Program Specifications for 1954 Cape Cod System Recording Function," has been issued.

(A. P. Hill, L. J. Murray) (CONFIDENTIAL)

Most of the past biweekly period was spent conducting a familiarization course of the Cape Cod, XD-1, and SAGE Systems. From the standpoint of the criticisms received by those attending, the course was relatively successful; however, it was evident that closer integration of the subject matter would be desirable for future courses.

At the present time a proposed syllabus for the next familiarization course is being written.

(D. Latimer) (CONFIDENTIAL)

I have been gathering information to revise Memorandum 6M-3078 ("Program and Storage Organization for 1954 Cape Cod Tracking Program"), and I am studying the organization and operation of the Cape Cod System program for the purpose of assisting in the documentation of the tracking program.

(A. Mathiasen, B. Stahl) (CONFIDENTIAL)

All radar-orientation Raydist missions scheduled for this period were canceled. The computer time was used instead for trouble shooting and improving the hyperbolic to rectangular coordinate conversion program. Work on the program for Ed Rawson has continued. (See Biweekly for 25 February 1955).

(R. Smith) (CONFIDENTIAL)

The addenda to the Cape Cod Equipment Notebook have been issued.

Errata 2 to 6M-2854 are processed and will be issued in the next biweekly period.

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(W. Vecchia) (CONFIDENTIAL)

	<u>hr</u>	<u>min</u>
Total Assigned Time	125	
Extra Assigned Time	<u>5</u>	<u>55</u>
	130	55

	<u>hr</u>	<u>min</u>
Analysis	11	45
Equipment Checkout	5	15
Raydist	7	45
Tracking	23	55
Weapons Direction	41	15
CCS System Operation	<u>29</u>	<u>20</u>

TOTAL 119 15

Time Given to Group 64 (Systems)	3	30
Time Given to Group 6345	3	40
Computer Malfunction	<u>4</u>	<u>30</u>

TOTAL 11 40

<u>hr</u>	<u>min</u>
119	15
<u>11</u>	<u>40</u>

GRAND TOTAL 130 55

1.1.3 ID-1 Programming

(L. Collins, I. Hazel, W. Ball) (CONFIDENTIAL)

We have been evaluating WWI operating times for the situation and digital displays in the 1954 Cape Cod System.

We have also attempted to extrapolate from WWI data to determine operating times for the corresponding ID-1 programs.

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(R. Gildea, J. Yienger, S. Knapp, C. Gaudette) (CONFIDENTIAL)

A basic trace program has been operated successfully on the XD-1 computer. However, this program will not function properly if the program being traced includes in-out instructions. A modification to correct this defect has been written and will be operated using the XD-1 simulation program on IBM's 701 computer in New York on 12 March. An arctangent subroutine and a binary-octonary read-in program will also be processed by the 701's simulation program on the same day.

Certain unassigned XD-1 operation codes perform a useful programming function but should be used with caution. Memorandum 6M-3435, "Proposal for the Use of Illegal XD-1 Instructions by Group 61," suggests a method of utilizing the functions performed by selected, unassigned operation codes in the operational program.

(F. Gucker, F. Brooks) (CONFIDENTIAL)

We have been studying and outlining the operation of data input, track initiation, and track monitoring for XD-1.

(S. Hauser, F. Garth) (CONFIDENTIAL)

Discussions of the 1954 Cape Cod identification operations at the Cape Cod familiarization sessions led to our private discussions with Mr. R. J. McCune, BTL. He is interested in writing specifications of procedures and personnel requirements for the SAGE System. We discussed in general the mode of operation of the identification technicians. It was agreed that we keep him advised of further recommendations which may affect final preparation of operational specifications.

Our tests in manual inputs place the average rate of O26 card-punch operation at 50 seconds/full card. This rate was used in preparing recommendations for the number of O26 card-punch machines in Production System. A memo on this subject is in the making.

(J. Ishihara, D. Bailey) (CONFIDENTIAL)

As part of an extensive program to predict program operating times for the SAGE System, we have participated in the measurement of corresponding times in the 1954 Cape Cod System. We have also generated equations for operating times of the automatic tracking programs, based on actual order counts of the programs. The results from these two procedures are being compared, and an equation will be derived to represent the equivalent times with XD-1, estimating the effects of using index registers, split accumulators, etc.

(E. McEvoy) (CONFIDENTIAL)

The past biweekly period has been spent gaining background information on height finding in preparation for writing operational specifications for the XD-1 height-finding program. Some time was spent with A. Favret determining the operating time of the 1954 height-finding program.

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(P. R. Vance) (CONFIDENTIAL)

The past 2 weeks were devoted to studying the weapons-direction problem in the XD-1 System, attending the CCS familiarization lectures, and making a timing study of the WA program in the 1954 CCS.

1.1.4 SAGE Planning

(J. J. Cahill, Jr.) (CONFIDENTIAL)

I attended a meeting at Coles Signal Laboratory, SCEL, on 8 March where the AN/TSQ-7 series of data transmitters was compared with the so-called AT&T data-transmission service to be used in SAGE; the problem of translating from one system to the other was discussed. I have reported the features in a memo to C. R. Wieser and J. A. Arnow.

On 4 March I attended a meeting at Lincoln with Rome Air Development Center personnel and representatives of CRC, ADES, and Lincoln where the AN/FPS-6 height finder and the AN/FST-2 semiautomatic SAGE height-finder equipment were discussed. I recommended that the program to produce an FPS-6 with a pulse length instantly changeable from 2.0 microseconds to 0.5 microsecond should be pressed with General Electric because of the utility of the shorter pulse in flight-size estimation. I further recommended that A-scopes should be made definite parts of the FST-2, because they would be useful in flight-size estimation whether or not the shorter pulse can be achieved. Other conclusions and recommendations are contained in a memo by P. Sebring, Group 24.

The problem of bias in favor of low track numbers in the target-battery evaluation program, mentioned in the last Biweekly, can be partially resolved by a preliminary program to classify tracks according to relative threat.

Army personnel concerned with the evaluation of the Lincoln proposal for integration of antiaircraft with SAGE have requested help in preparing an evaluation and test plan. I have begun to accumulate material for them and will continue after returning from a 1-week recruiting trip to New York.

(A. G. Favret) (CONFIDENTIAL)

A timing analysis was made of the height-finding program of the 1954 Cape Cod System including an extrapolation based on FSQ-7 orders. This analysis is reported in an inter-office memorandum to J. Arnow.

Memorandum 6M-3440 was published. This memo assigns all digital-display slots for XD-1 and FSQ-7.

On 2 March a meeting was held at Lincoln Laboratory with representatives from the Hawk missile project. This meeting is reported in an inter-office memo by J. Cahill and myself.

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(A. G. Favret, A. R. Shoolman) (CONFIDENTIAL)

We have begun work on specification of the wiring of display-selection switches and assignment of display-category and display-assignment bit lines to each situation-display console in AN/FSQ-7 Direction Centers.

(W. F. Harris) (CONFIDENTIAL)

I completed the 1954 Cape Cod System course and am now familiarizing myself with the SAGE System in preparation for beginning work with the SAGE System Planning Section.

(F. Heart) (CONFIDENTIAL)

A good part of the last biweekly period was spent completing a trip to the West Coast primarily concerned with recruiting, but including attendance at the Western Joint Computer Conference, a visit to Rand Corporation, and a visit to the 750th AC&W Squadron at Boron, California.

With Bill Lone an attempt is being made to study requirements and specifications for the Combat Center program and computer. Some coordination effort in the countermeasure's area has continued, and visitors from several outside groups are expected in the near future.

(W. Lone) (CONFIDENTIAL)

I have been serving on a committee with B. Housman (IBM) and P. Bagley, the purpose being to produce specification for FSQ-8, Combat Center. Three of the most critical problems requiring early decisions are:

1. How much auxiliary memory should be provided for FSQ-8?
2. How much display capacity is required for FSQ-8?
3. Is one data circuit between a DC and CC sufficient?

(A. R. Shoolman) (CONFIDENTIAL)

Memorandum 6M-3330, "Auxiliary Console and Wing Unit Equipment Allocation and Layout for AN/FSQ-7 Direction Centers," and Memorandum 6M-3330, Supplement 1, "Errata and Changes in Auxiliary Console and Wing Unit Equipment Allocation and Layout for AN/FSQ-7 Direction Centers," have been issued.

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1.1.5 SAGE Training

(S. B. Hibbard) (CONFIDENTIAL)

A general training program for the SAGE System has been drawn up and is contained in the "Summary Report of Engineering-Installation Phasing Committee, Report No. 6."

Some of the problems remaining to be solved before a final training program can be completed are:

1. What roles will Air Force Personnel Research Training Command, Air Force Training Command, ADES Western Electric, and BTL have in formulating the training program?
2. Which organization has over-all responsibility?
3. Where will training be conducted after personnel for the first five S.S. have been trained on XD-1?

1.1.6 Test Program Planning

(D. R. Israel) (CONFIDENTIAL)

Progress of the test program continues to be hindered by delays in the preparation of programs required before actual tests can be conducted.

Following several meetings with George Harris and A. Nedzel of Group 22, A. Herckmans and E. Ennis of BTL, and Walter Wells of Group 61, a revised second draft of the outlines and work items for the test program has been prepared. This material has been issued as DRAFT Memorandum 6M-3385.

Memorandum 6M-3418 describes the results of discussions with personnel from the Rand Corporation during the week of 21 February.

(W. Z. Lemnios) (CONFIDENTIAL)

Discussions have been held with R. Davis relative to a series of flight tests to measure tracking accuracy. General agreement was reached on the necessary flight plans. Together with D. R. Israel, I wrote the general specifications for these tests.

Preliminary work was done for a conference to be held in April with representatives from several laboratories to discuss interceptor vectoring techniques and problems.

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(J. Levenson) (CONFIDENTIAL)

A first draft of a memo outlining general-purpose data-reduction programs for the 1954 Cape Cod System is almost finished. H. Frachtman and I have agreed on basic specifications for the simulated-data-generation program, and flow diagrams will be made by him before details are settled.

(J. Nolan) (CONFIDENTIAL)

A preliminary estimate has been made of the degree of dependence of returns to two radar sets from the same aircraft. Two samples of concurrent SDV data from the South Truro FPS-3 and an associated gap-filler set were taken from data collected by A. Mathiasen and B. Stahl during a recent Raydist calibration test.

	<u>Sites</u>	<u>Blip/Scan</u>	<u>Correlation Coefficient</u>
Sample 1 (76 consecutive scans)	South Truro	0.55	- 0.047
	Clinton	0.68	
Sample 2 (71 consecutive scans)	South Truro	0.79	- 0.020
	Martha's Vineyard	0.52	

Although essential independence is indicated, more samples will be required to support a general working assumption of independence.

(E. W. Wolf) (CONFIDENTIAL)

A camera has now been installed at the monitor scope in the mapping room but has not yet been checked out. This camera can be indexed manually or automatically by the SDV north strobe.

The effects of jamming on system operation were discussed with Division 5 personnel. Their experiments indicate that the angle of the sector of radar coverage lost for tracking purposes as the result of electronic jamming is approximately proportional to the fourth root of the jamming power and inversely proportional to the square root of the distance to the radar. The results of their jamming with chaff show that 0.3 lb of suitably prepared material will fill at least six SDV quantum boxes. It is planned to train the mapping personnel to cope with jamming activities and to test system operations under such conditions.

Bill Harris of Group 38 reports that the SAGE mapper incorporates a number of significant improvements over the present equipment.

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1.1.7 Analysis and Simulation

1. Charactron Display

(H. D. Houser) (CONFIDENTIAL)

A program which simulates XD-1 situation displays has been completely checked out. This program will be modified slightly so that tests on the legibility of moving displays can be made by B. F. Green and R. T. Mitchell of Group 38.

2. Numerical Evaluation of Markov Processes

(C. Friedman) (CONFIDENTIAL)

The program to evaluate first-order Markov processes has been checked out. Some elementary problems concerning automatic initiation have been solved.

3. Manned-Interceptor Simulation

(H. D. Neumann) (CONFIDENTIAL)

After MTC computer troubles were cleared away, the manned-interceptor-simulation program ran satisfactorily. Several test runs were made, and the resulting data reduced automatically. These results will be checked.

A program is being written to control the simulation and data-reduction programs to make the runs and evaluation fully automatic.

I attended a 2-day symposium on the Design and Evaluation of Bomber Fire-Control Systems conducted by the Servomechanisms Laboratory at MIT.

(B. Smulowicz) (CONFIDENTIAL)

The manned-interceptor-simulation evaluation program has been checked out and tested using the results of a typical simulation.

Work has begun on a weather-clutter generator and correlation program for the manned-interceptor simulation. This program will use the track-correlation techniques adopted for the 1954 Cape Cod System.

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4. Blip-Scan Investigation

(W. I. Wells) (CONFIDENTIAL)

A program has been written to read the IEM cards (containing the blip-scan data prepared by Group 22) into the Memory Test Computer. A memorandum is being prepared describing the program. In the meantime other programs will be written to aid in the analysis of the data.

(R. Sittler) (CONFIDENTIAL)

A program has been written to compute certain small-sample statistics for use in testing blip-scan models.

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1.2 Whirlwind I1.2.1 Cape Cod System Engineering

(A. M. Werlin) (CONFIDENTIAL)

A meeting was held among members of Group 64 and Group 24 to discuss the arrangement of phone-line messages from FGD equipment at South Truro to the Cape Cod System. As a result of this meeting, Memorandum 6M-3438, "Acceptance of the South Truro Fine Grain Data (FGD) Message by the Cape Cod System," was written, specifying message labels used in addition to the drum word structures.

1.2.2 WWI System OperationRecords of Operation

(M. F. Currier, B. H. Jacobs) (UNCLASSIFIED)

The following is an estimate by the computer operators of the usable percentage of assigned operation time and the number of computer errors for the period 25 February - 10 March 1955:

Number of assigned hours	198
Usable percentage of assigned time	96
Usable percentage of assigned time since March 1951	89
Usable percentage of assigned time since September 1953	94
Number of transient errors	2
Number of steady-state errors	8
Number of intermittent errors	0

Analysis of WWI Failures

(A. R. Curtiss) (UNCLASSIFIED)

The following is a breakdown of interrupting and potentially interrupting failures occurring in the WWI computer system for the biweekly period, 25 February - 10 March 1955, inclusive:

Total Number of Failures	20
Total Number of No-Lost-Time Failures	5
Total Number of Lost-Time Failures	15
Total Lost Time in Hours	12.5
Total Operating Time in Hours	278.5

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Class of Failure	Attributable to New Installation or Modification		Essential Maintenance		Chargeable to System			
	No.	Min. Lost	No.	Min. Lost	Explained		Unexplained	
	No.	Min. Lost	No.	Min. Lost	No.	Min. Lost	No.	Min. Lost
Tubes					3	56		
Passive Electrical Components					1	0		
					1	210		
Fuses					3	0		
					2	8		
Alarms							3	20
Miscellaneous	1	0	3	303	2	138	1	11
Number of Lost-Time Incidents			3	303	8	412	4	31
Number of No-Lost-Time Incidents	1	0			4	0		

(L. L. Holmes, D. A. Morrison, A. J. Roberts) (UNCLASSIFIED)

Equipment failures resulted in 12.5 hours of down time during 276.5 computer operating hours. The majority of the lost time was attributed to three types of steady-state failure.

A faulty circuit breaker in the feeder line to the buffer-drum filament transformers led to a total loss of 6.5 hours. Internal arcing and heating destroyed the breaker's mechanism and housing.

Computer alarms occurring during the use of buffer-drum storage were traced to a shorted diode crystal. The location of the fault required 3.5 hours.

An improperly seated power plug caused 40 minutes of down time.

(L. L. Holmes, A. J. Roberts) (CONFIDENTIAL)

During this period it was decided to install a PPI display system for monitoring fine-grain data. The display console will be installed in Room 228 (mapper room), and the rack of control equipment will be located in Room 156. It is hoped to have the system in operation by the conclusion of the next biweekly period.

Fine-grain data from the S. Truro site will be available to the Barta Building for test purposes during the next biweekly period. The data will be time-multiplexed with Mark I data.

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Power Supplies

(E. W. Pughe, Jr.) (UNCLASSIFIED)

The 600-v capacitors across the thyratrons in the +250-v supply were changed to 1500-v capacitors, because there is over 600 volts peak inverse voltage across the tubes.

A memo was issued outlining the proper procedure in the event of a power failure.

Two Raytheon power supplies were installed for the tube burning racks. A drift in the +120-v power supply was due to grid emission in the input tube of the error amplifier.

The 50-amp circuit breaker feeding the buffer-drum filaments failed. It was replaced by a 90-amp fuse. The fuse is the correct size to protect the feeder.

1.2.3 Terminal EquipmentFairchild Camera for Mapping Monitor

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

The Fairchild camera has been installed, but some focussing adjustments are yet to be made. Two modes of operation are available: manual indexing and semiautomatic north indexing. This camera will be available for use the week of 14 March.

Equipment Malfunction and Deficiency Reports

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

A system of recording Cape Cod operation malfunctions has been set up. A summary of the first 3 weeks' reports has shown some major sources of trouble, particularly in the SDV equipment at the sites. Discussions with Bill McDonald of Group 22 should expedite correction of these troubles.

Output Coder

(L. H. Norcott) (UNCLASSIFIED)

Power-wiring changes have been made on the output coder to break it up into smaller blocks for marginal-checking purposes.

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The present test-message selector switch has proven unreliable, and we plan to overhaul it thoroughly in the next few days and install a new stepping switch.

Maintenance Programming

(J. N. Ackley) (UNCLASSIFIED)

The ninth and last test program for the Room 156 consolidated test, the MITE control check, is now in regular service.

Much time was spent this period on deleting the six obsolete drum programs from the WWI consolidated test and comparing the margins of the old and new programs. Many marginal-checking lines required resetting of the limits.

The shortened WWI consolidated test and the Room 156 consolidated test are now run each morning, requiring a total of 50 minutes but checking more equipment more thoroughly than the old WWI consolidated test which required about 45 minutes.

(T. Sandy) (UNCLASSIFIED)

The FGD and Mark X display decoder has been designed and is being drawn and laid out by a system technician.

(C. S. Lin, L. D. Healy) (UNCLASSIFIED)

It has been decided that both FGD and Mark X information will be recorded through MITE 0. Mark X and height information will be recorded on slot 0 and FGD information on slot 3 of the buffer drum. The MITE test program is being modified to check this system.

The necessary modification to MITE 0 will be completed during the next biweekly period.

The Room 156 consolidated test program is being used daily to check the drum systems. The MITE check programs are not yet ready for daily use.

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## II - AN/FSQ-7

Group 62 Summary

(N. H. Taylor) (UNCLASSIFIED)

The interdivisional SAGE Experimental Subsector Planning Approval Committee has agreed to and signed a set of broad-brush equipment-flow schedules and has agreed upon procedures for handling future business.

The XD-1 central computer has passed encouragingly its first critical evaluation by members of the MIT Test Planning Section.

The XD-1 drum system is due to arrive at Lexington on 17 March. The MIT engineers that have been working on the system in Poughkeepsie have returned to aid in installation and test.

The first installation of a Typotron in a display console is complete, and tests of it have begun.

2.1 Liaison2.1.1 SystemProduction Coordination Office

(A. P. Kromer) (UNCLASSIFIED)

The monthly status-review meeting conducted by Western Electric-ADES organization was held in New York on Tuesday, 8 March 1955. Discussions covering status of engineering work, manufacture of equipment, construction of buildings, etc., indicated these areas were progressing satisfactorily. Orders for communications equipment from the Air Force to Bell System are now approximately 2 months behind schedule, and it was agreed that special action would be instituted by the Western Electric-ADES group to insure release of this item within the very immediate future. Plans for training of personnel are being developed, but additional detail is required to coordinate this work with other aspects of the program. The ADES Status Report No. 15 will present the over-all status of the program in further detail.

Amendment 2 to AFCRC Exhibit-1A (which covers the AN/FSQ-7 XD-1 prototype) and Amendment 1 to AFCRC Exhibit-17 (which covers the production AN/FSQ-7 systems) were issued to Cambridge Research Center. These amendments provide for the addition of six auxiliary memory-drum units, associated MCD frame, and other minor changes to certain frames required by the addition of this equipment. Other TIR's issued during the period are noted below, as well as reports indicating the status of certain portions of the XD-1 equipment.

Technical Information Releases

(P. Bragar, E. D. Lundberg, J. J. Carson) (UNCLASSIFIED)

The following material has been released as engineering data for AN/FSQ-7 and SAGE System.

<u>TIR</u>	<u>M-Note</u>	<u>Subject</u>
1-63	6M-3147-1, Supplement 1	Master Reference List, Lincoln Laboratory Requirements for Direction Center Buildings.
1-64	6M-3198-1, Supplement 1	Master Reference List, Lincoln Laboratory Requirements for Combined C.C.-D.C. Buildings.
1-65	6M-3147-1, Supplement 2	Master Reference List, Lincoln Laboratory Requirements for D.C. Buildings.
1-66	6M-3291, Supplement 1	Specifications for the Central Computer System for the AN/FSQ-7, Supplement 1.
	6M-3292, Supplement 1	Specifications for the Drum System for the AN/FSQ-7, Supplement 1.

SAGE System and XD-1 Schedules

(W. H. Ayer, F. F. Manning) (UNCLASSIFIED)

We have begun to collect back-up information on the XD-1 and SAGE progress for scheduling purposes. The XD-1 progress has been posted on mechanical-type schedule charts (Production Boards).

The following XD-1 Status Reports have been written:

<u>Report</u>	<u>Subject and Status</u>
1	The digital-data display generator frame 25 is having the back-panel wiring checked. Actual testing has been delayed approximately 3 to 5 days.
2	The situation-display frame 24 will be shipped from IBM, less intermodule cables, on or before 15 March 1955.
3	The display console calls for delivery of the first three air-situation consoles on 1 March 1955. Delivery at Lexington, however, will probably be after 15 April 1955.

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(E. L. Smiley, W. H. Ayer) (UNCLASSIFIED)

The light-testing room is presently being remodeled to change the color of the ceiling, walls, and egg-crate ceiling. New lighting fixtures are being installed to raise the light-intensity level while using the blue lights. This work should be completed the week of 14 March.

The Direction Center fourth-floor equipment layouts are being revised to agree with 6M-3330 and should be ready for concurrence by Friday, 18 March 1955.

A specification for the air-conditioning warning system has been written and should receive Lincoln-IBM concurrence during the week of 14 March.

Construction drawings for the first combined D.C.-C.C. buildings are to be signed the week of 14 March 1955 and sent out by W.E. Co. for bids.

## 2.2 XD-1, XD-2

### Programming Manuals

(P. R. Bagley) (UNCLASSIFIED)

It appears that most of the IBM Programmer's Manuals are not scheduled to be available soon enough to train XD-1 programmers properly. I am investigating ways to remedy this situation.

#### 2.2.1 Systems

(J. P. May, P. R. Bagley) (UNCLASSIFIED)

A proposal for the use of the Memory Test Computer as an equipment-testing facility has been written and will be published as Memorandum 6M-3445. This proposal outlines an expansion in the scope of application of MIT to include the testing of terminal-equipment systems associated with the AN/FSQ-7.

### SAGE Experimental Subsector Planning Section

(H. E. Anderson, I. Aronson, H. J. Platt) (CONFIDENTIAL)

At the meeting of the Planning Approval Committee on 7 March 1955, a set of schedules for equipment in the Experimental Subsector was approved. These schedules are to be found on sheets 1 through 4 of B-75093-2. These schedules will be posted by members of the PCO.

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A draft memorandum 6M-3415, describing the present state of the knowledge concerning changes to equipment in Bldg. F, was circulated for comments on a limited-distribution basis. When all comments are gathered, the note will be issued in final form. From time to time, this note will be revised as changes are put into the equipment and as new modifications are brought to light.

A proposal for transferring responsibility for maintenance of the phone-line receivers and transmitters from Group 62 to Group 22 is described in 6M-3423. The gist of this proposal is that a staff member and two technicians from Group 22 will begin working with those members of Group 62 who have been carrying out the work to date. As the Group 22 people become familiar with the equipment, the Group 62 people will break off from the activity. This phase of the operation will begin when the equipment arrives from IBM.

An evaluation of the data-link problem has been carried out among H. E. Anderson, H. K. Rising, H. Sherman, and C. R. Wieser. A note describing this evaluation, 6M-3437, has been published. The recommendation of the study was that the Experimental Subsector use the frequency multiplexing data link until a time division data link is available in sufficient quantity.

#### Logical Services Committee

(R. P. Mayer, N. T. Jones) (UNCLASSIFIED)

Auxiliary Memory. IBM-MIT Systems Office concurrence has been received for those changes in the duplex-system specifications required by the addition of six auxiliary-memory drums. The concurrence documents are: DR-140 (program element), DR-141 (arithmetic element), DR-142 (drum specifications), and DR-143 (selection and in-out element).

Mechanical Clock. Memorandum 6M-3409 states that XD-1 will not have a "mechanical" (relay) clock system.

Clock Register Counting. In the present design, the clock register stops counting after a halt instruction, an alarm stop, or any manually controlled stopping of the computer. Group 61 has requested that the clock count continuously (unless power is removed from the circuits involved). Steps are being taken to correct this situation.

Index Register Numbering. When there were only two index registers, number "3" referred to the "right accumulator" (RAC). Now that two more registers are being added, there is the question of their numbering. Two different IBM proposals suggest RAC should be 3 or 5, respectively, and Group 61 suggests 7. This conflict is being resolved.

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Training Program for SAGE System

(A. Vanderburgh, Jr.) (UNCLASSIFIED)

Memorandum 6M-3348-1, "Systems Office Training Program," contained a request for opinions about the course. No opinions have been received. Since it appears that most staff members did not notice the request for opinions, it will be redistributed soon.

Lectures 1 through 10 have been given in class, and notes for lectures 1 through 7 have been distributed in rough-draft form. Notes for lectures 8, 9, and 10 will be distributed at the next class session (Wednesday, 16 March 1955). Lectures 8 and 9, entitled "Utility Programs" and "Maintenance Programs," were given by P. R. Bagley.

The notes for this course are prepared by A. Vanderburgh. Back copies of lectures 5 through 7 are available. These rough drafts are distributed so that many comments will be available when the final memorandum is written. Please forward any comments to A. Vanderburgh or R. P. Mayer.

XD-1 Telephone Communications

(C. J. Carter, H. J. Kirshner) (UNCLASSIFIED)

Supplement 5 to 6M-3000, "AN/FSQ-7 (XD-1) External Voice Telephone Traffic Diagram," was published in draft form and circulated for comments.

An attempt is being made to generate accurate telephone-installation time schedules for the New England Telephone and Telegraph Co. These schedules reflect the presence or absence of related schedules for computer equipment, display-console delivery, and external site installation. Present estimates indicate that the dial system (including the maintenance system) will be completed by 1 May 1955, the first external circuits will be installed 18 July 1955, the console telephone equipment will be installed concurrent with console delivery (15 April - 30 August 1955), and the ground/air radio system will be installed by mid-September 1955.

A detailed schedule of circuit installations will be circulated the week of 14 March in 6M-3275.

LRI Monitor

(J. McCusker) (UNCLASSIFIED)

Several schemes for displaying LRI data rapidly on a monitor scope are being investigated. The results so far on those schemes which use small amounts of equipment are not good.

Mr. Mico (IBM), who has been assigned to the production-monitor

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project, indicated that IHM favors a rapid deflection scheme.

Lexington-Poughkeepsie Data Circuit for GFI Tests

(J. P. May, H. I. Rundquist) (UNCLASSIFIED)

The operation of the data circuit and the results of tests on it have been satisfactory. Further tests are planned to determine the maximum and minimum limits of all phone-line parameters by formulating simulated data with the Memory Test Computer (MTC) with a program to be written by H. I. Rundquist.

2.2.2 Installation

XD-1 Installation Information - Report 30 (Extract)

(H. Mercer, P. Morrill, H. Wainwright) (UNCLASSIFIED)

I. Building Construction

The Air Force conducted their inspection on 28 February, but it did not result in building acceptance. Completion of the lighting systems, that is, installation of the second-floor louvered ceiling, and testing of the sprinkler system were major deterrents to building acceptance. Neither of these jobs is completed.

IHM Basement -

Contractors have been given verbal go-ahead on construction of:

1. Additional stair well
2. Heat-exchanger-room partition
3. Stockroom partition
4. Office-area partition
5. Lighting.

The general contractor has been asked to submit a sprinkler-system proposal.

III. Equipment Cooling

In the last report, it was erroneously stated that insulation of the chilled-water lines was a 1-week job, and, thus, chilled water was expected to be ready this week. Insulation will prove to be closer to a 3-week job, but it is expected that chilled water will be ready for central-computer equipment by 14 March.

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IBM Basement -

Equipment-cooling installation is under way.

IV. Cabling and Method of Distribution

A. Drawings, Troughs, and Distribution Boxes

Drawings

All drawings are completed.

Troughs

First-floor signal-trough modifications are complete. Second-floor equipment suspended-trough system is about 95% installed.

Distribution Boxes

Console signal-cable distribution-box installation is complete; Console power-cable distribution-box installation is about 90% complete.

B. Cabling

First-floor power cabling is all prefabricated and waiting delivery of remaining frames. Signal cables are being expedited to get delivery to Building F before the frames arrive.

Console power cabling is about 20% installed. Signal cables have started to arrive.

V. Equipment Layout

IBM basement - as noted in Section I, above, verbal go-ahead has been given all the contractors involved in the preparation of this area.

Projection Room - Second Floor. Some new considerations of the requirements for this area are being discussed.

VI. Lighting

The louvered ceiling has been installed in all but two of the rooms. A shortage of clips is holding up the job, but these are being expedited by the contractor.

VII. Telephones

About half of the cables for the west-side consoles have been pulled into place. Frame wiring continues in the basement.



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## VIII. General

Except for the deficiencies noted above, the building is slowly approaching completion.

The cleaning crew was increased in an all-out effort to get the building ready for receipt of the drum frames.

In addition, it has been decided to install plywood on the expanded-metal ceiling directly over the drum area, and, further, we have ordered a plastic shelter to enclose completely the drum-housing section. This is a temporary expedient, but it is proposed to use the shelter until such time as building construction or modification is complete.

2.2.3 Testing

(J. A. O'Brien) (UNCLASSIFIED)

The dust and dirt problem in the XD-1 machine has become quite troublesome, and we have taken steps to correct this situation. More laborers have been hired to vacuum the floor and expanded-metal ceiling and to clean up after the contractor's people. In addition, we have arranged to use some Telephone Company equipment to blow the dust off the electronic equipment and collect it.

The first evaluation-test run has been made on XD-1, and the results were about as expected; further details will be found in the evaluation report.

(J. D. Crane) (UNCLASSIFIED)

Memorandum 6M-3443, "Results of the XD-1 Central Computer Evaluation," reports the results of tests which were made to determine the reliability of the XD-1. The physical and logical state of the machine is also described.

(J. D. Crane, S. L. Thompson) (UNCLASSIFIED)

A simple program to test the reliability of the XD-1 card punch has been written and turned over to the XD-1 maintenance crew. A more complete punch-testing program is being prepared.

XD-1 Memory

(W. Canty) (UNCLASSIFIED)

The causes of low margins while running certain test programs and of intermittent failures in Memory II of XD-1 are being investigated.

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A bad sense amplifier and several microphonic tubes have been replaced.

A day-by-day check on drive currents is being made to see if drift in these currents could be a cause of poor margins.

### 2.3 Production System

(S. H. Dodd) (UNCLASSIFIED)

An effort is being made to schedule the Systems Office activity over the next several months for the purpose of estimating the degree of cooperation with Group 61 which will be required. As an additional advantage of such a survey, it is expected that the planning activity which must necessarily precede such schedules will help the Systems Office to better organize its efforts over this period.

Work is currently proceeding on the technical requirements of the SAGE System for air/ground voice radio, digital-data transmitters and receivers, the AN/FSQ-8 Combat Center equipment, ground/ground digital-data equipment, the output system, and the AN/TSQ-7. Some supplementary work is being done on the long-range-radar input equipment, and preliminary studies of the gap-filler input facilities are in process.

(C. W. Watt, Jr., W. H. Ayer) (UNCLASSIFIED)

On Friday, 4 March, Bill Ayer and I attended an Air Force Progress Meeting at the Kingston IBM plant. The progress report that IBM would present at the ADES meeting the following Tuesday was previewed, and the progress report was amplified by individual reports from representatives of Production Engineering and Manufacturing. As of 1 March the report showed that IBM was essentially on schedule as far as the first production machine was concerned. This report did not show the effect of the auxiliary-memory change on IBM's production schedules. The information on these progress reports will be posted onto the summary schedule being maintained by Group 66, and copies of the progress report are available in the Production Coordination Office.

(C. W. Watt, T. R. Parkins) (UNCLASSIFIED)

We conducted a survey of the specific areas where Group 61 cooperation with the Systems Office will be required during the balance of 1955. A draft documenting this survey has been written and discussed at length on interviews conducted by S. H. Dodd with equipment and planning committees of the Systems Office. In the next period we expect to publish the corrected draft as an M-note.

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(M. D. Feldstein, S. B. Ginsburg, H. K. Rising) (UNCLASSIFIED)

On Friday, 25 February 1955, a conference was held at Bell Telephone Laboratories in New York to determine the feasibility of using non-interleaved G/3 digital-data messages. BTL will have to study the problem before a definite answer can be given. A forthcoming M-note describes the meeting in greater detail. It will include a description of the tests and the types of disturbances that are prevalent on phone lines.

A draft of the specification for the output system of the production machine was concurred on Thursday, 3 March 1955, and will be issued as Memorandum 6M-3441 within the next biweekly period. Minutes of this concurrence meeting are included in Memorandum 6M-3433.

On Tuesday, 8 March 1955, a conference was held at Coles Signal Laboratory, Red Bank, New Jersey, to discuss the relative merits of 1300-pps and 750-pps digital-message transmission. Some methods of making AN/TSQ-7 and an Army AAOC compatible with SAGE were discussed.

A survey has begun of all weapons that might possible be integrated into SAGE.

(K. E. McVicar) (UNCLASSIFIED)

The Engineering-Installation Phasing Committee of ADES has issued Summary Report 6 which contains the schedules generated by the various subcommittees for the installation and test period for the first SAGE Subsector. This report will be the subject of a meeting on Tuesday, 22 March, at which time the question of Lincoln concurrence will be discussed.

#### Digital-Data Circuits

(F. E. Irish) (UNCLASSIFIED)

The document "Fundamental Technical Requirements for Digital Data Transmitters, Receivers, and Associated Equipment," published by the Bell Telephone Laboratories, has been sent to IBM for comments. It is planned to have the Lincoln Laboratory and IBM concur on this document as specifying acceptable requirements for the DDR's and DDT's.

#### Ground/Air Voice-Radio System

(H. J. Kirshner) (UNCLASSIFIED)

A prospectus describing the SAGE ground/air voice-radio system has been prepared by the Special Systems Engineering Group of Bell Telephone Laboratories. This draft is currently being circulated among Division 6, Division 2, and Division 3 for comment. ("SAGE System Air/Ground Voice Radio Facilities," 2nd Edition, 21 Feb. 1955). It is planned to

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discuss and revise this draft among ADES, BTL, AT&T, and Lincoln during the next 2 weeks. Following revision, the prospectus will be presented to ADC.

Reliability of Duplexed Equipment

(R. C. Jeffrey) (UNCLASSIFIED)

A meeting was held on 11 March 1955 to discuss some formulas which express AN/FSQ-7 reliability in terms of XD-1 failure data. A partial draft of an M-note (6M-3441) on this subject has been Multilithed and distributed to participants in the meeting. Additional copies are available from Jean Bowse, B-121, Extension 111. The final draft of the note will include suggestions about kinds of failure data which should be recorded for XD-1 and for existing models of other equipment which will be used in the final SAGE System.

Using pessimistic data extrapolated from WWI experience, the following crude lower bounds on FSQ-7 reliability have been calculated. Mean free time between failures of the active machine > 5 hours. Mean free time between simultaneous failures of both machines > 50 hours. Annual time during which the two machines will simultaneously be down for unscheduled maintenance < 24 hours. A more detailed analysis is in progress to estimate total annual loss in effective air-defense time, including such factors as time to reinitiate tracks after a serious failure.

FSQ-8 Specifications

(P. R. Bagley) (UNCLASSIFIED)

The FSQ-8 Committee has held several meetings to discuss the three major problems concerned with FSQ-8 design:

1. The number of auxiliary-memory drums;
2. The number of crossting inputs;
3. The capacity of the display system.

Group 61 has been investigating some of the details in connection with these problems.

Long-Range-Radar Inputs (LRI)

(A. D. Hughes, J. P. May, A. M. Werlin) (UNCLASSIFIED)

Supplement 2 to 6M-3276 is ready for publication. It corrects errors in drum-slot bit arrangements reported in 6M-3276 and Supplement #1, and further clarifies the timing of phone-line messages and the description

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of the LRI monitor. Memorandum 6M-3382, "Justification of the Long-Range Radar Input Specifications for AN/FSQ-7," has been written and will be published in the next biweekly period.

Gap-Filler Inputs (GFI)

(A. D. Hughes, J. P. May, A. M. Werlin) (UNCLASSIFIED)

A schedule has been set up for data gathering, study, and evaluation leading to the writing of adequate GFI specifications for AN/FSQ-7. Presently, we are in the data-gathering stage.

Power Generation

(J. J. Gano) (UNCLASSIFIED)

Report 6M-3378, "Power Generation and Distribution for the Direction Center, Fourth and Subsequent Sites," has been revised and has been sent to IEM and WE-ADES for approval prior to a TIR.

Production System Power Generation

(R. C. Jahn) (UNCLASSIFIED)

I have been trying to get special load requirements such as those for telephone equipment, maintenance, and testing from IEM and WE in order to tie down the requirements in Joe Gano's report 6M-3378.

Power Conversion

(S. T. Coffin) (UNCLASSIFIED)

I have begun a study to determine what sort of a-c line transients can be tolerated at the input of the AN/FSQ-7 d-c power supply without causing malfunction of the computer. The first step will be to determine the magnitude of d-c supply voltage variation necessary to cause computer malfunction. Secondly, it will be necessary to determine what sort of line transients will produce such a variation in the d-c supply. Calculations will be based on tests conducted on XD-1. The results will be compared with studies made by the power group of predicted line transients to indicate reliability of the d-c power.

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Power-Conversion Equipment

(A. Chopourian) (UNCLASSIFIED)

A meeting was attended at IBM with General Electric personnel for the purpose of discussing switchgear for the Kingston Test Cells. The physical layout of the cubicles was agreed upon. Indication was given that the delivery date of early May for the motor-generator sets and associated switchgear will be met.

Power Distribution

(F. Sandy) (UNCLASSIFIED)

IBM is considering using the present design (i.e., that used for XD-1, XD-2, and the Kingston installation) of MCD (marginal checking and distribution) frames for the production machine. XD-1 and XD-2 experience shows that this may be a serious error. The Struthers-Dunn relays used in XD-1 and XD-2 have proven themselves unreliable and should not be used for the production machine. The XD-1 and XD-2 logs are being examined to document the unreliability of these relays.

2.4 Vacuum Tube CircuitsFlip-Flop, Model A

(N. J. Ockene) (UNCLASSIFIED)

A circuit has been found which has a delay insensitive to variations of trigger amplitude. Tests have shown that this new configuration does not adversely affect the operation of the flip-flop in any way. It is suggested that this new configuration, which makes use of a silicon diode, be used in all future flip-flop designs where feasible.

Phone-Line Demodulator and Modulator

(E. B. Glover) (UNCLASSIFIED)

The M-note entitled "Digital Data Receiver" (6M-3402) has been sent to the Duplicating Room. M-note 6M-3403, "Digital Data Receiver and Gap Filler Input Receiver," has been written and is now being checked for approval.

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XD-I Digit-Plane Driver (Mod. II)

(D. Shansky, J. Kriensky) (UNCLASSIFIED)

A prototype of this unit (built by IBM) is presently being tested. Some trouble is being experienced with the input circuitry. The cause of the trouble is yet to be determined.

Selection-Plane Driver (256 x 256 Core Memory)

(D. Shansky) (UNCLASSIFIED)

Trouble in this driver was traced to a shorted diode. A 1N34A has been used where a 1N38A had been specified. Excessive back voltage caused the diode to fail.

Sensing Amplifiers for Memory Planes

(R. C. Zopatti) (UNCLASSIFIED)

An approximate lumped-constant circuit has been found that synthesizes the source impedance of a memory plane. It consists of a 50- $\mu$ f capacitor in parallel with the series combination of a 14.7-ohm resistor and an 18- $\mu$ h inductor.

Experimental High-Speed Flip-Flop

(B. Barrett) (UNCLASSIFIED)

The experimental high-speed (10-mc) flip-flop driving a difference amplifier has a 28-v output. The output uses in 0.05 microsecond and falls in 0.02 microsecond. The full operating margins are now being determined.

Pulse Converter

(W. F. Santelmann, Jr.) (UNCLASSIFIED)

Delay-line control of a one-shot multivibrator has been found to produce well-shaped pulses. However, this technique does not permit a duty factor above about 40%.

A new circuit has been devised in which the delay line is separate from the multivibrator. In this circuit, the multivibrator is essentially bistable; it is set to a ONE by the input trigger and cleared to a ZERO by the same pulse delayed by a variable delay line. The cycling of the multivibrator in this way produces the desired output pulse. Such a circuit has been used to generate pulse durations from 40 to 500 millimicroseconds with duty factors up to 80%.

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2.5 Display

(C. L. Corderman) (UNCLASSIFIED)

Four days of this period were spent at Hughes and Convair discussing purchase and test specifications and problems encountered with Typotron and Charactron tubes. Both companies are experiencing realization rates on tube production below those which were expected by this time. For the Typotron, screen blemishes and interelectrode leakage are causing the most rejections. The most frequent Charactron failures are caused by screen defects and gun-operation alignment. A change in the gun structure was recommended to Convair, and parts needed to make this change on 18 guns were left with their production manager.

In addition to the basic Charactron test unit, IBM has ordered from Convair the equipment needed to enable this tester to test Typotron tubes. Delivery of these modified units cannot be made until 15 April, however. A Typotron tester to be used in the interim period is being constructed. Adequate metering is being provided to simplify tube checkout as well as a program-mode-selection switch to select rapidly the various test sequences required.

(R. S. Fallows, R. J. Callahan, B. Gurley) (UNCLASSIFIED)

Testing of frame 25 has been delayed approximately a week because of late delivery of pluggable units. Test procedures have been modified to limit the effects of delayed deliveries, but we are still handicapped.

Frame 25 wiring charts have been corrected so that XD-2 can be reworked before shipment to Hazeltine.

Frame 24 arrived on 10 March, and wire-checking has started.

Pluggable units are being inspected for wiring errors by Nicker-son's shop, and one of each type is being tested electrically by Porter's PU test group.

An attempt was made to assembly a complete schedule for installation and testing of the XD-1 display system. Full information is not yet available.

(R. B. Paddock) (UNCLASSIFIED)

Most of my recent effort has been directed to planning the detailed frame test for frame 25 (digital-display generator and display-tester elements). With this planning about half completed, the remaining planning will be mixed in with actual frame-test operations.

Preliminary continuity checking of frame 25 has been completed; detailed frame testing has begun and will continue for an anticipated 4 weeks.



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Design of the display-tester console is nearly complete. Construction of the special panels for this console has begun at MIT, and construction of the plug panels and resistor boards internal to the console has begun at IHM.

(H. Ziemann) (UNCLASSIFIED)

Marginal checking of the display decoders has been completed, and all required modifications have been turned in as engineering change requests. Data will be presented for circuit approval and concurrence.

#### System Test Planning

(R. H. Gerhardt) (UNCLASSIFIED)

D. J. Williams of IHM has written a preliminary note describing the tests planned for the digital display. It is difficult to predict what display will be if certain display flip-flops should fail. For these cases, we hope to simulate these failures with MTC connected to the digital-display generator.

#### Display Console

(J. Woolf) (UNCLASSIFIED)

Recently the vectors displayed in the simulated XD-1 program appeared to have a curl, which was traced to a ringing in the magnetic-deflection amplifiers. This ringing will be eliminated in the final amplifier designs.

A Typotron has been installed in the console and is operating, but the contrast gate needs to be connected before the installation is complete.

The preprototype console will be in operation during the coming period and will be available for photographing displays.

The light gun will be debugged during the coming period.

#### Automatic Camera Control and Camera

(L. Sutro) (UNCLASSIFIED)

Like an octopus with many writhing tentacles, the camera-control system reaches out into many parts of the computer disturbing things wherever it appears. Manual controls, indicator lights, and shortage-of-film alarms have forced their way into a maintenance console. In the selection-control frame, a flip-flop and AND circuit have been taken over, the flip-flop to

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be set when the camera system is in operation, the AND circuit to permit branch on sense. Time pulses 1 and 5 have been extracted from the central computer, TD and RD pulses from the drum system. Frame 25 is being loaded with five more pluggable units and 15 relays. For the console that will support the camera, Corderman has devised modifications that permit the camera-control system to control intensification at bright and dim levels distinguishable on film.

The camera, if mounted in line with the Charactron, would reach 4 feet out from the console. Our mechanical engineers, working with Fairchild, have tentatively agreed on a folded-light-path mount that Fairchild would build. The camera has changed enough in meeting XD-1 requirement that Fairchild proposes to make a new set of drawings. The final tentacle of the camera system has reached the film and led Lloyd Sanford to experiment in search of a film that is satisfactory.

## 2.6 Vacuum Tubes

### 2.6.1 Activities of Group 65

(P. Youtz) (UNCLASSIFIED)

J. S. Palermo and I spent the first 2 days of this period at the Convair Charactron Tube Plant reviewing bulb-processing techniques in the production line.

The San Diego water is difficult to de-ionize and clean. The recent rainy season in the San Diego area put considerable burden on the Charactron water de-ionizing unit. In fact, the water coming from the de-ionizer was marginal for the phosphor settling. This matter is now under control but has caused Convair to fall behind schedule in the production of 19-inch Charactrons.

Convair has had considerable trouble with astigmatism and beam-center shift in the Charactron. A. Zacharias, in cooperation with F. A. Rodgers and C. L. Corderman, made some tubes to investigate the cause of astigmatism and the possible recommendations. A solution to the problem was a disc on the exit aperture of the electron gun. We supplied Convair with 54 discs so that this production section could be put immediately into their production line. A program for polycasting electron-gun display at beam-center shift has been initiated. This will be continued over the next month.

Hughes had considerable shrinkage in producing Typotron tubes with satisfactory storage assemblies. We have inaugurated a program to make Typotron tubes at MIT so that we can fully understand and evaluate the problem associated with making Typotron storage surfaces. We hope to get out of this program some suggestions for improving the production line at Hughes. L. B. Martin will conduct these studies for Group 65; C. L. Corderman and members of Group 25 will participate in these investigations.

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Considerable time was spent with IBM on a review of second-source bids for the twin triode and the pentode. In order to ascertain their production ability to meet the needs of the AN/FSQ-7 tube program, all of the companies were visited and facilities carefully studied, engineering proposals reviewed, and their production record on similar tubes investigated. Meetings will be held the week of 14 March at Kingston to make recommendations for awarding the second-source contract.

#### 2.6.2 Tube Research and Development

(S. Twicken) (UNCLASSIFIED)

I attended a progress meeting on the Z-2177 with IBM at the General Electric Plant, Owensboro, Kentucky. Production has been doubled to meet IBM's requirements. As a result of careful planning, the production increase is well in hand. Sleeves of the present cathode-alloy melt will have run out in June. An intensive program is getting under way to find another acceptable melt sufficiently in advance of that time to forestall difficulties. Test shrinkage at the plate-current spec limits is running higher than we would like. A dual investigation is to be made. IBM-MIT will determine actual circuit requirements, and GE will determine better methods of product control and the statistical variability of the product.

Together with P. Youtz and the IBM Tube Group I visited Bendix, RCA, and Raytheon for a final review and facilities inspection prior to a decision on second sources of the low-power twin triode and gate pentode.

(D. C. Lynch, J. S. Palermo) (UNCLASSIFIED)

Two days were spent at Convair carefully reviewing their phosphor-settling and aluminizing procedures. Controlled experiments were set up in the Barta Building chemical laboratory to check Convair's Charactron tube-manufacturing specifications in an attempt to estimate the margin within the specifications. This gives some estimate of the risk and control involved in using a certain process to produce a tube to a given specification. For the past fortnight we have concentrated on the lacquering procedures that are preparatory to aluminizing. We have some estimate of the factors that might cause a margin result.

We have polycast a number of electron guns to aid the electron-gun study program.

Some phosphor-settling work was done for the big-display program.

(P. C. Tandy) (UNCLASSIFIED)

Nine 19-inch Charactrons, CHT-61, CHT-62-1, CHT-68-1, CHT-72-2, CHT-73, CHT-75, CHT-80, Convair 7-1, and Convair 0082, have completed from

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312 to 3255 hours on life test. At the last testing period there was no appreciable change in CHT-61, CHT-68-1, CHT-72-2, CHT-73, and CHT-80. Of the last three transfer characteristics made on CHT-62-1, the first and third were similar, while the second indicated that the tube was deteriorating. CHT-75 has shown some improvement near zero bias, while Convair 0082 has shown a slight drop in emission. Emission in the cathode of Convair 7-1 was poorer, while the matrix current was slightly increased; as a result there was a change in ratio of pulse-cathode current to pulse-matrix current from 77 to 45. Both ratios are greater than the usual 10 to 15 for a good tube.

A gas-ratio test was made on all available 19-inch Charactrons. The ion current of all tubes was well within the limit of 1 microampere. The leakage currents of Convair 7-1 and 0082 with the cathode cut off could not be balanced out on the ion-current meter on any scale less than 1 microampere; thus, a comparison between Convair and MIT tubes could not be obtained. We have not made any leakage tests on these tubes recently.

Life-test facilities are presently being expanded to 15 positions.

(L. B. Martin) (UNCLASSIFIED)

Ten Typotron tubes received from Hughes Aircraft were tested for leakage. Three tubes passed leakage specifications, six failed, and one was gassy.

The gain and centering ranges in the 16-position tester were inadequate for all tubes. The mounts have been modified accordingly, and nine good tubes will be started on life immediately.

The eight-position life test is temporarily shut down for metering changes.

The following is a list of tubes, their condition, and total hours on life test:

<u>Tube</u>	<u>Total Hours</u>	<u>Condition</u>
265	7685.7	marginal
280	6867.7	satisfactory
389	4265.1	satisfactory
390	5348.9	satisfactory
392	5348.9	satisfactory
394	4566.8	marginal
11521	417.0	satisfactory
11601	661.5	satisfactory

Tube 265 has been marginal for approximately 5000 hours because of ion damage to center of storage surface. Tube 394 has been marginal from the start of life. Some areas of the storage surface switch positive at collector potentials too low to store data on other areas.

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(A. Zacharias) (UNCLASSIFIED)

The first half of this period was spent on electron-gun studies. C. L. Corderman and IEM reported that astigmatism was present in the Convair Charactron tubes. A preliminary investigation showed that the electron gun might be at fault. Convair has been using Sylvania 5CP guns in the electron-optic assembly. Most of the Charactron tubes made at MIT used RCA electron guns. Using our CT type construction which has a phosphor screen at the same distance from the electron gun that the matrix is from the selection gun of the Charactron tube, RCA and Sylvania type 5CP guns were observed. All the Sylvania guns showed excessive astigmatism; the RCA guns had considerably less astigmatism. The Superior 5CP guns which Convair contemplated using were also put in CT type tubes and studied. These guns also had considerable astigmatism. F. A. Rodgers and C. L. Corderman investigated and determined that the mounting tabs on the  $G_2$  barrel of the Sylvania and Superior guns were the cause of the astigmatism. A number of CT type tubes were made with a disc over the exit end of the  $G_2$  barrel of the Sylvania and Superior guns. In these tubes the field distortion caused by the  $G_2$  tabs and the resultant astigmatism were eliminated.

The second feature of the Superior and Sylvania guns, and to a lesser extent the RCA gun, has been beam-center shift with varying focus voltage. F. A. Rodgers attributed this to the misalignment of the axes of the gun parts causing the beam to enter the field of  $G_2-A_1-A_2$  at a finite angle to the axis of the lens. This may result in the beam-center shift.

We inaugurated a program to imbed in thermo-setting plastic guns exhibiting beam-center shift in the Charactron tubes. The guns will be sliced and an attempt made to correlate the physical dimensions of the gun with the beam-center shift phenomena. This program has just been initiated and will continue over the next two biweekly periods.

(T. F. Clough) (UNCLASSIFIED)

In cooperation with Group 35 and the Institute Metallurgical Department, procedures are being developed to secure accurate radiographs for the determination of electron-gun grid-cathode spacings.

Work continues on the reorganization of the tube processes specifications.

## 2.7 Memory Test Computer

### General

(W. A. Hosier) (UNCLASSIFIED)

Herb Ziegler joined the MTC staff on 7 March; his long and varied experience with WWI should be a big asset to MTC. Beside familiariz-

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ing himself with the system generally, he is undertaking to improve the linearity, resolution, and brightness of the MTC display scopes, with all that this implies.

The usual apportionment of operating time among display development, simulation studies, pattern-recognition studies, and card machine has continued substantially as before, except that time devoted to the card machine has been for program checkout rather than equipment development.

Certain auxiliary installations in the computer room have been completed this fortnight: a blackout curtain has been installed around the prototype display console, imparting a mortuary cast to that corner of the room; also, most of the 3-inch conduit has been run from MTC to (but not yet into) Building F, including a section through the floor near the drum. The building electricians have done a quick and impressive job on this conduit, which included installation of new hangers all along the run.

A baffling source of intermittent machine errors was tracked down this period and, we trust, cleared up: for the last 2 months or so, parity alarms (usually spurious) would interrupt the read-in or tape-conversion process, though not affecting the general run of programs. Also, the read-in program would occasionally abort in capricious ways, and a few other programs, particularly if they contained "index camera" or other instructions entailing delays over 10 milliseconds, would run amok. Our routine test programs disclosed no troubles.

It was ultimately found that one flip-flop, digit 8 of the A-register (MTC Mod II, same circuit as XD-1 type A), had two diodes with low back resistance (output clamping diodes to the -30-v supply). The result was that for rapid computer operation (in which the FF was turned over every 5 of 10 microseconds) and on the test bench (where the FF was set, cleared, and complemented by trains of 2-mc and 100-kc pulses), operation of this FF was entirely normal. It was only when the FF was allowed to sit for a few milliseconds in its "1" state and was then hit, not by a single pulse but by a short train of rapid pulses, that the defect, which took the form of a upper output level at ground instead of at +10 volts, became apparent. Since the A-register is a central logical nexus in MTC, the consequences of such failure were many and varied, but fortunately the parity count gates were sufficiently sensitive to this sort of trouble to enable us to cause the failure consistently by proper programming and use of margins.

This incident is recounted here in considerable detail, because it points to improvements that should be made in maintenance procedure both in MTC and XD-1:

1. Test programs should include strategic sequences of pauses and "workouts" for important registers;
2. Bench tests for FF's should also include such sequences;

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3. Test scopes should be available with slow sweeps and delayed expanded sweeps (such as Tektronix 535 and 545) for observance of phenomena which recur only infrequently.

We are trying to come up with such test procedures and will see to it that the problem is treated more fully in a subsequent M-note. Any suggestions will be welcome.

Distribution of computer time, 28 February to 11 March, inclusive:

	<u>Hours</u>	<u>Per Cent</u>
Programming	65.1	43.9
Development	42.2	28.4
Scheduled Maintenance	35.9	24.2
Interrupting Failures	3.1	2.1
Installation	1.4	0.9
Power Supplies	<u>0.7</u>	<u>0.5</u>
	148.4	100.0

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MTC Drum

(E. Gates) (UNCLASSIFIED)

Construction of equipment for the link between the MTC drum system and Building F is almost complete. The new drum heads from IEM have not arrived.

MTC Control Block Schematic

(A. Vanderburgh, Jr.) (UNCLASSIFIED)

The MTC Control Block Schematic is being redrawn by M. L. Storm and A. Vanderburgh, Jr. and will include terminal-jack and panel numbers. It is intended as an aid to trouble shooting rather than as an educational schematic.

Analysis of MTC Tube & Component Defects

(E. Albanese) (UNCLASSIFIED)

The following is a summary, for the period 25 February to 11 March, of defects found in tubes and in components in MTC:

<u>Tube or Component</u>	<u>Defect</u>	<u>Quantity</u>	<u>Hours Lost</u>
5687*	Tap short	3	0
5965	Gone to air	1	0
6AG7*	Broken base	1	0
6AG7*	Tap short	2	0
6145	Heater defect	1	0
6145	Gone to air	1	0
6145*	Tap short	7	0
6145*	Shorted	1	0
7AK7*	Tap short	3	0
Z2177	Gone to air	2	0
Z2177*	Tap short	2	0
Crystals type 1N34A	Wrong label	1	0

\* These tubes were removed as a result of the last routine tube-tapping session (conducted monthly).



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<u>Tube or Component</u>	<u>Defect</u>	<u>Quantity</u>	<u>Hours Lost</u>
Crystals type 1N34A	Back resistance too low	2	0
Crystals type 1N38A**	Back resistance too low	19	0
Toggle switches	Intermittent	3	0
Resistor	Burned out	1	0
Pulse transformer	Open	<u>1</u>	<u>0</u>
		51	0

\*\* These diodes were removed from the core-memory selection-plane-driver address-decoding matrices in their first detailed check after 2800 hours of operation. They were not yet causing any known failure.

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## SECTION III - ADVANCE DEVELOPMENT

(D. R. Brown) (UNCLASSIFIED)

An experimental multiplier is being designed, for completion 1 July 1955, to use high-speed, surface-barrier-transistor circuits. The multiplier control, which has been built up of Burroughs test equipment, will be replaced by transistor circuits at a later date.

Construction of the first 256 x 256 memory plane is under way. Thirty-five more are scheduled. Cores are being provided by our pilot plant and core-test facilities. Techniques for small, fast memories are also being investigated.

A contract with Philco for improvement of surface-barrier transistors is now in effect. Philco's first report, covering the period 15 January to 25 February, has been received.

3.1 Chemistry of Magnetic MaterialsFerrite Cores

(F. E. Vinal) (UNCLASSIFIED)

Large-scale production of ferrite memory cores becomes a more stabilized operation as time passes. Current maximum production is of the order of 100,000 cores per week. With receipt of equipment soon to be delivered, this number should increase to about 250,000 cores per week and stabilize there. Core-testing facilities will, at top efficiency, be able to cope with this output on a single-test basis. Double-testing will result in a lag of tested cores behind production.

With stabilization of core production, some attention may again be diverted toward further improvement of cores, cores for specialized applications, and development of new core materials.

Production of Memory Cores

(J. Sacco) (UNCLASSIFIED)

Two new memory-core batches, DCL-2-833 and DCL-2-835, have been test-fired. Electrical results show these cores to be satisfactory duplicates of DCL-2-832. Approximately 25,000 F397 cores from batch DCL-2-833 have been fired, and 130,000 "green" cores are on hand.

At the present time, five new batches of the DCL-2-832 type are being processed.

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Microstructure of Experimental Switch Cores

(F. S. Maddocks) (UNCLASSIFIED)

A microstructure analysis of nine General Ceramics experimental switch-core materials, SW-64 through SW-72, has been made. SW-64, -65, and -66 are MgO-NiO-ZnO-Fe<sub>2</sub>O<sub>3</sub> bodies and are all single phase, with relatively large grains. SW-67, -68, and -69 are MgO-NiO-ZnO-CuO-Fe<sub>2</sub>O<sub>3</sub> bodies containing 2.5% CuO. A noticeable change in grain structure is observed, but no change in grain size, and no second phase are observed. SW-70, -71, and -72 are MgO-NiO-ZnO-CuO-Fe<sub>2</sub>O<sub>3</sub> bodies containing 7.0% CuO. In these bodies, an unidentified second phase occurs at grain boundaries, explaining the poor loop squareness observed in these samples.

Ferrites for Magnetostriction Measurements

(D. L. Brown) (UNCLASSIFIED)

The preparation of samples for this program has been completed for the present. Other compositional series are contemplated, however, for the future.

Lithium Ferrite

(D. L. Brown) (UNCLASSIFIED)

Studies of preparative methods for lithium ferrite have been continued. Recent trials included some admixtures with zinc ferrites.

Chemical Analysis

(E. Keith, P. Reimers) (UNCLASSIFIED)

Quantitative analyses of the following have been completed:

1. Three samples of magnetite for total iron and ferrous ion;
2. A sample of zinc ferrite for total iron;
3. A sample of ferrous germanate for total iron;
4. An assay of chromic oxide.

Quantitative analysis of DCL-2-833, a memory-core composition, is in progress.

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Inorganic Chemistry

(D. G. Wickham) (UNCLASSIFIED)

The preparation of a series of compositions in the solid-solution range between zinc ferrite and ferrous germanate continues.

Two new instruments, a semi-automatic balance and an automatic titrator, have been set up, calibrated, and put in operation to facilitate our analytical work.

Core Testing for 256 x 256 Memory

(J. W. Schallerer) (UNCLASSIFIED)

We have now double-tested 114,000 cores. The output of double-tested cores should show a marked increase during the next biweekly period through the full-time use of the automatic tester. Repairs and revision of the automatic tester have been completed.

The first 256 x 256 memory plane is being plane-tested by testing each of the 16 modular units of 64 x 64. At present 11 of these 16 units have been plane-tested.

3.2 Physics of Magnetic MaterialsMagnetization of Ultra-Thin Metal Tapes

(N. Menyuk) (UNCLASSIFIED)

A new model of magnetization in ultra-thin metal tapes was discussed in the previous Biweekly Report. In order to check the model quantitatively, an approximation of the eddy-current coefficient was necessary. The best approximation available led to results at variance with experimental results. Unfortunately, a more exact calculation of this coefficient is inordinately complex. However, on a semiquantitative basis, this model successfully explains why relaxation effects act over a longer distance of domain-wall motion than eddy-current effects.

Current Calibrator, Mod. III

(R. A. Pacl) (UNCLASSIFIED)

An M-note is being compiled on this current calibrator of increased precision and should be ready shortly. Six units are now available, though only one has been checked out.

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Pulse Measurement of Incremental Permeability

(J. D. Childress) (UNCLASSIFIED)

A pulse tester for measuring incremental permeability has been designed. Standard test equipment has been assembled, and the measuring instruments are being calibrated.

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### 3.3 New Components and Circuits

(Torben Meisling) (UNCLASSIFIED)

In order to meet the increasing demands of the advance-development program, it has become necessary to make better use of the limited manpower available. As a result, five research assistants are now spending 2 or more days a week in Lexington. In order to make room for them in the laboratory, small-size benches will be used exclusively. In addition, the office space has been rearranged to provide for a slight expansion of laboratory space. The net result is that the Section operates--even if somewhat cramped--in the same total area as before the changes.

#### Surface-Barrier-Transistor Life Tests

(D. J. Eckl) (UNCLASSIFIED)

The first group of eight SBT's has been on life test for 2550 hours. The second group of 16 units has been operating for 1750 hours. All circuits continue to show no change.

#### First Monthly Progress Report from Philco

(D. J. Eckl) (UNCLASSIFIED)

The first monthly progress report from Philco on subcontract #49 has arrived, and a limited number of copies are available. The report covers the material presented by Philco at their recent visit here: high-temperature storage, reverse-recovery characteristics, and circuit marginal-checking procedures.

#### Visit from Philco Circuit Engineers

(D. J. Eckl) (UNCLASSIFIED)

W. Bradley and Frank Keiper will be here on 16 March to discuss memory-driving problems with Bill Papian's Section in an attempt to bring about a better understanding of mutual problems and the eventual evolution of a core-driving transistor.

#### Transistor Procurement

(D. J. Eckl) (UNCLASSIFIED)

We have 700 surface-barrier transistors on order for use in the multiplier, life tests, small systems, and general circuit work. Two hundred General Electric 2N43A pnp transistors have been ordered for low-speed work. For power-supply and core-driving experimentation 20 Minneapolis-Honeywell 2N57 high-power transistors have been ordered. A further delay

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of about 2 months on the delivery of the Raytheon CK762 high-frequency pnp transistors has developed. Raytheon is having production difficulties.

Transistor Parameter Measurements

(D. J. Eckl) (UNCLASSIFIED)

We will duplicate some of Philco's measuring circuits to enable us to check production transistors for storage and maximum frequency of oscillation. This should also give us a check on our frequency-response plotter.

A Single-Rank Surface-Barrier-Transistor (SBT) Flip-Flop

(C. T. Kirk) (UNCLASSIFIED)

The experimental SBT flip-flop described in the last Biweekly was found to have a maximum, complementing prf of 1.2 mcps. The waveform of the delay amplifier appeared quite distorted at this prf (1.2 mcps). It is believed that the maximum prf at which the SBT flip-flop will operate is limited by the rise and fall times of the delay amplifier.

This belief has led to a detailed study of various delay amplifiers and the design problems involved. The results of this study should determine whether a delay amplifier can be designed which will allow the flip-flop to be complemented at prf's greater than 1.2 mcps.

(M. Cerier) (UNCLASSIFIED)

Among the different methods for complementing a transient storage flip-flop, indications are that those where the storage is between the gate and the flip-flop are best.

Voltage-Type Decoder

(L. Jedynek) (UNCLASSIFIED)

Recent efforts have been made to reduce the effects of variations of transistor parameters upon the decoder operation. This has been achieved to a considerable degree. Eight transistors, selected at random and compared in a given stage of the decoder, showed virtually no dissimilarity in output wave shapes. Rise and fall times over a 25-v range is of approximately 0.3 microsecond duration, using Radio Receptor 67 and Raytheon CK-721 transistors.

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(P. Griffith) (UNCLASSIFIED)

At the present a study is being made concerning the use of surface-barrier transistors for multiposition switching.

Flip-Flop Design

(E. U. Cohler) (UNCLASSIFIED)

Design of a flip-flop with a passive short-time storage has led us to the study of flip-flops with delay lines. We have been investigating the structure of delay lines necessary to provide proper temporary storage as well as the effects of different placement of the delay within the circuit. So far we have not been able to find a delay line which would realize the full prf capabilities of the flip-flop.

The problem of isolating the flip-flop from its loads is being approached with two different amplifiers: the emitter follower and the simple inverter. Evidently the delay line involved in the flip-flop will have to be tailored to the particular amplifier.

We would welcome any comments from people with experience in the delay-line field.

Basic Circuits of the Direct Coupled Type

(E. U. Cohler) (UNCLASSIFIED)

Some of the work on the static characteristics of the SBT's has been compiled in usable form and has resulted in a more optimistic appraisal of the circuit problem. It seems that the saturation beta (defined as the ratio of collector current to base current on the verge of saturation) is more consistent than was previously thought, varying in the range of 13.5 to 31.3 in a sample of 20 SBT's. Moreover, plots of saturation beta as a function of both  $I_c$  and normal alpha (as we measure it) show the possibility of correlating the saturation characteristics to the small signal characteristics.

No good quantitative results have been found in the data on hole storage; however, it can be said that the most important factor in recovery time is undoubtedly the amount of saturation current. There are many good theories for this phenomenon which bear investigation, but I fear that our necessity to accomplish the urgent will prevent us from attacking the important.

(J. R. Freeman) (UNCLASSIFIED)

Tests on the SBT one-digit shift register have been performed to ascertain the tolerance to collector-bias disparities. Results indicate that, while the shift register with 1000-ohm collector resistors will operate reliably with uniform collector-bias voltages when driven by 0.24-v pulses, larger pulses are required if collector-bias differences exist in



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the circuit. With driving pulses of 0.34 volt, it was found that with 2.3-volt collector bias a variation from this voltage of from minus 1.6 to plus 2.4 volts on one of the collector circuits can be tolerated. This extremely large tolerance, however, is greatly reduced by departures of the driving-pulse amplitudes in either direction.

(G. Davidson) (UNCLASSIFIED)

I am studying old material on point-contact and junction diodes to determine what the approach to the problem of driving memory cores has been in the past.

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### 3.4 Memory

(W. N. Papian) (UNCLASSIFIED)

Emphasis on the role of transistors in the memory circuits is increasing. In addition to Sarles' thesis work on transistor sense amplifiers, we hope to find a good thesis problem for G. Davidson in the area of transistor drivers for the large memory. Meanwhile, Group 24 is pushing along on a completely transistorized 64 x 64 x 32, 6- $\mu$ sec memory.

Group 35 is giving us some help on induction-soldering problems in connection with assembling the 64 x 64 unit planes into 256 x 256 digit planes. We expect to make some tests soon using their induction-heating machines.

R. Endres and S. Warren from R.C.A., Camden, visited. We learned about their problems with core switches for driving memories; they ran into serious problems much like those which International Telemeter encountered in driving their large, extended, core switch.

### Mechanical Design and Layout for 256 x 256 Memory

(E. A. Guditz) (UNCLASSIFIED)

Four memory-plane modules have been completed for the first 256 x 256 memory plane. The remaining 12 planes are in various stages of construction.

More experiments have been conducted with induction-soldered connections. Results were very satisfactory.

Design of a plug-in unit and mounting subrack is almost completed.

### Printed Plane

(E. A. Guditz) (UNCLASSIFIED)

Parts of a 4 x 4 printed plane are being prepared for Electro-Tec Corporation. They will complete the plane using their spiral-conductor pegs. Connections will be made by their electrodeposition process.

Results continue to be encouraging from our experiments on laminating copper foil to plastic base materials.

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256 x 256 Memory

(J. Raffal) (UNCLASSIFIED)

It appears that the sense winding for the 256 x 256 memory will be split into four separate parts, each having a separate stage of amplification followed by a mixing stage and a common amplifier providing the final output. This will essentially reduce the sensing problem to that of a 64 x 64 plane. Tests indicate that this should allow adequate discrimination.

Some basic experiments with transistors were run for educational purposes.

Memory with External Selection

(S. Bradspies) (UNCLASSIFIED)

Attempts to build a three-core-per-bit memory using General Ceramics' fast-switching 2201B cores have been unsuccessful.

The switch cores have been present standard-sized memory cores, and the memory core is about 1/7 this size. It has been found that the information held by the memory core is destroyed by excessive disturbances. The probable reason for this behavior is the low coercive force of these cores.

Loop resistance has been raised, excitations reduced, and biases increased - all to no avail. The size of the ZERO's grows larger with each additional partial selection.

There are still other possibilities that may be tried in the attempt to make the unit work. The ratio of switch-core size to memory-core size may be reduced, and/or the loop resistance may be increased still further. The driving current cannot be made smaller than has been done and still obtain a 1-usec cycle time.

256 x 256 Memory

(D. H. Ellis) (UNCLASSIFIED)

A test setup for observing the outputs of metallic-tape cores is being built. The tester will allow measurements of switching time, half-select, and full-select outputs of the various type cores which could be used in the matrix switch.

An effort is being made to allow rapid test, since this machine will be used for final selection of cores for the matrix switch.

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Sample cores have been received from Burroughs and will be compared with other types available.

Visit to the Rand Corporation

(J. L. Mitchell) (UNCLASSIFIED)

Last week I visited the Rand Corporation in Santa Monica, California, and discussed the 4096-register magnetic-core memory which was built for Rand by the International Telemeter Corporation. This memory is installed in the JOHNNIAC computer and is now being "tuned up" in preparation for the acceptance tests. Anyone desiring further information should contact the writer.

3.5 Logical Design

(J. W. Forgie, W. A. Clark, N. L. Daggett) (UNCLASSIFIED)

Block schematics of two multiplier versions will be available 16 March. The first will be a rudimentary version using Burrough's test equipment for control. The second will be an extension of the first to include a transistor control element.

From the nature of the circuitry, the block schematics are nearly equivalent to circuit schematics. However, it should be appreciated that these drawings are based on a "best guess" as to what circuit configurations will be used. It may well happen that information fed back from the circuit-design section will require substantial reworking; of the logical design.

3.6 System Design

(D. Farfenuk) (UNCLASSIFIED)

Several plug-in unit models have been designed and built using printed wiring boards. Conventional wiring methods are also being considered.

An A.M.P. tapered pin crimper machine has been ordered. Much of the frame wiring, it is expected, will be done with tapered pin connectors.

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(Chesley A. Norman) (UNCLASSIFIED)

The past biweekly period was spent investigating methods for flip-flop indication; low current relays and low-voltage and current incandescent lights are among the possibilities.

Time was also spent with J. Fadiman constructing and testing transistor circuits.

Work was started on a cathode-follower probe to be used with the DuMont oscilloscope type 336.

(Royce N. Sawyer) (UNCLASSIFIED)

The past biweekly period was spent investigating circuits which could be used in a high-speed-carry line for counters and adders.

(R. H. Hughes) (UNCLASSIFIED)

A variable-width pulse shaper which reshapes the pulse output of Burroughs' standard test equipment has been made. The output-pulse width is variable from 30 to 120 millimicroseconds. The output-pulse amplitude is variable from 0 to -10 volts. The frequency limit of this unit with the above specifications is 3.5 megacycles; at higher frequencies the pulse gets very narrow. I hope to improve this condition shortly.

Design work has started on a crystal oscillator clock for use with the transistor multiplier.

(Jonathan Fadiman) (UNCLASSIFIED)

Work is continuing on circuits that use the full voltage swing allowed by the transistor - about 4 volts. It takes more time to rise 4 volts than a smaller voltage, but breadboard flip-flops with this swing have been made with a rise time of about 0.1 microsecond.

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## IV - CENTRAL SERVICES

4.1 Material Requirements & Stock

(H. B. Morley) (UNCLASSIFIED)

Division 6 Special Stockroom is being rearranged. The new layout will be more compact and will conform to regulations.

February's requisitions exceeded January's by about 6%. During February we averaged 2.3 more requisitions per day than in January.

The order has been placed for the 48-kva M-G set (WWI filament power).

4.2 Engineering Services4.2.2 Test EquipmentTest Equipment Headquarters

(L. Sutro, A. Bille) (UNCLASSIFIED)

Six DuMont 336 oscilloscopes were bought with the assurance that they would display the standard 0.1- $\mu$ sec pulse without attenuation. Checked with great care, the six scopes have been found to attenuate the pulse 5%. A complaint to the DuMont representative, Howard Schuft, brought assurance that the scopes will be made to perform as promised. Yet the DuMont 336 has features that make it desirable.

Tektronix representatives demonstrated on 2 successive days the Tektronix 545 oscilloscope which will be available this summer. The vertical amplifier of this scope did not attenuate the 0.1- $\mu$ sec pulse. Proof of this is band width which we measured and found flat within 3 db to 35 mc and within 6 db to 45 mc. The deflection sensitivity direct to the plates of the tube is 7 v/cm, through the amplifier 0.05 v/cm.

Paul Harris, who has been training in Test Equipment Headquarters, now has his own bench in Building F, where he is maintaining test equipment for XD-1 under the direction of A. Bille.

The first shipment of test equipment has been made to Dr. Frank Verzuh for use in teaching computer circuits to graduate EE students. He will borrow 36 units for different lengths of time during the spring.

4.2.3 Mechanical Engineering

(A. Smith, L. Smith, L. Prentice) (UNCLASSIFIED)

An automatic loader has been designed which accurately spaces cores on the setter plates in 10% of the present 14 manhours. The loader will also increase the maximum furnace load from the present 35,000 to the range of 70,000-98,000 cores.

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#### 4.4 Administration & Personnel

##### 4.4.1 Staff

###### New

(J. C. Proctor) (UNCLASSIFIED)

Jonathan R. Fadiman is a new staff member in Group 63. He received his BA in Physics from Amherst College, and for the past year and one half he has been studying at the Harvard Graduate School, Division of Applied Sciences.

Floyd W. Graham is a new staff member in Group 61. He graduated from the US Naval Academy with a BS in Engineering and has had 5 years of experience with the US Air Force.

Harold A. Keit is a new staff member assigned to Group 61. Mr. Keit received his BS in Math from St. Francis College, N.Y., and has had over 5 years of working experience.

Lee Mah is a new Research Assistant in the Building 10 group.

###### Transfers

(J. C. Proctor) (UNCLASSIFIED)

Joseph Kriensky has transferred from Group 31 to Group 62

Theodore Parkins has transferred from Group 60 to Group 64.

###### Terminations

(J. C. Proctor) (UNCLASSIFIED)

Philip Baltzer  
Philip Gray

##### 4.4.2 Non-Staff

###### New

(R. A. Osborne) (UNCLASSIFIED)

Barbara Smith is a new clerk in the Print Room.

Clifford Monzeglio is an MIT student working part time in Group

65.

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Terminations

(R. A. Osborne) (UNCLASSIFIED)

Robert Costello  
Dorothy Roberts

Open Requisitions

(R. A. Osborne) (UNCLASSIFIED)

1 Clerk-Typist for Group 62  
1 Electro-Mechanical Checker  
1 Layout Draftsman  
1 Technician C for Group 63  
1 Technical Assistant for Group 61



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Accessions List

(D. B. Helwig) (CONFIDENTIAL)

The following documents were published by Division 6 or received from IBM during the period 25 February - 11 March 1955:

NO.	AUTHOR	TITLE	CLS.
6M-3286	C. Walston F. Irish	Input Channel Switching Specifications	U
6M-3322	G. Davidson	Forward and Reverse Recovery in Transition-Type T-6 Gold Bonded Germanium Diodes	U
6M-3330	A. Shoolman	Auxiliary Console and Wing Unit Equipment Allocation and Layout for AN/FSQ-7 Dir. Ctrs.	C
6M-3364	A. Vanderburgh	MTC Technician Training Manual, Chapter II	U
6M-3389	P. Bagley	Description and Estimated Storage Requirement of the AN/FSQ-7 Standby Computer Program	C
6M-3390	J. Mitchell	Memory-Plane Margins: DCL-2-720 Cores vs. S-1 Cores	U
6M-3393	J. Ackley	Rules for Programming for the Room 156 Consolidated Test Control Program	U
6M-3394	J. Ackley	Description of ISR 3613m5 and T-3693	U
6M-3395	A. Favret	Visit to Raytheon - Project Hawk	S
6M-3397	C. Gaudette S. Knapp J. Yienger	Operating Procedures for the Card Preparation Equipment and the XD-1 Computer	U
6M-3399	C. Grandy	Nomenclature for XD-1 Console Labels	C
6M-3401	- - -	Personnel List for March	U
6M-3404	B. Morriss	IBM Engineering Systems Office Concurrence Meeting #16	U
6M-3405	- - -	Biweekly Report of February 25, 1955 & Supp.(U)	C
6M-3406	J. Mazza	Notes on Systems Planning Meeting 28 February	U
6M-3407	P. Bragar	SAGE System Meeting February 28	U
6M-3408	H. Frachtman	Program Specifications for 1954 Cape Cod System Recording Function (M-2706S)	C
6M-3409	R. Mayer	Omission of Mechanical Clock from XD-1	U
6M-3412	L. Sutro	Test Equipment Committee Meeting of 25 Jan. 1955	U
6M-3413	A. Smalley	Op. 61 Mission Specs. (22-55) for an Accuracy Training Test on Tues. 8 March 1955 (LLUO)	U
6M-3414	A. Smalley	Mission Specs. (23-55) for Raydist Orientation on 9 and 11 March 1955 (LLUO)	U
6M-3418	D. Israel	Report on Visit to Rand Corp. to Discuss Systems Training	C
6M-3419	W. Lemnios	Procedures and Program Specifications to Compare 1954 CCS Track Data with Raydist Measurements	C
6M-3420	W. Vecchia	CSII Conversion and Post Mortems	U
6M-3421	H. Platt	Changes to XD-1 Display System from Present Design Status	C
6M-3422	S. Manber	Status of SDV Data Collection for Noise Studies	C
6M-3423	I. Aronson	Proposal for Transferring Responsibility for Maintenance of Phone Line Receivers and Transmitters from Group 62 to Group 22	U

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Accessions List (Continued)

NO.	AUTHORS	TITLE	CLS.
6M-3426	J. Mazza	Notes on Systems Planning Meeting of March 7	U
6M-3427	P. Bragar	SAGE System Meeting March 7, 1955 (IDO)	U
6M-3428	A. Smalley	Gp. 61 Mission Specs. (25-55) for an Accuracy Training Test on Tuesday 15 March 1955(LLUO)	U
6M-3429	A. Smalley	Mission Specs. (26-55) for Raydist Orientation on 16 March 1955 (LLUO)	U
6M-3430	A. Smalley	Gp. 61 Mission Specs. (26-55) for a Saturation Test on Thursday 17 March 1955 (LLUO)	U
6M-3431	A. Smalley	Gp. 61 Mission Specs. (28-55) for Program Analysis Test on Friday 18 March, 1955 (LLUO)	U
6M-3433	N. Jones	Minutes of Concurrence Meeting #18	U
	H. Rising		
6M-3434	B. Morriss	Minutes of IBM-Lincoln Concurrence Meeting #17	U
6M-3435	C. Gaudette	Proposal for the Use of Illegal XD-1 Instructions by Group 61	U
6M-3437	Systems Office	Data Link Recommendation for Experimental Subsector	C

IBM REPORTS

IBM-697	G. Hallgren	Prototype Drum System Frame Test	U
	C. Jackson		
IBM-698	- - -	Program Element, Central Computer System, PM2-3	U
IBM-699	W. Wittenberg	A Transistor-Transformer Circuit for Driving a 256 x 256 Memory Array, H-163	U
IBM-700	R. Dawson	Drum Unit, H-165	U
	H. Boyd		
IBM-701	N. Jacobs	Minutes of Display Limitations Meeting	U
IBM-702	- - -	Central Reference Room Bulletins 64 through 69	U
IBM-703	W. Wittenberg	A Three-Wire Coincident-Current Memory, H-164	U
IBM-705	- - -	AN/FSQ-7 Biweekly Progress Report	C
IBM-706	J. Brownlow	Project High Progress Report on Ferrite Core Research, TR-37	U
	A. Eschenfelder		
IBM-707	W. Hunt	Drum Specifications for the Production System, D-13-2	C

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