Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

SUBJECT: BIWEEKLY REPORT, March 27, 1953

To: Jay W. Forrester

From: Laboratory Staff

1.0 SYSTEMS OPERATION

1.1 Whirlwind I System

1.11 Operation (F. J. Eramo)

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 13 - 26 March 1953:

Number of assigned hours	117
Usable percentage of assigned time	88
Usable percentage of assigned time since March, 1951	85
Number of transient errors	53
Number of steady-state errors	2
Number of intermittent errors	40

(S. H. Dodd)

We are continuing our practice of having two installation days per week and have made very good progress in eliminating weak points in the circuits and readying the computer for operation with the new terminal equipment.

Plans are now being formulated for a change in the positions of some of the ES control circuits so that a spare ES digit column can be installed. Thus when the second bank of storage is in operation, there will be one parity digit and one spare digit available for each bank. An intensive program of testing of the various digit columns in Electrostatic Storage has been going on for several weeks with the view of determining the reasons for positive switching and, in general, increasing the reliability of operation of Electrostatic Storage.

The evaporative condenser in the present air-conditioning system has been moved to a new location to prepare for the installation and tie-in of the new air-conditioning system.

1.11 Operation (continued)

During the past few weeks we have been troubled with poor margins on the photoelectric tape reader. Some of these difficulties are probably caused by wear in the tape-handling section of the PETR. I would like to take this opportunity to emphasize the need for care by computer operators while using the photoelectric tape reader. There have been recently a number of cases where the thin glass covering plate has been broken by careless dropping of the light-bulb housing, and several of the light bulbs have burned out.

(D. M. Fisher and C. L. Corderman)

Favorable results were obtained from storage during this period. Margins have increased considerably in ES row since the use of storage tubes containing the mica quadrant spacer between the main collector and target.

Besides transient errors, positive switching of digits appears to be the paramount issue at this time.

Nine storage tubes have been installed and are in operating condition in Bank A.

(S. E. Desjardins)

An auxiliary intercom panel has been installed in Test Control. This new panel allows audio from accumulator digit 13 to be heard through the new Teletalk intercom and also allows this audio to be piped to any station from the master station in Test Control. The panel also permits the handset mounted on the small test table in front of TC-4 and 5 to be used for communicating to speaker station by pressing the talk button mounted on the handset. The Koiled Kord used with this handset allows it to be used at some distance from the test table (i.e. while the operator uses the marginal checking equipment, etc). When neither of these special features are used, the intercom in Test Control functions identically as any other master station in the system.

The long-sought-after "Scope Switch Panel" is being built and should be in use by the next biweekly report.

(D. A. Morrison and J. H. Hughes)

The M-C counter-selector-decoder panel has been constructed. Preliminary tests have shown the unit to be satisfactory. Further testing will take place when the new panel-selection frame is available.

1.11 Operation (continued)

The construction shop is cabling the cross-bar switch and skip-switch panel in the panel-selection frame and should finish within ten days.

Richard Dickie is installing filament transformers and terminal strips in rack P9, where the new panel-selection frame is to go.

John Hughes is making up cabling specifications for the system.

1.12 Component Failures in WWI (L. O. Leighton)

The following failures of electrical components have been reported since March 13, 1953:

Components	No. of Failures	Hours of Operation	Reasons for Failure
Crystals			
1N38A	2	2000 - 3000	Low R_b
1N34A	1	4000 - 5000	Low R_b
D-357	1	11000 - 12000	Low R_b
	1	16000 - 17000	Low R_b
D-358	2	0 - 1000	Low R_b
Relays			
10 Amo 115-Volt AC Time Delay Cramer Type TEC	1	17000 - 18000	Intermittent operation of +90 and +120 control circuit
Resistors			
5000-ohm 1-watt ±1% deposited carbon	1	3000 - 4000	Above tolerance
Transformers			
1:1 pulse 193-6	1	2000 - 3000	Open secondary
Tubes			
VR-105	2	17000 - 18000	High starting voltage and poor regulation
715 B	1	7000 - 8000	High leakage
	1	17000 - 18000	Low I_b

1.12 Component Failures in WWI (continued)

Components	No. of Failures	Hours of Operation	Reasons for Failure
Tubes			
SR-1407	1	0 - 1000	Short
	1	2000 - 3000	Short
	1	3000 - 4000	High cutoff
	1	4000 - 5000	Short
	2	9000 - 10000	Short
	1	17000 - 18000	Interface
7AK7	2	0 - 1000	1-Short, 1-high grid cutoff
	6	16000 - 17000	3-Short, 2-low I_b, 1-leakage
5670	2	6000 - 7000	1-Short, 1-low I_b
	1	7000 - 8000	Low I_b
3D21A	1	17000 - 18000	Low I_b
5Y3	1	10000 - 11000	Low I_b
	1	17000 - 18000	Low I_b
6SL7	1	13000 - 14000	Low I_b
5651	2	17000 - 18000	High starting voltage
6Y6	1	16000 - 17000	Short
	1	17000 - 18000	Low I_b
6SN7	1	7000 - 8000	Low I_b
	1	9000 - 10000	Low I_b
	1	12000 - 13000	Low I_b
	1	13000 - 14000	Low I_b
6AS7	2	5000 - 6000	Low I_b
	1	6000 - 7000	Low I_b
	1	7000 - 8000	Low I_b
	5	13000 - 14000	3-Short, 2-sagging heaters
6AS6	1	17000 - 18000	Low I_b
6AL5	1	10000 - 11000	Low I_b
7AD7	2	0 - 1000	1-Low I_b, 1-short
	1	1000 - 2000	Short
	1	4000 - 5000	Short
	2	6000 - 7000	Low I_b
	3	8000 - 9000	2-Short, 1-leakage
	2	9000 - 10000	Low I_b
	4	10000 - 11000	3-Low I_b, 1-short
	7	12000 - 13000	1-leakage, 3-low I_b, 3-short

1.12 Component Failures in WWI (continued)

Components	No. of Failures	Hours of Operation	Reasons for Failure
Tubes			
7AD7	3	13000 - 14000	2-Low I_b, 1-short
	1	14000 - 15000	Low I_b
	4	15000 - 16000	1-Leakage, 1-short, 1-grid emission, 1-low I_b
	8	16000 - 17000	5-Short, 2-low I_b, 1-leakage
	3	17000 - 18000	Short

1.13 Storage-Tube Failures in WWI (L. O. Leighton)

The following Storage-Tube Failures were reported during this biweekly period:

ST-717-C-2 in Storage-Tube Mount #23 was rejected after 1335 hours of operation because of low margins.

ST-604 in Storage-Tube Mount #19 was rejected after 2295 hours of operation because of poor margins.

ST-715-C in Storage-Tube Mount #9 was rejected after 17.8 hours of operation because of failure to hold a positive array.

ST-714-C in Storage-Tube Mount #22 was rejected after 24.0 hours of operation because of failure to hold a positive array.

ST-730-1 in Storage-Tube Mount #30 was rejected after 947 hours of operation because of control grid to cathode short in High-Velocity Gun.

1.14 Storage-Tube Complement in WWI (L. O. Leighton)

Following is the storage-tube complement as of 2400 March 26, 1953:

Digit	Tubes	Hours of Installation	Hours of Operation
0 B	ST-619-C-1	10069	3215
1 B	ST-711-C	11989	1195
2 B	ST-603	8322	4962
3 B	ST-601	8524	4760
4 B	ST-516	6641	6643
5 B	ST-745	12982	302
6 B	ST-751	13170	114
7 B	ST-540	7937	6347
8 B	ST-739	12729	555
9 B	ST-720-C	12937	347
10 B	ST-700-C	10917	2367
11 B	ST-753-1	13129	155
12 B	ST-747	13261	22
13 B	ST-710-C-1	12889	395
14 B	ST-624-C-1	10507	2777
15 B	ST-729-1	12600	684
16 B	ST-716-C-1	11702	1582
0 A	ST-722-C	13130	154
1 A	ST-752-1	13170	114
2 A	ST-754-1	13170	114
8 A	ST-702-C	11113	1488
9 A	ST-742	12640	644
11 A	ST-744-1	12822	462
12 A	ST-746	12982	302
14 A	ST-614	13235	48
15 A	ST-609-1	13027	256
16 A	ST-613	9046	4238

ES Clock hours as of 2400 March 26, 1953 13284
Average life hours of tubes in service in Bank B.... 2142
Average life hours of tubes in service in Bank A.... 782
Average life hours of last five rejected tubes..... 884

2.0 CIRCUITS AND COMPONENTS

2.1 Circuits by System Number

2.14 Input-Output

M.I.T.E. (R. Paddock and A. Werlin)

Modified MITE has been used further with the computer during the past two weeks and has continued to operate satisfactorily. Trouble with the video filter now appears not to be due to M.I.T.E. directly but to grounding problems with the long cables from the demodulator and the decoder amplifiers.

Inter-register wiring of buffer storage is progressing very satisfactorily and is expected to be completed next week. All inter-rack cables as well as those for the WWI tie-in have been ordered.

Pulse-amplitude and waveform tests have been recorded for all M.I.T.E. in rack K-3 of room 156.

2.2 Vacuum Tubes and Crystals

2.21 Vacuum Tubes (S. Twicken)

After 700 hours conducting on life, during which plate current showed a slight increase, a lot of 6145's was run for 500 hours with some "on" and others "off". At the end of this time the conducting tubes showed a very slight increase in plate current while the cut-off tubes showed a greater increase accompanied by increased gas currents and some grid emission. Those with grid emission came from the same early lot one of which on inspection showed little, if any, gold plating on the control grid. It is thought that this early lot may not have been gold plated. Further investigation is being made. The tubes have been returned to life test with a 0.95 duty factor on the "on" tubes and a 0.05 duty factor on the "off" tubes to more nearly simulate operating conditions.

Design of the new tube tester by the Division 7 drafting department continues uninterrupted. Layout of the power supply sub-assemblies is about 1/3 done as is the frame. Complete layout and detailing may take another 2 months. No arrangements for construction of the unit have as yet been made.

The supply of tested 6145's continues to be short but is improving. The new pre-burning rack has doubled our capacity and we are catching up with back orders. Since some will have to continue to wait while other back orders are being filled, the situation will not be radically improved for all concerned for several weeks.

2.22 Transistors (D.J. Eckl)

The accumulator, now in operation for 3700 hours, recently operated for 120 hours without error. During the 14-hour period following 1700 March 11, one error was recorded when the number 10000 was read out of the accumulator instead of 11111. This result corresponds to 48 successive additions instead of the required 49. The previous maximum error-free run was 44 hours.

During the week previous to this run, the -150-volt supply in the large PEC power supply blew a fuse. It was found that a 5U4G in the regulating circuit was arcing from plate to cathode. This tube was replaced; it was also necessary to replace an NL-653 gas-tube rectifier in the main circuit. This tube was suspected earlier, but no replacements were available. Tube replacements were also necessary in two gate and delayed-pulse generators. A coder was replaced. It is very possible that the -150-v d-c supply was to a large extent responsible for the previous average error-free run of 12 hours.

The marginal-checking system for the transistor circuits has been installed and overall margins determined. They are:

Flip-flops:	High negative collector voltage	- 96 v to -87 v
	Low negative collector voltage	- 17 v to -15.5 v
	Base voltage	- 32 v to +30 v
Gates:	Collector voltage	- -60 v to -54 v
	Collector voltage (read-out gates only)	- -57 v to -28 v
	Base voltage	- +43 v to +24.5 v
Amplifiers:	Collector voltage	- -29.5 v to -27 v
Buffers:	Base voltage	- -12.5 v to -8.5 v

These margins include all circuits of a given type and are in general far below the optimum margins. Transistors will be replaced in the near future to improve this situation.

Marginal checking is being installed on the vacuum-tube gates in the control system.

2.22 Transistors (continued)

Transistor Core Driver (S. Oken)

Mo-permalloy, 1/4-mil, 5-wrap cores have been driven using the transistor core driver. The core is placed directly in the collector circuit of the transistor. The input pulse to the core from the transistor was a 25-ma, 4-μsec-wide pulse. The output from the core was an 0.8-volt, 3.5-μsec pulse. These results were obtained with 12-turn primaries and a 10-turn sensing winding.

Although according to calculations the usual power ratings of the transistor are not nearly approached, several hours of operation in this circuit seems to affect the transistors investigated adversely.

Hole Storage (N.T. Jones)

A group of transistors has been selected and isolated for hole-storage analysis. These include a few of each of the more plentiful types. The present work consists of observing the response of the emitters and collectors independently as diodes and comparing these to junction, gold-bonded, and point diodes. The Tektronix 517 scope has been used to observe the short-time transients involved.

Measurements (N.T. Jones)

Two CBS-Hytron type PT-2S transistors were received and partially measured. A sample order for ten of these units has been placed. The report of the revision of the rise- and fall-time measurement has been completed and will be distributed shortly as E-455, Supplement 1.

Transistor Symposia (N.T. Jones)

D. Eckl and N. Jones attended the transistor symposia at the National IRE Convention in New York on March 23, 24, and 25. Contacts were made with several companies manufacturing transistors. The two most important items of note from the symposia were:

1. Most of the transistor-life troubles are due to humidity or water vapor seeping into the units; and

2. Most manufacturers are changing to the standard basing recommended by the Signal Corps.

2.22 Transistors (continued)

Two-Transistor Flip-Flop (E. Cohler)

The final design work and analysis has been done on a two-transistor flip-flop. This flip-flop operates on small pulses at relatively high repetition rates with high swings and good waveform. Input circuits are now being considered and a satisfactory pulse standardizer is being thought of for use at each of the flip-flop inputs. Some work has been done on using smaller components in the flip-flop, and Earl Gates has designed some special ferrite-core inductors for use in compensation. Also, B. Paine has indicated that miniature delay lines may be forthcoming for use in the pulse standardizers. Along this same line, Earl Gates is investigating the possibility of using a smaller type of pulse transformer in the input to the complement trigger point.

In addition to the study on the flip-flop itself, some investigation of the characteristics which are desirable in a transistor intended for flip-flop service has been undertaken. It has been found that the best overall criterion for the operation of the transistor is its output in a certain circuit which resembles one-half of the flip-flop. Simple parameter measurements are too intertwining in their effects to be easily interpretable in terms of operation in the flip-flop.

2.3 Ferromagnetic and Ferroelectric Materials

2.31 Magnetic-Core Materials (D. R. Brown)

Cores for 17 planes have been delivered, some to Group 62 and some to IBM. Group 62 is fabricating eleven of the planes and IBM is fabricating six. Cores for several spare planes will be obtained during the next week.

Considerable progress is being made in reaching an understanding of rectangularity and the switching mechanism in our ferrites. A low value of saturation flux density and small grain size appear to be essential for rectangular loops and fast switching times.

Our ceramics facilities are now firing approximately 500 cores per week. A systematic investigation of the ferrites now in use is being undertaken.

Seminar on Magnetism (A. L. Loeb)

The atomistic and collective-election models for magnetism have been studied in detail, and the significance of Zener's articles with regard to both have been determined. Following the series of Zener's articles, some others of the same school have been discussed with assistance from J. Goodenough and P. Baltzer. D. Buck presented information of $FeNi_3$ alloys; the discussion that followed has been recorded in memo M-1929.

For the collective picture, papers by Slater, Stoner, and Wohlfarth have been discussed, including an outline of the Hartree and Hartree-Fock approximations.

On March 26, Prof. Bloembergen of Harvard discussed ferrites and the mechanism of domain-wall motion; this initiated the fundamental examination of ferrites. Prior to this, one meeting was devoted to angular-momentum operators, tensors, and spinors.

Preparation of Ferromagnetic Materials (F. Vinal, R. Maglio, J. Sacco)

Preparations of $MnO-MgO-Fe_2O_3$ bodies for the purpose of studying the variation of firing time at various temperatures are proceeding. Some of these bodies have been fired at 1400° C and 1450° C for periods up to one hour. Additional firings will be made at 1350° C.

Faulty thermocouple operation in one of the Burrell furnaces has resulted in loss of two sets of ferrite bodies. These runs will be made over. Steps have been taken to prevent additional loss of runs with furnace operation by using a second thermocouple.

A schedule has been put to use for the firing of the Burrell furnaces to obtain maximum capacity. Firings are made on Monday, Wednesday, and Friday. The alternate days are needed for cooling and reloading the furnaces.

2.31 Magnetic-Core Materials (continued)

Magnetic Ceramic Materials (G. Economos)

The status of the magnetic-testing program for the F-109 toroids is still as reported in the previous report; no facilities have yet been found to wind the toroids as required. D. Epstein and I have contacted local manufacturers of winding machines with the idea of either purchasing a machine capable of meeting our future needs or to contract for winding the toroids by hand. Both possibilities appear very encouraging.

Toroids of 3A10 composition and seven variations of it have been prepared to satisfy the requirements of N. Menyuk.

X-ray Examination of Ferrites (J. H. Epstein)

Samples fired in an atmosphere at which magnetite is stable showed the following behavior. Fe_3O_4 was a good spinel, likewise $MgFe_2O_4$. But $MnFe_2O_4$ showed considerable MnO present. In the mixed (MnMg) Fe_2O_4, the second phase seemed to be Mn_3O_4. Therefore, the correct atmosphere for $MnFe_2O_4$ is somewhat less reducing than that for Fe_3O_4, but less oxidizing than air. These samples also showed a great deal of preferred orientation which the samples fired in air did not.

Measurement of Switching Coefficient, S_w (B. Gurley)

Five MF-1326B, F-262, cores from the same lot have been measured. The maximum variation of S_w from the mean value was 8%. S_w has also been measured for several mo-perm cores.

Current and Voltage Calibrators for Core Testing (B. Gurley)

The first unit has been delivered by the shop and is operating satisfactorily. Three more units are completed but not tested as yet.

Production Tester (J. Schallerer)

At the present time, enough cores for MTC have been turned over to IBM and Papian's group for array construction. Out of 59,414 cores received, 18,316 were found acceptable for MTC. This represents an overall yield of 32.2%. A memo is being prepared on the results of the tests made on these cores.

One of the test setups is being converted for the testing of metallic cores.

2.31 Magnetic-Core Materials (continued)

New Materials (B. Smulowicz)

To investigate the effects of a special manufacturing process on the core characteristics, two specimens (MF-1326B and MF-1371B) were pulse tested. The results were graphically represented for comparison.

Work has begun on the experimental investigation of high-voltage insulation properties of No. 32 quadruple Formex wire used in the MTC memory arrays.

Instrumentation (B. Smulowicz)

Careful study of the performance of the 60-cycle hysteresigraph has indicated that the low-frequency noise cannot be eliminated unless the present circuit is completely redesigned. It is recommended that for improved performance the new hysteresigraph be operated at a considerably higher frequency, preferably about 1000 cps.

A simplified design for a squareness-ratio indicator has been suggested. The proposed method utilizes double-throw, low-frequency vibrators for video mixing.

Pulse Characteristics of MTC Ferrite Cores (J.R. Freeman)

It has been discovered that by using a driving magneto-motive force approximately 25 percent greater for write pulses than for read pulses, an improvement in the discrimination ratio of ferrite cores is achieved. Increasing the writing magneto-motive force by 25 percent decreases the peak disturbed ONE output by approximately 10 percent, and also results in a larger disturbed ZERO. However, the magnitude of the first half-selected ONE is enormously reduced. The overall advantage gained by this reduction is great enough to make the discrimination ratio at least equal to that achieved by the post-write disturbing method.

A logic has been designed to test thoroughly the pulse characteristics of cores operated in both fashions.

2.32 Magnetic-Core Memory

Magnetic-Matrix Switch (A. Katz)

A second 32-position magnetic-matrix switch has been completed. Preliminary tests, involving the use of a dummy load to simulate an MTC digit plane, indicate that this switch should be capable of driving the MTC memory. Further study of the switch is in progress.

(D. Shansky)

A regulated-pulse current source for use in driving a magnetic-core matrix switch has been designed and is now being breadboarded. The driver will deliver 250 ma to 400 ma into a load which presents a back voltage of the order of 200 to 300 volts at a rise time of approximately 0.2 μsec.

Memory Test Setup IV (Ceramic) (J.L. Mitchell, R.S. DiNolfo)

A new z-plane driver has been installed to drive Memory Plane 4 and is operating successfully. A duplicate of this driver has just been received from the shop, and will be installed to drive Memory Plane 7.

The comparison of the pulse bias and quasistatic bias systems of operating the Olsen switch has continued. Pictures comparing the noise outputs under both modes were taken. Also, pictures were taken showing the effect on switch outputs of switching a memory core. The next few days will be spent completing the necessary data and then correlating and evaluating this data.

2.32 Magnetic-Core Memory (continued)

Memory Arrays for MTC (A. D. Hughes)

Progress on memory arrays for MTC is as follows:

1. Planes 1 through 6
   a. x and y wiring completed;
   b. individual cores tested;
   c. z and sense windings added.

2. Planes 7 and 8
   a. x and y wiring completed;
   b. individual cores tested.

3. Plane 9 -- x and y windings completed.

4. Planes 10 and 11 -- x and y wires being strung.

Memory Test Setup V (E. A. Guditz)

All panels have been installed in the memory rack. Power wiring is completed and video testing is under way.

The test-logic equipment is checked out and timing adjustments are completed.

Resistors for the current-control panel and lugs for the end strips on the memory frame must be delivered and installed before testing of memory planes can begin.

2.33 Magnetic-Core Circuits

Junction-Diode Life Test (C. J. Schultz)

The usefulness of the GE-4JA1A1 junction diode as an element in a magnetic-core stepping-register circuit depends upon the stability of its characteristics during long-time operation. Ten diodes are being life tested in sample stepping-register circuits under expected operating conditions. Forty hours of operation has revealed a change in one of the diodes--a reduction of about 50% in the back resistance.

2.34 Ferroelectric Materials

Two-Position Switch (C. D. Morrison)

A two-position switch has been constructed and is in the process of being tested. In some of the preliminary tests, trouble was encountered with the breaking down of the barium-titanate ceramic with the application of a d-c biasing voltage of 450 volts. The reason for the breakdown will be explored in an attempt to find some remedy for it.

2.4 Test Equipment

Test Equipment Headquarters (L. Sutro)

The man who hands out test equipment, takes requests for repairs, and apportions the work among the technicians in the Test Equipment Headquarters will be Anthony Bille. He will replace Jim Delmege who is going to MTC. John Doyle is training now to replace Bille in the Barta Building.

Work completed:

STANDARD TEST EQUIPMENT		TEKTRONIX EQUIPMENT	
Inspected & Tested	114 units	Inspected and Adjusted	- 4 new scopes
Repaired	5 units		1 time mark generator
Experimental Work	5-1/2 man days	Repaired and Adjusted	- 4 old scopes

Test Equipment Committee (L. Sutro)

The committee has approved purchase of an all-transistor power supply to provide up to 60 ma from two outputs, each continuously variable from 0-100 volts. The committee considered two new pieces of standard test equipment, the G.R. Variable Delay Line and a 93-ohm attenuator panel. Julius Woolf is assisting General Radio in the development of the delay line; Herb Platt is developing the attenuator panel.

Differential Video Probe for Scope Use (H. Zieman)

A video probe has been designed and built which will permit the observation of waveforms across circuit elements which are not necessarily grounded at either end. The circuit consists of a simple differential amplifier, with a second tube, arranged as a constant-current device, being used as the cathode load for the differential amplifier. This in effect gives a very high cathode resistor to insure good balance in the amplifier and to give a high common-signal rejection.

The circuit still has to be tested for frequency response.

2.4 Test Equipment (continued)

Rapid-Rise Gate Generator (S. Bradspies)

Considerable difficulty has been encountered in getting this generator to work. The major source of trouble at the present time appears to be the inability to fire either of the two 2021 thyratrons with the present setup. Several changes in the circuit have been made; none have been of any help thus far.

Production-Core-Tester (R. Pacl and R. Jenney)

Preliminary tests on the mechanical elements of the production-core-tester prototype are expected to begin by April 1st. The purpose is to determine to what extent contact resistance, stray flux, etc. will affect the operation of the final model.

(R. Jenney, R. Pacl)

A method for quickly obtaining maximum squareness ratios of hysteresis loops has been developed, and the necessary equipment is being constructed.

2.5 Basic Circuits

Gate-Tube Circuit (H. Platt)

Initial investigatory work on the gate-tube circuit (7AK7) has shown that the circuit will be able to handle the logic designed to date.

It appears that there may be two or more versions of the circuit for different applications. For light loads, a plate voltage of +150 volts and a 1:1 transformer in the output will suffice. For several loads, +250 volts will be needed. One inconclusive experiment has shown that under heavy load, a 3:1 transformer, properly terminated, will give more output than a 1:1 transformer, properly terminated, under the same conditions.

The suppressor grid voltage and impedance are highly important factors in determining the output, as well as the type of load. The greatest effect of the suppressor voltage is in the region of large input-pulse amplitude. So far, it seems desirable to have the suppressor grid returned to at least +10 volts.

Under heavy load, for a given input amplitude, the output appears to be somewhat insensitive to plate voltage, whereas at light loads there is a fairly linear relationship between output and plate-supply voltage.

2.5 Basic Circuits (continued)

Not much has been done in the way of marginal testing. This will be shelved until the operation of the gate-tube circuit has been nearly optimized. Final optimizing will be dependent on marginal testing.

Much more experimentation is needed before we can arrive at a final circuit.

Diode-Driving Cathode Followers (B. Remis)

A set of normalized fall-time curves has been drawn to aid in the design of diode-driving cathode followers.

Phase-Measuring Equipment (B. Remis)

A rack-mounted phase-measuring device is nearly completed in breadboard form for an M.S. Thesis.

Pulse Delays (J. Woolf)

The General Radio variable-delay line when driven with 0.1-μsec pulses was found to attenuate the standard pulse by 50%. Mr. Frank Lewis of General Radio said that a redesign of the delay line in the direction of a lower characteristic impedance should give us a line of 10% attenuation. This sounds promising.

High-Speed (Gate-tube driving) Flip-Flop (H. Boyd)

WWI comments were received on this unit and no changes need be made. The unit chosen was the one capable of being set, cleared, and complemented on either all positive or all negative triggers.

High-Speed Flip-Flop Cathode Followers (H. Boyd)

Several cathode followers were designed as appurtenances to the high-speed (gate-tube driving) flip-flop. M-1928, a collection of data on the load-driving cathode followers, will soon be published. WWI comments will then be needed before work is continued on these units.

Diode-Driving Flip-Flop I (low input impedance) (H. Boyd)

Preliminary specifications for this diode-driving flip-flop have been written (M-1925) and will soon be published. WWI comments have been received; no portion of the flip-flop need be changed.

2.5 Basic Circuits (continued)

Diode-Driving Flip-Flop II (H. Boyd)

As requested by I.B.M., a diode-driving flip-flop was designed which will have output voltage levels of +10 and -30 volts. This unit, although not yet built, is expected to be twice as tolerable of components as the high-speed gate-tube-driving flip-flop.

Pulse Standardizer (J. Woolf)

Various methods of standardizing pulses with off tubes have been investigated. One method using a modified blocking oscillator appears to have promise.

2.6 Component Analysis and Standards

2.61 New Components (B. Paine)

The past two weeks have been taken up with trips to Aerovox, Erie Resistor Corporation, Bell Telephone Laboratories, and the IRE show. Much useful information has been compiled and will be recorded in M-notes in the "Reliable Components Discussions" series.

The Amphenol Blue Ribbon connector appears to be perhaps the best connector available for most of our uses. Further study and life testing will be carried out to obtain fuller data on this device.

2.63 Standards (H. Hodgdon)

On March 17, I visited Aerovox Corporation in New Bedford with B. Paine for a discussion on selection of reliable capacitors, manufacturing methods, etc. See reports being prepared by B. Paine for details.

Three days this week were spent at the IRE National Convention. Approximately half this time was spent in visiting manufacturers' booths at the Engineering Show and discussing new and improved component developments. The balance was spent in attending symposiums and an RTMA Computer Components Committee meeting.

Plans are being formulated to present information on component selection in abbreviated form for use by design engineers. This information is being coordinated with IBM, and will combine the experience information available from both organizations.

2.7 Memory Test Computer

Computer Operation (P.R. Bagley, H.E. Anderson, R. Hughes)

Operation has been satisfactory. The computer has been operating on an interim control during the past biweekly period. This has been necessary because:

1. All buffer-amplifier panels for CPO lines have not been completed.

2. No tubes for buffer amplifiers or delay-line panels have arrived.

Component failures thus far have amounted to 3 subminiature toggle switches.

Timing studies are being made. Use of substitute tube types has hindered progress here.

In-Out (R. Pfaff)

The MTC in-out equipment has been tested and is ready to operate with the computer.

For in-out, MTC utilizes two Flexowriters, one for tape preparation and one for computer operation. The second one mentioned is used for reading tape into the computer and for punching and printing out. As previously mentioned, Lou Norcott and his group have modified these Flexowriters to conform with WWI's. Thus, in an emergency, units may be directly interchanged.

When the computer is carrying out a "print" or "read" order, it must stop and wait for a complete pulse from in-out before continuing computations. This method of operation saves a flip-flop in-out register and timing and interlock equipment over simultaneous in-out operation and computation. As a consequence, greater reliability and simplicity of operation is attained. The B-register accepts incoming information and the accumulator holds the information to be printed out.

MTC in-out utilizes a relay input register, a relay output register, and an in-out control panel. The relay input register is set up by the sensing pins in the Flexo tape reader and it, in turn, operates MTC gas-tube pulse generators which set the B-register. Thyratrons connected to the cathode followers following the accumulator partial-sum flip-flops set up the relay output register. These relays energize the Flexo punch and translator (print) magnets.

Experience to date has indicated that the Flexowriter itself will be the weak point in the in-out system as far as reliability is concerned.

2.7 Memory Test Computer (Continued)

Power Supplies (R.G. Farmer)

The design of the regulators for the MTC power supplies has been completed. The amplifier section of the -30-volt and -15-volt regulators will require a 200-volt auxiliary supply to produce the proper plate voltage on the tubes in this section. This auxiliary supply will probably be similar to the -300-volt auxiliary supply which is used as a reference voltage in each regulator.

Magnetic Memory (W.J. Canty)

During the past biweekly period, test procedures have been drawn up for resistance and voltage measurements on the following MTC units: digit-plane driver sensing amplifier, selection-plane-driver panel, selection-plane current-control panel, and selection-plane-driver control switch. Work on a video-test procedure for the sensing amplifier and digit-plane driver is progressing.

(H. Henegar)

Most of the past biweekly period has been spent investigating the problem of adding plug-board storage to MTC. It is planned that this will parallel the present toggle-switch storage, thereby doubling the number of panel storage registers.

(W.A. Hosier)

The alarm system was installed and partially tested; however, its proper functioning awaits completion of MTC plug-in flip-flops and cathode followers now under construction. The necessary output swing and capacitive loading are too much for Burroughs equipment.

3.0 STORAGE TUBES (P. Youtz)

Work continued on the problems of lower stability failure and positive switching. These problems and the work associated with finding solutions to them have been reported in the biweeklies of the past two months. Tests indicate that the operation of the storage tubes is more sensitive to any contamination within the tube than was heretofore realized. During this period, the vacuum systems were redesigned and built to improve the pumping speed at the neck of the tubes. It was anticipated that this increased pumping speed would improve the vacuum of the tubes during the baking process. Tests showed that the gas from the conductive coating on the walls of the envelope and from the metal components choked sufficiently within the manifold from the tube to the pumps to raise the pressure within the tubes to a point where some of the parts may have oxidized. Besides improving the pumping speed at the tube, more monitoring equipment was added to the vacuum systems and investigations have begun on better control of the vacuum within the tube during its processing. The vacuum in the storage tubes has always been several orders of magnitude better than any commercial tubes. It will take considerable effort to get any improvement on the present vacuum.

Two members of the storage-tube group attended the IRE convention to discuss our processing problems with other tube and vacuum engineers. Many members of the group attended the three-day meetings of the Physical Electronics Conference at MIT. One paper on the Philips "L" cathode was given at this conference by a member of the group.

3.1 Construction (P. Youtz)

In Section 1.14, it is recorded that tubes are being installed in Bank A. In addition to the research and development effort noted in the previous section, tubes are being constructed and tested as replacements for Bank B and for installation in Bank A.

Tubes were also constructed to support the Philips "L" cathode research.

Several experimental tubes with no guns or target assemblies, but with different types of conductive coatings on the envelopes, were processed to find a coating that could be processed for the optimum vacuum during baking, at sealoff, and during operation of a storage tube.

3.2 Test

Television Demonstrator (D. M. Fisher)

Five storage tubes were tested since the last report. All five storage tubes tested favorably and were sent to the STRT.

3.2 Test (continued)

Among other modifications, the 800-series tube has the ion-collector lead brought out on pin 11 of the holding-gun socket, but there is no internal connection between the holding-gun cathode and ion collector inside the tube. This modification was made for the purpose of obtaining more information concerning the cause of lower switching failure which 700-series tubes have been experiencing.

ST800 and ST801 have been life tested at the TVD with a recording device monitoring the ion-collector and auxiliary-collector currents. ST800 and ST801 did not fail during their life tests.

Storage Tube Reliability Tester (R. E. Hegler)

ST747, ST752-1, ST753-1, ST754-1 and ST800 had satisfactory spot interaction areas at the STRT.

ST747 and ST800 operated for 100 hours at the STRT with no lower stability failure.

3.3 Research and Development

Positive Switching (C. L. Corderman)

A survey of the records concerning TV observations of positive switching seems to show three distinct types of switching according to the shape of the area which has gone positive. As a rule, in 600-series tubes, only the corners switch positive; in 700-series tubes, the center usually is positive; while with both tube types the entire surface will frequently be positive. Also, 700-series tubes occasionally have positive areas which resemble the shape of the ion-collector plates introduced in that series. Thus, there may be some relationship between positive switching and the lower stability failures encountered in the 700-series tubes.

In the next period a tube which has exhibited this switching in WWI will be operated at the STRT with monitoring circuits connected to all tube elements.

"L" Cathodes (T. S. Greenwood)

The standard RCA gun components have dimensions which make them suitable for mounting cavity-type "L" cathodes. These parts are designed primarily for low-temperature operation, but the possibility exists for using them with "L" cathodes if activation temperatures are kept low. Two tubes were made using these parts to mount "L" cathodes. The first of these appeared to process satisfactorily and gave quite

3.3 Research and Development (continued)

satisfactory currents during aging. Between the time of processing and testing, severe poisoning of the center of the cathode took place. Since no poisoning of the remainder of the cathode took place the mount is not immediately suspected. The second tube was made in an attempt to shed some light on the situation. Unfortunately, a grid-cathode short developed during processing of this tube and activation was not completed. A third tube will be constructed soon.

On March 26, a paper entitled "L" Cathodes in Electron Guns was presented at the MIT Physical Electronics Conference. This paper summarized our work to date.

Envelope Bakeout (T. S. Greenwood)

In an attempt to trace the source of lower switching failures, Pirani gauges have recently been installed on three of the vacuum systems to enable pressure during a bakeout to be observed. A study of these pressures shows that very severe pressure surges occur during preliminary bakeout. Peak pressures of better than a tenth of a millimeter of mercury are encountered as the envelope is brought to bakeout temperature.

Since both the target and ion collector are in the envelope at this time they are subjected to high pressure and high temperature simultaneously. Two lines of inquiry are being initiated to correct this difficulty.

First, an investigation is being made of stannic-oxide coated envelopes. When properly prepared, the stannic oxide does not release large surges of gas; however, in order to provide continuity in A3 the body seal between the two halves of the tube must be coated with dag. An investigation of an alcohol suspension of dag is now being made for replacement of the present sodium-silicate suspension.

Second, a control unit is being acquired to reduce the oven input and to control the rates of temperature rise during bakeout. By either or both methods we are aiming at a maximum pressure of 1×10^{-2} mm of mercury.

Velocity-Distribution Measurements (C. T. Kirk)

Equipment is being assembled for the proposed 10-Kc system. A breadboard 10-Kc oscillator was constructed using an RC phase-shifting network. The storage-tube mount has been modified to provide a simple RC coupling network between the oscillator and holding-gun grid. The decoupling networks in the electrode leads were changed to function at 10 Kc.

3.3 Research and Development (continued)

A single breadboard stage of the 10-Kc amplifier, employing a Twin-T feedback network, was built to determine the operating characteristics of the circuit. Using this breadboard stage and a Tektronix Amplifier, the 10-Kc output signal from the cage can be detected quite easily.

Pulse Readout (A. J. Cann)

On 13 March, a spot interaction area was obtained with pulse readout which almost exactly overlapped the area obtained with r-f readout on the same day. The only change required to achieve this was to use the same value of read-signal plate gate as for r-f readout. Why this should be so is still a mystery because from spot-discharging considerations a 20-volt gate should suffice.

Measurements have been made of the relative amounts of spot discharging caused by r-f readout and pulse readout. A 2-μs r-f readout seems to cause about 20 times as much discharging as the pulse readout, which is in remarkably good agreement with theory. The minimum holding time required per pulse readout is about 50 μs, as compared with 1000 μs for r-f readout, but this is still somewhat too large to permit eliminating rewrite on some of the programs that the computer might be asked to perform. Further improvement may be possible.

3.4 General (C. L. Corderman)

The last week of this period was spent attending the IRE National Convention and the MIT Physical Electronics Conference.

4.0 TERMINAL EQUIPMENT

4.3 Display (R. H. Gould)

Three new deflection yokes for the 16-inch display scopes have been tested. One of a type different from that now in use has a much faster response than any other yoke we have used. If it operates well with the computer this type of yoke will be ordered for the remainder of the display system.

(T. J. Sandy, J. Dintenfass, S. B. Ginsburg)

Video cabling for the new display system in WWI was ordered. The IOS expansion for the new display system is being checked statically.

A wiring layout of the video cabling was drawn. The necessary 16-conductor wiring is also on this drawing.

4.4 Magnetic Drums (C. W. Simmonds)

A satisfactory design has been made for a cathode-follower circuit for use with the auxiliary-drum monitoring system. Eighteen of these circuits are being built on a standard ERA chassis. These cathode followers change the impedance levels of the signals to be monitored prior to their transmission over long coaxial cable runs from the magnetic-drum assembly to the monitoring system installed on the next floor.

To provide a means of converting 0.1-microsecond pulses to 0.5-microsecond pulses, a Plug-In Gate Generator, Mod 2, has been modified with satisfactory results.

(H. L. Ziegler)

All the necessary circuitry for the auxiliary-drum monitor has been tested, much of it in breadboard form. As the finished panels become available they will be incorporated into the system, part of which is already in operation.

5.0 INSTALLATION AND POWER

5.1 Power Cabling and Distribution (G. F. Sandy)

The wireways for the new control room have been ordered. They are to be fabricated and installed by Metallic Arts of New England. Work will begin on the installation Saturday, March 28. The wireways are to be completed in four weeks.

5.1 Power Cabling and Distribution (Continued)

The power wiring of racks in the Computer is proceeding rapidly. It is planned to have the racks necessary for the in-out addition completely wired for power by April 13. The panels necessary for power distribution and control for the new control room are on hand except for one which is expected next week. The wiring of Rack J1 which contains the above equipment will proceed next week.

5.2 Power Supplies and Controls

MTC Alternator (R. Jahn)

The MTC M-G set has been bolted to the floor and leveled. The starter and its associated equipment has also been mounted and wiring will be completed within the next biweekly period.

MITE Supplies (R. Jahn)

Capacitors across the output of the -125 and +250-volt generators have reduced the ripple to a satisfactory level. Bleeders are being installed on several WWI supplies to provide -125 and +5-volt alternate supplies. A separate supply for -60 volts is also being installed.

Air Conditioning (R. E. Garrett)

The first step in the two-step program of connecting the existing system with the new system was accomplished during an installation period. The existing evaporative condenser was relocated and the two new units are now in position. The contract is proceeding on schedule.

D-C Power Supplies (S. T. Coffin)

Plans have been completed for the rearranging of the Whittemore +150-volt and -150-volt d-c power supplies, which will take place March 28. The 10-amp, -150-volt supply, which has been redesigned, will be exchanged for the +150-volt, 50-amp supply, which will undergo redesigning to improve its dynamic line stability and overall performance.

8.0 MATHEMATICS, CODING, AND APPLICATIONS

8.1 Programs and Computer Operation

Progress during this biweekly period on each general applications problem is given below in terms of programming hours, minutes of computer time, and progress reports as submitted by the programmers in question. In particular it should be noted that the auxiliary magnetic drum has become available. Some of the work done to incorporate the drum into the comprehensive system of service routines is described in the reports on general applications problems 100 and 122.

100. Comprehensive System of Service Routines: Briscoe, 42.75 hours; Demurjian, 44 hours; Denman, 25 hours; Frankovich, 25 hours; Hazel, 27 hours; Helwig, 60 hours; Kopley, 30.5 hours; Porter, 27 hours; Vanderburgh, 21 hours; WWI, 371 minutes

A new input program which occupies the last six TS registers and which uses groups 0, 5, and 7 of the auxiliary magnetic drum was decided upon during the last biweekly period. The program has two entry points. Starting at one of these (to be used for direct read-in, conversion, post-mortem programs, etc.) records ES on group 0 and then reads group 7 into ES. Starting at the other (to be used by Group 61) reads group 5 into ES. This program will be put into TS along with the present 5-56 read-in program and both will remain in use until two banks of ES are available. At that time the present 5-56 read-in program will be discarded.

A read-in program for 5-56 paper tape which operates with the new input program was written and tested. A modified version of this program which will provide also for read-in of 5-56 information from magnetic tape is being written.

The comprehensive system is being adapted to use the new input program.

The most effective use of the magnetic drum within the framework of the comprehensive system has been under discussion. In particular, the feasibility of storing both program instructions and constants on the drum (with an interpretive subroutine in ES) is being considered. Such a scheme would effectively remove the logical distinction between the drum and ES for a large class of programs.

Helwig

101. Optical Properties of Thin Metal Films: Denman, 8.5 hours; Loeb, 6 hours; WWI, 15 minutes

A program for printing the headings for the columns of results to be obtained from the automatic program has been written and tested. The automatic program is still being checked.

Attempts to read in only those of a set of parameters for T2265-3 (also a part of the automatic program) that differ from corresponding parameters of a previous set were unsuccessful. Therefore a new set of parameters is read-in in its entirety, even though several numbers are repeated.

Future plans include checking the periodicity and multivalue properties of Reflection and Transmission, and running the automatic program for evaluation of optical constants.

Loeb

8.1 Programs and Computer Operation (continued)

102. Scattering of Electrons from Gases: Uchiyamada, .5 hours; Uretsky, 8 hours; WWI, 103 minutes

A program has been written which will calculate and print (delayed printer) the radial-wave function for electron scattering from Helium. This program will now be tested. When completed it is planned to modify the program to take polarization into account.

Uretsky

103. Transmission Cross Section of Absorbing Spheres; Spherical Bessel and Hankel Functions: Demurjian, 1.5 hours; WWI, 147 minutes

Complete results have been obtained.

The data computed on Whirlwind I will be included in an article being prepared for publication in one of the professional journals, probably the Journal of the Optical Society of America. Present plans call for completion of the manuscript by summer and the relevant portions will be made available to the Computer Laboratory as our final report.

Terrell

104. Hydro Thermal Power System; Calculus of Variations: Demurjian, 1.5 hours; Cypser, 10 hours; WWI, 121 minutes

Repeatable successful operation has been obtained for magnetic-tape data layout, delayed print involving reverse reading of result tape, and post mortem involving delayed print of pertinent (24,6) numbers.

Overflows have been caused by large "penalty-costs" assigned when hydro-system operating limitations are violated. A limiter on the size of elevation modification allowed at each iteration has eliminated most of the trouble.

Consideration is being given to the use of a discrete filter to reduce the size of modification per iteration in accordance with the change in size in successive iterations.

Cypser

106. MIT Seismic Project: Briscoe, 1.75 hours; Galpin, 20 hours; Simpson, 20 hours; Smith, 20 hours; Walsh, 20 hours; WWI, 55 minutes

A program which determines the statistical frequency distribution of an aggregate of random variables was prepared and tested successfully. A General Prediction program which computes either errors, squared errors, or sums of squared errors was prepared. This program utilizes drum storage, and its output may be either magnetic tape or the oscilloscope.

In the past few months the theoretical foundations for a statistical method to extract step-out times on seismograms have been developed by the Geophysical Analysis Group. In the future we plan to program this method on Whirlwind so that we may test its validity on seismograms recorded at different parts of the world.

Robinson

8.1 Programs and Computer Operation (continued)

107. (a) Autocorrelation and (b) Fourier Transform, Evaluate Integrals: Frankovich, 5 hours; Ross, 60 hours; WWI, 101 minutes

Tape T2235-12, Fourier Transform , is now working and two good test runs were made. All programs now use delayed output.

The versatility of these programs will be further investigated through their use by other programmers. The problem will be completed after one set of such runs. A memo is available describing the preparation of data for use in these programs. A complete report will be published at a later date.

Ross

108. An Interpretive Program: Hazel, 4 hours; Laning, 50 hours; WWI, 29 minutes

Several runs were made for the purpose of detecting and eliminating an error in the conditional programming mode of operation, and to allow two or more print orders. So far as is known the program as represented by Tape T2134-8 and Tape P2135-10 is now free from error. These tapes are being combined in a single tape, T2518-0. This represents successful completion of about two thirds of the task.

Because of the limited amount of unused ES storage, the present program can do very little of practical value. The program is therefore being modified at present to use magnetic-drum storage , and a number of new features (e.g., function subroutines, superscript notation) are being incorporated. This programming should be completed in about a month, with about two additional months estimated for trouble-shooting.

Laning

109. Fighter Gunsight Calibration, 8th Order D. E.: Hazel, 1.5 hours; Zierler, 2 hours; WWI, 26 minutes

After correcting several physical parameters, results were obtained that check extremely well with IBM Card-Programmed-Calculator and Rockefeller Differential Analyzer results.

It might be recalled that this problem involves the solution of an 8th order non-linear system of differential equations by a 4th order Runge-Kutta technique.

It is tentatively planned to make several runs with different values of the time interval and to use (39,6) instead of (24,6) arithmetic for purposes of error analysis. It is also planned to investigate the possibilities of programming WWI to do a larger portion of the overall problem of which this system of differential equations is a part.

Zierler

111. Fourier Analysis--Autocorrelation Problem: Hazel, 1.5 hours; Zierler, 10 hours; WWI, 141 minutes

About 5/6 of the desired results have been obtained but difficulties not

8.1 Programs and Computer Operation (continued)

as yet fully explained have prevented the completion of the problem. It is expected that the problem will be successfully concluded within the next two biweekly periods.

Zierler

112. Lawley's Method of Factor Analysis; Characteristic Vectors (modified): Denman, 15 hours; WWI, 47 minutes

The program for solving the matrix equation was checked by comparing the results of two iterations of the program with the result obtained by starting the computation with the result of the first iteration. Since this check was satisfactory, the program is now ready to be tried on production runs.

Denman

113. Shear-Wall Analogy, Simultaneous Linear Equations: Sydney, 25 hours; WWI, 27 minutes

Only partial results were obtained from two runs of the program. The program printed out results before the solution had converged sufficiently. Approximately 85% of the analysis is completed.

The analysis of the shear walls is continuing. Modifications in the program will be made in an effort to eliminate the unsatisfactory convergence of the solution.

Sydney

114. Design of Optical Instruments: Combelic, 32 hours; WWI, 155 minutes

A program has been written to trace 10 rays through the unchanged optical system, printing out the three important quantities (tangent and two coordinates) of each ray at each of the 16 surfaces. Testing of this program has been held up due to conversion difficulties.

A complete study of the focussing problem has been completed. The calculated results showed that there is no solution for the large initial tangents chosen. These values will be decreased; it is believed that it will then be possible to focus the system as originally planned.

Work on the generalized ray-tracing program has progressed so that tests should start next week. In this new program the magnetic drum will replace magnetic tape as auxiliary storage; tape will be used only for output on the delayed printer.

Combelic

116. Torpedo Impulse Response; Convolution: Frankovich, .5 hours; Kramer, 10 hours; WWI, 11 minutes

Two runs were made in this biweekly period, one of which gave satisfactory results. The other run disclosed an illegal symbol on one of the data tapes, the lower-case symbol, and this was corrected.

8.1 Programs and Computer Operation (continued)

Techniques for determining corrections to the system function will continue to be explored. The use of Fourier transformations will also be investigated.

Kramer

118. Quantized Group Communication and Learning; Non-Markovian Stochastic Process: Ralston, 16 hours; Denman, 6 hours; WWI, 21 minutes

This problem may be described as follows. Let us consider a group of five people who can communicate with each other through several channels. Some of these channels are two way in that information can be sent in both directions and others are one way allowing information to travel in only one direction.

Each person is initially given some specific information and they are allowed to transmit messages simultaneously to each other. At each act, each person sends just one message to one other person, all the people sending a message at the same time. The objective is to distribute all the information to all the people in a minimum number of acts. As the group repeats this process with new information they become more skilled at distributing the information in a small number of acts.

The Group Networks Laboratory at MIT has developed a mathematical model for such networks. The probability that the information be completely distributed in a given number of acts cannot be calculated analytically except in particularly simple cases. It is the purpose of this problem to determine these probabilities by simulating the networks on the computer and using a Monte Carlo Method.

A method for generating random numbers as the terms of the recurrent series

$$u_n = u_{n-1} + u_{n-k}$$

the terms being taken modulo a given number m, has been programmed and tested. The method gives 19 binary digit numbers uniformly distributed between 0 and 1 . Tests of 123,000 of these numbers show them to be quite good.

K. Ralston

119. Spherical Wave Propagation: Fox, 2 hours; Ralston, 20 hours; WWI, 29 minutes

The comprehensive program has been completed and the trouble shooting process has just begun.

The next few weeks will be taken up in getting the comprehensive program in working order.

A. Ralston

120. Thermodynamic and Dynamic Effects of Water Injection into Gas Streams of High Temperature and High Velocity simultaneous algebraic equations: Porter, 6 hours; Gavril, 80 hours; WWI, 447 minutes

With the cooperation of the DCL Staff, 16 parameters of Tape 2338m7 covering 440 different combinations of the seven variables were successfully run. This completes Phase II of this study. The third and final program is about

8.1 Programs and Computer Operation (continued)

1/4 completed. Due to the complexity of the analysis, it is expected that supplementary storage using the magnetic drum will be necessary. The differential equations being treated involve about 12 primary parameters.

This program is not likely to be available for testing until after 9 April.

Gavril

122. Coulomb Wave Functions: Combelic, 30 hours; Newstein, 20 hours; WWI, 36 minutes

A generalized drum subroutine has been written and tested for use on this problem. This subroutine has the following features:

1. recording on the drum (bo) is accomplished by entry at register 0r;
2. reading from the drum (bi) is accomplished by entry at register 5r;
3. in either case the sp to the subroutine is followed by three program parameters.

a. The first program parameter is the desired drum address (as a decimal integer, greater than 2047 since drum group zero is reserved for use by the drum input program). However, if the first program parameter is set to ± 0 , the recording or reading will start with the next available drum register. In either case, the initial drum address actually used for the block in question is in the AC when control returns to the main program at the register following the third program parameter (in regular WWI mode).

b. The second program parameter is theinitial addressof the ES block to be read or recorded.

c. The third program parameter is the number of words in the ES block.

This subroutine is 70 registers long.

A quarterly progress report on this work has been prepared for the Machine Methods of Computation Group, under the direction of Professor P. M. Morse.

Combelic

123. Earth Resistivity Interpretation: Integration of Empirical Functions: Briscoe, .5 hours; Madden, 2 hours; Vozoff, 40 hours; WWI, 35 minutes

Tape 2293, for calculating $J_o(x)$, $0 < x < 2$, now gives better than one percent accuracy up to x = 2.0, but $J_o(2)$ is off by several percent. This is probably due to a poor selection of the criterion for the termination of the series. A new criterion will be tested.

T2481, the Simplex-normalization, is not working correctly and the trouble has not been found yet.

A program to determine the resistivity of the earth, assuming variation only with depth, from a measured potential distribution around an electrode on the surface of a semi-infinite earth will be written making use of this routine for calculating $J_o(x)$.

Vozoff

8.1 Programs and Computer Operation (continued)

124. Deuteron Binding Energy and Wave Functions: Denman, 2 hours; Combelic, 40 hours; WWI, 19 minutes

Except for the logical routines, all the subroutines mentioned in the last biweekly have now been successfully tested. The logical part of the program will determine the eigenvalue for each set of parameters. Serious consideration is being given to using the magnetic drum as auxiliary storage instead of magnetic tape. However, the delayed printer will still be used for output.

Combelic

125. Analytical Differentiation: Porter, 2 hours; Nolan, 35 hours; WWI, 8 minutes

Most of this biweekly period was devoted to rewriting and enlarging the entire program to include trigonometric, logarithmic, and exponential forms.

The rewritten print-out program was run with trial functions and failed to operate correctly due to a programming error in the decimal number subroutine. A modification has been made to correct this error.

The modified print-out program will be tested. If this performs correctly, we will proceed to the testing of the new differentiation program with rational and transcendental forms.

Nolan

127. Finite Bending of Circular Ring Plate due to Edge Moments; two coupled second order non-linear differential equations: Porter, 3 hours; Hicks, 10 hours; WWI, 14 minutes

Two runs were tried but difficulty was encountered with the read-in. This difficulty was traced to a misinterpretation of the read-in instructions. Upon clarification, a successful run was made.

Test programs for the first phase of this problem are now considered complete. The entire interpolation program will be tried next.

Hicks

128. MIT Subject 6.537 Digital Computer Applications Practice--Spring 1953: Vanderburgh (Glantz, Ricketts), 32 hours; WWI, 83 minutes

Two of the eight students registered in 6.537 used WWI to finish the bouncing-ball exercise and to start work on term problems. More details of the individual term problems will be given in later reports.

Adams

130. Six-component Distillation, Variable Enthalpy and Equilibrium Data Simultaneous Non-linear Equations: Briscoe, 1.5 hours; O'Donnell, 40 hours; WWI, 12 minutes

This problem is to find the number of theoretical plates necessary to accomplish a specified separation of two key components by distillation of a volatile mixture. The general principle of solution of steady-state distillation is this fact. When the concentration of the liquid on a given plate of a distillation tower is known, the concentration on an adjacent plate may be found by

8.1 Programs and Computer Operation (continued)

the application of material balances, enthalpy balances, and equilibrium relationships. How complicated the problem is depends on the number of components, the type of separation desired, and the form of the equilibrium and enthalpy data. In the past (S&EC Problem No. 83) programs have been written to demonstrate the solution of 3- and 4-component problems, assuming constant molal overflow and constant relative volatility. These are forms of the data that make iteration unnecessary in going from plate-to-plate because only one of the simultaneous equations is non-linear.

In this problem the enthalpies of the liquid and vapor are taken as functions of temperature, pressure, and molecular weight (following the method of Scheibel and Jenny). The equilibrium constant for each component, K, is taken as a function of temperature and pressure. (MIT data.) Going from plate-to-plate thus necessitates solution of simultaneous equations of which two for each component are non-linear. This must be done by iteration.

In this solution the data will be expressed in tabular form. Having specified the concentration of the liquid at each end of the tower (the products) plates will be calculated down from the top and up from the bottom until the concentrations pass the concentration of the feed. At that point the sum of the number of plates in the two halves equals the number of plates in the tower.

Because the proper concentrations of all components in the products will not be known initially several complete solutions must be made in order to match the concentrations at the feed plate.

The demonstration of the utility of the machine method in this type of calculation should be of considerable interest to the petroleum and chemical industries.

The complete program, including two basic subroutines, has been written utilizing the (15,15) number system. An old (15,15) typewriter output routine has been rewritten for the new PA, tested, and is operating satisfactorily. Some mistakes have been found in the two basic subroutines for equilibrium and enthalpy data calculation. These have been corrected. When these routines are satisfactory, the main program will be tested.

O'Donnell

133. Non-linear Meson Equation: Arden, 16 hours; Kopley, 1 hour; Finklestein, 20 hours; WWI, 0 minutes

A problem for the solution by the Runge-Kutta method of a second order ordinary non-linear differential equation with a movable singular point describing the field of a single source in non-linear meson theory has been completed and is ready for testing. The program will be tested by making a slight change in the equation which will not alter the non-linearity but will make the equation explicitly soluable. The Runge-Kutta solution will then be compared

8.1 Programs and Computer Operation (continued)

with this explicit solution. When the test is successful, a program will be added for the calculation of the position of a singular point of a solution for each of 40 values of a parameter.

Arden

Computer Time	
Programs	34 hours, 18 minutes
Conversion	13 hours, 08 minutes
Scope Calibration	58 minutes
Magnetic-Tape Test	04 minutes
Magnetic Drum Test	04 minutes
Total Time Used	48 hours, 32 minutes
Total Time Assigned	54 hours, 49 minutes
Usable Time, Percentage	86.7%
Number of Programs Operated	179

9.0 FACILITIES AND CENTRAL SERVICES

9.1 Publications

(Diana Belanger)

The following material has been received in the Library, Room W2-301, and is available to laboratory personnel.

LABORATORY FILES

No.	Title	No. of Pages	Date	Author
E-525	Normalized Flip-Flop Chart	14	2/17/53	H. W. Boyd
E-531	Driving Current Margins on Memory Test Setup I	13	3/6/53	S. Fine
E-532	Nucleation of Domains of Reverse Magnetization and Switching Characteristics of Magnetic Materials	31	3/9/53	J. Goodenough N. Menyuk
E-533	Effect of Current Pulse Duration on the Pulse Response of MTC Memory Cores	5	3-10-53	P. Baltzer
M-1887	MTC Accumulator Test	2	3/10/53	H. Anderson
M-1888	Preliminary MTC System Test	2	3/6/53	H. Anderson
M-1903	Level Inverter	1	3/12/53	J. Gillette
M-1909	WWI Experience with Dust and Blemishes on Magnetic Tape	3	3/13/53	J. Forgie
M-1911	Biweekly Report, March 13, 1953			
M-1915	Test Equipment Committee Meeting of March 9, 1953	3	3/17/53	L. Sutro
M-1916	Transient Changes in Oxide-Coated Cathodes (Sc.D. Thesis Proposal)	13	3/17/53	H. B. Frost
M-1918	Group 63 Seminar on Magnetism, XL	5	3/18/53	A. Loeb N. Menyuk
M-1920	Meetings at Project High on March 13, 1953	3	3/18/53	C. Watt
M-1502-1	Construction Procedures for Engineers	10	3/1/53	C. Watt

LIBRARY FILES

No.	Identifying Information	Source
2286	The Electromagnetic Cam	Military College of Sci.
2292	The Solution of Simultaneous Equations	PSYCHOMETRIKA, 4/41 Repr.
2293	Motion of a Ferromagnetic Domain Wall in Fe_3O_4	PHYSICAL REV.,2/52 Repr.
2294	Studies of the Propogation Velocity of a Ferromagnetic Domain Boundary	PHYSICAL REV.,12/50 Repr.
2295	On the Theory of the Dispersion of Magnetic Permeability in Ferromagnetic Bodies	PZS, Repr.
2296	On Computable Numbers, A. Turing	Proceedings of the London Math. Soc.
2297	Stabilization of Wide-Band Direct-Current Amplifiers for Zero and Gain	RCA REVIEW, 6/50 Repr.

9.1 Publications (Continued)

LIBRARY FILES (Continued)

No.	Identifying Information	Source
2301	Improved Energy Band Calculations for Soft X-Ray Emission	U. of Wisconsin
2302	Principles and Practice of Radio Servicing	U.S.A.F. Institute
2303	Electronics Technician 2, Navy Training Courses, Vol I	NAVPERS
2305	Instructions for the Operation of Communications Facilities, 2/E	CAA
2307	The MIT Flight Simulator and Analogue Computer	DACL
2310	Crosstalk in Tubes for a Williams-Type Electrostatic Memory	NBS
2311	Removal of Blemishes from Cathode Ray Tubes for Use in the Electrostatic Memory of SEAC	NBS
2312	The Measurement of Frequency Modulation in Pulsed Magnetrons with a Microwave Interferometer	Lincoln Laboratory
2313	Aerodynamic Studies, Vol. I and Supplement	U. of Chicago
2314	Interaction Between the d-Shells in the Transition Metals, III	PHYSICAL REV., 7/51 Repr.
2315	Intrinsic Magnetization in Alloys	PHYSICAL REV., 2/52 Repr.
2316	Interaction Between the d-Shells in the Transition Metals, IV	PHYSICAL REV., 1/52 Repr.
2317	Interaction Between the d-Shells in the Transition Metals, II	PHYSICAL REV., 5/51 Repr.
2318	Interaction Between the d-Shells in the Transition Metals, I	PHYSICAL REV., 2/51 Repr.
B-249	THE RADIO AMATEUR'S HANDBOOK, 30th Edn., 1953	American Radio Relay League
B-250	NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS, W. E. Milne, 1953	John Wiley & Sons

9.2 Purchasing and Stock (H.B. Morley)

The Barta stockroom is now functioning on an open-stock basis.

The services of Division 1 Transportation have been helpful when our truck was unable to handle all the calls scheduled for it.

DuMont promises to ship six (of forty on order) K1084p metallized cathode-ray tubes urgently needed by April 1.

Industrial Products Corporations's interest in the coaxial-connector problem should result in improved delivery and performance.

A major vendor of connectors left us with the impression of general lack of interest; an alternate vendor, under consideration for some time, was approached. His local representatives will call on us and explore the situation.

Information on Amperex 1N38A crystal humidity characteristics were not available, but are promised us for perhaps early next week. Delivery, which was 3 - 4 weeks in late January, is now 2 - 3 months.

An improved price relationship was discussed with Centralab, on the basis of larger unit orders with staggered deliveries.

Precision Metal Products continue their interest and willingness to cooperate fully with the project on peculiar and difficult terminal problems.

Critical items continue as reported in the previous biweekly.

9.3 Construction

Production Control (F.F. Manning)

The following units have been completed since March 13, 1953:

CR#	QTY	TITLE	ORIGINATOR
1633-8	4	Lab Bench Wiring	Mercer
1633-9	1	A-C Circuit-Breaker Box	Mercer
1684	2	Low-Speed 2^6 Counter	Test Equip Com
1900-3J	1	115-V A-C Power Bus Panel	F. Sandy
1952-11A	5	Power-Distribution Panel, Mod. III	Smead
1952-15	8	Crystal-Matrix Switch, Mod. II	Smead
1952-V	25	Standard D-C Power Cables	Smead
1952-35	13	Video Cables	Smead
1952-35A	80	Video Cables	Smead
1952-58A	2	Selection-Plane-Driver Cont. Switch	Smead
1952-70A	4	Crystal Mixer	Smead
1952-82A	16	Terminal Boards for Memory Mounting	Smead
1952-91 -92	114	Lamicoid Labels	Test Equip Com
1984-28			Curtiss
2033-2			

9.3 Construction (Continued)

CR#	QTY	TITLE	ORIGINATOR
1984-8	8	Core Driver, Mod. V	Test Equip Com
1984-33	1	PEC 730C Power-Supply Modification	Jahn
2000-13	30	Video Cables	Norman
2000-14	50	Video Cables	Norman
2033-2	3	Tester D-C FF PIU, Mod II	Curtiss
2103-2	3	Tester D-C FF PIU, Mod II	Curtiss
2103	1	Magnetic-Tape Drive Control	Farnsworth
2110	1	Digit-Plane-Driver Breadboard	Piro
2110-86	8	Delay Lines	Woolf
2120-7	19	Rework Dumont Power Supply	Manning
2142	1 set	Preburn Panels and Rack	Twicken
2401-1	3	IOS Matrix	Newitt
		The following units are under construction:	
1633-5	8	D-C Circuit-Breaker Boxes	Mercer
1794A	23	Rework Mod. I to Mod. II, Low-Speed 2^6 Counters	Test Equip Com
1718	4	Power-Distribution Panel	Dickie
1952-48B	1	Power Supply for Regulator	Smead
1952-48D	1	Filament-Voltage-Control Panel, Mod. I	Smead
1952-51A	3	Push-Button Pulse Generator	Smead
1952-73	1	Memory-Address Panel	Smead
1952-78	2	Cathode Follower, Mod. IV	Smead
1952-78A	2	Cathode Follower, Mod. IV	Smead
1952-83	1	Bus Panel	Smead
1952-91	1	PI Mtg. Panel Sensing Amp.	Smead
1952-92	1	PI Mtg. Panel Digit-Plane Driver	Smead
1984-12	16	Video-Probe Modifications	Test Equip Com
1984-28	6	Burroughs Test Equip Lamicoid Labels	Test Equip Com
1984-23	2	Core Driver, Mod. V	Test Equip Com
1998B	1	Relay-Panel Marginal-Checking Control Mod. II	Test Equip Com
2033-1	3	Tester GT-BA Dual-BA PIU, Mod. II	Curtiss
2033-3	3	Tester-Switch Unit,PIU	Curtiss
2000-15	24	Video Cables	Norman
2025	1	Marginal-Checking Control, Mod. II	J. Hughes
2105	1	Skip-Switch Panel	J. Hughes
2120-12	20	16" Scope Power Cables	Newitt
2127	6	Current-Voltage Calibrators	Gurley
2132	1	X-Bar to Skip-Switch Rack Wiring	J. Hughes
2155	2	Portable Disconnect Box	Platt
2401-1A	2	IOS Matrix	Newitt
2402-2	1	Indicator-Light Register	Neville
2403-1/1A	2	Intervention-Gate Circuits	Ginsburg
2404-1/1A	3	Display-Gate Circuits	Newitt
2405-3	1	PIU Vector Generator	Irish
2406-1B	1	Remote-Station Distribution Boxes #1, 2, 3	F. Sandy
2406-4A	1	115-V A-C Filament Bus Panel	F. Sandy
2410-1	22	Video Cables	Norman

9.3 Construction (continued)

Outside Vendor (R.F. Bradley)

P.O.#	Firm	Title	Ord.	Del.	Due	Type Work
L-32622	Advance Machine	S.T. Parts	675	--	4:8	Machine
L-31854	Browning Lab.	Display Scopes	4	1	1	Assy. & Wire
L-32045	Dane Electronic	Power-Distr. Panels	10	4	3:31	" "
L-32601	" "	Fix. Volt. Sw. Panels	3	--	4:6	" "
"	" "	Volt. Vari. Sw. "	8	--	4:20	" "
"	" "	Fuse-Indic. Rack Inter.	1	--	4:6	" "
L-32544	Hauman Instr.	PIU Gate Gen.	11	--	4:1	" "
L-32545	" "	Reg. Sw. Tube Sec.	30	--	5:11	" "
L-32305	" "	Display Scopes	10	--	5/ 5/ 5/1 5/15	Compl. Fab.
L-31853	" "	Buffer Ampl.	13	7	4:1	Assy. & Wire
L-32108	Hardware Products	Springs	1000	662	5:1	Machine
L-32446	Huse Liberty	Getter Shields	200	--	5:4	"
L-32543	A.J. Koch	Low-Speed Counters	23	--	4:13	Assy. & Wire
L-32438	" "	Cathode Followers	50	--	4:20	" "
"	" "	PI Drivers	65	--	4:13	" "
"	" "	Inten. Gate Ampl.	20	--	3:30	" "
L-32304	MacLeod & Hanopol	Display Scope	10	--	5/ 5/ 5/15 6/1	Compl. Fab.
L-32707	Metallic Arts	Wireways	--	--	4:27	" "
F-10440	Raytheon Mfg. Co.	Gate Buffers	1505	725	140	" "
"	" " "	Flip-Flops	646	469	--	" "
"	" " "	Switch Tubes	272	268	--	" "
"	" " "	26" Mtg. Panels	310	165	30	" "
"	" " "	Spec. Delay Lines	800	150	--	" "
			5666	2451		

9.4 Drafting (A.M. Falcione)

Title	Cir. Sch.	Assy. & PL.	Al. Panel
Buffer Drum Plug-in Chassis (WWI)		D-53752	D-53753
Negative Voltage Interlock Panel (MTC)	D-53955	E-54113	D-54221
Positive Voltage Interlock Panel (MTC)	D-54132	E-54112	D-54182
Alt. Control Panel (MTC)	C-53815	E-54169	D-54133
Light Gun (Cape Cod)	SB-54102	D-54009	C-54010
Alarm Relay Panel (MTC)	SB-53862	D-53786	C-54271
420 In-Out Sw. 16 Pos. Matrix (WWI)	D-54170	D-54178	D-54304
Bus Control Panel (MTC)	SD-53860	E-54255	E-54256
Activate Register (Cape Cod)	SD-54266		
Vector Generator Integrator (Cape Cod)	SB-54349	SC-54350	
Wireways for Test Control (Cape Cod)		E-54225	
Regulator Ampl. Sect.; +250, ±150, +120, +90 (MTC)	SB-54327		

10.0 GENERAL

New Staff (J.C. Proctor)

Richard S. Fallows is a new staff member assigned to Taylor's Group. He received his BS in EE at MIT in 1943 and his MS in Physics at the University of Michigan in 1947. He was associated with the Radiation Lab during the war. He joined Sylvania in 1947 and was on their project for the construction of Whirlwind I.

New Non-Staff (R.A. Osborne)

Helen Connelly is returning to work part time as a secretary in Group 61.

John Devlin is a new laboratory assistant in Group 64.

Francis Divran is a new member of the Drafting Department.

Lillian Durso is a messenger girl at Whittemore Building.

Nancy Jones is a new senior clerk in the Group 64 Records office.

Joan O'Neil has joined the Drafting Department.

Richard Rainey has joined Group 64 as a laboratory assistant.

Terminated Non-Staff (R.A. Osborne)

Henry Aronson
Frances Brunswick
William Cass
Barbara Halpern
Neal Kempt
Frank Kuritsky
William O'Sadcia