

Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

SUBJECT: PROGRESS REPORT, AUGUST 9 THROUGH SEPTEMBER 5, 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, 722 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 41 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.

Two simulated computers were developed by the S&EC staff and used by the 65 students enrolled in the special Summer Session Course 6.531 on "Digital Computers: Business Applications". This course was given under the supervision of Prof. C. W. Adams and Dr. S. Gill during the period August 16-27. The problems that were solved by the students on these simulated computers are described briefly under S&EC problem 198. The "computers" themselves are described under problems 196 and 197.

Detailed initial descriptions are provided below for problems 195 (analytical study of intestinal motility records) and 207 (solution of 16th and 19th order differential equations for the M.I.T. Flight Control Lab).

During this period the S&EC Group played host to 220 visitors. A brief summary of the groups represented by these people is given under problem 131.

1.2 Programs and Computer Operation

100. The Comprehensive System of Service Routines: Demurjian, 25 hours; Frankovich, 16 hours; Helwig, 40 hours; Siegel, 4 hours; Watson, 56 hours; Porter, 2 hours; WWI, 719 minutes

CS II has been modified to operate under the guidance of "director" control tapes. These are Flexo tapes containing information equivalent to that in a performance request and typed in a manner to be described in a memo being written by F. Helwig. These tapes are read by the new Input Program (soon to be recorded on drum group 11) via the mechanical tape reader.

J. M. Frankovich

A director tape for a particular run is a paper tape which is obtained by typing the performance request for the run on a Flexowriter. Under certain restrictions it will soon be possible to place the director tape in the mechanical tape reader, the tapes involved in the run (spliced together in the proper sequence) in the PETR, and then to execute the run by a single pushing of the read-in button.

A director tape program which reads in words from the director tape and effects the appropriate "button pushing" has been written and checked out.

The introduction of director tapes requires that several of the S&EC recorded utility programs be modified. Some of these mods have been written and tested. Work continues on those remaining.

A memorandum describing the standard abbreviations to be used in filling out S&EC performance requests is being written. This will also contain a description of the director tapes.

F. Helwig

Two (30, 0) divisions for quantities in fractional form have been completed and are being written up.

One routine using the binomial theorem and 84 registers produces results with a minimum accuracy of 27 digits. The other routine using 140 registers and the method used in the Summer Session integer divide routine gives a result accurate to the last digit.

R. Watson

As mentioned in the previous progress report the routines for use in automatic curve plotting on the scope have been recorded on magnetic tape. We are now in the process of testing the conversion of tapes using these instructions and of testing the routines themselves.

N. Saber

106 C. MIT Seismic Project: Grine, 50 hours; Simpson, 50 hours; WWI, 466 minutes

The time used during the past 4 weeks by problem 106 represents almost exclusively experiments conducted on multi-trace seismograms not utilizing the linear operator as such. Instead, various new mixing techniques are being tested to derive information supplementary to filtering. In one experiment Fourier Transform phase angle mixing is being used to determine input signal-to-noise ratio as a function of frequency. Both the theoretical and practical aspects of this problem do not permit analytic solution and are being computed. One example tested under controlled conditions yielded expected results, but full interpretation must await the theoretical solution.

A correlation function mixing technique being tested should theoretically yield time varying estimates of signal power with dip of reflecting horizons as a parameter. Preliminary tests have yielded significant information from a set of records previously considered worthless.

120 D. The Aerothermopressor: Porter, 1 hour; Gavril; WWI, 124 minutes

A study of the fourth-order Runge-Kutta method for solving the differential equations of the aerothermopressor has continued and is nearly completed. This study involved carrying out the computations for a typical case using the Runge-Kutta method with various increment sizes and comparing the results with those obtained from the Euler method for various increment sizes.

It has been found that the spurious behavior in the Euler solution which had been believed to be the result of truncation error (see progress report of July 12, 1954) has been completely eliminated by the more refined numerical procedure. For increment sizes of 1% (i.e. the range of the independent variable divided into 100 parts), the final computed pressure was in error using the Runge-Kutta method by an amount equivalent to that which would arise with the Euler method using an increment of $.04\%$. For this accuracy (within about $.3\%$ in the pressure) the Runge-Kutta method is therefore about six times as fast as the Euler method. An increase of increment size to 2% with the Runge-Kutta method was found to give acceptable results with the error only twice as large as that corresponding to the increment size of 1% . The apparent linearity of the error using the fourth-order Runge-Kutta method is not yet clearly understood, and further computations are being carried out.

The results so far obtained seem very promising from the point of view of reducing the time of computation by using large increments over part of the range of the independent variable. It appears that the computations must begin and end with 1% increments, while in the mid-range, steps of 4% may well be taken.

Previous plans to write a completely new program remain unchanged, and this work will begin as soon as the necessary preliminary details are worked out in the present study. It is planned to use the current subroutines to continue aerothermopressor computations to a limited extent while the new program is being written.

126 C. Data Reduction: D.T. Ross; W. Wolf; D. Hamilton; WWI, 153 minutes

This progress report covers the last two monthly periods since vacation schedules interfered with the writing of reports. Three complete versions of the Data Reduction Program have been tested with and without the Mistake Diagnosis Routine (MDR), described previously, which was developed under this problem for this purpose. The MDR has served its purpose very well and its use is now a routine matter. The first version of the Data Reduction Program was a simplified version and has now been discarded since it has served its purpose of simplifying the debugging process. The second version of the Data Reduction program has been completely checked and has given useful results. The second version will also be discarded, however, in favor of the third which uses modified computing techniques for higher speed and greater efficiency. Checking of the third, the so-called Basic version, is progressing rapidly with the use of the MDR. Further modifications of the Basic version will be made to compute different answers. Each successive version will be an extension of a previous version, designed to handle more complicated problems.

Work is progressing on another phase of this problem, using auxiliary in-out equipment both as an integral part of the Data Reduction Programs for monitoring purposes and as an aid to experimenting with improved computational techniques. Intervention registers and scopes will constitute the working parts of this system with efforts being made to provide the flexibility normally associated only with analog computing programs. Present work is concerned with the development of programs to decode intervention register inputs and an alpha-numeric scope routine equipped to handle (24, 6), (15, 0) and alphabetical characters with decimal points suitably placed, etc. A large-letter title display is also being written.

131. Special Problems (Staff Training, Demonstrations, etc.): Demurjian, 6 hours

During the past period 220 people attended the tours of Whirlwind. On August 12 the regular monthly demonstration of the computer facility was held. There were 33 visitors present.

Sixty-eight students from the Summer Session course 6.531 Digital Computers: Business Applications were shown the computer and control area on August 18 and 19 in preparation for their later use in solving assigned problems.

On August 23 the movie "Making Electrons Count" was shown to the teachers attending the M.I.T. Mathematical Institute Meetings. Sixty-eight of these teachers visited the Digital Computer Lab. for a demonstration on August 24.

The last demonstration of the period was for 51 students from the Servomechanisms Laboratory at M.I.T. on September 1, 1954.

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, 36 minutes

Time used this month was devoted entirely to milling machine tape checking. A program modification for printing milling machine order totals at preset intervals was used to facilitate location of errors.

141. S&EC Subroutine Study: Mahoney, 49 hours; WWI, 80 minutes

Several modifications or replacements of existing subroutines have been made and are now in the Library of Subroutines. These are

LSR Fu1	Exponentials subroutine
Fu2a	Square root (24, 6)
Fu2b	Square root (30-j, j) (four iterations)
Fu5	Hyperbolic functions
MA4	Matrix diagonalization

The Auxiliary Buffer Routine (LSR SPL) has been obsoleted since it is unnecessary with CS II in operation

- 143 D. Vibrational Frequency Spectrum of a Copper Crystal: Jacobsen;
WMI, 97 minutes

The previous program developed in problem 143 calculated the vibrational spectrum for a face-centered cubic crystal. This program is now being modified in order to calculate the vibrational spectrum for a body-centered cubic crystal and will include 1st, 2nd, and 3rd neighbor effects as did the original program. In particular, the calculation will be made for α -iron employing the tensor force constants determined by H. Curien, College de France, 1952. This calculation will conclude problem 143.

- 156 A. Evaluation of the Reflection Coefficient in a Semi-Infinite Rectangular Wave Guide: A. Balsler; WMI, 8 minutes

Another test run was held for the range $0 \leq \alpha < \pi^2$. The results, when compared with check results which are available for some values of α , were off in the second or third place. Consequently, a test run was then held for $\alpha = 0$ and a post-mortem was made. The results are now being studied in an attempt to detect the error.

- 159 D. Water Use in a Hydroelectric System: Little; WMI, 1074 minutes

Improvements in the optimization program and a graphical scope output routine are now incorporated into the main tapes. Final results are being run off for the model of the hydro system under study. The scope output is excellent for seeing how the system, using the operation determined by the program, behaves when the historical river flows are the input.

- 166 C. Construction and Testing of Delta Wing Flutter Model: Chen, 3 hours;
WMI, 95 minutes

During the past period, several runs were made to find the Δc 's. It is intended to make a parametric study in order to determine the effect on Δc 's due to a change of x . The existing tapes can be used for this purpose.

- 167 D. Transient Effects in Distillation: Jordan, 80 hours; O'Donnell,
160 hours; Smith, 5 hours; Porter, 2 hours; WMI, 1013 minutes

About half the machine time was utilized in obtaining additional solutions for the case of a transient in a continuous distillation column caused by a step change in feed composition. Two correlations had been obtained for the data available previously. The additional solutions were used to determine the effectiveness of the correlations in predicting results for different parameter combinations. The work showed that the correlations were quite successful for conditions within the range previously studied. However, some extreme sets of parameters, outside the range studied, gave results that were not predicted by the correlation satisfactorily for engineering purposes. This was rather probable and further work will be done to improve the situation. Jordan has completed his Master's thesis on this subject and has submitted it in the Chemical Engineering Department. A considerable improvement in understanding of the situation has been achieved.

The remaining machine time has been spent on the problem of batch distillation take-off. Most of this time has been utilized for obtaining solutions for the situation described in the Progress Report of August 8, 1954. This is the limiting case of batch distillation take-off assuming the hold-up is negligibly small. The basic relationship is:

$$W = \exp \left\{ \int_{x_{w,0}}^{x_w} \frac{dx_w}{x_D - x_w} \right\}$$

where W is the fraction of the charge not yet 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. The initial value of x_D corresponding to $x_{w,0}$ is calculated by iteration. Thereafter x_D is chosen and x_w calculated. The resulting increments in x_w are unevenly spaced. One of the problems was the question of how to carry out the integration.

Initially it was hoped that using the trapezoidal rule, solutions of sufficient accuracy could be obtained with reasonable machine time. By running two sample cases on the machine, each with at least three different interval sizes, it was determined that the results, W , for any value of x_w when plotted against h^2 , where h is the increment size, was a straight line. This implies that Richardson's h^2 extrapolation might be used. Briefly the scheme actually followed in the solution was to calculate values of W using two different interval sizes alternately with one half the other. That is, two steps would be taken using the smaller interval size and then one with the larger, at the end of which there was available W at an x_w calculated using two interval sizes. Then the mathematical equivalent of Richardson's h^2 extrapolation would be done to get a corrected value. This was printed out. The results were very satisfactory. Less machine time and output was used than would have been necessary if the two calculations had been done separately (because it was not necessary to calculate x_w from x_D again for the larger step). Also less machine time was used than would have been necessary if each calculation had been done only with one increment size, small enough to insure sufficient accuracy. A check was made at the time the extrapolation was carried out to see that it was not too large.

Some machine time was spent getting additional data for the case of batch-distillation take-off with holdup.

At present most of the effort is going into attempts to understand and correlate the data for batch-distillation take-off. Some machine time was used attempting to explore a correlation which involved solution of a complicated equation by iteration. This may continue.

183 D. Blast Response of Aircraft: Shulman, 130 hours; Porter, 2 hours; WWI, 45 minutes

Two new programs (III, IV) were started. Program III is a modification of the previous programs to include a different forcing function, and to provide a means to stop the program when the beam resistance is zero, i.e. at the breaking

point. Trial runs were started on this program, which is still in a debugging stage.

The other program started (IV) necessitated the use of the auxiliary drum for high-speed storage. The forcing function for Program IV is the representation of the actual conditions and is expressed in terms of the Wagner function unlike the multi-linear approximations that were used in the previous programs (I, II, III). This required the use of the exponential library subroutine.

Difficulty was experienced with the programming for the auxiliary drum but was overcome quickly. It is hoped that production runs can be started shortly.

184 D. Scattering of Electrons from Hydrogen: Newstein; WWI, 464 minutes

Final runs have been made on a series of programs. The results check to the required accuracy with the exact values which can be determined analytically for special values of the parameters.

186 C. Tracking Response Characteristics of the Human Operator: Elkind; WWI, 31 minutes

During the past period, 31 minutes of computer time have been used. Most of this has been devoted to correcting errors made in previously computed power density spectra. Human operator transfer functions are in the process of being computed from the power density and cross power density spectra determined by WWI.

188 C. Effect of Gravity on Relative Water Production in Oil Reservoir: Kern; Porter, 2 hours; WWI, 33 minutes

This problem is concerned with the solution of Laplace's equation in two regions separated by a free boundary. Attempts to improve on an initial guess of the boundary position from the solution within the regions have not been successful. It is not known whether this failure is due to inaccuracies in the solution (occasioned by an extremely low rate of convergence) or to a basic unsoundness of the method. An effort to increase the rate of convergence is being considered.

190 D. Zeman and Stark effect in Positronium: Kendall; WWI, 131 minutes

The routine for computing the perturbed energy eigenvalues and partial lifetimes of the $n=2$ states of positronium has been completed and checked. The program of computation is now underway.

191 B. Earthquake Epicenter Location by Geiger's Method: Grine, 40 hours; WWI, 184 minutes

The location of an earthquake epicenter observed by eight stations has been successfully determined. A generalization of this program is now being developed so that data from any number of observing stations from three to forty may be fed in on a separate parameter tape.

195 C. Intestinal Motility: Farrar; Hamilton; WWI, 19 minutes

Existing methods of analysing human and animal intestinal motility records do not permit an objective, accurate measurement of the total amount of motor activity present, nor do they permit analysis of the component functions which make up the complex motility record.

Intestinal motility in man is composed of several different basic wave forms. These include: (1) periodic "segmental" waves having a frequency of 8 - 11 c.p.m., (2) large "peristaltic" waves of low frequency and questionable periodicity, (3) random wave forms. Quantitative analysis of these components in a motility record has been impossible, as has been the evaluation of their relative contributions to the total motility record.

During the past year a cooperative program has been undertaken between the Gastroenterological section of the Evans Memorial Hospital and Mass. Institute of Technology. The aim has been to apply analytical methods used in the study of sound to the interpretation of intestinal motility records. The tracings of rabbit intra-enteric pressures and one very simple human balloon-Kymographic record have been analysed by generation of the auto-correlation function. This analysis has yielded numerical values for the frequency and amplitude of the various motility components, as well as their relative contribution to the total record. The auto-correlations were initially obtained by using the mechanical correlator in Bldg. 32 of the Servomechanisms Laboratory. However, this machine proved unsatisfactory for the analysis of the more complex human records since the wave excursions of the original data exceeded the narrow limits of the machine.

Generation of the auto-correlation function of a complex human motility record has been very satisfactorily achieved by the use of the Whirlwind I digital computer. Recordings are made originally on rolls of paper having a 1 mm grid. Numerical amplitudes are then read at each of the equally-spaced (1 mm) points on the motility record. This data is prepared by Whirlwind personnel and the auto-correlation function calculated.

It is thought that these exploratory studies done on Whirlwind may form the basis for a more extensive study of intestinal motility by these analytical techniques.

Dr. Farrar

The work being done under problem 195 involves about 80 sets of auto-correlation data and Fourier transforms of the results. The program being used is the one developed by D. T. Ross under problem 107.

Tape units have been assembled in groups of five data tapes with logging titles so that greater speed and a logging record can be obtained. Three of these assembled tapes have been run. These indicated minor errors in the output routine. These errors are being corrected. Mass production of runs is expected soon.

D. Hamilton

196. Single Address Computer: Frankovich; 41 hours; Siegel, 36 hours; Watson, 12 hours; WWI, 1429 minutes

All modifications to the 1953 Summer Session computer (SS) to produce the 1954 Single Address Computer (SAC) were completed on schedule in time for use in the 1954 Summer Session Course 6.531. In addition, several existing errors were found in SS and corrected in SAC. The SAC computer has fixed point integer numbers only, but it has four 990 word pseudo-magnetic tape units and can combine numbers and instructions in ways forbidden in SS. A pseudo-time count is also made during SAC operations to inform programmers of the time a physically existent SAC would take to run their programs.

197. Three Address Computer: Demurjian, 7 hours; Helwig, 40 hours; Best; WWI, 1550 minutes

During the past several biweekly periods a hypothetical three-address drum computer (called TAC) has been developed. This was used by students during the earlier part of the 1954 summer session course 6.531. A brief description of TAC follows.

TAC is a 3 address computer with 110 registers of storage. Of these, 100 are contained on the drum (numbered 00, ..., 99) and 10 form a special high speed (zero access) storage (labeled x0, ..., x9).

A word in TAC is a series of 9 digits, letters or other characters (e.g., space, tab, \$, ¢, etc.). Register x0 always contains 000000000 and cannot be altered by any instruction. Registers x1 and x2 can automatically be dealt with as a double length number by many instructions. This double length location is labeled xx.

TAC has four magnetic tape units. Each tape unit contains 40 blocks of information where each contains ten TAC words.

Drum and tape speeds and operation times have been assumed for TAC. A hypothetical time, telling how long a program ran, is printed out each time a halt instruction occurs. Minimum latency programming is possible.

TAC words are typed in the form
 mn/abcdefghi
 and TAC tapes are terminated by
 mn/start

A conversion post mortem program detects all the typing errors on TAC tape and prints out the incorrect word (with the error in red), the line on the print at which this occurred, and the distance along the paper tape.

An operational post mortem prints out the following sort of information when an alarm occurs: e.g.

```
stopped at 561   a 01020304
01|+99999999   02|+99999999   03|+00000000   04|s04050607
Registers which have been changed:
10 | a10111213   20 | +23471211
```

Jump Table:

(1,2,3,4)², (6,7)³, 0,1

The jump table expresses the path of control which the program followed. Loops are denoted by parentheses and exponents. Arbitrary loops within loops within, etc. are printed out by the program.

198. Student Problems Coded for SAC and TAC: Staff; WWI, 1175 minutes

This problem number was set up for the use of students enrolled in the special summer session course 6.531 (Digital Computers: Business Applications).

All of the students in the course coded and debugged a problem assigned for solution on the simulated three-address computer called TAC (described under problem 197). The problem consisted of determining and printing out the day of the week corresponding to an arbitrarily specified date.

Most of the students also worked on a second problem to be solved on the simulated single address computer SAC (see problem 196). For this second problem, the students were permitted to select from among three suggested problems covering the maintenance of bank balance records, payroll calculations, and an autocorrelation calculation to detect a seasonal sale variation, respectively.

199. Laminar Boundary Layer of a Steady, Compressible Flow in the Entrance Region of a Tube: Toong; WWI, 97 minutes

In connection with the research on heat transfer coefficients, recovery factors, and friction coefficients for supersonic flow of air in a tube, a theoretical investigation of the characteristics of the laminar boundary layer in the entrance region has been carried out. Partial differential equations of continuity, momentum, and energy were developed for the boundary layer. These were then transformed into a series of ordinary differential equations, to be solved by WWI for several entrance Mach numbers and thermal conditions at the tube wall.

First, solutions are to be obtained for the case of constant viscosity and thermal conductivity. Then, the effects of temperature-dependence of these properties are to be studied.

Solutions of the first set of differential equations have been obtained for five cases of different entrance Mach numbers and thermal conditions at the tube wall. This represents approximately 5% of the entire job to be done by WWI. Routines are being prepared to solve the second set of differential equations.

The coding has been carried out in the "algebraic system" developed by Dr. H. Laning under S&EC problem 108. This system makes use of Gill's modified fourth-order Runge-Kutta method.

200. A Study of Recurrent Events: B. Jensen, 40 hours; G. Dinneen, 5 hours; Porter, 2 hours; WWI, 18 minutes

An alternative method of discriminating between Bernoulli sequences of type S and Bernoulli sequences of type N is by means of the density within

a given interval. If the interval is of length l , then all combinations of Q Bernouilli trials such that the number of ones is less than a threshold k compose our event. Whenever recurrence time exceeds one, we say we detect a Bernouilli sequence of type S. In terms of density measurements, a sequence of type S is detected when the number of ones exceeds the threshold k . The program for this investigation has been coded and results obtained. Further investigations will be made to determine the effect of changing l and k .

201. Study of the Ammonia Molecule: Meckler; WWI, 137 minutes

Self-consistent wave-functions have been calculated for two geometric configurations of the ammonia molecule. The integrals necessary for the final routine were derived by means of congruent transformations performed by WWI. These integrals were fed into the routine which achieved self-consistent one-electron wave-functions in the framework of linear combinations of atomic orbitals. The results will be tabulated and discussed in the Quarterly Progress Report of the Solid State and Molecular Theory Group.

205. Electron Lattice Interaction in Solids: Schultz; WWI, 290 minutes

To gain insight into electron-lattice interactions in crystal when the coupling is too strong to be treated by perturbation methods (e.g. alkali halides) exact results are being sought for a simple model consisting of two degenerate lattice oscillators (corresponding to left and right going plane waves of the same wave length) interacting with an otherwise free electron (moving in the direction of the plane waves).

The matrices of order $(n+1)(n+2)/2$ arising on neglect of all states having more than n phonons excited are being diagonalized for $n=1, 2, \dots, 6$ for divers values of coupling, oscillator wave lengths, and total momentum (electron plus wave field) with the following aims:

1. to see how the effect of the interaction on the ground state depends on wave length
2. to see if, for sufficiently strong coupling, the lowest energy state has non-zero total momentum
3. to provide an accurate yardstick for evaluating adiabatic methods used on real crystals and
4. to provide a starting point for considering the effects of a periodic potential.

Two values of the coupling constant (intermediate and strong) and two wave lengths (intermediate and long) are being investigated. For intermediate coupling good convergence has been obtained. For strong coupling it is found that a better criterion than total number of quanta must be used in cutting off the infinite secular equation if good convergence is to be obtained. Dr. Meckler is considering modifications in the present program which would include only those states with the n lowest diagonal matrix components.

206. Electron Energies of the Molecule H_2^+ : Dalgarno; WWI, 143 minutes

The programs for the 4 varieties of coulomb integrals and the 3 varieties of hybrid integrals were completed and tested. These programs have been used to obtain results for pertinent values of the parameters, thereby completing the problem (with the exception of the exchange integrals which will be done elsewhere).

207. Check for REAC: Larson, 30 hours; Whalen, 30 hours; Porter, 3 hours; WWI, 26 minutes

The problem involves actually two check solutions for analogue machines for two systems of differential equations representing two different aircraft target configurations with control systems. The first is a 16th order and the second is a 19th order system. Both are being solved by the 4th order Runge-Kutta method. The choice of interval is determined intuitively from past experience. Both routines have been punched on tape but no positive results have been obtained yet.

The following programs used computer time but did not report:

108 C.	An Interpretive Program	15 minutes
144 C.	Self-Consistent Molecular Orbitals	36 minutes
147 C.	Energy Bands In Crystals	87 minutes
155 D.	Synoptic Climatology	495 minutes
161 C.	Response of Mass Plastic Spring System to Transient Loading	8 minutes
169	Utilizing a General Purpose Digital Computer in Switching-Circuit Design	10 minutes
171 C.	Improved Power Spectrum Estimates	4 minutes
172 B.	Overlap Integrals of Molecular and Crystal Physics	6 minutes
174 C.	Tight Binding Calculations in Crystals	13 minutes
177 D.	Low Aspect Ratio Flutter	5 minutes
180 B.	Crosscorrelation of Blast Furnace Input-Output Data	16 minutes
193 C.	Eigenvalue Problem for Propagation of E. M. Waves	28 minutes
194 B.	An Augmented Plane Wave Method As Applied to Sodium	419 minutes
202	Calculation of Vertical Antenna Coverage Skeleton	29 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	180 hours, 8 minutes
Conversion	1 hour, 13 minutes
Magnetic Drum Test	1 hour, 30 minutes
Magnetic Tape Test	1 hour, 13 minutes
Scope Calibration	1 hour, 16 minutes
Demonstrations	0
Total Time Used	185 hours, 20 minutes
Total Time Assigned	192 hours, 57 minutes
Usable Time, Percentage	96.1%
Number of Programs	722

2. COMPUTER ENGINEERING

2.1 WVI System Operation

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

Computer dependability has been excellent. A failure of a relay in the direct printout-punchout system resulted in the loss of 1 hour.

Computer shutdowns have been planned for the weekends of 11 and 18 September. The first shutdown is to be used to realign our 600-amp alternator. The second shutdown will permit the relocation of the delayed printout equipment. Presently it is in P Row and is difficult to maintain. It will be moved to E Row.

(D. A. Morrison)

The consolidated test program, T-3432-16, is now in use in the WVI marginal-checking routine. PMC can now be modified to start over from a line number inserted in FF 4. A memo describing T-3432-16 is being written.

3. ADMINISTRATION AND PERSONNEL

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

Sumner Bartlett is a new technician with the Construction Shop.

Burton Ewalt is a new member of the Drafting Department.

Thomas J. Malloy, Jr., is another new technician in the Construction Shop.

Judith P. White is a new Barta Building receptionist.

Alfred W. Wojcicki has also joined the Construction Shop as a technician.

Terminated Non-Staff (R. A. Osborne)

Diana Bierer

4. RECENT LIBRARY ACQUISITIONS

The following documents have been recently acquired by the Barta Building Library, Room 109.

<u>No.</u>	<u>Title</u>	<u>Source</u>
B 52	German-English Dictionary for Electronics Engineers and Physicists	Regen and Regen
B 120	The Calculus of Finite Differences	L. M. Milne-Thomson
B 176	Petroleum Reservoir Efficiency and Well Spacing	Committees of Standard Oil and Humble Oil
B 194	Kettenbruchen (Continuous Fractions)	Oskar Perron

C-152	Report to the Association for Computing Machinery First Glossary of Programming Terminology	A.C.M.
C-159	A Comparison of Machine Methods for Evaluating Certain Mathematical Functions	W. Barkley Fritz
C-160	Proceedings: Railway Systems and Procedures Assn. Inventory Management and Data Processing	Meeting--Chicago
C-161	A New Approach to Office Mechanization; Integrated Data Processing Through Common Language Machines	U.S. Steel Program
C-162	Light on the Future	I.B.M.
C-163	Electronics...New Horizon in Retailing	Harvard Bus. School
C-164	Integrating the Office for Electronics	Am. Management Assn.
C-165	Short Range and Extended Forecasting by Statistical Methods; Air Weather Service Tech. Rept. 105-37	Air Weather Service
C-166	Colloquium on Linear Equations; Tech. Rept. 35-54	O.N.R.L.
C-167	Use of Flight Simulators in the Design of Aircraft Control Systems	H. Elmore Blanton
C-168	French Work in the field of Digital Computation	ONRL-133-53
C-169	The Work of the Swedish Board for Computing Machinery	ONRL Tech. Rept.
C-170	A High Speed Magnetic Drum Storage	ONR Tech. Memo.
C-171	WWI Operation Logic	R-221
F-185	Selective Analysis of the Scale of Atmospheric Turbulence (M.S. Thesis)	J. Howcroft, J. Smith