Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

SUBJECT: BIWEEKLY REPORT, May 8, 1953

To: Jay W. Forrester

From: Laboratory Staff

1.0 SYSTEM 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 April 24 - May 7, 1953:

Number of assigned hours	124
Usable percentage of assigned time	83
Usable percentage of assigned time since March, 1951	85
Number of transient errors	126
Number of steady-state errors	3
Number of intermittent errors	5

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

With the replacement of several storage tubes in Bank A during this period, its level of operation is now comparable to that of Bank B. Both banks are now being used for many problems and after May 15th, they will be in routine service. Until the spare digits have been installed, however, a complete failure of a tube in either bank will necessitate single-bank operation until the next ES maintenance period.

As a result of a slight drift in the deflection voltage and numerous parity alarms when going order by order, the 715-C's of both ESD output panels were replaced during this period. No serious trouble was encountered by this change but during the process of setting voltages to agree with past values an intermittent jump in voltage was observed on one side of the horizontal output panel. The fault could not be isolated completely so several suspected components are being replaced. This trouble may have caused the several parity alarms recently in which 3 or 5 tubes simultaneously lost ones.

The Brush Recorders recently ordered have arrived and will be put in service immediately to monitor various storage-tube elements. In this way we hope to get some information concerning conditions within the tubes at the instant of positive switching.

1.11 Operation (Continued)

(N.L. Daggett)

The 715C's of the ES decoders were recently replaced en masse in an attempt to eliminate deflection-shift troubles encountered with electrostatic storage. This has eliminated shifts due to duty-cycle changes. However, there is still an intermittent shift present which may be due to a bad resistor in the decoder-output amplifiers. Steps are being taken to replace the Sprague Koolohm resistors now in the amplifiers with a more reliable Ward Leonard type.

Programs to provide programmed marginal checking are to be tried out 9 May. If they work properly, this mode of marginal checking will be used hereafter for the routine daily checking. This should save a considerable amount of time by making it necessary to enter only those lines required for the check program instead of varying all lines in sequence as is done in the automatic mode now used.

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

The following failures of electrical components have been reported since April 24, 1953:

Component	No. Failures	Hours of Operation	Reason for Failure
Potentiometer			
2500 ohm, 2 watt carbon	1	20626	Noisy
Resistor			
220 ohm, 1 watt ± 5% carbon	2	8861	1 below tolerance 1 above tolerance
5 K 1 watt ± 1% Deposited carbon	1	6979	Above tolerance
Crystal			
D-357	1	2209	Low R_b
Tubes			
6145	4	0 - 1000	Short
C16J	1	17000 - 18000	Mechanical failure (plate split)
3E29	1	8388	Low I_b
6AS7	1	0 - 1000	Short
	3	4000 - 5000	2 low I_b; 1 grid emission
	2	7000 - 8000	1 short; 1 mechanical

1.12 Component Failures in WWI (Continued)

Component	No. of Failures	Hours of Operation	Reason for Failure
	1	8000 - 9000	1 short
	1	10000 - 11000	1 short
	6	14000 - 15000	6 short
6SN7	2	13000 - 14000	1 low I_b: 1 short
	2	16000 - 17000	2 short
	1	17000 - 18000	1 short
7AD7	1	0 - 1000	Low I_b
	1	8000 - 9000	Leakage
	2	9000 - 10000	1 interface: 1 low I_b
	3	10000 - 11000	2 low I_b; 1 leakage
	1	11000 - 12000	1 short
	3	13000 - 14000	1 low I_b: 1 interface; 1 short
	2	16000 - 17000	1 short; 1 low I_b
715	3	4000 - 5000	2 high grid cutoff 1 low I_b
	1	7000 - 8000	1 low I_b
	1	10000 - 11000	1 low I_b
SR-1407	1	7000 - 8000	1 low I_b
6AL5	1	1000 - 2000	1 low I_b
6AG7	1	1000 - 2000	1 low I_b

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

The following storage-tube replacements were reported during this biweekly period:

ST-739 was rejected after 1100 hours of operation because of failure to hold a positive array.

ST752-1 was rejected after 681 hours of operation because of low margins.

ST-810 was rejected after 111 hours of operation because of failure to hold a positive array.

ST754-1 was rejected after 740 hours of operation because of poor margins.

1.13 Storage-Tube Failures in WWI (Continued)

ST-809 was rejected after 81 hours of operation because of failure to hold a positive array.

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

Digit		STM No.	Tubes	Hours of Installation	Hours of Operation
0	B	38	ST-619-C-1	10069	3964
1	B	12	ST-711-C	11989	2044
2	B	31	ST-807	13501	532
3	B	10	ST-601	8524	5509
4	B	33	RT-380	13516	517
5	B	41	ST-745	12982	1051
6	B	3	ST-751	13170	863
7	B	26	ST-540	7937	6096
8	B	44	ST-742	12640	1283
9	B	42	ST-720-C	12937	1096
10	B	2	RT-382	13629	404
11	B	25	ST-753-1	13129	904
12	B	28	ST-747	13261	772
13	B	9	ST-803	13411	622
14	B	24	ST-624-C-1	10507	3526
15	B	16	RT-383	13629	404
16	B	11	ST-716-C-1	11702	2331
0	A	43	ST-722-C	13130	903
1	A	18	ST-812	13851	182
2	A	19	ST-816	13910	123
3	A	23	ST-802	13411	622
4	A	32	ST-808	13516	517
5	A	40	ST-525	13389	644
6	A	34	ST-710-C-1	12889	1144
7	A	35	ST-800	13340	693
8	A	29	ST-811	13829	204
9	A	39	ST-814	13910	123
10	A	30	ST-801	13363	670
11	A	36	ST-744-1	12822	1211
12	A	8	ST-746	12982	1051
13	A	14	RT-381	13581	452
14	A	5	ST-614	1235	798
15	A	22	ST-805	13457	576
16	A	27	ST-613	9046	4987

ES Clock hours as of 2400 May 7, 1953:	14032.8
Average life of tubes in service in Bank B	1230
Average life of tubes in service in Bank A	876
Average of last five rejected tubes	553

2.0 CIRCUITS AND COMPONENTS

2.1 Circuits by System Number

2.13 Arithmetic Element (Heineck, Callahan, Aronson)

An M-note describing a survey of time-pulse distributors was completed and should be available soon.

Heineck is now working on the interlock problem with Gerhardt, Jeffrey, and Epstein. This group will work up an interlock proposal and issue an M-note on their work.

R. Callahan and I. Aronson are working with R. Fallows on physical layout. This group attended the physical-layout meeting which was held recently at Hartford.

2.14 Input-Output (R.H. Gould)

All changes that had been planned to simplify in-out control have been made. The necessary additions for MITE vector display and number display have been made and the equipment tested. Additions to in-out control for use with programmed marginal checking have been made and will be tested on 9 May 1953. The final additions to in-out control for the indicator lights will be made during the week of 11 May.

(R.H. Gerhardt)

The past biweekly period was spent studying the proposed input-output orders for WWII. Several flow diagrams and block diagrams of interlocks have been made and others were studied.

MITE (A. Werlin, R. Paddock)

The modified MITE equipment and its associated buffer storage has been tied in with the computer during the past biweekly period. Additional cables have been run from IOC to provide programmed input data to MITE and a test program has run successfully in this manner.

Cables have been ordered for Standard MITE #1 and its buffer storage and for the demodulator-filter switching panel. Wiring of both these items should be completed during the next week or two; the switching panel was modified to incorporate switches for remote indicators.

2.14 MITE (continued)

A demodulator-input terminal panel has been made and mounted in K-10 of Room 156. A cable from Room 224 is being connected to this panel, and the cable has been ordered for connecting the demodulator inputs to this panel.

Lamicord-label drawings are nearly complete for buffer-storage panels, MITE panels (both modified and standard), the demodulator-filter switching panel, the remote-indicator panels, and the flip-flop indicators.

2.2 Vacuum Tubes and Crystals

2.21 Vacuum Tubes (H.B. Frost)

During this past period, several activities in connection with my thesis research have received attention. A special tube for these cathode studies has been designed and will be constructed by Group 65 in the near future. In addition, the test equipment for the measurement of cathode coating resistance and the determination of changes in coating resistance has been checked out with the addition of a new Tektronix 112 amplifier. The use of this amplifier in conjunction with a cathode-follower probe makes possible the measurement of pulse currents to about 1×10^{-9} amps in the present setup. A scheme to check constancy of emission has been tried with apparent success. A series of measurements on 5687 life test tubes has been started and will be continued during the next few weeks.

Life tests of the 5899 tubes have been restarted. These tubes are experimental tubes containing special cathode material with high activity but low tendency to form interface impedance. Initial results look good. In addition, 1 tube each of types 12BY7 and A4676 is being run strictly for preliminary information.

An M-note, Some Notes on Current Tube Types, has been written and published. This memorandum describes the newer reliable tubes which are replacing many of the older receiving types in present equipment. It should be checked carefully by all designers.

Tubes from the new sample lot of 6145's have been tested initially, burned 100 hours, and retested. There were 4 failures in the 20 tubes, considerably below the usual run of regular 6145 tubes. These tubes will be placed on life in the very near future. There were no failures for out-of-specification tubes. Two of these tubes have been cast in resin and cut up for dimensional studies.

2.21 Vacuum Tubes (continued) (Twicken, Frost)

A rather extensive program is underway to determine the duration and resistance of vacuum-tube shorts. One objective of this program is to determine whether any potentially trouble-producing shorts can be passed by the present intermittents detector. A lot of 179 6145 tubes rejected by the tester was checked, using a 513D scope as an indicator. Data was recorded on Land camera photos. All shorts were of 10 microsecond duration or greater except for three questionable tubes showing shorts lasting less than 1 microsecond. Whether these 3 tubes actually had shorts or merely exhibited socket noise remains to be determined. It has been verified that socket noise is very troublesome in this sort of test. Of 93 accepted tubes, about 10% evidenced some shorts none of which lasted less than about 3 microseconds. It should be noted that the acceleration on the experimental setup is higher than and not as uniform as that of the intermittents detector.

A lot of 110 5965 tubes rejected for various reasons was also tested for short duration and resistance. Only one short lasted less than 10 microseconds.

Evaluation of the data is at present incomplete. Additional tests will be undertaken when the data has been evaluated and when needed areas for more data have been determined.

2.22 Transistors

Minority Carrier Storage (N.T. Jones)

Cursory examination of the junction diodes on loan from Bradbury of AFCRC has been made with respect to reverse recovery time. A new problem of forward recovery time has arisen. This effect is apparent when a germanium diode has been conducting in the back direction for a period of time and then voltages to switch in the forward direction are applied. For a time, the diode remains in the back of high-resistance state, and then turns on with a positive exponential current waveform. This effect has been observed in a portion of the junction diode. Point diodes will be investigated for this forward-recovery-time effect.

A memo presenting a basic discussion of minority carrier storage in diodes and transistors is planned for the very near future.

Measurements: (N.T. Jones)

28 GE G11A transistors were received this period. D. Smith has completed all but the storage coefficient measurements on these units. This shipment is of very high quality.

D. Smith is continuing the remeasurement of all transistors on hand.

2.22 Transistors (continued)

Measurements (continued) (D.J. Eckl)

The diode-characteristic plotter has been completed by Frank Da Costa. This unit will display on appropriate scales the forward and reverse characteristics of crystal diodes as well as the emitter and collector diodes of transistors.

Sergio Valdez has a working model of the α vs I_e plotter in operation.

Transistor Accumulator (D.J. Eckl)

Total operating time is now 4600 hours. The margins are still being adjusted on the transistor circuits. However operation has been satisfactory. From 22-24 April, over a period of 47 hours, one error was recorded. This was caused by the control. Difficulties were encountered until 28 April, when a 7AK7 was replaced in a gate-tube panel in the control. From 28 April to 8 May, no errors were recorded during a total of 239 hours. This was not a period of continuous running, however. Shut-downs were made for changes in control and marginal checking. The d-c power supply also failed during this period.

The following tube failures occurred:

7AK7	gate-tube panel	low output	4366 hours
NL653	PEC Supply	intermittent arcing	4557 hours
6Y6	d-c supply	open filament	4000 hours

Transistor Core Driver (S. Oken)

After 400 hours of continuous operation two transistors of the four being tested have exhibited a change in their collector characteristics which make them unsuitable for use in the core driver although they can probably still work well in other types of circuits. This change in the characteristic is being more thoroughly investigated.

The drivers for the "Trans-Cor" (Transistor-magnetic core) memory have been built, and a memory-core plane is being assembled.

2.3 Ferromagnetic and Ferroelectric Materials

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

A careful study of MTC core characteristics by Freeman and McCusker has revealed several interesting facts. The first of these is that the response of a core to a half-read selecting pulse depends more upon whether the preceeding pulse was a half-read or a half-write than it does upon the one or zero state of the core. Another fact is that a memory array can never hold an undisturbed zero. These facts make the post-write disturbing method even more advantageous than had been anticipated. Worst possible patterns are being determined on the basis of this new information.

Symbols for the voltages from memory cores have been prepared.

Preliminary results of a series of stoichiometric $MgO \cdot MnO \cdot Fe_2O_3$ are very encouraging. Good squareness has been observed for some samples of this series.

The core-testing setup in Jack Goetz's group at IBM's Plant 2 has been brought into agreement with our core-test results on MTC cores.

Pulse-Voltage Outputs of Ferrite Cores (J. McCusker, J. R. Freeman)

Considerable information has been gathered on the affect of half-write pulses on the outputs of ferrite memory cores. It now is evident that the kind of disturbing pulse (i.e., half-read or half-write) preceding a selecting pulse has a much greater influence on the magnitude of half-selected voltage outputs than has the state of the core (i.e., ONE or ZERO). This fact makes the post-write disturbing method even more advantageous than previously has been appreciated.

Worst possible patterns have been determined in the light of the newer information. It has been verified that the "checker board" pattern now used is still the worst pattern when the post-write disturbing method is used.

Automatic-Core-Tester Circuitry (R. Jenney, B. Gurley)

It is planned to mix the output of the core under test with the outputs of two standard cores. These standard cores will represent the upper and lower limits of selection. The differences between each standard core and the unknown core will be amplified and turn gate tubes on for a good indication.

The preliminary design for the amplifier has been completed and construction of an experimental model started. The required logic for sensing and counting has been designed.

2.31 Magnetic-Core Materials (continued)

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

A stoichiometric series of $MgO \cdot MnO \cdot Fe_2O_3$ has been completed and cores have been fired at various time-temperature schedules. These cores are now being tested to determine squareness ratio, flux, and coercive-force values for the various stoichiometrical compositions prepared.

On the basis of information for values of R_s thus far received from testing, it appears that good squareness values may be obtained from such a series over a wide range of compositions. Portions of the range appearing to be of particular interest will be re-examined in more detail.

The squareness ratio for the series of $MgO \cdot Al_2O_3 \cdot Fe_2O_3$ has indicated a small maximum at the lower concentrations of Al_2O_3. A more detailed examination of this range has been started.

Ceramic Ferrites (G. Ecomonos)

Further investigations of variations of the original 3A10 composition have shown very interesting results. These variations which hold all fabricating factors constant involve changes in composition only. As the composition is changed, the squareness ratio (R_{sm}) can be changed from 0 to the present maximum of +0.83. This change appears continuous and follows a definite sequence with composition variations. Up to now, the study has been made on F-109 toroids which are not convenient for pulse testing. These changes are of particular interest to the theoretical group which is looking at the problems on a molecular scale. There appears to be a relationship between compositions and grain size with squareness ratio and switching time. The determination of the conditions at which a maximum squareness ratio and a fast switching time are obtained (an inverse relationship) should fit some statistical model and must be, for the present, determined by emperical methods.

The new plunger for the F-304 die (for pulse-test toroids) has arrived from the General Ceramics Co. with no chamfer. The entire die assembly has been sent to the machine shop to remove the chamfer from the bottom plunger and for realignment. When this unit is ready, a more detailed study of the above-mentioned compositions can be made by pulse testing.

The primary effort of this sub-group (LIR) at the moment is concentrated in the preparation of good manganese ferrite. The original idea was to study the basic ferrites involved in the preparation of a square-loop body under identical firing conditions. This can only be done with $MgFe_2O_4$, whereas $MnFe_2O_4$ and $FeFe_2O_4$ are in a separate catagory; they are not stable in atmospheric air firings. The "D" series (air-fired $MnFe_2O_4$) has been set aside because the amount of $MnFe_2O_4$ present is too low. Slow air cooling of this ferrite causes reoxidation of the spinel components into two separate phases: Mn_2O_3 and Fe_2O_3. Firing in a "magnetite" atmosphere appears to be too reducing; an MnO phase separates. Toroids and discs of this ferrite are now being prepared for firing in helium, carbon dioxide, and a less reducing "magnetite" atmosphere. As soon as time permits, the detailed study of the

2.31 Magnetic-Core Materials (continued)

square-loop ferrite compositions will again be given full-time consideration.

Arrangements are now being made to have our own personnel hand-wind the "A" and "B" series toroids.

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

The preparations of $MnFe_2O_4$ fired at 800° C under CO_2 and under He atmospheres showed less excess Mn_2O_3 and Fe_2O_3 than those done in air. A modified mixture of CO_2-CO less reducing than that used for magnetite showed mainly the spinel. The ceramics that G. Economos is firing in these atmospheres will be examined by x-rays also to determine the best conditions.

B-H Loops of MF-1312B (J. B. Goodenough)

Two cores of the General Ceramics MF-1312B ferrite body were randomly selected for a B-H loop test. One had good squareness characteristics. The other showed poor squareness for the saturation loop, good squareness for a small loop. This latter loop showed two points of discontinuity in the slope of its shoulder, one at an $H<0$ and the other at an $H>0$. Since both grain boundaries and lamellar precipitates will nucleate domains of reverse magnetization, it is suggested that in the latter core a very small amount of lamellar precipitate has begun to form. The nucleation field strength at the lamellar precipitate is lower than at the grain boundary and the resistance to wall motion is higher. That portion of the core which is affected by the lamellar precipitate will not change its induction appreciably during the traversal of a small loop, whereas the unaffected volume will act like the former core with motion of walls which are nucleated at grain boundaries. It is predicted, therefore, that a lamellar precipitate has begun to form in some part of the core with the anomolous loop. It is suggested that a micrograph study be made to test this hypothesis.

360° Bloch Walls (P. K. Baltzer)

The possibility that collision of two 180° Bloch walls does not result in mutual annihilation is being investigated. If the direction of displacement of the spontaneous magnetization through successive 180° Bloch walls is monotonic, then when two adjacent walls collide a 360° wall will be formed. This 360° wall will exist in low fields despite its high energy, since the interaction energy between adjacent spins in the wall form a potential barrier of the order of 10^{10} ergs/cm^3.

Experiments of L. F. Bates and others show that the free poles created on the surface of observation of a specimen by 180° domain walls alternate in sign. These would indicate that a monotonic displacement exists. Also, when a nucleation process is considered, it can be shown that the ultimate domain pattern will contain walls of successive vector rotations.

2.31 Magnetic-Core Materials (continued)

The importance of the existence of such a 360° wall is that domain walls and a nucleus of reverse magnetization are always in existence for our low-field applications.

It is hoped that further investigation of the 360° wall can be made by using Bitter patterns.

Energy Losses (N. Menyuk)

A calculation has been made of the energy losses involved in the reversal of magnetization in a square-loop material. The results are in good agreement with available experimental data. Specific application of the results to the switch-core problem indicates that metallic cores may be preferable to ferrite cores.

American Physical Society Meeting (N. Menyuk)

A ten-minute paper was presented April 30 on the magnetization reversal of square-loop polycrystalline materials by domain growth at the Washington Meeting of the American Physical Society. The material presented is given in the latter half of Engineering Note E-532.

Magnetism Seminar Reports (N. Menyuk)

Since last reported, five additional memoranda based on A. Loeb's seminar on magnetism have been printed. These reports cover meetings 46 to 49, inclusive, and Appendix VI.

2.32 Magnetic-Core Memory

Memory Test Setup I (S. Fine)

A method of sensing whereby array noise and half-selected core outputs are reduced to a minimum has been devised and tried with some success. Further investigations along these lines are being undertaken.

A report on some methods of improving magnetic-core-memory operation has been written.

Memory Test Setup V (W. Ogden, E. A. Guditz)

Changes were made in the test-logic equipment to permit operation with the "worst pattern" but complimenting each core before it is read out. This is a more difficult mode of operation.

Operating margins were taken on the three planes mounted in the memory test rack to determine optimum driving currents, sensing time, sensing-amplifier

2.32 Magnetic-Core Memory (continued)

gain, and array-terminating impedance.

After this data was obtained, all 17 memory planes were installed in the memory test rack and much of the above data retaken. It was found that margins were quite similar for all planes except when the "worst patterns" were used. About half of the memory planes would not hold the "worst pattern" without using the post-write disturb pulse. However, the "worst pattern" margins were satisfactory for all planes when the post-write disturb pulse was used.

The 17 memory planes are now installed in the Memory Test Computer and are undergoing initial testing.

RF Nondestructive Readout (B. Widrowitz)

Successful nondestructive readout of a 16 x 16 metallic-core memory plane has been accomplished. The memory lines were selected by clip-lead connection to the RF drivers. The x driving frequency was 7.3 mc, y was 5.8 mc, giving a difference-frequency beat at 1.5 mc. Readout time for positive discrimination was 2-3 μsec.

Magnetic-Matrix Switch (A. Katz)

A third 32-position matrix switch, 32-3, has been completed, and a fourth, 32-4, is nearing completion. These switches are identical except for the manner in which certain windings are made. The difference will enable us to evaluate the "delay-line" effect first noticed by K. Olsen.

The recent arrival of 20 metallic cores will permit the building of the first metallic matrix switch, 16-5. Since metallic cores appear to have (for switching applications) certain advantages over ferritic cores, it is important that experimental work along these lines be expanded.

The effect of pulse-repetition frequency on the temperature of the core is still under investigation. Results to date indicate the need for forced cooling of the switch if it is to operate at frequencies of the order of 100 kc.

Z-plane Driver (D. Shansky)

The breadboard mentioned in the last biweekly report has been debugged and operating margins have been checked. These have been found to be adequate. The final choice of the output tube is still in question. The decision will depend to a great extent upon an evaluation of several tubes by H. B. Frost.

Core Measurements (J. Raffel)

Measurements on MF-1312, F-262, cores indicate that the power input necessary to switch the core is of the order of 2 to 3 times the hysteresis loss as calculated from the d-c loop when driving-current pulses with rise time of less than 1 μsec are used.

2.32 Magnetic-Core Memory (continued)

Memory-Address Selection Systems (J. L. Mitchell)

An M-note describing the various memory-address selection systems that have been built as well as some of the systems that have been proposed has been written and is now being published. This note contains descriptions, block diagrams, tube counts, and comments on the various systems.

Memory Planes for MTC (A. D. Hughes)

The last of the 17 planes was tested. The advantages gained by the tests seem to have been born out by the few construction errors found when all 17 planes were connected together. An M-note will soon be out describing the tests and results.

2.4 Test Equipment

Test Equipment Committee (L. Sutro)

The need for oscilloscopes has again been considered. All of the 98 Tektronix scopes are in use with the exception of 5 that serve as replacements when any of the others fail. Since there is no shortage, the Committee has decided against purchasing the new Laboratory for Electronics scope, Type 401.

The Committee is ordering power supplies. Universal Electronics of Los Angeles will ship 15 more bringing the total from that company to 18. The 15 will be used by Vacuum Tube Section of group 62 to do the large amount of marginal checking required to test new circuits adequately.

Test Equipment Headquarters (L. Sutro)

The Tektronix 517, the scope with the band pass of 60 mc and accelerating potential of 24 KV, fell on its face May 5. Although it fell 4-1/2 feet the only broken parts were two tubes, a switch, and the probe. A new front panel (together with other small parts) is coming from Tektronix. Other bent parts are being straightened in the shop.

Four times this past winter, Tektronix 513D oscilloscopes have been brought into the Headquarters with eight to ten tube failures. On other occasions, 513D's have been brought in with nearly this number of failures.

Jack Day, Tektronix engineer, visited the Laboratory April 24 and recommended additional air cooling. He said that where a second fan has been added to 513 scopes the number of tube failures had noticeably decreased. Bonnell Frost attributes the tube failure to the use of tubes designed for TV service where low price often takes precedence over high quality. On his advice we are obtaining the test specifications that Tektronix uses for its tubes so that the tube shop can test accordingly. It is hoped that by testing all new tubes intended for scopes in the prescribed manner that shorts and other troubles will be detected before they fail in scopes.

Differential Video Probe For 'Scope Use (H. Zieman)

As presently designed, the video-probe gain is linear for input voltages from 0 to 4 volts. To increase the range of inputs for which the probe is useful, a compensated voltage divider has been designed which can be directly fastened to the probe stand. The circuit schematic for this attenuator is given in SA-54699, while a chassis is shown in SA-54687.

2.4 Test Equipment (continued)

The video probes being built by the shop appear to have less gain than the prototype which was built here. The cause has not yet been determined.

2.5 Basic Circuits

Gate-Tube Circuits (H.J. Platt)

The gate-tube circuit as used in the WWII adder was tested for prf sensitivity which was found to be less than 10%. Both hypersil and ferrite transformers were used in the output. The hypersil transformer was somewhat better than the ferrite transformer in both amplitude and prf sensitivity.

Some margins were run on the adder circuit with the following results:

For a given input and output voltage, the circuit seemed to be insensitive to vacuum tubes as far as suppressor and screen-grid voltages were concerned. The plate-supply voltage had not been varied at this time. The tubes used covered the entire range of acceptable tubes put out by the tube shop. One tube was about 1 mil below specifications.

For a given input and output voltage, the screen voltage is a poor method of directly finding a change of plate-supply voltage. However, the plate-supply voltage is a good way of finding a change in the suppressor-grid level during conduction.

Further work on margins will be undertaken.

Contacts (Single-Pulse Synchronizer) (C.A. Laspina)

A single-pulse generating circuit has been built which is insensitive to switch bounce and stray wiring capacities. This circuit will operate with remote control or with the contact placed at the generating circuit.

The unit can be fired with standard 0.1-μsec pulses at prf's of about 2 megacycles but with lower prf's, larger amplitude pulses are needed. For low prf's, the sync pulses will probably be used to trigger a blocking oscillator which will provide large pulses to fire the unit.

2.5 Basic Circuits (continued)

Pulse Delays (J. Woolf)

The past period was spent in efforts to improve the circuit previously referred to as a dynamic flip-flop. The nomenclature has changed; in the future, this unit will be called the pulse-delay repeater. The circuit operates marginally or fails to operate with any capacitor loading exceeding 16 μμf. Further efforts will be made to improve this before a buffer tube will be employed.

High-Speed Flip-Flop (H. Boyd)

The High-Speed Flip-Flop for driving both diode logic and gate tubes is now complete. An E-note E-543 describing practically all aspects of its operating characteristics will soon follow. It is expected that this circuit will be approved as is for WWII.

Buffer Amplifier (S. Bradspies)

After a number of tests with the buffer amplifier driving simulated gate tubes represented by 15 μμf paralleled by a series diode and 470 ohms, the question has arisen as to whether the aforementioned circuit represents a gate tube. At the present time, a more detailed set of tests is being conducted to determine what a gate tube actually looks like.

High-Input-Impedance Flip-Flop (B. Remis)

A partial set of margins have been run on the input triggering circuitry for the high-impedance flip-flop. The width of the input pulse and the components of the trigger circuitry have been varied to yield a minimum load on the driving sources (consistent with good margins and prf insensitive operation up to 1 mc).

Low-Speed Level Inverter (J.S. Gillette)

A circuit using a 5965 has been designed and tested. A total time of 1 μsec is obtained.

Low-Speed Level Amplifier (J.S. Gillette)

A circuit using a 5965 has been designed.

High-Speed Level Inverter (J.S. Gillette)

No further work has been done on this circuit.

2.6 Component Analysis (B. Paine)

Trips have been made to Corning Glass Works and Allen Bradley to gather reliable components information. The results of each of these trips will be summarized in M-notes to be issued shortly. The question of pulse-transformer construction for WWII has been discussed with IBM, Sprague, and Sickles. An application proposal for pulse transformers will be prepared.

A considerable amount of work has been done during the last bi-weekly period in consulting with design engineers on component-application problems. Anyone having an unusual component problem is urged to consult with myself or another member of the Standards Committee.

It is particularly important that any components that are removed from equipment and appear defective in any way be sent to me for analysis. It is only in this way that we can gain a realization of possible types of failure.

A quantity of type 1N70 diodes has been purchased from Radio Receptor Co. for use as a substitute for the Sylvania 1N38-A. The 1N70 has better characteristics than its predecessor, and special tests for back resistance and shape of characteristic curve are made by the manufacturer at 55° C before shipment. These diodes will be installed in equipment interchangeably with the 1N38-A.

2.63 Standards (H. Hodgdon)

On April 24, C.W. Watt and I visited El-Menco for the ninth in a series of meetings on reliable components. See Memorandum M-2127 for complete details.

April 27 and 28 were spent at IBM Corporation in Poughkeepsie, attending joint MIT-IBM Component Standards Sub-Committee meetings.

The following new and revised standards sheets have been issued recently:

6.024-3, -4	Capacitors, Fixed, Paper - Rectangular Can
6.025-2	Capacitors, Fixed, Electrolytic, Plug-In
6.046	Connectors, Plugs and Jacks
6.063	Fuses, High Voltage
6.181-1	Terminal Strips, Barrier Type
6.198-2	Transformer, Isolation

2.7 Memory Test Computer

MTC Operations (H.E. Anderson, P.R. Bagley)

The control element was checked out at the beginning of the biweekly period. A number of test and demonstration programs have been run successfully.

On May 8, the installation of the magnetic-core memory was completed. First adjustments are now being made. A short test program stored in magnetic memory has been run successfully.

MTC Utility Programs (S. Best, P.R. Bagley)

The following "utility" programs have been written for MTC:

1. Read-In Program for MTC Tapes;
2. Storage Punchout;
3. Basic MTC Conversion Program;
4. Read-In Program for WWI Tapes.

The first two programs have already been run using toggle-switch storage.

Marginal Checking of Control (H. Henegar)

It has been tentatively decided to marginal check the MTC control element by instructions as far as possible. This would mean that the equipment associated with particular instructions, such as ad, ca, etc, would be marginal checked simultaneously. This leaves the other instructions free to detect errors occurring because of excessive margins on the ca equipment.

Approximately thirty marginal-checking lines will be needed. Installation of the necessary cabling has begun.

MTC Power Supplies (R.G. Farmer)

It has been found that MTC will require more current from the +150-volt and -150-volt power supplies than was anticipated. Two more 150-volt, 10-amp supplies will be built to meet the requirements. All critical parts have been ordered, and shop time has been scheduled for the assembly of these supplies.

Alarm System (W.A. Hosier)

The MTC alarm system was put into operation about a fortnight ago and has seemed to perform as intended. Three types of alarm -- inactivity, programmed check, and overflow -- have been thoroughly tested under MTC operation with panel (i.e., toggle-switch) storage, but the parity alarm needs an operating

2.7 Memory Test Computer (Continued)

magnetic memory for final testing. This, of course, will be available in the next day or so.

A "stray control pulse" or "extra activity" alarm which had been proposed was shelved for the time being as necessitating too much complication of control, but the needed hardware for this is installed against the day when either it is needed or a simpler logic is found for generating it.

There is also provision for a "card copy" alarm to indicate that MTC is getting our of step with the IBM card machines -- if and when these are attached.

Magnetic-Memory Test Routines

Once the memory array is lined up and functioning, our first series of tests will be simple programs which can be put into the 32 registers of panel storage -- programs to write and check arbitrary patterns of 1's and 0's in the seventeen 32 x 32 planes. To date, the patterns programmed are only (a) solid 1's or 0's or same written at any regular address interval and (b) the "bordered checkerboard" pattern which, as Al Guditz points out in E-488, gives rise to the "worst possible" signal-to-noise ratio.

We welcome -- indeed, solicit -- suggestions by any of the staff with ideas on specific aspects of the magnetic array which they would like to see tested.

Panel Storage (J. Crane)

A sketch of the block schematic for panel storage, MTC, is now complete. This sketch includes the panel storage flip-flops, the 64-position switch, and the associated cathode followers.

Surge Suppressor

In order to prevent current surges from blowing fuses when switching power on, a surge suppressor was built and is now installed in MTC.

MTC Memory Rack (A.D. Hughes, W.J. Canty)

All the units in the rack were video tested and very little trouble encountered. All tests on the memory rack were completed, ready for the memory.

Digit Plane Drivers

Tests were completed and necessary changes made on the digit plane drivers to be ready for MTC. The last change was to slow down the rise time and eliminate ringing by changing a capacitor.

Sense Amplifiers

Tests were completed on all the amplifiers for their use in MTC and

2.7 Memory Test Computer (Continued)

the necessary changes made. However, work is still going on to improve the operation of the amplifiers. It is believed that a minor circuit change is needed, especially since there is considerable unbalance between the negative and positive amplified pulses.

3.0 STORAGE TUBES

3.1 Construction (P. Youtz)

800-Series storage tubes were constructed as replacements for any marginal tubes in Bank B and as replacements for the old-model tubes and marginal tubes of Bank A.

Three storage tubes with Philips "L" cathodes in the high-velocity guns were constructed this period.

3.2 Test

Television Demonstrator (D.M. Fisher)

Seven storage tubes and two "L" cathode research tubes were pre-tested. Six were accepted and were transferred to the STRT for further testing. Three were rejected because of failure to hold a positive array.

ST806, which was mentioned in the last report, was again tested after remaining idle for 16 days. Gas-pressure measurements were made as it was suspected that a minute leak in the tube may have contributed to its failure in WWI. However, this uncertainty was disproved because of the results of the gas-pressure measurements.

Storage Tube Reliability Tester (R.E. Hegler)

ST812, ST814, ST816 and ST817 have satisfactory spot interaction areas. ST815 was rejected because of small margins caused by non-uniform target-to-collector spacing.

RT374-C-1, which contains a Philips "L" cathode, has a satisfactory spot interaction area but will be retained at the STRT for further investigation.

3.3 Research and Development

Lower Stability Failure (C.L. Corderman)

None of the most recent tubes with ion plates, first hydrogen fired then vacuum fired, has yet failed from internal breakdown. Two tubes of this type have been in the computer for about 200 hours. Several of the tubes have had such high lower switching points that they have been rejected. This trouble does not appear to be associated with internal breakdown, however.

"L" Cathodes (T.S. Greenwood, R.J. Biagiotti)

The parts for mounting the impregnated "L" cathodes were completed during the last period. Using the resulting mount, three research tubes were made using "L" cathodes in the high-velocity gun. The mounts proved to be easy to assemble, mechanically rigid, and displayed satisfactory thermal characteristics. The heat loss due to the mount is apparently only slightly greater than that of the previously used interim mount. No new problems have

3.3 Research and Development (Continued)

arisen with the use of the mount and it is, therefore, felt to be a final design.

Of the three tubes made, only one produced satisfactory emission. In the other two poor tubes, both guns suffered some degree of poisoning and one tube showed a failure to hold a positive array when tested in the TVD. No immediate cause for the poisoning was discovered. Tests on the satisfactory tube showed that a maximum V_{HG} of 95 volts was necessary for good spot interaction behavior but at this voltage a large error-free area was obtained. Because a heater voltage of 9.5 volts was required this tube will not be immediately installed in WWI, but the tube is in other respects satisfactory for this service.

In the immediate future attention will be directed toward designing and procuring heaters which will give operating temperatures at voltages of 6-7 volts. This will alleviate the problems of separate heater supplies which exist on all of the "L" cathodes.

The problem of grid emission will be investigated more fully in the coming months to determine a satisfactory material for grid fabrication. At the present time platinum-plated grids appear to give excellent results but such plating may be an unnecessary refinement.

Stannic-Oxide Tubes (T.S. Greenwood)

Because of computer tube requirements no stannic-oxide tubes were made during the period. However, on investigation of emission currents of all guns made in the past year and a half showed that the poisoning of guns in SnO_2 tubes was not as severe as at first thought. It was found that cyclic variations exist in gun currents and that when the guns which used SnO_2 tubes are compared with other guns made at the same time the decrease in emission is very slight.

Velocity-Distribution Measurements (C. T. Kirk)

The 10-Kc system was set up and run successfully during this biweekly period.

However, noise spectrum associated with the desired signal still overlapped the signal spectrum and made differentiation of the signal impossible. The overlap was such that any attempts to filter adequately removed components of the signal spectrum so as to cause an observable change in the signal as viewed on a scope. This problem was overcome, however, by reducing the cage sweep and thus reducing the overlap between the signal and noise spectrum.

An analogue differentiator was designed and constructed also during this period.

3.3 Research and Development (Continued)

Pulse Readout (A.J. Cann)

It has been found necessary to work the gun driving circuits at 100-ohm impedance level to obtain the required rise time. A 9:9:9 turn transformer wound on the same type core used for ferrite 3:1 transformers can produce a .06-μs output pulse. A 5μh tail reversing inductance is needed across each secondary to allow the IN38A damping diodes to work. Driving the transformer to 70 or 80 volts is quite difficult and a larger core might help, since this one is undoubtedly quite saturated.

This problem will be left for someone else because of the press of thesis work. The thesis is expected to be finished on time.

4.0 TERMINAL EQUIPMENT

Signal Wiring (G. F. Sandy)

Two display-gate panels and those panels in AX5 & AX7 requiring signal-wire cables have been completely wired. One intervention-register panel and the last display-gate panel are being wired. These should be completed during the week of 11 May.

Fifty-six cables have been run from the RSDB to the new Control Room; 16 more will be run in 11 May.

4.1 Typewriter and Tape Punch (L. H. Norcott)

The past two weeks have been principally devoted to preventive-maintenance work on our Flexowriter recorder-reproducers. The machines are taken to the shop one at a time for disassembly, cleaning, oiling, adjusting, and checking before being returned to duty. This will be continued until all have been overhauled.

4.2 Magnetic Tape (J. W. Forgie, E. P. Farnsworth)

The new green-gray tape which was put on the computer tape units several weeks ago has been removed. The tape, though very satisfactory in its magnetic characteristics, was dimensionally unstable. We are assured by 3M, the tape manufacturers, that the mechanical properties of the tape we used were not a result of the new coating process in general but must have been due to a manufacturing fault in this particular lot. We expect them to replace the tape in the near future, at which time we will make another try using the new tape. In the meantime we will use the old brown tape.

We have requested information from 3M concerning the possibility of purchasing a few rolls of mylar-backed tape. Mylar is a plastic offering many advantages over the standard acetate. Mylar is considerably stronger and stretches less under the same tension. It should be ideal for our uses where deformation and breakage of the tape are serious problems. Unfortunately, mylar is not yet available in large quantities. As a result, it is expensive and, because it must be coated in small lots, there is increased probability of defects in the coating. However, if the price is reasonable, we will try a few rolls.

The CS conversion program has been permanently recorded at the beginning of the tape on unit #0. A second-limit switch contact has been placed on the tape beyond this recording. It is requested that any user of unit #0 begin his recording at this second-limit switch position (about 200 feet from the front end of the reel).

Discussions have been going on with members of the application group concerning the location and type of manual controls needed for the tape system. An M-note should appear in the near future outlining our final conclusions on this subject.

4.3 Display (R. H. Gould)

The 304-H 5-inch display scopes have been replaced by 304-A scopes which appear to be more satisfactory as to amplifier stability and sharpness of focus.

Tests on six more K1084P7M 16-inch cathode-ray tubes have disclosed one with stray emission. Delivery remains constant and should be adequate.

Character and Vector Display (F. E. Irish)

Both the character and the vector generator have been operated successfully with the computer. There are several minor details in these systems which will have to be corrected, but the operations so far indicate that the logic of the two systems is correct.

Before the vector generator was operated, it was thought that a vector might be displayed in the same length of time as that required for a point. Now it begins to look as if a longer time will be required in order to sufficiently intensify the vector.

Decoder-Output Amplifier (H. E. Zieman)

A new decoder-output amplifier has been designed and built according to SB54415. It consists of a phase inverter stage, two stages of differential amplifier, and an output stage consisting of a push-pull cathode follower driving an unterminated coax cable. The calculated differential gain varies from unity to 600 by controlling the amount of feedback. The maximum differential output should be $\pm$10 volts. The common-mode gain varies from -40 db to -60 db. The frequency response will be a function of the length of cable attached to the output terminals but is expected to be in the vicinity of 1 mc.

The amplifier is now ready for testing, but no testing has been done yet.

4.4 Magnetic Drums (P. W. Stephan)

A sketch of the new power system for the magnetic drum has been completed.

A program (2553-4) used in marginal checking of the drum was modified to omit Group 7 when it becomes disabled.

4.4 Magnetic Drums (Continued)

(K. E. McVicar)

The auxiliary-drum system has been operating with the computer on a full-time basis for over a month. Reliability during this time has been very good.

The input program is now on Group 7 of the drum and this group has been locked in "read", i.e., the information stored cannot be altered. To use the drum-input program instead of the one in toggle-switch storage, the "program-counter reset" and "start over" buttons are used instead of the "read-in" button. Full details on the new input program may be found in E-537 by J. Frankovich.

5.0 INSTALLATION AND POWER

5.1 Power Distribution and Control

Air Conditioning (R. E. Garrett)

The new air-conditioning system for Room 156 has been placed in operation and the existing air-handling unit of Room 222 tied into the new freon system. The major portion of the debugging has been completed, and it is expected that the computer system will be integrated on 14 May.

Building Power (R. E. Garrett)

The new main circuit breaker is now being installed by an outside contractor, and the additional transformer capacity (temporary) for the Barta Building is expected to be connected on May 16.

5.2 Power Supplies and Controls

MTC Alternator (R. Jahn)

Parameter measurements have been completed. I am now obtaining magnetization and regulation curves for resistive loads.

WWI Power Supplies (J. Lynch)

General Electric thyratrons GL5855 have been received. Because of their high commutation factor they will replace the Electron Inc. C16J now used in the +250-volt supply. Although 10,000 hours or more service should be obtained from the C16J's, they have been averaging only 5,000 hours.

5.2 Power Supplies and Controls (Continued)

D-C Power Supplies (S. Coffin)

The open-loop frequency-response tests have been made on the +150-volt, 50-amp regulated d-c supply. This data will be used in synthesizing the compensating circuit for optimum transient response and stability.

7.0 CHECKING METHODS

7.4 Marginal Checking, Mod II (J. H. Hughes)

The Programmed Marginal Checking Facility has been installed. The order si 3 selects the PMC start facility and an rc starts the PMC cycle. The order si 2 selects the PMC interrogate facility, and a following rd puts a 1 in ACO if a cycle is in progress.

I am now writing up the new Marginal Checking System in a report to replace Bob Hunt's E-393 on the old system.

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.

One new problem (#134) was initiated during the period. This problem was submitted by A. Meckler of the MIT Solid State and Molecular Theory Group and will be solved with the cooperation of D. Arden of the S&EC Group. The solution involves the programming of a numerical diagonalization procedure for obtaining eigenvalues and eigenvectors of large order symmetric matrices. A complete report will be given in the next biweekly.

Three problems (#107, 124, 125) are nearly completed. In particular, #107 provides general routines for the calculation of autocorrelation functions and Fourier transforms. These routines have already been utilized by other programmers. Problem #125 will provide routines for analytical differentiation.

Extensive tests are being made to determine the optimum settings for the Fairchild camera connected with the 16" scope. As a consequence of these tests, the attractiveness of the scope-camera combination for output and post-mortem purposes should be increased.

100. Comprehensive System of Service Routines: Briscoe, 41 hours; Demurjian, 32 hours; Denman, 33 hours; Frankovich, 24 hours; Hazel, 26 hours; Helwig, 50 hours; Kopley, 30 hours; Porter, 20.5 hours; Vanderburgh, 7 hours; WWI, 538 minutes

The necessary modifications to the Comprehensive System (CS) for adapting it to use two banks of storage have been made and the new program will be used when the second bank is available for routine use. This version of the CS will also be modified to store 556 tape on magnetic tape unit 3 and to use the drum input program. The resulting program will be considered as the final magnetic-tape CS. Future work on input conversion will then be directed entirely toward the development of a comprehensive system using the magnetic drum.

Helwig and Frankovich

The 556 basic conversion program has been modified to use the vocabulary of the CS. The resulting program will also be modified to provide for direct basic conversion and to use the drum-input program.

Briscoe

Modifications have been made in the two-way post-mortem for converting octal storage addresses correctly and for tabbing correctly. The tab settings on the direct printer and delayed printer have to remain fixed so that the program can set up generalized decimal numbers and interpreted instructions properly. These tabs are now set at 10 spaces apart.

Hazel

During the past biweekly period tests have been made of the automatic selection of output routines as part of the Comprehensive System. These tests have been successful. Programmers may now indicate their choice of output in their programs in the form described in E-516. The adaptation section of the

8.1 Programs and Computer Operation (continued)

automatic output selection will handle all of the suggested forms of outputs. However, at the moment, not all of the output routines have been written for inclusion in the CS. Up-to-date lists will be issued from time to time to indicate which output requests can be handled. For explanations of the abbreviations used the reader is referred to section IV of E-516.

The following output requests together with appropriate parameters will be handled automatically by the CS to give the desired form of output.

TOA, i TOA, FOR, DOB, i DOB, DIB, i DIB, COL, FRA

Demurjian and Porter

Three Scope Post-Mortems have been written and tested. The film has not yet been developed. The programs are Octal Instructions I, Octal Instructions II, and Decimal Instructions. An Interpretive Decimal Instruction Scope Post-Mortem has been written and is ready for testing. All scope routines will have to be rewritten to conform with the new system for intensifying spots.

Kopley

An investigation of the use of the magnetic-tape units by the S&EC group and associated programmers is being made to determine if the efficiency in using them can be increased. With the cooperation of the engineers in charge of these units, several changes have already been made, including a new push-button control, with rewind facility using limit switches (so that the tape unit stops automatically at the limit switches), the placement of the CS program on unit 0, (isolated from the rest of the tape by a pair of limit switches so that it remains permanently recorded on this unit having the rest of the reel of tape available for use by programmers), etc. Several other ideas are being discussed, and it is expected that a memo will be issued shortly covering some of the general points to be considered when using these units, some of the recent and proposed changes, and some instructions for programmers using these units.

Denman

104. Hydro Thermal Power System; Calculus of Variations: Cypser, 6 hours; WWI, 87 minutes

An examination of past data has revealed the critical nature of the size of the step in the gradient method. Indications are that the gradient introduced for the operating limitations is too low, while the size of the step initially taken was too large.

In the future, the size of the step will be reduced and higher penalty functions will be used. Also the effect of reduced plant capacity on the system operation will be investigated.

Cypser

106. MIT Seismic Project: Briscoe, .5 hours; Simpson, 25 hours; Walsh, 20 hours; WWI, 189 minutes

We obtained auto- and cross-correlations for three seismic traces up to 100 lags, and the "travelling" autocorrelation, or correlations over highly overlapping short intervals, up to 20 lags, for one seismic trace. Ross's spectrum program was used to obtain the spectrum of an entire seismic trace. Our General

8.1 Programs and Computer Operation (continued)

Prediction program has been used to obtain variance curves for seismogram traces as well as error curves for cosine operators of eleven frequencies.

We are writing a program which uses the General Prediction program to find optimum operators for seismic traces by a method of successive approximations. It will solve up to 40 operators of a very general nature in one run. By this means we hope to avoid having to set up and solve the simultaneous equations which result from a least squares fitting, a problem which presents an especially difficult programming task because of the near-singularity of our resulting matrices. In addition, this will permit a minute study of the stability of the operator, a problem of both practical and fundamental mathematical interest.

All of the new programs are being based on one data scheme with considerable use being made of magnetic drums to avoid taping duplication and read-in duplication.

Robinson

107. (a) Autocorrelation and (b) Fourier Transform, Evaluate Integrals: Frankovich, .25 hours; Ross, 20 hours; Hamilton, 30 hours; WWI, 29 minutes

All scheduled runs have now been completed. For short lengths of data and autocorrelation functions the power spectrum calculated has many negative values, as is indicated by theory. However, with proper interpretation valuable information as to frequency content can be obtained, although the relative amplitude associated with the various frequencies are more difficult to interpret. For longer runs the results are very satisfactory in both respects. Two additional sets of data will be processed during the next biweekly period.

Ross

109. Fighter Gunsight Calibration, 8th Order D.E.: Hellman, 60 hours; Zierler, 5 hours; WWI, 23 minutes

The program with the time as the independent variable has operated successfully using the delayed printer.

The program with the initial range as the independent variable has not operated successfully. A number of coding errors have been corrected and a performance request submitted to run the corrected program.

A program is being planned to approximate the ballistic tables by the method of least squares.

Hellman

113. Shear Wall Analogy, Simultaneous Linear Equations: Kopley, 1.5 hours; Sydney, 40 hours; WWI, 51 minutes

The testing of the program is almost complete.

In a symmetrical lattice framework, the program converges to a more satisfactory solution when symmetrical adjustments are made in the force system. We hope this is also true for the unsymmetrical lattice framework.

Sydney

8.1 Programs and Computer Operation (continued)

114. Design of Optical Instruments: Combelic, 8 hours; Mahoney, 48 hours; WWI, 26 minutes

Two of the three runs failed because of programming errors; the other failed because of incorrect conversion.

Another program is being developed concurrently with the generalized ray-tracing routine. This program computes third-order aberration terms for each surface in the optical system, and for the entire system.

Combelic

116. Torpedo Impulse Response; Convolution: Hamilton, 40 hours; WWI, 79 minutes

Five out of sixteen runs gave useful results. We now have almost completed a Fourier transform for input and output data for one run.

Of the eleven runs which were not successful, three were due to program errors (wrong scale factors, errors in the transform program, wrong frequency range), two were due to erroneous titles in the data tape, two were due to parity alarms, and the other four were probably due to a mistake in the data tape.

In the future we shall process data from Fourier transforms. If the results are good we will be able to make a good estimate of impulse responses for further convolutions.

Kramer

118. Quantized Group Communication and Learning; Non-Markovian Stochastic Process: Denman, .5 hours; K. Ralston, 10 hours; WWI, 6 minutes

A further check on the random number program indicates that discrepancies between the model programmed for Whirlwind I and observed data are not due to local variations of the random numbers.

In the future the model will be used to simulate another network, after which it should be possible to determine whether the model is adequate.

K. Ralston

119. Spherical Wave Propagation: A. Ralston, 20 hours; WWI, 187 minutes

The comprehensive program is now working. There has not been time yet to analyze the results but at first glance they look good. A lot of machine time was lost during the post-mortems due to parity and check alarms.

In the future one long run of the comprehensive program is planned in order to get enough data to analyze the results completely.

A. Ralston

8.1 Programs and Computer Operation (continued)

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, 102 minutes

A (24,6) program, occupying over 1800 registers in ES, for a step-by-step solution of the differential equations describing the process of water injection into hot, high velocity gas streams has been written and performed. Three failures in the performance occurred (see below) and were immediately corrected by 556 modifications. The fourth attempt was successful, and the information obtained is now being compared with hand calculations. The time required to execute the program (one increment) was found to be ten seconds.

The three failures were due to the following: (1) use of addresses greater than 1022(decimal), thus conflicting with the buffer detection in the PA routine; (2) requiring too much precision in determining roots by use of Newton's method; (This resulted in a closed loop condition. The difficulty was removed by comparing differences in successive values to 2^{-23}.) (3) error in program; only one address needed to be changed to rectify this error.

In the future, we plan to: (1) check data from the run against hand calculations; first appraisal of data indicates one error yet undetermined; (2) modify the root subroutine to incorporate means for obtaining a better first approximation (it is believed that the iterations in determining the various roots needed in the program occupy a substantial fraction of the total computation time); (3) test portion of program (yet untested) for calculation of change in state across a normal shock; (4) set up parameters for production runs as soon as possible.

Gavril

124. Deuteron Binding Energy and Wave Functions: Combelic, 50 hours; WWI, 619 minutes

The eigenvalues and auxiliary data have been calculated for about half the parameters. Analysis has shown that the intervals between some values of the primary parameter can be increased; for other values the intervals must be decreased.

Two programming errors showed up for some new parameter values which necessitated one rather major revision in the program. The remainder of the biweekly period has been devoted to several production runs, some of which suffered considerably from parity alarms.

It appears desirable from the standpoint of the physics of the problem to calculate eigenvalues and the other data for as many sets of parameters as feasible before terminating the problem on May 26. Toward this end, the original interval of the secondary parameter has been doubled; the desired intermediate data will then be determined by sub-tabulation methods using differences.

Combelic

125. Analytical Differentiation: Nolan, 20 hours; WWI, 147 minutes

The program was tested with a wide variety of functions including inverse trigonometric forms.

8.1 Programs and Computer Operation (continued)

A number of programming errors were found and corrected and the functions retested. On the last run errors were found in the program sections which handle the function $(1-x^2)^{-p/2}$ and $\tan^{-1}x$. Otherwise the program performed correctly.

In the future, the errors above will be corrected.

Nolan

126. Data Reduction: Frankovich, .25 hours; Ross, 20 hours; Hamilton,10 hours; WWI, 25 minutes

The program for calculation of moments is not yet operative. Due to post-mortem difficulties the cause has not yet been found. One run was beset by programming, clerical, conversion and post-mortem troubles.

Ross

127. Finite Bending of Circular Ring Plate due to Edge Moments; two coupled second order non-linear differential equations: Hicks, 8 hours; WWI, 0 minutes

The complete interpolation program worked on its first run, printing out 90 desired values to be used as initial values in a power series development.

The final part of the problem will now be programmed. This consists of finding the power series expansions of functions representing solutions of the differential equations of the problem, and evaluating several expressions depending on these functions.

Hicks

128. MIT Subject 6.537 Digital Computer Applications Practice- Spring 1953: Arden, 2 hours; Vanderburgh, 12 hours; WWI, 205 minutes

Seven of the eight students registered in 6.537 used WWI to work on term problems. More details of the individual term problems will be given in later reports.

Adams

132. Revision, Extension and Testing of Subroutine Library Used in Programs for obtaining Data for the Numerically Controlled Milling Machine; routine numerical and logical operations: Runyon, 15 hours; WWI, 15 minutes

No significant results were obtained although some of the results may be useful in correcting errors in the program.

Trouble with the conversion program was encountered with tape 2527m4, which when it finally did run did not give correct numerical results.

An attempt will be made to operate tape 2527 successfully and the testing of tape 2538 will be resumed. The writing of additional routines will be continued.

Runyon

8.1 Programs and Computer Operation (continued)

133. Non-linear Meson Equation: Arden, 11 hours; Finkelstein, 10 hours; WWI, 19 minutes

It has been discovered that the methods being employed in connection with the simplest meson theory (neutral scalar) are equally applicable to all others, in particular to the theory of most interest (symmetric pseudoscalar). With such applications in view, the original program has been rewritten in the form of a collection of subroutines, only one of which will need to be changed. The resulting program is being tested part by part at present. It will also be applicable to a non-linear equation currently of interest in physical chemistry:

$$y'' + (2/x)\, y' - \sinh(y) = 0$$

Finkelstein

Computer Time

Programs	39 hours, 07 minutes
Conversions	13 hours, 39 minutes
Scope Calibration	1 hour , 09 minutes
Magnetic Tape Test	17 minutes
Total Time Used	54 hours, 12 minutes
Total Time Assigned	67 hours, 12 minutes
Usable Time, Percentage	80.6%
Number of Programs Operated	181

9.0 FACILITIES AND CENTRAL SERVICES

9.1 Publications
(Diana Belanger)

The following material has been received in the Library, W2-325, and is available to laboratory personnel.

LABORATORY FILES

No.	Title	No. of Pages	Date	Author
E-534	Transistor Grounded-Collector Coupling Circuit	15	3-23-53	(W. A. Klein (S. Oken
E-537	1953 Test Storage Input Program	4	4-7-53	J. Frankovich
E-539	An Approach to a Rationale in Ferrite Synthesis: Evaluation of Magnetic Moments	14	4-28-53	L. Gold
E-540	A Fast Core-Tube Register	1	4-27-53	(K. Olsen (R. Pfaff
M-1886	Specification of An Ideal Detector as a First Step in Filter Design	20	3-6-53	W. Wells
M-1986	"L" Cathodes in Electron Guns	7	4-21-53	T. Greenwood
M-1989	MF-1326-B, F-291, Life Test No. 2	8	4-23-53	J. Freeman
M-1996	Comments on IBM Military Reference Data Book	3	4-23-53	C. Watt
M-1997	Biweekly Report, April 24, 1953	44		
M-2112	Laboratory Personnel	15	5-1-53	
M-2120	Summary of Magnetic-Core Memory Meeting Held 4-24-53	2	4-29-53	(N. Edwards (W. Papian
M-2122	Tape Conversion Program T2545m2	2	4-29-53	W. Lone
M-2126	The Effect On Present Programs of In-Out System	2	5-1-53	B. Morriss
M-2128	Missing Test Equipment	5	5-4-53	(T. Chleboski (L. Sutro
M-2135	Some Notes on Current Tube Types	3	5-4-53	H. B. Frost
M-2137	April 1953 Storage and Research Tube Summary	4	5-5-53	D. Fisher

LIBRARY FILES

No.	Identifying Information	Source
2343	Electronic Structure of Atoms and Molecules	SSMT Gp., MIT
2344	Description of the MIT General Purpose Control Panels for Model II Card-Programed Calculator	Office of Statistical Service
2347	The Numerical Solution of Non-Linear Differential Equations by the Method of Steepest Descent	Ballistic Rsch. Labs.
2349	Large Prime Numbers	Repr. NATURE, 11/51
2350	Large Primes	Repr. EUREKA, 10/51
2351	The Adventures of a Blunder	Repr. MTAC, 4/52
2352	Table-Making for Large Arguments: Exponential Int.	Repr. MTAC, 7/51
2353	The Solution of Algebraic Equations on the EDSAC	Repr. PCPS, 1952
2354	The Use of a "Floating Address" System for Orders in an Automatic Digital Computer	Repr. PCPS, 1953
2356	Review of Input and Output Equipment Used in Computing Systems	Joint AIEE-IRE-ACM
2357	A New Look (at Russian Capabilities)	Fairchild Corp.

9.2 Standards, Purchasing, and Stock

Purchasing and Stock (H.B. Morley)

Dumont continues to meet their promised deliveries for metallized K1084 tubes. Nine K1084P7 and four K1084P19 were received during the past two weeks.

A new pick-up truck has been received and will go into service shortly.

New accounting procedures and simplified methods for internal administration are being studied and adopted where they increase efficiency.

Much inconvenience is caused by laboratory personnel who borrow catalogs and neglect to sign them out or return them. It is requested that, whenever possible, persons using catalogs review them in the Purchasing Office.

Under no circumstances should any material pertaining to orders or correspondence be removed at any time.

Critical items, requiring orders far in advance of need, continue as reported in the past two biweeklies.

Standards (C.W. Watt)

Development of component standards for joint IBM-MIT use is proceeding. Meetings of two-day duration every two weeks are being held alternately in Poughkeepsie and Cambridge, and the results are being published as application memos for the guidance of the circuit designers. These memos will eventually be expanded to include purchasing and test information. Memos already issued are the following:

Component Application Memo #1, Resistors, fixed composition carbon

Component Application Memo #2, Resistors, fixed deposited carbon, precision (nominally $\pm$ 1%)

Component Application Memo #3, Capacitors, less than 0.5 Mfd. (This is being expanded.)

Component Application Memo #4, Resistors, wire-wound, power.

These will be revised as time goes by. Copies may be obtained from Watt, Hodgdon, or Paine.

Components Conference (C.W. Watt)

Taylor and Watt attended the 1953 Symposium on Components in Pasadena, California, on April 29, 30, and May 1. A summary of the papers presented will be found in M-2139. Visits were paid to: the Consolidated Engineering Corp of Pasadena which is building a commercial digital computer; Hughes Aircraft, where diode production and standards were discussed, (see M-2146); Caltech; and North American Aviation.

9.3 Construction

Production Control (F.F. Manning)

There have been 18 Construction Requisitions totaling 670 items satisfied by Group 60 electronic shops since April 24, 1953.

There are 33 Construction Requisitions totaling 852 items under construction by Group 60 electronic shops.

For further information, please call the Production Control Office (Ext. 3492)

Outside Vendor (R. Bradley)

There are 36 open orders outstanding with vendors, totaling 17,424 items. Deliveries in the past biweekly period have totaled 940 items. Information on specific orders may be secured from the writer (Ext. 3476).

9.4 Drafting (A.M. Falcione)

1. Drawings for the Cape Cod System

The majority of drawings for the Cape Cod System have been completed except for a few panels which have yet to be designed by the engineering personnel. Many of the drawings used on the Cape Cod System were sketches which will now be redrawn to DCL Standards. This is also true of many of the MTC drawings.

2. Ozalid Reproduction Machine

During the past few months, I have received several complaints and criticisms regarding the delays encountered in the reproduction of prints in the Print Room. This applied not only to production-release drawings for our own shop, but also for prints going to outside vendors for fabrication. I realize that it is very important that drawings of this nature be changed, approved, and released from the Print Room with the minimum amount of delay, so that the respective parties will have the latest prints and information available, in order to fabricate parts properly and without delay. I have noticed in the past several weeks that engineers, technicians, etc, who desire check prints of some tracing will go to the Ozalid machine and run the print off themselves, even though there are operators present on the machines. These continual interruptions cause a bottleneck in our Print Room reproduction work; in order to relieve the situation, we are making the following changes in the Print Room procedure.

1. No one other than the authorized Ozalid operator will be allowed to operate the Ozalid machine (except in cases where the operators might be out sick or unable to operate the machine).

2. The Rocket machine which is the larger of the two print machines will be reserved for production-release drawings only. This means that this machine should run nine hours each day without interruptions and will enable us to release prints from the Print Room within a twenty-four hour period after receipt of drawings.

9.4 Drafting (Continued)

3. All requests for check prints or quick prints should be made to the operator on the small Streamliner machine.

3. Thesis Drawings

Four engineers are writing theses this semester for a total of approximately seventy drawings. It is expected that the drawings will be completed in time to meet the deadline of May 22.

10.0 GENERAL

Staff Terminations (J.C. Proctor)

T. Spencer Greenwood
D.J. McCann
N.S. Potter

New Non-Staff Personnel (R.A. Osborne)

Geraldine Brown is a new clerk in the Print Room.

John Dyer has joined Group 63 as a Laboratory assistant.

David Goldman is an MIT student working in Group 62.

Francis Gomes is a new laboratory assistant in the Tube Testing Lab.

Frank Leak is a bew laboratory assistant in the Construction Shop.

Terminated Non-Staff (R.A. Osborne)

Elaine Berry
Francis Dorron
Gordon Edlin
Blanche Fahey
Marcel Filteau
Mary Fisher
Robert Johnson
Henry Moynihan
Virginia Nicholson
Robert Pearlman