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ARGONNE NATIONAL LABORATORY
P. O. Box 299
Lemont, Illinois

APPLIED MATHEMATICS DIVISION
SUMMARY REPORT

November, 1956 through June, 1958

December, 1958

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PREFACE

Because of a widening scope of activities, the Computing Group of the Physics Division became a separate Applied Mathematics Division on November 1, 1956.

The objective of the Division is to provide mathematical assistance to other scientists in the Laboratory. This goal is achieved, in particular, by (1) conducting research in numerical analysis and other branches of mathematics. (2) providing mathematical consultation, and (3) operating a computational service, using both digital and analog machines. The Division is prepared to provide mathematical assistance at any stage of the development of a problem, from its initial formulation to its final solution.

APPLIED MATHEMATICS DIVISION

ORGANIZATION CHART

November 1, 1956 through June 30, 1958

DIVISION OFFICE

D. A. Flanders, Director*

D. A. Davis, Executive Assistant (B 12/56)

M. A. Schmidt, Secretary

P. R. Benson } Clerical

A. R. Sinnott }

MATHEMATICAL ANALYSIS

J. H. Alexander (R 2/57)	J. Hall (R 1/57)	N. F. Morehouse
E. H. Bareiss (B 2/57)	E. M. Keberle (B 4/57)	D. L. Phillips (B 7/57)
H. Cohn (S/58)	R. F. King	L. T. Wos (B 2/57)
J. M. Cook	W. F. Miller**	

DIGITAL PROGRAMMING R. F. King, Programming Director

C. G. Bachhuber (S/58)	H. L. Gray	L. I. Kassel
C. Chamot	W. G. Greenhow	A. V. Lemmon (S/58)
C. Y. Cho (S/58)	M. J. Hanson (B 10/57)	G. B. Rybicki (S/58)
J. E. Denes (B 12/57)	C. Harrison, Jr.	D. P. Satkus
G. J. Duffy	K. E. Hillstrom (B 9/57)	N. A. Siljander (B 9/57)
M. A. Fisherkeller	H. E. House	W. J. Snow
B. S. Garbow	R. T. Julke	S. B. Steidl (B 12/56)
		A. J. Strecok

DIGITAL MACHINE OPERATION S. A. Zawadzki, Supervisor

R. H. Ivan (B 1/58)	R. L. McGrane (B 9/57)	B. M. Richards (B 10/57)
C. J. Kilty	J. A. Nelson	E. J. Singletary
R. N. Little (S/58)	L. J. Nelson (B 9/57)	A. R. Turk (B 10/57)

ANALOG PROBLEM ANALYSIS, PROGRAMMING, AND MACHINE
OPERATION N. F. Morehouse, Group Leader

R. A. Aschenbrenner (R 5/58)	J. S. Dick
L. T. Bryant (B 8/57)	F. J. Maletich

CONSULTANTS

R. Courant - New York University	B. Friedman - University of California
L. D. Fosdick - University of Illinois	N. C. Metropolis - University of Chicago
	J. N. Snyder - University of Illinois

*Deceased

B - Began

**Acting Director

S - Summer Employee

R - Resigned

STATUS OF PROJECTS

No.-None; EXACT ERRORS IN PICARD'S ITERATION PROCEDURE

Originator: Erwin H. Bareiss, Applied Mathematics Div.

Analysts: Erwin H. Bareiss and Edward Keberle

Programmer: None

Machine: None

Description: The exact errors of a particular differential equation are calculated as functions of characteristic parameters of the Picard iteration scheme. The work will be continued on a new basis by Erwin H. Bareiss and David Phillips.

Status. Completed

No.-None; BIOLOGICAL KINETICS STUDIES

Originator: George Sacher, Biological and Medical Research Div.

Analyst: N. Frank Morehouse, Jr.

Programmer: N. Frank Morehouse, Jr.

Machine: Analog

Description: This is a parameter study of the effect of X rays on animal blood composition by means of mathematical models.

Status: Completed

No.-None; BOUNDARY CONDITIONS FOR A PARTIAL DIFFERENTIAL
EQUATION OF THREE INDEPENDENT VARIABLES

Originator: Ernesto Trucco, Biological and Medical Research Div.

Analyst: Edward M. Keberle

Programmer: None

Machine: None

Description: Demanded is the type of initial and boundary conditions which lead to unique solutions of a pseudo-linear partial differential equation with three independent variables, whose derivatives appear in different forms. The LaPlace transform is of little aid in this case. It is hoped that an answer may be obtained from the treatment of the corresponding system of two partial differential equations of first order with three independent variables.

Status: In progress.

No.-None; PATH LENGTH DISTRIBUTION BETWEEN CIRCULAR PLATES.

Originator: Oliver C. Simpson, Chemistry Div.

Analysts: Edward Keberle, David Phillips

Programmer: None, (Desk calculations, Charles Harrison)

Machine: None

Description: The distribution function is constructed. It turns out to be an integral where the independent variable appears as a parameter in the integrand as well as in the limits of the integral. By several transformations the integral is expressed explicitly. The curve is numerically calculated.

Status: Completed

No.-None; RADICAL YIELDS OF IONIZING RADIATION

Originator: Edwin J. Hart, Chemistry Div.

Analyst: Edward M. Keberle

Programmer: None

Machine: None

Description: Chemists have conjectured that there is an intricate correlation between e and H in the radiolysis chain in water. A mathematical treatment is attempted.

Status: In progress.

No.-None, CALCULATION OF A THERMAL UTILIZATION FACTOR

Originator: Harry Schludi, International School of Nuclear Science and Engineering

Analyst: Edward M. Keberle

Programmer: None

Machine: None, (Desk calculation, Edward M. Keberle)

Description: Numerical calculation of a function by the use of an input which was obtained by a second-order interpolation of a table is performed.

Status: Completed

No.-None, CONVERGENCE PROPERTIES OF THE CAUCHY PRODUCT OF TWO DIVERGENT SERIES

Originator: Hans Ekstein, Physics Div.

Analyst: Edward M. Keberle

Programmer: None

Machine: None

Description: An over-all picture of the theory of the Cauchy product of series is given.

Status: Completed

No.-None; SPACE ANGLE CORRECTION FACTOR TO THE INVERSE
SQUARE LAW FOR A POINT SOURCE

Originator: John Corcoran, Radiological Physics Div.

Analyst: Edward Keberle

Programmer: None

Machine: None

Description: A formula according to an experimental setup is derived and
the function of interest is graphically plotted.

Status: Completed

No.-None; LAWS CONCERNING MOISTURE EXCHANGE IN SOIL

Originators: J. E. Carson, Radiological Physics Div., and Erwin H. Bareiss,
Applied Mathematics Div.

Analyst: Edward M. Keberle

Programmer: None

Machine: None

Description: A system of two partial differential equations which governs
in a general way the moisture exchange in soil has been de-
rived. Additional assumptions concerning heat conductivity
in wet soil and evaporation of moisture are possible. Use of
one partial differential equation instead of two has lead, in
Problem 494/RPY 108, to natural boundary conditions.

Status: Completed

No. 282/U. of C.; No Title

Originator: Roger Hildebrand, University of Chicago

Analyst: William F. Miller

Programmer: William J. Snow

Machine: AVIDAC

Description: Statistical analysis of cloud chamber tracks is carried out.

Status: Completed

No. 439/AMD 104; IMPLICIT SOLUTION OF A PARABOLIC PARTIAL
DIFFERENTIAL EQUATION

Originator: Donald Flanders, Applied Mathematics Div.

Analyst: Donald Flanders

Programmer: Howard House

Machine: GEORGE

Description: The equations of CHEM 8A, B are solved numerically by an
implicit method to insure stability, and two integrals involving
these solutions are also evaluated.

Status: In progress.

No. 443/AMD 105; ENERGY-LOSS SPECTRUM OF GAMMA RAYS IN
SODIUM IODIDE

Originator: William F. Miller, Applied Mathematics Div.

Analyst: William F. Miller

Programmer: William Snow

Machine: GEORGE

Description: This program calculates the energy-loss spectrum of gamma
rays during absorption in sodium iodide crystals for many
photon energies, for different types of sources and different
size crystals.

Status: In progress.

No. 473/AMD 106; CALCULATION OF OSCILLATOR STRENGTHS FOR
VARIOUS GASEOUS MEDIA

Originator: William F. Miller, Applied Mathematics Div.

Analyst: William F. Miller

Programmer: William F. Miller

Machine: GEORGE

Description: This program determines the moments of oscillator strengths,

$$F_j = \sum_n f_n E_n^{-j} ,$$

by analysis of the index of refraction and Faraday effect.

Status: Completed

No. 480/AMD 107; FORTRAN SNG AND SNK CODES

Originator: Erwin H. Bareiss, Applied Mathematics Div.

Analyst: Erwin H. Bareiss

Programmer: John Denes

Machine: IBM 704

Description: The FLOCO SNG Code is translated into FORTRAN Language
but with (1) optional tape output, and (2) additional periodic
boundary conditions.

Status: Completed

No. 501/AMD 104A; INVESTIGATION OF TIME INTEGRATIONS IN THE
SPHERICAL LINEAR CASES OF 439/AMD 104.

Originator: Donald Flanders, Applied Mathematics Div.

Analyst: Donald Flanders

Programmer: Charles Harrison

Machine: GEORGE

Description: Certain auxilliary sums of AMD 104 are computed for
numerous values of the parameters involved.

Status: Completed

No. 505/AMD 108; AMD REPORTS

Originator: Dean Davis, Applied Mathematics Div.

Analysts: Dean Davis and Shirley Steidl

Programmer: Shirley Steidl

Machine: IBM 704

Description: Computing machine time and performance records and
programming time records are processed into forms usable
for monthly and other periodic reports.

Status: In progress.

No. 514/AMD 109; DECOMPOSITION INTO SQUARES

Originator: Harvey Cohn, Applied Mathematics Div.

Analyst: Harvey Cohn

Programmer: Alan Lemmon

Machine: GEORGE

Description: The object is to find an empirical law affecting the number N of squares required to represent

$$(a + 2b \sqrt{m}/\beta)/\beta = \sum_N [(x_i + y_i \sqrt{m})/\beta]^2$$

for $m \not\equiv 1 \pmod{4}$, $\beta = 1$, and for $m \equiv 1 \pmod{4}$, $\beta = 2$.

Status: In progress.

No. 215/BIM 2-1; STOCHASTIC THEORY OF LETHALITY.

Originator: George A. Sacher, Biological and Medical Res. Div.

Analyst: Joseph Cook

Programmers: Jean Hall and William Snow

Machine: AVIDAC

Description: A stochastic differential equation, the Langevin equation, is solved by a Monte Carlo method.

Status: Completed

No. 299/CEN 4; ISOTROPIC DIFFUSION THROUGH SPHERE

Originator: Geoffrey Goring, Chemical Engineering Div.

Analyst: Joseph Cook

Programmer: Howard House

Machine: GEORGE

Description: Given that $\frac{\partial \phi}{\partial \tau} = \frac{\partial^2 \phi}{\partial \rho^2} + \frac{2}{\rho} \frac{\partial \phi}{\partial \rho}$ for $0 \leq \rho \leq 1$, $0 < \tau$, with the boundary conditions $\phi(\rho, 0) = 1$, $\phi(1, \tau) = A + B \psi(\tau) + C \psi'(\tau)$, where $\psi(\tau) = 3 \int_0^1 \phi(\rho, \tau) \rho^2 d\rho$ the program computes $\psi(\tau)$.

Status: Completed

No. 462/CEN 101; VOLUME SUBTENDED BY INTERSECTION OF A PLANE
WITH A CYLINDER

Originator: Martin Steindler, Chemical Engineering Div.

Analyst: Shirley Steidl

Programmer: Shirley Steidl

Machine: IBM 704

Description: The volume subtended by intersection of a plane and a right circular cylinder is computed.

Status: Completed

No. 213/CHM 6; SURFACE TENSION COMPUTATION OF A BUBBLE IN
A LIQUID

Originator: Bernard Abraham, Chemistry Div.

Analysts: Richard King and Lawrence Wos

Programmer: Herbert Gray

Machine: AVIDAC and GEORGE

Description: This program computes the surface tension of a bubble in a liquid as a function of the density of the medium, the pressure within the bubble, and the radius of curvature of the bubble. The table of values is to be calculated at values of the independent variables so as to permit linear interpolation.

Status: Completed. The table is to be published.

No. 287/CHM 8A; DIFFUSION KINETICS OF THE ONE-RADIAL MODEL
FOR THE TRACK EFFECT IN A SINGLE-SOLUTE
SOLUTION

Originator: Hugo Fricke, Chemistry Div.

Analyst: Donald Flanders

Programmer: Howard House

Machine: AVIDAC

Description: The partial differential equation

$$\frac{\partial n}{\partial t} = D \left(\frac{\partial^2 n}{\partial r^2} + \frac{1}{r} \frac{\partial n}{\partial r} \right) - 2\alpha n^2 - \beta cn$$

is solved numerically for given initial and boundary conditions, and a related integral is evaluated. This is the cylindrical version of 228/CHM 8B.

Status: Completed. The results were published J. Chem. Phys. 28,6 (1958).

No. 228/CHM 8B; DIFFUSION KINETICS OF THE ONE-RADICAL
MODEL FOR THE TRACK EFFECT IN A
SINGLE-SOLUTE SOLUTION

Originator: Hugo Fricke, Chemistry Div.

Analysts: Donald Flanders and Richard King

Programmer: Howard House

Machine: AVIDAC

Description: Numerical solution of the partial differential equation

$$\frac{\partial n}{\partial t} = D \left(\frac{\partial^2 n}{\partial r^2} + \frac{2}{r} \frac{\partial n}{\partial r} \right) - 2\alpha n^2 - \beta cn$$

is effected for given initial and boundary conditions.

This is the spherical version of 287/CHM 8A.

Status: Completed. The results were published: J. Chem. Phys. 28,6 (1958)

No. 234/CHM 8C; APPROXIMATIONS FOR THE DIFFUSION KINETICS
PROBLEM OF CHM 8A, B

Originator: Hugo Fricke, Chemistry Div.

Analysts: Donald Flanders and Richard King

Programmer: Cynthia Chamot

Machine: AVIDAC

Description: Simplifying assumptions are made for 287/CHM 8A and
228/CHM 8B; truncated series approximations are used
to calculate the integrals involved.

Status: Completed

No. 235/CHM 8C; No Title

Originator: Hugo Fricke, Chemistry Div.

Analyst: Joseph Cook

Programmer: Cynthia Chamot

Machine: AVIDAC

Description: Certain transcendental functions, needed in CHM 8A and
CHM 8B, are evaluated.

Status: Completed

No. 290/CHM 10A; VAPOR PRESSURE

Originator: Darrell Osborne, Chemistry Div.

Analyst: Charles Harrison

Programmer: Charles Harrison

Machine: AVIDAC

Description: A table of vapor pressures as a function of temperature is
computed.

Status: Completed

No. 289/CHM 13; COMPUTATION OF MAGNETIC FIELD FOR BETA-RAY
SPECTROMETER

Originator: Melvin Freedman, Chemistry Div.

Analyst: William F. Miller

Programmer: Robert Julke

Machine: AVIDAC

Description: This program is for the calculation of the magnetic field generated by a specified configuration of current-carrying conductors. The conductors are arranged with axial symmetry about the spectrometer axis. The finite conductors are approximated by infinitesimal line elements.

Status: Completed

No. 466/CHM 101; EVALUATION OF FUNCTION

Originator: Theodore Novey, Chemistry Div.

Analyst: Donald Flanders

Programmer: Shirley Steidl

Machine: IBM 704

Description: A trigonometric function is tabulated for seven input parameters.

Status: Completed

No. 467/CHM 102, RANDOM WALK OF RADIATION DAMAGE IN
GRAPHITE; EXPLICIT SOLUTIONS

Originator: George Montet, Chemistry Div.

Analyst: Edward M. Keberle

Programmer: Kenneth Hillstrom

Machine: GEORGE

Description: The random walk of a source point in a squared net satisfies a difference equation which is a discrete analogue of a Poisson equation with Dirac's $-\delta$ as source. For the case of zero-values of the solution at a rectangular boundary, intricate explicit solutions of the difference equation are known. In the case of an hexagonal net, corresponding to graphite, compromises are made in order to obtain an explicit solution. A non-realistic boundary condition is chosen; it should be a good approximation, however. This is checked in 493/CHM 103 with a method not based on an explicit solution. The solutions for the square and the hexagonal net are programmed.

Status: Completed

No. 493/CHM 103; ALGEBRAIC LINEAR SYSTEM OF OVER 1000
UNKNOWN

Originator: George Montet, Chemistry Div.

Analyst: Edward M. Keberle

Programmer: Burton Garbow

Machine: GEORGE

Description: To solve problem 467/CHM 102 for arbitrary boundary conditions one can consider the elliptic difference equation as a linear algebraic system. For the physical situation at hand, a very large number of unknowns are to be taken into account. The algebraic system is solved by the method of best strategy in two steps. The second step removes the residues, corresponding to the lowest eigenvalues of the matrix, which have been left by the first step.

Status: In progress

No. 495/CHM 104; SOLUTION OF EQUATION FOR EXTRACTION
EQUILIBRIUM.

Originators: James Sullivan and Jan Rydberg, Chemistry Div

Analyst: William F. Miller

Programmer: Marilyn Hanson

Machine: IBM 704

Description: This program determines the equilibrium parameters a_n by
least squares analysis of the experimental data.

Status: In progress.

No. 498/CHM 105; LEAST SQUARES DETERMINATION OF SLATER
PARAMETERS FROM OPTICAL SPECTRA.

Originator: Mark Fred, Chemistry Div

Analyst: Erwin H. Bareiss

Programmer: Robert Julke

Machine: IBM 704

Description: Linear combinations of the Slater parameters yield the ele-
ments of a matrix whose eigenvalues approximate the spec-
trum of atoms. The Slater parameters are determined by a
method of least squares to best fit in complete sets of optical
spectra.

Status: In progress.

No. 440/EL 101; FLOATING POINT GEORGE DEVELOPMENT.

Originator: David Jacobsohn, Electronics Div

Analyst: Charles Harrison

Programmer: Charles Harrison

Machine: GEORGE

Description: The proposed floating point unit for GEORGE is simulated.

Status: In progress.

No. 508/ISNSE; SUMMER REACTOR KINETICS SYMPOSIUM PROGRAM

Originator: Gerard Pawlicki, International School of Nuclear Science and
Engineering

Analyst: N. Frank Morehouse, Jr.

Programmers: Jerald Dick and Lawrence Bryant

Machine: Analog

Description: The purpose is to develop analog equations and a series of
demonstrations to illustrate typical experiments which can
be performed on the school's reactor.

Status: In progress

No. 227/MET 6; NEUTRON DISTRIBUTION IN A FINITE CIRCULAR
CYLINDER

Originator: Frank Taraba, Metallurgy Div.

Analyst: None

Programmer: Charles Harrison

Machine: AVIDAC

Description: The neutron distribution in a three-region cylindrical
lattice cell is found.

Status: Completed

No. 233/MET 7; EIGENVALUES OF THE PRODUCT OF TWO
SYMMETRIC MATRICES

Originator: Frank Taraba, Metallurgy Div.

Analyst: Richard King

Programmer: Burton Garbow

Machine: AVIDAC

Description: Eigenvalues of the product FG of symmetric matrix G and symmetric positive-definite matrix F are computed by the following: find the matrix R of eigenvalues and Y of eigenvectors of F ; let $U = YR^{-1/2}$; then find the eigenvalues of $U^{-1}GU^T$, which are also the eigenvalues of FG .

Status: Completed

No. 231/MET 8; CRYSTAL LATTICE PARAMETER DETERMINATION
BY LEAST SQUARES

Originators: LeRoy Heaton and M. H. Mueller, Metallurgy Div.

Analyst: William F. Miller

Programmer: Willard Greenhow

Machine: AVIDAC

Description: From data on Bragg reflections the best values of crystal lattice parameters are determined by least squares determination. Corrections for absorption effects, eccentricity, and film shrinkage are included.

Status: Completed

No. 240/MET 9; LEAST SQUARES FIT TO POLYNOMIAL

Originator: S. T. Zegler, Metallurgy Div.

Analyst: William F. Miller

Programmer: Mary Anne Fisherkeller

Machine: IBM 650

Description: This program fits a set of experimental data (y_i, x_i) to the polynomial $y = a_0 + a_1x + a_2x^2 + \dots + a_nx^n$ for values of $1 \leq n \leq 14$.

Status: Completed

No. 265/MET 10; LEAST SQUARES FIT TO LINEAR FUNCTION OF
SEVERAL VARIABLES

Originators: Frank Yaggee and James Ayer, Metallurgy Div.

Analyst: William F. Miller

Programmer: Shirley Steidl

Machine: AVIDAC

Description. Given the experimental data $(y, x_1, x_2, \dots, x_n)$, where y is treated as a dependent variable and $x_1, \dots, x_n$ are independent variables, the program finds the best values of $a_0, a_1, \dots, a_n$ by fitting

$$y = a_0 + a_1x_1 + a_2x_2 + \dots + a_nx_n \quad .$$

Status: Completed

No. 269/MET 11; SOUND VELOCITIES AND DIRECTIONS OF VIBRATION
IN URANIUM CRYSTALS

Originator: Edward Fisher, Metallurgy Div.

Analyst: Joseph Cook

Programmer: Shirley Steidl

Machine: AVIDAC

Description: Given the values of six of the nine elastic constants, the sound wave velocities and directions of atom vibration for a number of different wave-propagation directions are obtained from solutions of secular equations, for different values of the remaining three elastic constants. The purpose is to determine the directions at which propagation and vibration are coincident.

Status: Completed

No. 274/MET 12; ANISOTROPIC GRAIN GROWTH IN URANIUM

Originator: Frank Taraba Metallurgy Div.

Analyst: Joseph Cook

Programmer: Howard House

Machine: GEORGE

Description: By sampling from various distributions on the set of all possible grain orientations, it is intended to predict certain experimentally observed statistics.

Status: Completed

No. 276/MET 13; LEAST SQUARES ANALYSIS

Originator: Eugene Godfredsen, Metallurgy Div.

Analyst: Joseph Cook

Programmer: Mary Anne Fisherkeller

Machine: IBM 650

Description: A least squares analysis of experimental data on temperature dependence of conductivity is made.

Status: Completed

No. 277/MET 14; TEMPERATURE DISTRIBUTION IN AN INFINITE
RIGHT-CIRCULAR CYLINDER WHERE THE THERMAL
CONDUCTIVITY IS A FUNCTION OF TEMPERATURE
AND THE HEAT GENERATION IS A FUNCTION OF
(RADIAL) POSITION

Originator: Frank Taraba, Metallurgy Div.

Analysts: Erwin H. Bareiss, Donald A. Flanders and Edward M. Keberle

Programmers: Edward M. Keberle and Howard House

Machine: GEORGE

Description: The problem solves the diffusion equation with temperature-dependent conductivity coefficient and source term. The latter is a given polynomial in the radius. The conductivity coefficient as a function of temperature is given as a table. A least-squares fit here leads to a polynomial, so that explicit integration is possible. The problem is thus reduced to finding the roots of a polynomial equation. Large amounts of input and output are required.

Status: Completed

No. 306/MET 15; FOURIER ANALYSIS OF NEUTRON DIFFRACTION
DATA

Originator: LeRoy Heaton, Metallurgy Div.

Analysts: William F. Miller and Nancy Siljander

Programmer: Nancy Siljander

Machine: GEORGE

Description: This program is the GEORGE version of AVIDAC's MET 5,
with extension to higher harmonics.

Status: Completed

No. 416/MET 101; NEUTRON DISTRIBUTION IN A FINITE CIRCULAR
CYLINDER

Originator: Frank Taraba, Metallurgy Div.

Analyst: Joseph Cook

Programmer: Charles Harrison

Machine: GEORGE

Description: The neutron flux distribution in a cylindrical three-region
cell, consisting of fuel, spacer, and moderator, is computed
by a modified diffusion equation.

Status: Completed

No. 441/MET 103; THERMAL DISTRIBUTION IN AN INFINITE RIGHT-CIRCULAR CYLINDER

Originator: Frank Taraba, Metallurgy Div.

Analysts: Erwin H. Bareiss and Edward M. Keberle

Programmer: Howard House

Machines: GEORGE and IBM 704

Description: The differential equation

$$\nabla \cdot k(T) \nabla T + S(r) = 0,$$

where $k(T)$ is an empirical function, sectionally approximated by polynomials, is solved by polynomial approximations for the maximum temperature T in the center of the cylinder.

Status: Completed

No. 481/MET 106; TEMPERATURE DISTRIBUTION IN AN INFINITE CIRCULAR CYLINDER

Originator: J. Howard Kittel, Metallurgy Div.

Analyst: Erwin H. Bareiss

Programmers: Howard House and Mary Anne Fisherkeller

Machines: GEORGE and IBM 704

Description: The differential equation

$$\text{div } k(T) \text{ grad } T + S(r) = 0,$$

where

$k(T)$ is a linear function of T and
 $S(r)$ a rational function of r ,

is solved for 630 different boundary conditions. The functions $k(T)$ are obtained by a least squares fit.

Status: Completed

No. 280/PAD 3A, 281/PAD 3B; FOSSITRON TRANSFORMATIONS

Originators: Edwin Crosbie and Lee Teng, Particle Accelerator Div.

Analyst: Anthony Strecok

Programmer: Anthony Strecok

Machine: AVIDAC

Description: Algebraic transformations are applied sequentially to phase space points.

Status: Completed

No. 284/PAD 6; EQUILIBRIUM ORBIT CALCULATION FOR ARGONNE
SYNCHROTRON

Originator: Edwin Crosbie, Particle Accelerator Div.

Analyst: William F. Miller

Programmer: Burton Garbow

Machine: GEORGE

Description: This program calculates the position and length of the equilibrium orbit for the Argonne Synchrotron as a function of energy.

Status: Completed

No. 308/PAD 7; SYNCHROTRON OSCILLATION AND FREQUENCY
ERRORS

Originator: Lee Teng, Particle Accelerator Div.

Analyst: Lawrence Wos

Programmer: Gerald Duffy

Machine: GEORGE

Description: This program computes the RF phase angle, the energy deviation from the equilibrium value and the increment in equivalent radius of the orbit for a simplified version of the ANL synchrotron, consisting of eight identical sectors with symmetric magnets.

Status: Completed

No. 424/PAD 102; BETATRON OSCILLATION OF SECTORIAL
CYCLOTRONS

Originator: Lee Teng, Particle Accelerator Div.

Analyst: Lawrence Wos

Programmer: Robert Julke

Machine: IBM 704

Description: This program is a parameter study relative to particle accelerator development.

Status: Completed

No. 459/PAD 103, SELF-TRACKING STUDIES

Originator: Edwin Crosbie, Particle Accelerator Div.

Analyst: Lawrence Wos

Programmer: Mary Anne Fisherkeller

Machine: GEORGE

Description: This program calculates the proportionality constants which lead to damping, of the average phase and average radius, to the ideal case for randomly sampled phases and radii.

Status: In progress

No. 211/PHY 29A; CENTER OF MASS CORRECTIONS FOR SCATTERING
OF NEUTRONS BY GAS MOLECULES USING GAUSSIAN
NEUTRON SPECTRUM

Originators: G. Roy Ringo and Victor Krohn, Physics Div.

Analyst: William F. Miller

Programmer: Robert Julke

Machine: AVIDAC

Description: Evaluate the integral

$$f(o,A) = \int_0^\infty \int_0^\infty \frac{\epsilon(x) \exp - \left\{ \frac{\left(x^2 - y^2 \frac{A-1}{A+1} - \frac{2xy \cos \theta}{A+1} \right)^2}{\frac{4A}{(A+1)^2} R (x^2 + y^2 - 2xy \cos \theta)} + y^2 \right\}}{\sqrt{x^2 + y^2 - 2xy \cos \theta}} x^2 y^2 dx dy$$

for $\theta = 45^\circ$ and 135° for various values of A and for specified $\epsilon(x)$.

Status: Completed

No. 444/PHY 29B; CENTER OF MASS CORRECTIONS FOR SCATTERING
OF NEUTRONS BY GAS MOLECULES USING EMPIR-
ICAL NEUTRON SPECTRUM

Originator: G. Roy Ringo, Physics Div.

Analyst: William F. Miller

Programmer: Robert Julke

Machine: AVIDAC

Description: This program calculates the relative angular distribution
for scattering of neutrons by gas molecules using an
empirical neutron spectrum.

Status: Completed

No. 248/PHY 33, 33B; No Title

Originator: Lowell Bollinger, Physics Div.

Analyst: None

Programmer: Anthony Strecok

Machine: AVIDAC

Description: A table of integrals is computed; the integrands are functions
of Doppler Integrals.

Status: Completed

No. PHY 34, 35; LEAST SQUARES ANALYSIS OF OPTICAL DATA

Originator: William F. Miller, Physics Div.

Analyst: William F. Miller

Programmers: Diana Satkus, Mary Anne Fisherkeller

Machine: AVIDAC

Description: Measurements of such optical quantities as index of refraction and Verdet's Constant (Faraday Effect) are analyzed by least squares fitting to polynomials in $(1/\lambda)^2$, where λ is the wavelength of the incident light. The coefficients are moments of the oscillator strengths to the various levels.

Status: Completed

No. 210/PHY 36; A PARTITION PROBLEM IN STATISTICAL MECHANICS

Originator: Norbert Rosenzweig, Physics Div.

Analyst: William F. Miller

Programmer: Mary Anne Fisherkeller

Machine: AVIDAC

Description: Given two positive numbers, N and E , and the infinite set, S , of positive numbers $\epsilon_1, \epsilon_2, \dots$, solve the following two simultaneous equations for α and β :

$$N = N(\alpha, \beta) = \sum_{i=1}^{\infty} \frac{1}{1 + \exp(-\alpha + \beta \epsilon_i)}$$

$$E = E(\alpha, \beta) = \sum_{i=1}^{\infty} \frac{\epsilon_i}{1 + \exp(-\alpha + \beta \epsilon_i)} + \frac{1}{e^{\beta} - 1}.$$

Having found α and β , calculate

$$T'(N, E) = \frac{e^{f(\alpha, \beta)}}{2 \pi D},$$

where

$$f(\alpha, \beta) = E \beta - N \alpha - \log(1 - e^{-\beta}) + \sum_{i=1}^{\infty} \ln[1 + \exp(\alpha - \beta \epsilon_i)],$$

$$D^2 = \frac{e^{\beta}}{(e^{\beta} - 1)^2} \sum_{i=1}^{\infty} p_i + \left(\sum_{i=1}^{\infty} p_i \right) \left(\sum_{i=1}^{\infty} p_i \epsilon_i^2 \right) - \left(\sum_{i=1}^{\infty} p_i \epsilon_i \right)^2,$$

and

$$p_i = \frac{\exp(-\alpha + \beta \epsilon_i)}{[1 + \exp(-\alpha + \beta \epsilon_i)]^2}.$$

Status: Completed

No. 207/PHY 37; ATTENUATION COEFFICIENTS FOR ANGULAR COR-
RELATION MEASUREMENTS

Originator: Louise Meyer, Physics Div.

Analyst: Joseph Cook

Programmer: Anthony Strecok

Machine: AVIDAC

Description: Attenuation coefficients for correcting angular distribution measurements for the effect of finite solid angle are computed as a function of crystal size, distance, and efficiency, as well as of gamma-ray energy.

Status: Completed

No. 232/PHY 38; MULTIPLE SCATTERING CORRECTIONS FOR NEUTRONS
IN THIN PLATES

Originators: Raymond Lane and Alexander Langsdorf, Physics Div.

Analyst: William F. Miller

Programmer: William J. Snow

Machine: AVIDAC

Description: The observed angular distribution of cross section is corrected for multiple scattering by the Monte Carlo method. It is assumed that the incident neutron beam is homogeneous, that the dimensions of the scattering volume are small compared with the distances to the detectors, and the dimensions of the plate are large compared to the reciprocal cross section. Polarization of the incident and scattered beams is not considered, and the energy loss in scattering is considered to be classical-elastic. The effect of change of cross section with energy is taken into account.

Status: Completed

No. 230/PHY 39; NEUTRON CROSS-SECTION CALCULATION FROM
RESONANCE PARAMETERS

Originator: Lowell Bollinger, Physics Div.

Analyst: William F. Miller

Programmer: Anthony Strecok

Machine: AVIDAC

Description: The program calculates neutron cross sections from resonance parameters. It enables one to determine resonance parameters from experimental data by adjusting the parameters (trial and error) until the calculated cross sections agree with the experimental ones. Due to the limited capacity of AVIDAC it was not possible to effect a least squares fitting program.

Status: Completed

No. 264/PHY 40; TABLES OF CHARGED PARTICLE PENETRABILITIES

Originator: John Schiffer, Physics Div.

Analyst: William F. Miller

Programmer: Loretta Kassel

Machine: IBM 650

Description: The Coulomb functions A_l^2 are calculated over a limited range of parameters for use in analysis of experimental data. The approximate formulas for the Coulomb functions as given by Feshbach, Shapiro, and Weisskopf are used.

Status: Completed. Results published: ANL-5739 (June, 1957)

No. 270/PHY 41; π -MESON SCATTERING

Originator: Melvin Ferentz, Physics Div.

Analyst: Joseph Cook

Programmer: Diana Satkus

Machine: GEORGE

Description: It is attempted to predict, by a Monte Carlo computation, experimental data of Mitin and Grigorev on inelastic scattering of 300-Mev π -mesons by complex nuclei.

Status: Completed

No. 271/PHY 42; STUDIES OF THE WEIGHT MATRIX FOR FITTING IN
LEGENDRE POLYNOMIALS

Originator: James Monahan, Physics Div.

Analyst: William F. Miller

Programmer: Gerald Duffy

Machine: AVIDAC

Description: This program computes the inverse of the matrix

$$(b_{ij}) = \left[\sum_{k=1}^S p_i(\mu_k) p_j(\mu_k) \right] ,$$

where $\mu_k = \cos \theta_k$ and $p_\ell(\mu)$ is the ℓ^{th} Legendre polynomial.

Status: Completed

No. 272/PHY 43; SOLUTION OF THE OCCUPATIONAL PROBLEM FOR
ONE KIND OF PARTICLE AT LOW VALUES OF THE
EXCITATION ENERGY

Originator: Norbert Rosenzweig, Physics Div.

Analyst: William F. Miller

Programmer: Willard Greenhow

Machine: AVIDAC

Description: The level density function

$$C(g, x [Q, g, n]) = \frac{g e^{x \sqrt{2x/3}}}{\sqrt{48x}}$$

$$gx = g Q + \frac{g^2}{12} - \frac{1}{2} (n - g/2)^2$$

is tabulated.

Status: Completed. Results contained in Phys. Rev. 108, 817 (1957)

No. 275/PHY 44; TABULATION OF NUCLEAR LEVEL DENSITIES

Originator: Norbert Rosenzweig, Physics Div.

Analyst: William F. Miller

Programmer: Mary Ann Fisher-Keller

Machine: AVIDAC

Description: This program tabulates the following function of seven variables:

$$C(g, \lambda, h, k, n, p, Q) = \frac{\exp \left[g \sqrt{\frac{2}{3}} \left(\frac{g}{\lambda} + \frac{h}{k} \right) x \right]}{y}$$

$$x = Q + \frac{g\lambda}{12} - \frac{\lambda}{2g} \left(n - \frac{g}{2} \right)^2 + \frac{kh}{12} - \frac{k}{2h} \left(p - \frac{h}{2} \right)^2$$

$$y = g \left[\frac{(216) x^5 \left(\frac{g}{\lambda} \right)^2 \left(\frac{h}{g} \right)^2}{\left(\frac{g}{\lambda} + \frac{h}{k} \right)^3} \right]^{1/4}$$

Status: Completed. Results contained in Phys. Rev. 108, 817 (1957)

No. 283/PHY 45; COMPUTATION OF ERRORS OF CROSS-SECTION PARAMETERS

Originator: Lowell Bollinger, Physics Div.

Analyst: William F. Miller

Programmer: Robert Julke

Machine: AVIDAC

Description: This program computes the errors in cross-section parameters derived from the area analysis.

Status: Completed

No. 296/PHY 46A; SORTING AND CORRECTIONS FOR NEUTRON
SCATTERING ANGULAR DISTRIBUTION DATA

Originator: Raymond Lane, Physics Div.

Analyst: William F. Miller

Programmer: William Snow

Machine: GEORGE

Description: This program accepts the output data from the Van de Graaff output system, sorts the data by material, interprets the counts, corrects for background and efficiency, prepares tape for subsequent programs, diagnoses data for omissions, and converts data for print up.

Status: Completed

No. 435/PHY 46B; CONVERSION OF NEUTRON COUNTS AND FITTING
TO LEGENDRE POLYNOMIALS

Originator: Raymond Lane, Physics Div.

Analyst: William F. Miller

Programmer: William Snow

Machine: GEORGE

Description: This program accepts as input the tape prepared by PHY 46A, multiplies the counts by a multiple scattering correction factor, computes from the "Standard" the factor for converting counts to cross sections, fits by least squares the counts of the samples to a series of Legendre Polynomials, computes the Chi Square for the fit, converts the coefficients representing counts to coefficients representing cross sections, and computes the probable errors in the coefficients.

Status: Completed

No. 425/PHY 46C; MULTIPLE SCATTERING CORRECTIONS FOR
NEUTRON SCATTERING DATA

Originator: Raymond Lane, Physics Div.

Analyst: William F. Miller

Programmer: Nancy Siljander

Machine: GEORGE

Description: This program is the GEORGE version of PHY 38 with extension to more angles, alterations in the calculation of the scattering volume, and calculation of the errors in the correction factors.

Status: In progress

No. 452/PHY 46D; CENTER OF MASS CONVERSION

Originator: Raymond Lane, Physics Div.

Analyst: William F. Miller

Programmer: Kenneth Hillstrom

Machine: GEORGE

Description: This program converts cross sections from the Laboratory system to the center of mass system, or conversely. Also it converts coefficients for expansion of the cross sections from laboratory system to center of mass and conversely.

Status: Completed

No. 298/PHY 47; CALCULATION OF PENETRATION FACTORS

Originator: John Schiffer, Physics Div.

Analyst: William F. Miller

Programmer: Willard Greenhow

Machine: GEORGE

Description: This program calculates Coulomb penetration factors by asymptotic expansion.

Status: Completed

No. 300/PHY 48; COMPREHENSIVE CHOPPER DATA ANALYSIS

Originator: Lowell Bollinger, Physics Div.

Analysts: Loretta Kassel, and William F. Miller

Programmer: Loretta Kassel

Machine: GEORGE

Description: This program calculates transmission factors and cross sections, with the respective errors, from chopper data, making dead time and background corrections. This is the GEORGE version of PHY 27.

Status: Completed

No. 302/PHY 49; READ OUT AND CONVERSION

Originator: Lowell Bollinger, Physics Div.

Analyst: William F. Miller

Programmer: Kenneth Hillstrom

Machine: GEORGE

Description: This program interprets and converts chopper data into decimal form.

Status: Completed

No. 303/PHY 50; SUM OF DATA TAPES

Originator: Lowell Bollinger, Physics Div.

Analyst: William F. Miller

Programmer: Nancy Siljander

Machine: GEORGE

Description: This program combines the data recorded on separate tapes onto one tape.

Status: Completed

No. 304/PHY 51; FITTING ANGULAR DISTRIBUTIONS TO LEGENDRE
POLYNOMIALS

Originator: John Schiffer, Physics Div.

Analyst: William F. Miller

Programmer: Kenneth Hillstrom

Machine: GEORGE

Description: This program fits angular distributions by least squares and computes the errors on the coefficients.

Status: Completed

No. 305/PHY 52; EVALUATION OF SCATTERING INTEGRAL

Originator: Louise Meyer, Physics Div.

Analyst: William F. Miller

Programmer: Anthony Strecok

Machine: GEORGE

Description: This program evaluates the integral

$$F(N_i, w_i) = \frac{1}{\pi} \int_{-128}^{128} \frac{e^{\frac{-N_i}{4x^2 + 1}}}{4(x - w_i)^2 + 1} dx$$

Status: Completed.

No. 401/PHY 101; DATA RATIO GENERATOR

Originator: Lowell Bollinger, Physics Div.

Analysts: William F. Miller, and Anthony Strecok

Programmer: Anthony Strecok

Machine: GEORGE

Description: Two binary chopper data tapes are merged into one decimal tape and scaled ratios of corresponding quantities are computed.

Status: Completed

No. 408/PHY 102; ABRAHAM SCATTERING CALCULATIONS

Originators: Carroll Trail and Sol Raboy, Physics Div.

Analyst: David Phillips

Programmer: David Phillips

Machine: GEORGE

Description: A system of 3 nonlinear transcendental equations in 5 variables (3 are functions of energy, the other 2 are angles) is solved numerically for 3 of the variables as functions of the other 2.

Status: Completed

No. 412/PHY 103; CROSS SECTIONS FOR SCATTERING OF ELECTRONS
BY POSITRONS

Originator: Kenneth Smith, Physics Division

Analyst: William F. Miller

Programmer: Diana Satkus

Machine: IBM 704

Description: This program calculates the phase shifts, total cross sections, and scattering function for given potentials by numerical integration of the radial wave equation.

Status: Terminated

No. 417/PHY 104; ERRORS IN CROSS-SECTION PARAMETERS

Originator: Lowell Bollinger, Physics Div.

Analyst: William F. Miller

Programmer: Nancy Siljander

Machine: GEORGE

Description: This program is the GEORGE version of PHY 45.

Status: Completed

No. 422/PHY 105; CALCULATION OF PATH LENGTH THROUGH A
UNIFORM FIELD SECTOR MAGNET

Originator: Robert Holland, Physics Div.

Analysts: Burton Garbow, and William F. Miller

Programmer: Burton Garbow

Machine: IBM 704

Description: This program calculates the path lengths for charged
particles in the field of a magnet designed as uniform field
sector magnets with fringing field focusing.

Status: Completed

No. 423/PHY 106; LEVEL DENSITIES BASED ON THE SHELL MODEL

Originator: Norbert Rosenzweig, Physics Div.

Analyst: William F. Miller

Programmer: Shirley Steidl

Machine: IBM 704

Description: This program finds the minimum of a function of four inde-
pendent variables where the function is given as a finite series.

Status: Terminated

No. 426/PHY 107; LORENTZ SCATTERING CALCULATIONS

Originators: Carroll Trail and Sol Raboy, Physics Div.

Analyst: David Phillips

Programmer: Howard House

Machine: GEORGE

Description: Three transcendental functions of two variables are
evaluated at the grid points of a certain rectangular
region.

Status: Completed

No. 429/PHY 108; ENERGY LEVELS OF AN ATOM IN AN EXTERNAL
MAGNETIC FIELD

Originator: Leonard Goodman, Physics Div.

Analyst: William F. Miller

Programmer: Gerald Duffy

Machine: GEORGE

Description: This program finds the eigenvalues and eigenvectors of
the Hamiltonian for an atom in an external magnetic field.

Status: Completed

No. 434/PHY 109; PROCESSING DECAY SCHEME DATA

Originator: Gilbert Perlow, Physics Div.

Analyst: William F. Miller

Programmer: Howard House

Machine: GEORGE

Description: This program accepts the output from the counting experiments, interprets the counts, makes dead time corrections, calculates the decay rates as a function of time, makes background corrections, and calculates the standard deviations for the rates.

Status: Completed

No. 438/PHY 110, FITTING TO MODIFIED LEGENDRE POLYNOMIALS

Originator: John Schiffer, Physics Div.

Analyst: William F. Miller

Programmer: Kenneth Hillstrom

Machine: GEORGE

Description: This program is a modification of PHY 51 which takes into account the finite aperture of the detectors.

Status: Completed

No. 450/PHY 111; DETERMINATION OF EIGENVALUES AND
EIGENVECTORS FOR SEVERAL MATRICES

Originator: James Raz, Physics Div. Consultant

Analyst: Burton Garbow

Programmer: Burton Garbow

Machine: GEORGE

Description: Eigenvalues and eigenvectors of the weighted sum of three symmetric matrices are computed for various weights.

Status: Completed

No. 451/PHY 112; A PROBABILITY INTEGRAL

Originator: Norbert Rosenzweig, Physics Div.

Analysts: Robert Julke and William F. Miller

Programmer: Robert Julke

Machine: GEORGE

Description: The integral

$$2/\pi \int_0^{\pi/2} \exp(-\alpha^2 \sin^2 \theta) d\theta$$

is computed for various values of α .

Status: Completed

No. 454/PHY 113; DISTRIBUTION OF LEVEL SPACINGS

Originator: Norbert Rosenzweig, Physics Div.

Analyst: Joseph Cook

Programmer: Herbert Gray

Machine: GEORGE

Description: Symmetric matrices are sampled from given probability distributions and studies made of the distributions of their eigenvalues.

Status: In progress

No. 457/PHY 114; NUCLEAR RESONANCE PARAMETERS

Originator: Lowell Bollinger, Physics Div.

Analyst: William F. Miller

Programmer: Anthony Strecok

Machine: GEORGE

Description: This program is an extension of PHY 38 to cover a much wider range of parameters.

Status: Completed

No. 458/PHY 115, ANGULAR DISTRIBUTIONS FOR STRIPPING REACTIONS

Originator: John Schiffer, Physics Div.

Analyst: William F. Miller

Programmer: Loretta Kassel

Machine: GEORGE

Description: This program calculates the angular distribution of the cross section for a stripping reaction from Butler's theory for given values of angular momentum, energy, and nuclear parameters.

Status: Completed

No. 461/PHY 116; FIELD FOR RECTANGULAR CROSS-SECTION
"HELMHOLTZ" COILS WITH UNIFORM CURRENT
DENSITY

Originator: Sidney Warshaw, Physics Div.

Analyst: Edward M. Keberle

Programmer: Nancy Siljander

Machine: GEORGE

Description: The components of the magnetic field parallel to the central axis of two coils has to be calculated along this axis and perpendicular to it. The appearing integral reduces in the first case to an explicit expression. This is not so, however, because of the appearance of elliptic integrals in the integrand, in the second case. Because of the large input, both cases are programmed.

Status: Completed

No. 461/PHY 116; z-COMPONENT OF MAGNETIC FIELD OF SEMI-
INFINITE CYLINDER WITH UNIFORM CURRENT
DENSITY

Originator: Juergen Heberle, Physics Div.

Analyst: Edward M. Keberle

Programmer: Nancy Siljander

Machine: GEORGE

Description: This is an extension of the program with "Helmholtz" coils and tabulation of the function for the general case.

Status: In progress

No. 464/PHY 117; SMOOTHING AND CORRECTION OF DATA FROM
CHOPPER

Originator: J. Patricia Marion, Physics Div.

Analyst: Charles Harrison

Programmer: Charles Harrison

Machine: GEORGE

Description: Data from the chopper are smoothed by averaging over
several successive points, and corrections are made for
errors in the recording equipment.

Status: Completed

No. 489/PHY 120; FIELD CALCULATIONS FOR COMPTON
SPECTROMETER

Originator: Richard Preston, Physics Div.

Analyst: William F. Miller

Programmer: Kenneth Hillstrom

Machine: GEORGE

Description: This program calculates the equipotential surfaces for the
the field of a spectrometer by numerical integration of
Laplace's equation with certain initial conditions.

Status: In progress

No. 499/PHY 121; CALCULATION OF DECAY TIMES FROM COINCIDENCE
EXPERIMENTS

Originator: Robert Holland, Physics Div.

Analyst: David Phillips

Programmer: Willard Greenhow

Machine: GEORGE

Description: An integral equation of the first kind is given. The solution is known to be of the form $c e^{-\lambda t}$, where c and λ are constants. The decay constant λ is determined by the method of moments.

Status: In progress

No. 515/PHY 123; STATISTICAL PROPERTIES OF THE EIGENVALUES
OF RANDOM MATRICES

Originator: Norbert Rosenzweig, Physics Div.

Analyst: Lawrence Wos

Programmer: Herbert Gray

Machine: GEORGE

Description: This program calculates the distribution of the "reduced spacing" of adjacent eigenvalues for several collections of random matrices.

Status: Completed. Results intended for publication.

No. 509/RE; EBWR CONTROL SYSTEM STUDIES

Originator: James DeShong, Reactor Eng. Div.

Analyst: Carlo Pesce

Programmers: Carlo Pesce and Jerald Dick

Machine: Analog

Description: The purpose is to study various control systems for EBWR.

Status: In progress

No. 513/RE; SEN EVALUATION STUDIES

Originator: Leonard Link, Reactor Eng. Div.

Analyst: N. Frank Morehouse, Jr.

Programmer: Jerald Dick

Machine: Analog

Description: This is a series of fuel burnout studies for the SEN evaluation project.

Status: Completed

No. 522/RE; URANIUM FUEL BURNOUT STUDIES FOR MIGHTY MOUSE

Originator: David Rossin, Reactor Eng. Div.

Analyst: Jerald Dick

Programmer: Jerald Dick

Machine: Analog

Description: This is a series of parameter studies on fuel burnout in a Uranium Reactor.

Status: Completed

No. 262/RE 34; REACTOR SHIELDING

Originator: Marshall Grotenhuis, Reactor Eng. Div.

Analyst: Joseph Cook

Programmer: Margaret Butler

Machine: IBM 704

Description: The diffusion equation $D\nabla^2\phi - \sigma\phi + Q = 0$ is solved for three different geometries.

Status: In progress

No. 236/RE 37; CONVECTION COOLING OF REACTOR

Originator: Thomas Bump, Reactor Eng. Div.

Analysts: Richard King and William F. Miller

Programmer: Charles Harrison

Machine: AVIDAC

Description: The system of partial differential equations which describe the temperatures and flow rates of the coolant in a reactor is approximated by a system of coupled ordinary differential equations.

Status: Completed

No. 226/RE 40; ANNULAR REACTOR

Originator: Charles N. Kelber, Reactor Eng. Div.

Analyst: Joseph Cook

Programmers: Herbert Gray and Mary Anne Fisherkeller

Machine: AVIDAC

Description. The neutron flux distribution in a reactor of annular cylindrical shape is found by a two-group iteration method.

Status: Completed

No. RE/41; A REACTOR FLUX CALCULATION

Originator: William Reardon, Reactor Eng. Div.

Analyst: William Snow

Programmer: William Snow

Machine: AVIDAC

Description. A weighted sum of fluxes is calculated.

Status: Completed

No. 225/RE 42B; CALIBRATION OF NEUTRON SPECTROMETER

Originator: Harold Greenspan, Reactor Eng. Div.

Analyst: Joseph Cook

Programmer: Burton Garbow

Machine: AVIDAC

Description: A Monte Carlo estimate is obtained of the per cent of neutrons counted from among the total number entering the spectrometer.

Status: Completed

No. 293/RE 47; FOURIER ANALYSIS AND SYNTHESIS

Originator: Henry Sandmeier, Reactor Eng. Div.

Analyst: Edwin H. Bareiss

Programmer: Mary Anne Fisherkeller

Machine: IBM 650

Description: The first six harmonics are determined for any given discrete set of equally spaced points. Optional is the Fourier synthesis at the given points and the mid-points for up to six harmonics.

Status: Completed

No. 420/RE 108; FOURIER ANALYSIS AND SYNTHESIS

Originator: Rodney Mattson, Reactor Eng. Div.

Analyst: Erwin H. Bareiss

Programmer: Mary Anne Fisherkeller

Machine: IBM 650

Description: Problem 293/RE 47 has been extended to determine any six successive higher harmonics. The last interval may be smaller than the previous ones.

Status: Completed

No. 427/RE 110; COMPUTATION OF EXCESS REACTIVITY FROM
KINETICS EQUATIONS AND THE EXPERIMENTAL
FLUX-TIME CURVE

Originator: Jerry J. Kaganove, Reactor Eng. Div.

Analyst: Erwin H. Bareiss

Programmer: Cynthia Chamot

Machine: IBM 704

Description: The numerical method is based on the analytical solutions given in References 1 and 2. Interpolation of the flux is performed up to fourth order (Newton's, Everetts', and Gauss' formulas). Specific integration formulas are devised. Output lists excess reactivity k_{ex} , dk_{ex}/dt , d^2k_{ex}/dt^2 ; total neutron flux n , $n/(dn/dt)$, and the corresponding error estimations.

References:

1. ANL-5577, Appendix C(p. 26).
2. Memo from J. J. Kaganove to R. O. Brittan (Sept. 16, 1957).

Status: In progress

No. 433/RE 115; REACTOR SAFETY CALCULATION

Originator: David Okrent, Reactor Eng. Div.

Analysts: Roger Lazarus and Joseph Cook

Programmers: Roger Lazarus, Diana Satkus and Mark Wells

Machine: IBM 704

Description: The behavior of an idealized, spherically symmetric reactor, exploding under its own internally generated pressures, is predicted.

Status. Completed

No. 436/RE 116; COMPUTATION OF SCATTERING RATES IN THERMAL REGIONS

Originator: Vytautas Jankus, Reactor Eng. Div.

Analyst: Erwin H. Bareiss

Programmer: Anthony Strecok

Machine: GEORGE

Description: Given:

$$G(x \rightarrow y) = \frac{y}{x} e^{-\left[\frac{y^2 - x^2}{2}\right]} \cdot s(x, y)$$

$$s(x, y) = \theta^2 \left[e^{1/2(x^2 - y^2)} \left\{ \operatorname{erf}(\theta x - \zeta y) \pm \operatorname{erf}(\theta x + \zeta y) \right\} + e^{1/2(y^2 - x^2)} \left\{ \operatorname{erf}(\theta y - \zeta x) \mp \operatorname{erf}(\theta y + \zeta x) \right\} \right],$$

where the upper (lower) sign is used when $y > x$ ($y < x$).
A code is developed which computes

$$\int_{x_1}^{x_2} N(x) \int_{y_1}^{y_2} G(x \rightarrow y) dy dx / \int_{x_1}^{x_2} xN(x) dx,$$

where $N(x)$ may be 1 or any function furnished by a subroutine.

Status: In progress

No. 442/RE 117; MODIFICATIONS OF RE 102, SNG, FOR THE 704

Originator: Walter B. Loewenstein, Reactor Eng. Div.

Analysts: Erwin H. Bareiss and David Phillips

Programmer: Diana Satkus

Machine: IBM 704

Description: The Los Alamos SNG code is adjusted for reflecting boundaries in plane geometry.

Status: Completed

No. 446/RE 119; AUTO-CORRELATION AND POWER-SPECTRUM
ANALYSIS

Originator: Joseph Thie, Reactor Eng. Div.

Analysts: Mary Anne Fisherkeller and Joseph Cook

Programmer: Mary Anne Fisherkeller

Machine: IBM 704

Description: A set of time-series data from EBWR are analyzed by SHARE
program NY CP2.

Status: Completed

No. 455/RE 123; CROSS-SECTION MEANS

Originator: Peter Moldauer, Reactor Eng. Div.

Analyst: Joseph Cook

Programmer: Robert Julke

Machine: GEORGE

Description. Cross sections are averaged over a distribution of resonances.

Status. Completed:

No. 502/RE 141; TABULATION OF THE INTEGRAL OF COHEN'S
FORMULA FOR INELASTIC SCATTERING

Originator: Vytautas Jankus, Reactor Eng. Div.

Analyst: Erwin H. Bareiss

Programmer: Diana Satkus

Machine: IBM 704

Description: The functions

$$F_a(x,y) = \theta^2/x \left\{ \exp(x^2 - y^2) \operatorname{erf}(\theta x - \zeta y) + \operatorname{erf}(\theta y - \zeta x) \right\}$$

$$F_b(x,y) = \theta^2/x \left\{ \exp(x^2 - y^2) \operatorname{erf}(\theta x + \zeta y) - \operatorname{erf}(\theta y + \zeta x) \right\}$$

were integrated analytically with respect to y by the originator. Numerical values of the resulting formulas are tabulated as functions of x and y:

$$I_a(x,y) = \int_0^y F_a \, dy$$

$$I_b(x,y) = \int_0^y F_b \, dy$$

Status: Completed

No. 516/RE 142; NEUTRON CAPTURE CROSS-SECTION COMPUTATION

Originator: Peter Moldauer, Reactor Eng. Div.

Analyst: Lawrence Wos

Programmer: Mary Anne Fisherkeller

Machine: GEORGE

Description: The program computes the neutron capture cross sections averaged over many resonances in the energy region up to several Mev, based on low energy resonance parameters.

Status: In progress

No. 517/RE 143; CALCULATIONS OF INELASTIC MATRIX ELEMENTS
FOR A MONOATOMIC MODERATOR

Originator: Vytautas Jankus, Reactor Eng. Div.

Analyst: Erwin H. Bareiss

Programmer: Diana Satkus

Machine: IBM 704

Description: This is a numeric-analytic double integration of Cohen's formula, i.e. $G(x,y) = F_a(x,y) \pm F_b(x,y)$. Definitions are given in problem 502/RE 141.

Status: Completed

No. 521/RE 145; CALCULATION OF MICROSCOPIC CROSS SECTIONS
WITH ARBITRARY LAWS OF NEUTRON DISTRIBUTION
FOR DIRECT INPUT TO THE TRANSPORT THEORY
CODE

Originator: Vytautas Jankus, Reactor Eng. Div.

Analyst: Erwin H. Bareiss

Programmer: John Denes

Machine: IBM 704

Description: This code finds inelastic cross-section matrix elements for for multigroup calculations by numeric-analytic double integration of Cohen's formula. Several approximations to the actual neutron density can be used as weight functions over the velocities of the initial groups. Modified and supplemented results are presented on binary cards and/or tape for direct input to the Argonne Transport Theory Codes or the SNG CODE, or for off-line output.

Status: In progress

No. 218/RPY 3; EFFICIENCIES AND PHOTOFRACTIONS OF NaI
CRYSTALS

Originator: John C. Reynolds, Radiological Physics Div.

Analyst: William F. Miller

Programmer: William Snow

Machine: AVIDAC

Description: The efficiencies and photofractions for monoenergetic gamma rays incident on sodium iodide crystals of various sizes are calculated by the Monte Carlo method. The program is constructed so that different sources can be employed.

Status: Completed. The results were published: Rev. Sci. Instr. 28,
717 (1957).

No. RPY 4; ANALYSIS OF PLUME PROFILE FOR SMOKE PLUMES

Originators: Harry Moses and Gordon Strom, Radiological Physics Div.

Analyst: William F. Miller

Programmer: Willard Greenhow

Machine: AVIDAC

Description: Parameters characterizing the vertical and horizontal visual profiles of smoke plumes as seen on multiple films are calculated from film measurements.

Status: Completed

No. 278/RPY 5; DECAY SCHEME ANALYSIS

Originator: Andrew Stehney, Radiological Physics Div.

Analyst: William F. Miller

Programmer: Robert Julke

Machine: AVIDAC

Description: This program is for fitting decay rates to linear combinations of exponentials by the least squares method using the Gauss linearization. Good initial guesses are required.

Status: Completed

No. 301/RPY 6; LAGRANGIAN TURBULENCE CORRELATION

Originator: Paul Frenzen, Radiological Physics Div.

Analyst: Joseph Cook

Programmer: Cynthia Chamot

Machine: GEORGE

Description: Data from a study of turbulent diffusion in the Argonne Meteorological Model Towing Tank is processed

Status: Completed

No. 494/RPY 108; DETERMINATION OF SOIL MOISTURE FROM SOIL TEMPERATURE DATA

Originator: Harry Moses, Radiological Physics Div.

Analysts: Erwin H. Bareiss and Edward Keberle

Programmer: Mary Anne Fisherkeller

Machine: IBM 704

Description: This problem is a theoretical investigation on the feasibility of calculating soil moisture from soil-temperature measurements. The main results are summarized in AMD Technical Memorandum No. 4.

Status: Completed

No. 496/RPY 109; TABULATION OF ELECTRON ENERGY DISTRIBUTION
FUNCTION

Originator: Joseph C. Bowe, Radiological Physics Div.

Analyst: Erwin H. Bareiss

Programmer: Marilyn Hanson

Machine: GEORGE

Description: The electron energy distribution functions are computed for gas with constant electron transport cross sections. Tabulation is for the parameters σ , (e, E) , $k T$, ϵ .

Status: Completed

No. 497/RPY 110; COMPUTATION OF ELECTRON DRIFT VELOCITY

Originator: Joseph C. Bowe, Radiological Physics Div.

Analyst: Erwin H. Bareiss

Programmer: Marilyn Hanson

Machine: GEORGE

Description: The electron drift velocities are computed for gas with constant electron transport cross sections. Parameters are σ , $(e E)$ and $k T$.

Status: In progress

No. 519/RPY 111; COMPUTATION OF ELECTRON ENERGY DISTRIBUTION FUNCTIONS FOR NITROGEN, HELIUM, NEON, AND ARGON WITH EMPIRICAL CROSS-SECTION FUNCTIONS

Originator: Joseph C. Bowe, Radiological Physics Div.

Analyst: Erwin H. Bareiss

Programmer: Marilyn Hanson

Machine: IBM 704

Description: (I) Sectionally continuous and steady curves are determined which approximate discrete sets of experimental data of electron transport cross sections, σ , versus electron energy in the sense of least squares and with sufficient smoothness for each of the gases nitrogen, helium, neon, and argon.

(II) For each of these gases and for various values of the parameters (eE) and (kT) the electron energy distribution function $\sqrt{\epsilon} f_0/A$ is computed and tabulated. Here

$$f_0(\epsilon) = A e^{-a(E)} I(\epsilon)$$

$$a(eE) = \frac{6m}{M} \left(\frac{1}{eE} \right)^2, \quad b = (kT) a(eE)$$

$$I(\epsilon) = \int_0^\epsilon \frac{\sigma^2(\epsilon') \epsilon' d\epsilon'}{b(eE) \sigma^2(\epsilon') \epsilon' + 1}; \quad \sigma(\epsilon) \text{ from Part I.}$$

Status: In progress.

No. 520/RPY 112; COMPUTATION OF ELECTRON DRIFT VELOCITY IN
NITROGEN, HELIUM, NEON, AND ARGON WITH
EMPIRICAL CROSS SECTION FUNCTIONS

Originator: Joseph C. Bowe, Radiological Physics Div.

Analyst: Erwin H. Bareiss

Programmer: Marilyn Hanson

Machine: IBM 704

Description: For each of the gases nitrogen, helium, neon, and argon, and for different values of (eE) , (kT) , and empirically given transport cross section functions $\sigma(\epsilon)$, the electron drift velocities are calculated and tabulated, as follows:

$$\bar{w} = C(eE) A(eE) \int_0^{\infty} \frac{\sigma(\epsilon) \cdot \epsilon^2 e^{-a(eE) I(\epsilon)}}{b(eE) \sigma^2(\epsilon) \cdot \epsilon + 1} d\epsilon$$

$$[A(eE)]^{-1} = 4\pi \sqrt{\frac{2}{m^3}} \int_0^{\infty} \sqrt{\epsilon} e^{-a(eE) I(\epsilon)} d\epsilon;$$

$$C(eE) = \frac{16\pi \cdot 10^{-6}}{m M(eE)} \cdot \sqrt{1.60208}$$

Status: In progress.

ROUTINES AND SUBROUTINES

GEORGE

<u>Number</u>	<u>Title</u>	<u>Analyst and/or Programmer</u>
<u>Classification A - Test Routines</u>		
A-1-138	One Bit Multiply Test	Stanley Hanson
A-2-139	Zero Bit Multiply Test	Herbert Gray
A-3-140	A and B Adder Test	Herbert Gray
A-4-141	Multiply - Divide Test, Register Test IV	Howard House Herbert Gray
A-5-142	One Word Leap Frog, Ac	Herbert Gray
A-6-143	One Word Leap Frog, Qt	Herbert Gray
A-7-144	Three Word Through the Memory, Ac	Herbert Gray
A-8-145	Three Word Through the Memory, Qt	Herbert Gray
A-9-146	Tadpole	Stanley Hanson Herbert Gray
A-10-147	Shift End Connection 1	Stanley Hanson Howard House
A-11-148	Shift Gate Test	Stanley Hanson Howard House
A-12-149	Load and Copy Test 1	Herbert Gray
A-13-150	F8, Record STT Test	Herbert Gray
A-14-151	β Test	Herbert Gray
A-15-152	Jump Test	Herbert Gray
A-16-153	Left Shift End Connections II	Stanley Hanson Howard House
A-17-154	Register Test	Herbert Gray

<u>Number</u>	<u>Title</u>	<u>Analyst and/or Programmer</u>
A-18-155	1's and 0's Test	Howard House Herbert Gray
A-19-156	α Test	Howard House Herbert Gray
A-20-157	Tag Test	Howard House Herbert Gray
A-21-158	Pattern Test	Herbert Gray
A-22-159	Break Point Test	Herbert Gray
A-23-160	Sum Test I	Herbert Gray
A-24-161	Sum Test II	Herbert Gray
A-25-162	Leap Frog Mark I	Herbert Gray
A-26-163	Short Form Input Output Test	Herbert Gray
A-27-164	Shift Test I	Stanley Hanson Howard House
A-28-177	Leap Frog - Mark II	Herbert Gray

Classification B - Input - Output

B-1-116	Floating Decimal to Standard Binary Floating Point Input and Conversion	Loretta Kassel
B-2-117	Standard Binary Floating Point to Floating Decimal Conversion and Output	Loretta Kassel
B-3-165	Fixed Point Decimal to Binary Fraction Conversion	Herbert Gray
B-4-166	Fixed Point Binary to Decimal Fraction Conversion	Herbert Gray
B-5-184	Standard Binary Floating Point to Floating Decimal in Scientific Notation, Conversion and Output	Loretta Kassel Shirley Steidl

<u>Number</u>	<u>Title</u>	<u>Analyst and/or Programmer</u>
B-6-188	Fixed Point Binary to Decimal Conversion and Output, with Scaling and Format.	Loretta Kassel Herbert Gray
B-7-197	Floating Decimal (Scientific Notation) to Standard Binary Floating Point, Input and Conversion	Marilyn Hanson
B-8-202	Fixed Point Decimal to Binary Integer Input and Conversion	Loretta Kassel
B-9-203	Point-Plotter, Fixed Point	Nancy Siljander
B-10-208	General Decimal to Binary Input and Conversion, for Fixed or Floating Point Fractions or Integers, with Scaling	Loretta Kassel Herbert Gray
B-11-209	Floating Decimal to Indexed Binary Floating Point Input and Conversion	Charles Harrison
B-12-210	Indexed Binary Floating Point to Floating Decimal Conversion and Output	Charles Harrison
B-13-213	Decimal to Binary Fraction Input and Conversion, Fixed Point	Kenneth Hillstrom
B-14-214	Decimal Memory Print-Out, Fixed Point	Nancy Siljander
B-15-228	Twelve Digit Decimal to Binary Conversion	Kenneth Hillstrom

Classification D - Arithmetic

D-1-115	Floating Point Arithmetic	Herbert Gray Loretta Kassel
D-2-110	Double Precision Arithmetic, Fixed Point	Charles Harrison Loretta Kassel Herbert Gray
D-3-131	Floating Point Arithmetic with Precision Index	Charles Harrison

<u>Number</u>	<u>Title</u>	<u>Analyst and/or Programmer</u>
<u>Classification E - Elementary Functions</u>		
E-1-103	Exponential, Fixed Point	Jean Hall Loretta Kassel
E-2-104	Scaled Negative Exponential, Fixed Point	Jean Hall Loretta Kassel
E-3-105	Square Root, Fixed Point	Jean Hall Loretta Kassel
E-4-106	Square Root for Small Arguments, Fixed Point	Jean Hall Loretta Kassel Charles Harrison
E-5-107	Negative Exponential, Fixed Point	Jean Hall Loretta Kassel
E-6-108	Arcsine $x2^{-1}$, Fixed Point	Diana Satkus
E-7-114	Exponential, Floating Point	Loretta Kassel
E-8-109	Square Root, Floating Point	Loretta Kassel
E-9-118	Natural Logarithm, Fixed Point	Cynthia Chamot
E-10-127	Fast, Scaled General Exponential, Fixed Point	Anthony Strecok
E-11-168	Sin (πx) or Cos (πx), Floating Point	Cynthia Chamot
E-12-169	Sin (πx) <u>and</u> Cos (πx), Fixed Point	Cynthia Chamot
E-13-170	Natural Logarithm, Floating Point	Cynthia Chamot Loretta Kassel
E-14-171	Arctangent, Fixed Point	Cynthia Chamot Willard Greenhow
E-15-172	Arctangent, Floating Point	Cynthia Chamot Charles Harrison
E-16-173	Natural Logarithm $x2^{-5}$, Fixed Point	Cynthia Chamot Charles Harrison

<u>Number</u>	<u>Title</u>	<u>Analyst and/or Programmer</u>
E-17-174	Sin (πx) or Cos (πx), Fixed Point	Cynthia Chamot
E-18-182	Hyperbolic Sine, Cosine, Fixed Point	Nancy Siljander Mary Anne Fisherkeller
E-19-207	Cube Root, Floating Point	Mary Anne Fisherkeller
E-20-227	Arctangent, Fixed Point	Choong Yun Cho Loretta Kassel

Classification F - Special Functions

F-1-133	Gamma Function, Fixed Point	Anthony Strecok
F-2-199	Doppler Integrals, Fixed Point	Anthony Strecok
F-3-216	Bessel Function J_0 , Fixed Point	Carl Bachhuber

Classification I - Integration

I-1-112	Trapezoidal Integration, Fixed Point	Robert Julke Anthony Strecok
I-2-113	Simpson Integration, Fixed Point	Anthony Strecok Robert Julke
I-3-124	Sin πx , Cos πx , Error Function, Fixed Point	Robert Julke Anthony Strecok
I-4-125	Fifteen Point Gaussian Integration, Fixed Point	Robert Julke Anthony Strecok
I-5-134	Seven Point Gaussian Integration with Optional Controls, Fixed Point	Anthony Strecok
I-6-135	Fifteen Point Gaussian Integration with Optional Controls, Fixed Point	Anthony Strecok
I-7-183	$f(x) = e^{x^2} \int_x^\infty e^{-t^2} dt$, for $x \geq 0$, Fixed Point	Anthony Strecok
I-8-191	Laguerre-Gauss Quadrature, Fifteen Point, Floating Point	Robert Julke

<u>Number</u>	<u>Title</u>	<u>Analyst and/or Programmer</u>
I-9-192	Laguerre-Gauss Quadrature, Modified, Floating Point	Robert Julke
I-10-193	Trapezoidal Integration, Floating Point	Robert Julke
I-11-200	Double Integration Using Seven Point Gaussian Quadratures, Fixed Point	Anthony Strecok
I-12-201	Double Integration Using Fifteen Point Gaussian Quadrature, Fixed Point	Anthony Strecok

Classification K - Differential Equations

K-1-194	Runge-Kutta Integration, Fixed Point	Robert Julke
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Classification L - Linear Equations

L-1-190	Linear Equation Solver, Fixed Point, General Routine	Kenneth Hillstrom Lawrence Wos
L-2-219	Linear Equation Solver, Fixed Point	Kenneth Hillstrom Lawrence Wos

Classification M - Matrix Algebra

M-1-119	Matrix Inversion with Accompanying Solution of Linear Equations, Floating Point	Burton Garbow
M-2-120	Matrix Product, Fixed Point	Burton Garbow
M-3-121	Eigenvalues and Eigenvectors of a Real Symmetric Matrix, Fixed Point	Burton Garbow Lawrence Wos
M-4-178	Square Matrix Transposition	Burton Garbow
M-5-179	Matrix Product, Floating Point	Burton Garbow
M-6-180	Matrix Inversion with Accompanying Solution of Linear Equations, Floating Point, General Routine	Burton Garbow

<u>Number</u>	<u>Title</u>	<u>Analyst and/or Programmer</u>
M-7-181	Eigenvalues and Eigenvectors of a Real Symmetric Matrix, Fixed Point General Routine	Burton Garbow Lawrence Wos
M-8-198	Matrix Inversion, with Accompanying Solution of Linear Equations, Floating Point	Burton Garbow
M-9-205	Eigenvalues and Eigenvectors of a Real Symmetric Matrix, Fixed Point	Burton Garbow Lawrence Wos
M-10-206	Enlargement of a Triangular to a Square Symmetric Matrix	Herbert Gray
M-11-211	Eigenvalues and Eigenvectors of a Real Symmetric Matrix, Fixed Point General Routine	Burton Garbow Lawrence Wos
M-12-224	Eigenvalues and Eigenvectors of the Product of Two Real Symmetric Matrices, Fixed Point	Burton Garbow
<u>Classification N - Non-Linear Equations</u>		
N-1-215	Solution of a System of Non-Linear Equations by the Newton-Raphson Method, Floating Point	Charles Harrison
<u>Classification P - Algebraic, Miscellaneous</u>		
P-1-204	Polynomial Generator, Fixed Point General Routine	Lawrence Wos
P-2-137	Characteristic Equation Generator	Gerald Duffy Lawrence Wos
<u>Classification Q - Probability Distribution</u>		
Q-1-111	Error Function, Fixed Point	Shirley Steidl
<u>Classification R - Roots of Equations</u>		
R-3-123	Zeros of a Polynomial, Newton's Method, Fixed Point General Routine	Joseph Cook

<u>Number</u>	<u>Title</u>	<u>Analyst and/or Programmer</u>
<u>Classification S - Statistics</u>		
S-1-129	Least Squares Linear Fit, Floating Point General Routine	Shirley Steidl
S-2-122	Least Square Fit of a Linear Combination of Exponentials, Floating Point General Routine	William Miller
S-3-128	Least Squares Fit to a Polynomial, Floating Point General Routine	Willard Greenhow
S-4-185	Fitting Linear Combinations of Legendre Polynomials, Fixed Point General Routine	William Miller
S-5-195	Least Square Linear Fit of Arbitrary Functions, Floating Point General Routine	Shirley Steidl
S-6-196	Least Squares Fit for Linear Combinations of Exponentials, Floating Point General Routine	Shirley Steidl
<u>Classification X - Service Routines</u>		
X-1-126	Subroutine Loader	Shirley Steidl Herbert Gray
X-2-000	Command Routine	Herbert Gray
X-3-167	Subroutine Error Stop	Herbert Gray
X-4-175	Store - Restore	Herbert Gray
X-5-176	Register Print-Out	Herbert Gray
X-6-187	GEORGE Code Listing Routine	Herbert Gray
X-7-212	Address Search	Alan Lemmon
X-8-217	Flow Monitor	Alan Lemmon
X-9-218	Memory-Tape Comparison	Nancy Seljander

<u>Number</u>	<u>Title</u>	<u>Analyst and/or Programmer</u>
X-10-220	Checkpoint Monitor	Alan Lemmon
X-11-221	Tape Comparer, with or without Duplication	Alan Lemmon
X-12-222	Fixed Point Decimal Memory Print-out	Nancy Seljander
X-13-223	Program Trace	Loretta Kassel
<u>Classification Z - Miscellaneous</u>		
Z-1-130	Maximum or Minimum of a Function of Several Independent Variables Floating Point General Routine	Kenneth Hillstrom
Z-2-132	GEORGE - AVIDAC Decoder (GAD)	Herbert Gray
Z-3-186	Floating to Fixed Point Conversion	Cynthia Chamot
Z-4-189	Word Sorter	Herbert Gray
Z-5-225	Cap-Punch	Herbert Gray

IBM 704

AN C201	Real Root Finder	Erwin H. Bareiss Mary Anne Fisherkeller
AN C203	Complex Root Finder	Erwin H. Bareiss Mary Anne Fisherkeller
AN E201	Least Square Legendre Polynomial Fit	Marilyn Hanson
AN E205	Least Square Polynomial Fit	Marilyn Hanson
AN I111	Tape Lower Binary Loader	Richard King
AN I112	Card to Binary Tape Loader	Richard King

IBM 650

R-1-101	Roots of a Polynomial	Joseph Cook Diana Satkus
R-2-102	Resultant Procedure	Erwin H. Bareiss Mary Anne Fisherkeller

PUBLICATIONS AND PAPERS

Publications

Joseph M. Cook, "Convergence to the Møller Wave-Matrix," J. Math. and Phys. 36, 82 (1957).

Joseph M. Cook, "Rational Formulae for the Production of a Spherically Symmetric Probability Distribution," Math. Tables and Other Aids to Computation, Vol. 11, p. 81 (1957).

Joseph M. Cook, "On the Vanishing of the Interaction Hamiltonian," II Nuovo Cimento, 4, 1585 (1956). Errata; 7, 901 (1958).

Donald A. Flanders and Hugo Fricke, "Application of a High-Speed Electronic Computer in Diffusion Kinetics," J. Chem. Phys. 28, 6, 1126 (1958).

W. F. Miller and R. L. Platzman, "On the Theory of the Inelastic Scattering of Electrons by Helium Atoms," Proc. Phys. Soc. (London) A70, 299 (1957).

W. F. Miller, John Reynolds, and William J. Snow, "Efficiencies and Photo-fractions for Sodium Iodide Crystals," Rev. Sci. Inst. 28, 717 (1957).

Lawrence Wos, "On Commutative Prime Power Subgroups of the Norm," Ill. J. Math., 2, 271-284 (1958).

Applied Mathematics Division Technical Memoranda

- No. 1 "Compound Matrices," by Donald A. Flanders.
- No. 2 "A General Theorem on Iteration Procedures," by Erwin H. Bareiss.
- No. 3 "The Modified Hessenberg Method and the Characteristic Value Problem for Arbitrary Matrices," by Erwin H. Bareiss.
- No. 4 "Determination of Soil Moisture from Soil Temperature Data," by Erwin H. Bareiss and Edward M. Keberle.
- No. 5 "Resultant Procedure, A Method for Finding the Zeros of Real Polynomials," by Erwin H. Bareiss.

Papers Presented at Meetings

"The Modified Hessenberg Method and the Characteristic Value Problem for Arbitrary Matrices," by Erwin H. Bareiss, presented at the 64th Annual Meeting of the American Mathematical Society in Cincinnati, Ohio January 28-30, 1958.

"Resultant Procedure," by Erwin H. Bareiss, presented at the 13th National Meeting of the Association for Computing Machinery in Urbana, Illinois June 11-13, 1958.

"Quantitative Evaluation of the Dispersion of Helium," by W. F. Miller and Robert L. Platzman, Washington Meeting of the American Physical Society, April, 1957, paper UA1

SEMINARS, LECTURES AND COURSES

Applied Mathematics Seminar

The following one-hour lectures were presented by invited guest speakers and by members of the staff of the Applied Mathematics Division:

- December 26, 1957 "Descent Methods for the Solution of Linear Equations," by Dr. E. H. Bareiss, Argonne National Laboratory.
- January 24, 1958 "A Class of Methods for Inverting Matrices," by Dr. Alston S. Householder, Chief, Mathematics Panel, Oak Ridge National Laboratory.
- February 6, 1958 "Canonical Forms of Matrices," by Dr. David L. Phillips, Argonne National Laboratory.
- February 13, 1958 "Iterative Methods of Solving Eigenvalue Problems," by Dr. Donald A. Flanders, Argonne National Laboratory.
- February 19, 1958 "Inversion by Biorthogonalization and Related Results," by Professor M. R. Hestenes, Chairman, Department of Mathematics, University of California, Los Angeles, California.
- February 27, 1958 "Lower Bounds for Eigenvalues by Finite Difference Methods," by Professor Hans Weinberger, University of Maryland and Mathematics Research Center, University of Wisconsin.
- March 6, 1958 "Computation of Plane Unitary Rotations Transforming a General Matrix to Triangular Form," by Professor Wallace Givens, Chairman, Dept. of Mathematics, Wayne State University, Detroit, Michigan.

- March 13, 1958 "New Aspects of the Theory of Wave Propagation (First Lecture)," by Professor Richard Courant, Institute for Mathematical Sciences, New York University, New York, New York.
- March 14, 1958 "New Aspects of the Theory of Wave Propagation (Second Lecture)," by Professor Richard Courant, Institute for Mathematical Sciences, New York University, New York, New York.
- March 27, 1958 "Method of Conjugate Gradients for Solving Linear Systems," by Dr. William F. Miller, Argonne National Laboratory.
- April 2, 1958 "The Approximate Solution of Matrix Problems (First Lecture)," by Dr. Alston S. Householder, Chief, Mathematics Panel, Oak Ridge National Laboratory, Oak Ridge, Tennessee.
- April 3, 1958 "The Approximate Solution of Matrix Problems (Second Lecture)," by Dr. Alston S. Householder, Chief, Mathematics Panel, Oak Ridge National Laboratory, Oak Ridge, Tennessee.
- April 17, 1958 "The Relevance of the Perron-Frobenius Theory of Non-negative Matrices to Successive Over-relaxation Theory," by Dr. R. S. Varga, Senior Mathematician, Westinghouse Atomic Power Division, Pittsburgh, Pennsylvania.
- April 24, 1958 "Singularity and Near-singularity in Numerical Analysis," by Professor George E. Forsythe, Stanford University, Stanford, California.
- May 2, 1958 "An Analytic Study of the Structure of the Vascular Tree," by Dr. David L. Cohn, Bell Telephone Laboratories, Whippany, New Jersey.
- May 8, 1958 "Computational Stability of Partial Difference Equations," by Professor W. R. Wasow, University of California and Mathematics Research Center, Madison, Wisconsin.

- May 23, 1958 "Successive Over-relaxation," by Dr. David M. Young, Manager, Mathematical Analysis Dept., The Ramo-Wooldridge Corp., Los Angeles, California.
- June 5, 1958 "Bounds of Eigenvalues of Matrices," by Dr. Olga Taussky-Todd, California Institute of Technology, Pasadena, California.
- "Results of Numerical Matrix Experiments," by Professor John Todd, California Institute of Technology, Pasadena, California.
- June 9, 1958 "Stable Predictor-Corrector Methods for Integrating Ordinary Differential Equations," by Dr. R. W. Hamming, Bell Telephone Laboratories, Murray Hill, New Jersey.
- June 20, 1958 "Characterization of the Normal Distribution," by Paul Gunther, University of Chicago, Chicago, Illinois

Lectures Presented at Meetings

"Electronic Computers and their Application in Chemistry," presented before the Chemical Society of Chicago by Erwin H. Bareiss on June 14, 1957.

"Computers and Automation in Scientific Research," presented to the Student Chapter of the Institute of Radio Engineers, Northwestern University, Evanston, Illinois, by William F. Miller on November 26, 1957.

COURSES IN APPLIED MATHEMATICS, NUMERICAL ANALYSIS, AND PROGRAMMING

Numerical Analysis, Part I: 3 hours per week, from March 4, 1957, to June 13, 1957.

Instructor: Erwin H. Bareiss

Contents: Divided Differences, Lagrange and Hermite Interpolation. Integration Formulas. Finite Differences. Operations with Finite Differences. Difference Equations. Zeros of Polynomials. Numerical Solution of Differential Equations and Integro-Differential Equations.

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Numerical Analysis, Part II: 3 hours plus one hour laboratory per week, from September 16, 1957, to January 16, 1958.

Instructor: Erwin H. Bareiss

Contents: Matrices and Linear Equations. Some Principles of Functional Analysis. Orthogonal Functions and Least-squares Approximations. Ordinary and Partial Difference Equations. Numerical Methods for the Consistent Solution of Partial Differential Equations of Elliptic, Parabolic, and Hyperbolic type. Numerical Solution of Integral Equations.

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Fortran: 3 hours per week, from March 17 to April 11, 1958.

Instructor: Burton Garbow

Contents: FORTRAN programming for the IBM 704, geared to non-professional programmers.

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GEORGE: 3 hours per week for 5 weeks in Spring, 1957.

Instructors: Burton Garbow and Loretta Kassel

Contents: GEORGE order structure and programming.

EQUIPMENT

Automatic digital computation has been and is carried out in the Applied Mathematics Division by three high-speed electronic computers: AVIDAC and GEORGE, designed and primarily constructed at Argonne National Laboratory, and an IBM 704. AVIDAC was replaced by GEORGE in the Fall of 1957, at which time the 704 was also acquired. In addition an IBM 650 in the Accounting Department is available for use by the Division.

Analog computations were accomplished on a Reeves REAC until its replacement in the Spring of 1958 by an Electronic Associates' PACE.