Memorandum DCL-6

Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

SUBJECT: PROGRESS REPORT, JULY 12 THROUGH AUGUST 8, 1954

To: Jay W. Forrester

From: Scientific and Engineering Computation Group

1. MATHEMATICS, CODING AND APPLICATIONS

1.1 Introduction

During the four week period covered by this report, 790 coded programs were run on the time allocated to the Scientific and Engineering computation (S&EC) Group representing work that has been carried on in 39 problems.

Section 1.2 contains progress reports as submitted by the programmers together with an indication of the machine time (and, in some cases, of the programming time) expended on each problem.

Three problems were completed during this period: #149 (digital methods of detecting signal from noise), #185 (scale of turbulence), #194 (augmented plane wave method).

Detailed initial descriptions are provided below for problems 193 (eigenvalue problem for propagation of e.m. waves), 199 (the laminar boundary layer of a steady, compressible flow in the entrance region of a tube), 200 (a study of recurrent events), 201 (a study of the ammonia molecule), 205 (electron-lattice interaction in solids), and 206 (calculation of the electronic energies of H_2^-).

No reports have been included on the two simulated computers SAC (a single address computer) and TAC (a three plus one address computer) being developed under problems 196 and 197 for use in the summer course 6.531. However, complete reports will be made available when the development work has been completed.

A set of modifications to the Comprehensive System (CS II) comprising four corrections and three additions are described under problem 100. Routines to be used for automatic curve plotting on the oscilloscope are also described under that problem.

The MIT Summer Session Course 6.532 on Advanced Coding Techniques was offered during the week of August 2-6. About 45 persons attended the course and participated in the many discussions. Preparations are being completed for course 6.531 on business applications of digital computers to be offered from August 16 through August 27.

A summary of the various groups that visited the laboratory during this period is given under problem 131.

1.2 Programs and Computer Operation

100. The Comprehensive System of Service Routines: Combelic, 16 hours; Demurjian, 27 hours; Frankovich, 6 hours; Helwig, 10 hours; Mahoney, 11.5 hours; Porter, 1.5 hours; Siegel, 50 hours; Watson, 50 hours; WWI, 1223 minutes

A series of modifications to the Comprehensive System were completed at the beginning of this biweekly period. Some corrected existing difficulties in the system. These were: 1) the occasional apparent ambiguity of the special words "OCTAL" and "NOT PA", 2) the overflow alarm sometimes produced during conversion of generalized decimal numbers, 3) the incomplete printout of unassigned flads in the CS conversion PM, and 4) the misinterpretation of some titles which contained the digit "8". The system was improved by adding facilities: 1) to detect and print an indication of requests for "t" when its value is unspecified, 2) to stop PETR soon enough to avoid missing the following character on Flexotape, and 3) to allow programmers to address the auxiliary drum on both direct and indirect read-ins of Flexo tapes and the buffer drum on indirect read-ins.

A description of this last facility will shortly be available in the form of an appendix for M-2833, "Programming Procedures for CS II." One additional modification contemplated for CS II will allow the use of director "control tapes" during read-ins of Flexo tapes (see M-2900)

J. M. Frankovich

Ten routines (5 interpretive and 5 non-interpretive) have been written for use in automatic curve plotting on the scope. Two different formats are available; one for use when the variables involved are symmetric about the origin and another for use when the variables are asymmetric about the origin. Along with the formats, routines for displaying calibrated or uncalibrated axes and point-by-point curve plotting were written. These routines have been put in form for recording on the magnetic tape as part of the CS II Output and will soon be tested in this form.

N. Saber

106 C. MIT Seismic Project: Grine, 10 hours; Simpson, 10 hours; WWI, 28 minutes

Only a relatively small amount of machine time was used during the last four week period. The group has concentrated on graphing and evaluating previous computations for inclusion in reports and theses. The experiments they represent have been described in previous biweeklies. The 28 minutes used partially represents tests of a new correlation program and partially several Fourier Transform computations involved in the determination of frequency coherency.

120 D. The Aerothermopressor: Porter, .5 hours; Gavril; WWI, 304 minutes

Several types of numerical methods for solving first order differential equations have been adapted to the simultaneous differential equations of the

Aerothermopressor process. During the past month, a comparative study of these various techniques has been nearly completed, and a summary of the results will be presented below.

The original purpose of the study was to evaluate the comparative merits of the Runge-Kutta Method on the one hand, and a forward and successive integration scheme on the other. Since the latter requires special starting procedures, the investigation logically began with a study of the behavior in the vicinity of the initial point where, fortunately, conditions are very stringent. A satisfactory agreement between the numerical solution and the exact solution in this region conservatively indicates the applicability of the method for continuing the solution.

Two starting procedures were compared. (1) A four-point interpolation scheme in which $y_1, y_2, \ldots y_n$ are simultaneously adjusted by difference equations involving differences of order n. (2) The Runge-Kutta Method. It should be noted that the latter method can be used for continuing the solution as well.

Denoting the time required to compute all the derivatives of the Aerothermopressor properties by the symbol τ and remembering that the time required for manipulation in any programmed numerical procedure is small compared with τ the following information is of interest:

METHOD	INCREMENT SIZE, Δx	VALUE OF τ FOR INTERVAL $0-3\Delta x$	INCREMENT SIZE REQUIRED BY EULER METHOD FOR SAME ACCURACY	% ERROR
Euler	.01	3	.01	1.117
Euler	.001	30	.001	.0729
Four-Point Interpolation Formulas	.01	43	.0013	.0943
Runge-Kutta (Fourth-Order)	.01	12	.00025	.0107

The very apparent superiority of the Runge-Kutta Method in this range indicated that it would likely be more rapid for the same accuracy than a forward and successive running scheme depending upon iteration, particularly since the increment size in the Runge-Kutta Method can be readily varied, while with the latter it cannot. For a given increment size, the value of τ is 4 for the Runge-Kutta Method, while with the difference method, τ would be at least 3 with no upper limit since the iteration would continue until the accuracy criterion is satisfied.

The writing of a program for the difference method has accordingly been postponed while a study of the Runge-Kutta Method applied to the entire range is carried out. The purpose of this study is to determine the largest increment size, or combination of sizes, that can be used while maintaining sufficient accuracy. If the increment size can be increased on the average by a factor of 4 over what has been used with the Euler method, this more elaborate procedure will not require any additional time for computation.

It is planned to continue computations of Aerothermopressor performance to a limited extent, using this composite program, while a completely new program is being written. The core of the present program was written in April, 1953 and, in addition to containing obsolete programmed arithmetic subroutines, suffers from the inefficiency brought about by the manifold functions it performs which were never contemplated in the original version.

131. Special Problems (Staff Training, Demonstrations, etc.): WWI, 142 minutes

A total of 142 people attended the four tours of Whirlwind that were conducted during the past period. On July 15, twenty-six students in the summer course on Communication Theory were given a computer demonstration. Forty-four members of the Transistors and Their Applications course were present for a Flexowriter tape preparation demonstration and computer tour on July 28. Forty-six experienced computer programmers who were enrolled in the special summer course on Digital Computers: Automatic Coding Techniques were given a demonstration of Whirlwind with an emphasis on Automatic Coding as used by the Applications Group. The last tour of the period was for twenty-six secondary school teachers who were members of the Summer Program for Science Teachers. This consisted of a showing of the movie, "Making Electrons Count" and a computer demonstration on August 4.

132 C. Revision, Extension and Testing of the Subroutine Library Used in Programs for Obtaining Data for the Numerically Controlled Milling Machine: Runyon, 20 hours; WWI, 26 minutes

Two long milling machine tapes were checked on the computer. One was found to be correct except for an error in the code of one Flexowriter character. The other had errors which caused the overall totals to be incorrect. To aid in determining where the errors occurred, the checking program is being modified so that totals of milling machine orders can be printed at various intervals.

140. Summer Session System: Watson, 3 hours; WWI, 7 minutes

In the process of annotating the summer session divide routines, a breakdown of the instruction dhr for a zero dividend and two register divisor was suspected and verified.

141. S&EC Subroutine Study: Arden, 14 hours; Mahoney, 40.5 hours; WWI, 101 minutes

Routines for computing natural logarithms and inverse tangents by means of continued fractions have been successfully run. The accuracy of the results obtained will be compared with that obtained from RAND Polynomials.

149 C. Digital Methods of Detecting Signal from Noise: Dineen

During this period, a modification was tried to investigate the detection of relatively long signal trains in noise. The results show that the method of digital detection of signals which worked successfully for relatively short signals is unsatisfactory. The main deficiency is in the measurement of the width of the signal train. These trials essentially complete the investigation. Any further studies will be carried out as part of a new problem.

The program for the near future may involve either a trial and error or a relaxation approach to the problem making use of the first three tapes.

167 D. Transient Effects in Distillation: Jordan, 160 hours; O'Donnell, 160 hours; Porter, 1 hour; Smith, 10 hours; WWI, 274 minutes.

During the preceding period work has continued on two phases of the above problem. A considerable number of valuable results have been obtained for the case of batch distillation take-off with holdup. Various combinations of parameters have been tried and the effect of varying amounts of holdup has been determined. This will be continued.

For comparative purposes, a program has been written which determines the results of batch distillation assuming no holdup is present. Trouble-shooting is being done on it and should be completed shortly.

The basic relationship is given by

$$(1 - \theta) = (1 - \theta_o) \exp \left\{ \int_{x_{w,o}}^{x_w} \frac{dx_w}{x_d - x_w} \right\}$$

where θ is the fraction of the charge distilled, x_d is the distillate composition, and x_w is the still pot composition. From a combination of material balance and equilibrium relationships x_w can be expressed explicitly in terms of x_d. However the only way x_d can be obtained from x_w is by iteration. Consequently the initial value of x_d corresponding to $x_{w,o}$ is calculated by iteration. Thereafter x_d is chosen and x_w calculated. The resulting increments in x_w are unevenly spaced. At present it is hoped that a satisfactory procedure will be the use of the trapezoidal rule for the integration, assuming that machine time and accuracy may be balanced reasonably in this way. This should be determined in the near future.

About two-thirds of the machine time used during the preceding period has been spent on the above described problems. The remainder has been spent on problems of transient effects in continuous distillation. Jordan has been working on this problem and has spent most of his effort studying and correlating the data of Smith and Polk. A correlation has been obtained for the case of a step increase in feed composition to a column. At present Jordan and Smith are taking some more data using different parameter combinations in an attempt to widen the coverage and test the present correlation.

169. Utilizing a General Purpose Digital Computer in Switching-Circuit Design: E. Hoy; WWI, 20 minutes

The first draft of the S.M. thesis discussing this problem should be completed within the next couple of days.

172 B. Overlap Integrals of Molecular and Crystal Physics: Corbato, 40 hours; WWI, 184 minutes

The basic overlap integral subroutine was used for 70 minutes production work for Dr. Dalgarno during the last period. In addition, the subroutine which calculated the primary functions for the 2-center integrals was generalized and revised; this routine will be used by Dr. Dalgarno as a key part of Problem 206. In the process of making the revision an additional subroutine was written for "spherical Bessel functions of imaginary argument (of the first kind)." The latter routine will be of use to P. Merryman (Problem 204) in his work on 2-center exchange integrals. Finally, considerable improvements were made in the exponential subroutine and this routine has been submitted to J. Mahoney for inclusion in the subroutine library.

175 C. Impurity Levels in Crystals: G. Koster; WWI, 938 minutes

The computation of the inverses of the matrices necessary for the study of impurity levels in chromium has proceeded on a production basis for the last two week period. This period has brought to a conclusion this process of inversion. The results are now being compiled so as to give the actual energy levels of the impurities in chromium.

177 D. Low Aspect Ratio Flutter: Voss; WWI, 11 minutes

During the past four week period, one problem was run and completed. This was the determination of the pressure distribution on a flat plate of aspect ratio unity at steady angle of attack in a flow at Mach number 0.866. The solution required only minor modification of a previous program.

183 D. Blast Response of Aircraft: Sternlight, 120 hours; WWI, 242 minutes

The Newton-Raphson solution for the blast function converges after five passes, so a check was incorporated to reject a parameter if more than forty passes were required to obtain convergence. This was completely successful in eliminating the troublesome oscillating parameters. It later turned out that these parameters gave trouble only for specific values of the time increment in the differential equation solutions, and that by reducing the time increment further, even these untractable sets of parameters could be forced through.

Solutions have been found for approximately one hundred twenty parameters with bilinear moment-curvature curves. This completes the first phase of the problem. Work is now in progress on three other types of moment-curvature curves. Each of these will require about one hundred twenty runs. Results of the first phase have all been plotted, and the output data is smooth and physically reasonable.

184 D. Scattering Electrons from Hydrogen...Integral Equation: Newstein, 40 hours; WWI, 91 minutes

During the last month programs have been written and tested for a variety of integrands of two dimensional integrals. Each of these integrands is typical of a class whose members are generated by varying two parameters (angle and energy). Trial runs have been made for certain values of parameters, and these were performed in reasonable times to satisfactory accuracy.

185 B. A Scale of Turbulence: WWI, 97 minutes

Production runs have been satisfactorily completed on all seven sets of data. The results are now being analyzed and will be described in an MS thesis to be written jointly by J. Howcroft and J. Smith for the MIT Meteorology Department.

186 C. Tracking Response Characteristics of the Human Operator: J. Elkind; WWI, 52 minutes

A quasi-linear transfer function, H(w), has been computed from power density and cross-power density functions of stimulus and response that were calculated by WWI. This transfer function is the first of a series of transfer functions that will be computed to obtain a measure of the variability of the human operator response characteristics. Power density and cross-power density functions of five additional tests with one subject have already been calculated by WWI. Transfer functions have not yet been computed from these spectra.

Until we are able to complete the calculations on those spectra and on other spectra yet to be determined by WWI it will not be possible to reach any conclusions about the variability of the human operator characteristics. To complete the results for the tests on one subject it will be necessary to determine about thirty more spectra. The data for these will probably be ready for WWI in about a week. If it is justified, the spectra for tests on two other subjects will be calculated by Whirlwind I.

192 D. Frequency and Phase Spectrum Analysis of Seismograms: Walsh, 25 hours; WWI, 79 minutes

Traveling frequency and phase spectra of surface waves from an earthquake in Vancouver Is. were computed. The group velocity curves derived from these calculations proved considerable lateral inhomogeneity in the crystal layers of North America. These curves also suggested at the same time the possibility of a three layered configuration where the velocity of shear waves increases with depth.

At the present no further computation is intended in this problem.

193 C. Eigenvalue problem for Propagation of E. M. Waves: Porter, 2 hours; Dwight; WWI, 72 minutes

This problem seeks to find the roots (values of w) for which:

$$\frac{h_1(w - sg)}{h_2(w - sg)} = 24\, e^{-i\pi/3}\ w^{3/2} \quad \text{expon}\left[i\,\frac{4}{3}\ w^{3/2} \right]$$

These roots are to be computed one at a time, each calculation depending upon the values of the roots already computed. For each of these values of w, the following expression is then evaluated:

$$12^{-1/3}\pi\, e^{i4\pi/3}\left[\frac{1-s^3}{32s^2w^2}\right]\left[-i\,\frac{4}{3}\,w^{3/2}\right] h_1(w - sg + sZ_1)h_1(w - sg + sZ_2)$$

$$\times\left\{1 - \frac{h_2(w - sg + sZ_1)}{h_1(w - sg + sZ_1)} \cdot \frac{h_1(w - sg)}{h_2(w - sg)}\right\}$$

$$\times\left\{\frac{h_2(w - sg + sZ_2)}{h_1(w - sg + sZ_2)} \cdot \frac{h_1(w - sg)}{h_2(w - sg)}\right\}$$

where

$$h_1(z) = g + \frac{i}{\sqrt{3}}(g - 2f), \quad h_2(z) = g - \frac{i}{\sqrt{3}}(g - 2f)$$

$$f(z) = a_o + a_1 z^3 + a_2 z^6 + \ldots$$

$$g(z) = b_o + b_1 z^3 + b_2 z^6 + \ldots$$

The coefficients a_o, a_1, b_0, ... are given in Table I of Vol II published by the Computation Laboratory of Harvard University. sg, sZ_1, sZ_2 and s are known, real constants. The values of z lie between approximately -6 and 6.

194 B. An Augmented Plane Wave Method as Applied to Sodium: Howarth; Saffren; WWI, 912 minutes

The problem has been terminated. The augmented plane wave method has proved successful. Assistance was given to Mr. Saffren in his application of the program to sodium.

D. Howarth

The first part of Howarth's program for the augmented plane wave method has been applied (with Howarth's help) with success to sodium. The second part, however, is still in the process of being applied. Because this part contains the major portion of the program, and is the more complex part, the spotting of errors is more difficult.

Coding has begun on the additions to the augmented plane wave method which will make it the symmetrized augmented plane wave method. These routines are as yet untested.

M. Saffren

199 C. The Laminar Boundary Layer of a Steady, Compressible Flow in the Entrance Region of a Tube: Porter, 2 hours; T. Toong; WWI, 36 minutes

Partial differential equations of continuity, momentum, and energy were developed for the laminar boundary layer of a steady, compressible flow in the entrance region of a tube. These were transformed into ordinary differential equations, to be solved by WWI for several entrance Mach numbers and thermal conditions at the tube wall.

This paragraph will make use of the algebraic coding system developed by Laning and Zierler under problem 108 and described in Instrumentation Laboratory Memo E-364. The basic numerical procedure employed by the algebraic system for intergrating a set of diferential equations is the Gill method.

Three sets of equations were coded for the algebraic system and successful results were obtained for each set on the first run.

200 C. A Study of Recurrent Events: B. Jensen; WWI, 64 minutes

This problem is a modification of the usual recurrence time problems in which one searches for the occurrence of a single event E. Our problem consists of searching for the occurrence of events E_j for k in the interval I_j of length l_j for j = 1, 2, ... n. If E_j occurs for k in I_j, the k counter is reset and the search restarted. If E_j does not occur, then we search for E_{j+1}. If no event E_j occurs in the interval $I = I_1 + I_2 + \ldots I_n$, the k counter reaches $L = l_1 + l_2 + \ldots l_n$. When k attains or exceeds L, we say the Bernouilli sequence is of type S. If k does not exceed L we say the Bernouilli sequence is of type N. The Bernouilli sequence is determined by the probability p of a one. Given a detector which operates under the rules described above, we want to plot the probability that this detector will call a Bernouilli sequence type S as a function of p.

The probability equations describing this process have been written and will be solved by an iterative method for various settings of the parameter k.

The probability that the detector will call a Bernouilli sequence type S as a function of p was obtained for p = .1, .2, .3, .4, .5, .6, .7, .8, and .9 in the non-steady state region and p = .10 in the steady state region. To eliminate or minimize the cases of double detection, different reset conditions will be tried.

201. Study of the Ammonia Molecule: A. Meckler; WWI, 150 minutes

Dr. Kaplan and Dr. McWeeny of the Solid State and Molecular Theory Group are calculating an approximate wave-function and associated binding energy for two spatial configurations of the ammonia molecule. The general theory is described in various progress reports of the SSMTG and is basically the compounding of a many-electron wave-function out of a set of one-electron wave function.

The first job for WWI will be a congruent transformation. This will effect a calculation of interaction integrals between a set of molecular orbitals which are linear combinations of a basic set of atomic orbitals. The data to be fed in are the integrals between the atomic orbitals. This technique has been described under problem 160.

After the integrals have been computed, a self-consistent LCAO job will be done using the routine developed and described under Problem 144.

Finally a limited configuration interaction will be considered which will necessitate the solution of large order secular equations.

During this report period a number of inverse square roots of matrices have been calculated and a number of congruent transformations have been performed. The inverse square roots were requested by Dr. R. McWeeny for his companion study of the water molecule and the congruent transformations were requested by him and Dr. H. Kaplan for the study of the ammonia molecule. Because of the large order of matrices involved (36x36) there exists a great problem of accurate typing and proof-reading but the time sequence of corrections seems to be converging.

205. Electron Lattice Interaction in Solids: A. Meckler; WWI, 17 minutes

A simple model of the electron-lattice system is being studied. The model is that of one electron in the field of two degenerate one-dimensional lattice oscillators. For various coupling constants, the matrix of interaction of the electron and the many quantum states will be constructed and diagonalized. The eigenvalues will be the energy levels of the electron-oscillator system and the eigenvectors will represent the occupation numbers of the various oscillator quantum states that were allowed to interact. The matrix diagonalization will be carried out by means of routines developed under problem 134.

An initial program was written and adjusted to permit the computation of partial time constants. This program is now being tested.

206. Electronic Energies of the Molecule H_2^-: A. Dalgarno; WWI, 21 minutes

WWI will be used for the computation of the electronic energies of the negative molecular hydrogen ion. The purposes of this computation are manifold. It will decide whether or not H_2^- is stable--a result of interest regarding the formation of ion complexes--and it will provide an estimate of the electron affinity of H_2^-, thus enabling the spectral range to be determined over which the photo-detachment process

$$H_2^- + h\nu \rightarrow H_2 + e$$

is energetically possible. It will make possible in a finite length of time the evaluation of the cross section for the charge transfer process $H^- + H \rightarrow H + H^-$ the mobility of the negative atomic hydrogen ion in gaseous hydrogen and the rate of the associative detachment process $H^- + H \rightarrow H_2 + e$. The important part played by negative ions in the absorption of solar radiation in the outer layers of the sun and in the formation of the ionized layers of the upper atmosphere is well-known. (cf Aller, 1953, Astrophysics, Ronald, New York; Mitra, 1952, The Upper Atmosphere, Asiatic Society, 2nd edition)

These calculations will enable properly quantitative theories to be developed.

The computation of the electronic energies of H_2^- reduces to the evaluation of a number of two-centre integrals. If r_{1a} and r_{1b} denote the positions of an electron, (1) from nuclei A and B respectively at a fixed distance R apart, these integrals have the form

$$\int r_{1a}^{n} \exp(-\alpha r_{1a}) r_{1b}^{m} \exp(-\beta r_{1b})\, dr$$

$$\int \frac{r_{1a}^{n} \exp(-\alpha r_{1a}) r_{1b}^{m} \exp(-\beta r_{1b}) r_{2a}^{p} \exp(-\gamma r_{2a}) r_{2b}^{q} \exp(-\delta r_{2b})}{r_{12}}\, dr_1\, dr_2$$

where n, m, p, and q are positive or negative integers, α, β, γ, and δ multiples of R and r_{12} is the distance between electrons 1 and 2. Integrals for which any one of $\alpha, \beta, \gamma, \delta$ vanishes may be expressed as linear combinations of products of the functions

$$A_n(x) = \int_1^{\infty} e^{-xt} t^n\, dt \quad , \quad B_n(y) = \int_{-1}^{+1} e^{-yt} t^2\, dt$$

the coefficients being polynomials in R (the problem requires n to be an integer less than five.). When none of $\alpha, \beta, \gamma, \delta$ is zero, the integral can be expressed as an infinite series of sums of products of integrals

$$W_\tau = \int_1^{\infty}\int_1^{\infty} Q_\tau(\lambda>) P_\tau(\lambda<) e^{-x\lambda_1} e^{-y\lambda_2} \lambda_1^m \lambda_2^n\, d\lambda_1\, d\lambda_2 \;;\; G_\tau = \int_{-1}^{+1} e^{-x\mu} P_\tau(\mu)\mu^n\, d\mu$$

where Q_τ, P_τ are the Legendre polynomials of the first and second kind. Each of W_τ can be written as rather complicated combinations of integrals

$$V_\tau = \int_1^{\infty} Q_\tau(t) e^{-xt} t^m\, dt$$

It is estimated that six or seven terms of the series will be sufficient. The integrals are required for R = 0(1)4(0.5)10 and $\alpha, \beta, \gamma, \delta$ are selections from 1.0, 0.6875, 0.83, 1.04, 0.2808 and linear combinations of these.

The following programs used computer time but did not report:

107 C.	(a) Autocorrelation and (b) Fourier Transform; Evaluate Integrals	55 minutes
122 B.	Coulomb Wave Functions	113 minutes
126 C.	Data Reduction	265 minutes
136	Matrix Equations	6 minutes
143 D.	Vibrational Frequency Spectrum of a Copper Crystal	17 minutes
147 C.	Energy Bands in Crystals	1380 minutes
173	Course 6.537 Digital Computer Application Practice	63 minutes

180 B.	Crosscorrelation of Blast Furnace Input-Output Data	5 minutes
181 C.	Perturbed Coulomb Wave Functions	31 minutes
195 C.	Intestinal Motility	64 minutes
196	Single Address Computer	348 minutes
197	Three Address Computer	1220 minutes

1.3 Operating Statistics

1.31 Computer Time

The following indicates the distribution of WWI time allocated to the S&EC Group during the four week period covered by this report.

Programs	156 hours, 46 minutes
Conversion	1 hour, 30 minutes
Magnetic Drum Test	1 hour, 30 minutes
Magnetic Tape Test	2 hours, 45 minutes
Scope Calibration	1 hour, 32 minutes
Demonstrations (#131)	2 hours, 22 minutes
Total Time Used	166 hours, 25 minutes
Total Time Assigned	181 hours, 15 minutes
Usable Time, Percentage	91.5%
Number of Programs	790

2. COMPUTER ENGINEERING

(S. H. Dodd)

Computer reliability dropped slightly during the past biweekly period. This was primarily caused by malfunctions of the terminal equipment and a blown fuse in the core-memory system which gave no blown-fuse indication.

A new compliment of core-memory sense amplifiers has been installed in WWI to replace the original amplifiers. These new amplifiers recover more rapidly from the effects of transients and are more tolerant toward tube and component deterioration than were the old ones. In addition, the output signal has a flat top which makes the strobe timing less critical.

2.1 WWI System Operation

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

The changeover to the sensing amplifier, Mod. III, has been completed. No difficulties were encountered. During the forthcoming biweekly period, we will probably reduce the required time for a core-memory cycle.

The magnetic-tape relay switch panel has been modified by the addition of two relays. The relays are used to eliminate crosstalk between Unit 2 when computer controlled and units functioning in the delayed-printout systems.

It is intended to revise the Room 156 power-control system. Several meetings have been held with McVicar, Healy, Roberts and Holmes in attendance. It is expected that a logical diagram for the new system will be completed during the coming biweekly period.

(D. A. Morrison)

The WWI tube-statistic survey, part of the computer-reliability study, has just completed the data-collecting phase. Information should be forthcoming shortly.

Modification of the consolidated test program to allow starting PMC from line numbers inserted in FF 4 has been approved. When this has been accomplished a memo will be prepared concerning the consolidated test program.

2.2 Terminal Equipment

(R. H. Gould) [illegible] ([illegible])

The Fairchild display-scope camera and its magazine have been modified to provide a film-supply alarm, and the necessary additions to the camera control panel will be done on 2 August. When the film supply in the magazine becomes dangerously low a light called "Film Alarm" on the camera control panel in TC 13 will light, and a buzzer on the panel will sound. Pressing "Alarm Acknowledge" button on the panel will shut off the buzzer, but the light will remain on until the camera magazine is replaced. Up to 10 frames may safely be taken after the alarm first sounds, but the magazine should preferably be changed immediately.

A switch will be installed by 2 August in test control which when "ON" will cause the computer to switch to pushbutton (i.e., stop) on TP 8 of an si order whose address is either 0011(0) or 0012(0). Restarting from this point will allow the si order to complete its action and clear or complement the timing register. This facility should help prevent accidental destruction of the real-time count in the timing register.

The high-voltage transformers of all the 16-inch-scope high-voltage supplies have been anointed with a silicone grease which has shown significant effectiveness in preventing corona, arcing, and subsequent flames.

2.21 Magnetic Drums

(L. D. Healy)

Groups 0 & 1 of the buffer drum are now in operation.

Group 2 of the buffer drum is ready to be tested, and group 3 will be ready as soon as the necessary IN92 crystals arrive.

The entire buffer-drum parity system must be altered to add the parity check for groups 2 and 3. The buffer-drum system will have no parity check for a day or two while this modification is taking place.