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Information on the Bureau's publications can be found in NBS Circular 460, Publications of the National Bureau of Standards ($1.25) and its Supplement ($0.75), available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Inquiries regarding the Bureau's reports should be addressed to the Office of Technical Information, National Bureau of Standards, Washington 25, D. C.
PROJECTS and PUBLICATIONS
of the
APPLIED MATHEMATICS DIVISION
A Quarterly Report
October through December 1958
APPLIED MATHEMATICS DIVISION

October 1 through December 31, 1958

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NUMERICAL COMPUTATION

MATHEMATICAL PHYSICS

*On leave of absence
**Part time
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Status of Projects
December 31, 1958

1. NUMERICAL ANALYSIS

RESEARCH IN NUMERICAL ANALYSIS AND RELATED FIELDS
Task 1101-12-1104/55-55

Origin: NBS
Manager: P. Davis
Full task description: July-Sept 1954 issue, p. 1

Authorized 8/29/54

Status: CONTINUED. W. Rheinboldt continued his studies of the application of functional analysis to numerical analysis. Dr. Rheinboldt, W. Gautschi, and J. Arms jointly presented a series of seminar lectures on functional analysis to members of the division staff. In this seminar special attention was given to Newton's method for operator equations in Banach spaces.

N. Bazley has obtained numerical estimates of a lower bound for the second eigenvalue of helium from his extension of Aronszajn's method, and this has been combined with Temple's formula to find a satisfactory and rigorous lower bound for the first eigenvalue. An account of the method, together with its combination with Weinstein's method, has been partially written up and will be completed soon.

N. Bazley has also been investigating applications of Monte Carlo methods to the numerical calculation of Markov chains.

E. Haynsworth has found that the theorems in her paper "Generalizations of Brauer theorems on stochastic matrices" (see July-Sept 1958 issue, p. 2) were special cases of a more general theorem on partitioned matrices. For this reason the paper has been rewritten under the title "Reduction formulae for partitioned matrices."

The code for finding the largest positive eigenvalue of a positive matrix using a modified Brauer method has been completed and checked out. It works especially well for matrices which are nearly singular, e.g., the Hilbert matrix.

In a paper entitled "Optimal approximations and error bounds" (Proceedings, Conference on Numerical Approximation, Mathematics Research Center, U. S. Army 1958, to appear), M. Golomb and H. F. Weinberger showed how to find a best linear approximation to a certain linear functional in terms of given data, and a bound for the error in this approximation. If the data are the values of a function at N equally spaced points and a bound on the square integral of the kth derivative, the above process involves the inversion of a matrix of order N + k. Since in practice N may be large, although k is in general fairly small,
such matrix inversion presents numerical problems. H. F. Weinberger has used special features of the matrix to reduce the problem of inverting the above matrix to that of finding the zeros of a polynomial of degree $2k$ and inverting a matrix of order $k$. This work is now in progress and will be applied to various particular problems.

Publications:
(8) On the relations between summation methods and integral transforms. W. Greub. In manuscript.
(9) Uniform asymptotic expansions for Weber parabolic cylinder functions of large orders. F. W. J. Olver. In manuscript.
(10) Reduction formulae for partitioned matrices. E. Haynsworth. In manuscript.

RESEARCH IN MATHEMATICAL TOPICS APPLICABLE TO NUMERICAL ANALYSIS
Task 1101-12-5116/55-56

Origin: NBS
Sponsor: Office of Naval Research
Manager: M. Newman
Full task description: July-Sept 1954 issue, p. 5

Status: CONTINUED. M. Newman has completed two manuscripts entitled respectively "Modular forms whose coefficients possess Euler products", and "Weighted restricted partitions". In the first all modular forms of a certain class are determined whose coefficients are multiplicative and for which the associated Dirichlet series possess Euler products. In the second, linear recurrence formulas of fixed length are determined for weighted partitions into parts not divisible by a fixed integer.
A seminar on Vinogradov's methods in number theory is being conducted by M. Newman. Five lectures covering introductory material have been given.

K. Goldberg has continued his work on algebras with an incidence matrix basis, together with E. C. Dade.

Dr. Goldberg has shown that a conjectured result on the gaps in the sequence of integers relatively prime to a fixed integer \( n \) implies that there is always a prime between \( x^2 \) and \( (x+1)^2 \). The conjecture on gaps has been verified for those \( n \) which have 15 or fewer distinct prime factors.

Dr. Goldberg has also investigated certain general types of combinatorial generation and has derived a necessary and sufficient condition that an incidence matrix have a permutation matrix for one of its principal submatrices.

A. Ostrowski prepared a paper on the application of the classical Rayleigh quotient to nonsymmetric matrices. Although the resultant convergence is only quadratic, the iteration procedure offers from the computational point of view an advantage as compared with the generalized Rayleigh quotient iteration.

Dr. Ostrowski also finished a paper on the qualitative sharpening of Sylvester's law of inertia in which he derives bounds for the factors multiplying the eigenvalues of a symmetric matrix as it is transformed by a linear transformation. He prepared a paper on the determination of inertia characters and a quadratic form considered on linear manifold. Another note was completed developing the results of a previous note on univalent transformations in the \( n \)-dimensional space.

Preparation of the expository manuscript by A. J. Goldman, "Tensor, Grassmann, and Clifford algebras," continued.

Publications:


(2) Abelian groups of unimodular matrices. E. C. Dade. Submitted to a technical journal.

(3) Incidence algebras. E. C. Dade and K. Goldberg. In manuscript.


(6) Some combinatorial lemmas. K. Goldberg. In manuscript.


(17) On the convergence of the Rayleigh quotient iteration for the computation of characteristic roots and vectors, IV. (Generalized Rayleigh quotient for nonlinear elementary divisors.) A. Ostrowski. In manuscript.

(18) A quantitative formulation of Sylvester's law of inertia. A. Ostrowski. In manuscript.

STUDY OF DIFFERENTIAL EQUATIONS FOR NERVE EXCITATION
Task 1101-12-5116/56-148

Origin and Sponsor: National Institutes of Health Authorized 9/30/55
Manager: W. Gautschi (11.2)
Full task description: July-Sept 1955 issue, p. 7

Status: INACTIVE.
2. **MATHEMATICAL TABLES AND PROGRAMMING RESEARCH**

**TABLES OF COULOMB WAVE FUNCTIONS**

Task 1102-40-1110/47-2

Origin: NBS
Manager: I. A. Stegun
Full task description: Apr-June 1949 issue, p. 45

Status: INACTIVE.

**TABLES OF POWER POINTS OF ANALYSIS-OF-VARIANCE TESTS**

Task 1102-40-1110/51-8

Origin: Section 11.3, NBS
Manager: S. Peavy
Full task description: Apr-June 1951 issue, p. 49

Status: INACTIVE.

**REVISION OF MATHEMATICAL TABLES**

Task 1102-40-1110/52-7

Origin: NBS
Managers: W. F. Cahill, I. Stegun
Full task description: July-Sept 1951 issue, p. 41

Status: INACTIVE.

**SPHEROIDAL WAVE FUNCTIONS**

Task 1102-40-1110/52-37

Origin: NBS
Manager: D. Liepman
Full task description: Oct-Dec 1951 issue, p. 38

Status: INACTIVE.
Status of Projects

SIEVERT'S INTEGRAL
Task 1102-40-1110/52-57

Origin: NBS Authorized 2/12/52
Managers: M. Paulsen, P. O'Hara
Full task description: Jan-Mar 1952 issue, p. 46

Status: INACTIVE. For status to date, see Jan-Mar 1958 issue, p. 8.

MATHEMATICAL SUBROUTINES
Task 3711-60-0009/56-160

Origin: NBS Authorized 9/30/55
Managers: Staff
Full task description: July-Sept 1955 issue, p. 13

Status: CONTINUED. The Corbato eigenvalue routine was modified by R. Zucker to print the eigenvalues (in descending magnitude) and their corresponding eigenvectors in column form, five columns at a time. Previously, the eigenvalues were printed in random order and the eigenvectors were printed contiguously.

A code has been written and checked out by C. Wade, which incorporates a new matrix inversion routine designed for the solution of large systems of equations.

AUTOMATIC CODING
Task 3711-60-1120/55-65

Origin: NBS Authorized 9/29/54
Manager: J. Wegstein
Full task description: July-Sept 1954 issue, p. 11

Status: CONTINUED. A code for performing the computations associated with mass weighings was placed in service as the first of a series of Black Box Computer codes. This code can be called into service by merely sending its number and the data to be used to the computer. This is a special purpose code and is useful to only one laboratory. Other general purpose-code packages are being added to the Black Box collection which will interpolate data, do least-squares, minimizations, etc. These can be called into action by anyone who supplies the proper calling number along with the data to be used.
Origin and Sponsor: National Science Foundation  Authorized 12/27/56
Manager: I. A. Stegun
Full task description:  Oct-Dec 1956 issue, p. 10

Status: CONTINUED. Revision and editing of the textual material for chapters 9, 10, 11 (Bessel Functions of Integer Order, Bessel Functions of Fractional Order, and Integrals of Bessel Functions) was in process.

Typing of the textual material was in progress for chapter 19 (Parabolic Cylinder Functions). The accompanying tables are ready in preliminary form.

Work is currently under way on the preparation and checking of the graphs for chapters 9, 10, 14, 19, 22. Typing and checking of the manuscript of the tabular material for chapter 11 (Integrals of Bessel Functions) was completed and is in progress on chapter 9 (Bessel Functions of Integral Order). Revisions of chapters 3, 13, 23, 24 continued.
3. PROBABILITY AND MATHEMATICAL STATISTICS

MISCELLANEOUS STUDIES IN PROBABILITY AND STATISTICS
Task 1103-12-1107/51-2

Origin: NBS
Manager: C. Eisenhart
Full task description: July-Sept 1950 issue, p. 58

Status: CONTINUED. N. C. Severo continued his work on a manuscript on the convergence of distributions of random variables whose powers are normal.

W. S. Connor, N. C. Severo and W. J. Youden completed a draft of a manuscript entitled "Measurements made by matching with known standards," giving the probabilities associated with positioning of unknowns with respect to a series of standards.

Publication:
(1) The weighted compounding of two probabilities from independent significance tests. M. Zelen and L. Joel. Submitted to a technical journal.

STUDIES IN THE MATHEMATICS OF EXPERIMENT DESIGN
Task 1103-12-1107/53-1

Origin: NBS
Manager: W. S. Connor
Full task description: Oct-Dec 1952 issue, p. 60

Status: INACTIVE.

Publication:

STUDY OF NON-PARAMETRIC STATISTICAL TECHNIQUES
Task 1103-12-1107/56-170

Origin: NBS
Manager: Joan R. Rosenblatt
Full task description: Oct-Dec 1955 issue, p. 14

Status: INACTIVE.
MEASUREMENT OF RELIABILITY  
Task 1103-12-1130/56-182

Status: CONTINUED. M. Zelen and C. Dannemiller have completed sampling experiments on the IBM 704 to test the robustness of procedures for analyzing life tests having an underlying exponential distribution. The results of the experimental sampling strongly indicate that these procedures depend heavily on the exponential assumption.

J. R. Rosenblatt and M. Zelen have completed work on a Department of Defense problem pertaining to the reliability of missiles.

J. R. Rosenblatt made a rough translation of "Redundant systems with contact elements" by G. V. Druzhinin (Izvestiya Akademii Nauk SSSR, Otdelenie Tekhnicheskikh Nauk, No. 6, pp. 96-98, June 1958).

M. Zelen presented a paper entitled "Problems in life testing: factorial experiments" before the Thirteenth Midwest Quality Control Conference, Kansas City, Missouri, November 1958.

M. Zelen presented a paper entitled "Factorial experiments in life testing" before the annual meeting of the American Statistical Association, Chicago, Illinois, December 1958.

Publications:
(2) Analysis of two-factor classifications with respect to life tests. M. Zelen. In manuscript.

FRACTIONAL FACTORIALS FOR THE MIXED SERIES  
Task 1103-12-5148/58-291

Status: CONTINUED. Thirty-nine fractional factorial designs of the $2^{m-n}$ series have been constructed and analyzed. There is one for each of the cases $2^4,\ldots,2^9; 3^2,\ldots,3^2; \ldots; 2^{13}$. The designs are such that the grand average, main effects, and interaction effects can easily be estimated.

Publication:
Status: CONTINUED. C. M. Tchen has continued work on the statistical method initiated in his paper on "Diffusion of particles in turbulent flow" (see July-Sept 1958 issue, p. 12). As an extension, Tchen is studying the trapping of particles by an inhomogeneous and unsteady magnetic field. This serves as a statistical model of the Fermi mechanism of acceleration to explain the origin of cosmic rays. The checking of galley proofs of "Diffusion of particles in turbulent flow", to appear in the Proceedings of the Symposium on Atmospheric Diffusion, Oxford University, has been finished.

A. Ghaffari has studied the critical points at infinity of Rayleigh's nonlinear equation

\[ \frac{d^2x}{dt^2} + \mu [- \frac{dx}{dt} + \frac{1}{3} (\frac{dx}{dt})^3] + x = 0, \quad 0 < \mu < 2, \]

which is associated with acoustical phenomena and steady vibrations, and has analyzed the full phase-portrait. Noting that (1) may be replaced by the equivalent system

\[ \frac{dx}{dt} = y, \quad \frac{dy}{dt} = -x - \mu (-y + \frac{1}{3}y^3), \]

and following the analysis of Lefshetz [see Differential Equations: Geometric Theory (Interscience, 1958)], he has obtained the following results. The unit sphere \( x^2 + y^2 + z^2 = 1 \) has four critical points on its equator \( z = 0 \) located at its intersections with the lines \( x = 0, \quad y = 0 \) (in the plane \( z = 0 \)). There are also critical points at the poles \( (0,0,\pm 1) \) of the unit sphere, which correspond to the critical point of (1) at the origin (unstable focus). The arcs of the equator \( z = 0 \) between consecutive critical points on it are paths of (1).

The analysis by V. M. Yevdjevich of the fluctuations in the flows of rivers due to annual variations in rainfall continues. Following is the status to date:

(a) Analysis of the statistics of annual flows has been computed for 65 river stations using the IBM 704. (This part is principally completed.)
Status of Projects

(b) The data on annual flows for another 60 river stations from many parts of the world have been gathered, studied, corrected, and prepared for processing on the 704.

(c) The data on monthly river flows for about 45 stations has been collected, studied, and forwarded for processing on the 704. (This is for the second part of the project.)

(d) The study of the influence of the errors in the river flow data and of the inconsistence (nonhomogeneity) of flow time series upon the fluctuations in annual flows was initiated.

(e) The study of the very abundant literature has been continued.

(f) The first part of the report on the fluctuation of annual flow has been written.

J. P. Vinti has prepared a paper, primarily of didactic interest, deducing the rotations that leave a two-dimensional lattice invariant and the forms of the corresponding lattices. Unlike previous treatments, the method does not involve the use of group theory or matrix algebra, but makes use only of the algebra of complex numbers and of the integer solutions of certain quadratic equations. It should serve as a simple and rigorous introduction to the theory of two-dimensional crystals.

Publications:

(1) Rotational properties of two-dimensional lattices. J. P. Vinti. In manuscript.


(6) On some mathematical properties of wedge solution. A. Ghaffari. In manuscript.


(8) On the solution of compressible flow past a wedge. A. Ghaffari. In manuscript.

(9) On the asymptotic behavior of the integral curves of a certain non-linear differential equation. A. Ghaffari. In manuscript.
FOURIER TRANSFORMS OF PROBABILITY DISTRIBUTION FUNCTIONS  
Task 1104-12-5160/56-154

Origin: NBS  
Sponsor: Office of Naval Research  
Manager: F. Oberhettinger  
Full task description: July-Sept 1955 issue, p. 20

Status: CONTINUED. Publication is delayed pending the preparation of a section on inverse tables of Fourier transforms to be included.

RESEARCH IN FLUID DYNAMICS OF TWO-PHASE FLOWS  
Task 1104-12-5160/56-155

Origin and Sponsor: Office of Naval Research  
Manager: W. H. Pell  
Full task description: July-Sept 1955 issue, p. 21

Status: TERMINATED. J. P. Vinti is preparing a summary report for the sponsor on the theory of a hydroduct.

RESEARCH IN CONTINUUM MECHANICS  
Task 1104-12-5160/55-85

Origin: NBS  
Sponsor: Office of Scientific Research, ARDC, USAF  
Manager: W. H. Pell  
Full task description: Oct-Dec 1954 issue, p. 30

Status: CONTINUED. C. M. Tchen has continued his study of statistical plasma dynamics. Emphasis has been placed on the phenomenon of degeneration of high order correlation functions into lower order ones. Application of this result to the study of the runaway of electrons is being made.

C. M. Tchen presented a paper "Structure of Correlation in Plasma with an External Field" at the Divisional Meeting of the Fluid Dynamics Division of the American Physical Society, San Diego, Cal., November 26. Dr. Tchen visited General Atomics, San Diego, and discussed problems of plasma dynamics with Drs. M. Rosenbluth and N. Rostoker, and also discussed magnetohydrodynamics with Prof. H. Liepmann of California Institute of Technology and with Drs. Wegener and Davies at the Jet Propulsion Laboratory, Pasadena, Cal.

W. H. Pell presented a paper "Bending and Stretching of Corrugated Diaphragms" at the American Society of Mechanical Engineers
meeting in New York, December 3, in the absence of its author, R. F. Dressler.

Work on the problem of Stokes flows about axially symmetric bodies has been continued by W. H. Pell. The body currently under consideration is the torus [see July-Sept 1958 issue, p. 14]. Finding the appropriate stream function involves the determination of the circulation about the torus. This has now been shown to be determined uniquely by the condition that the pressure in the fluid be single-valued.

A paper is under preparation for publication which will contain the general theory as well as the Stokes flow solution for the lens-shaped body contained in the initial manuscript by L. E. Payne and W. H. Pell [see July-Sept 1958 issue, p. 15]. It is planned to include a table of Stokes drag for various bodies. The remainder of the first manuscript will form a second paper.

A limited number of prepublication copies of the following manuscripts are available:

a) Kinetic equation for a plasma with unsteady correlations. C. M. Tchen.

b) Compressible turbulent boundary layers with heat transfer and pressure gradient in flow direction. Alfred H. Walz.

Publications:


(2) The Stokes flow problem for a class of axially symmetric bodies. L. E. Payne and W. H. Pell. In manuscript.

(3) Compressible turbulent boundary layers with heat transfer and pressure gradient in flow direction. Alfred H. Walz. In manuscript.


(7) Note on the integration of the elastic plate equation with variable flexural rigidity. W. H. Pell. In manuscript.

Status of Projects

COMPUTATION OF OUTFLOW FROM A BREACHED DAM
Task 1104-12-5160/58-369

Origin and Sponsor: Army Map Service
Manager: V. M. Yevdjevich
Full task description: July-Sept 1958 issue, p. 16

Status: CONTINUED. V. M. Yevdjevich has continued (1) the study of the outflow hydrograph from a breached dam, and (2) the analysis of the modification of the hydrograph as it progresses downstream from the dam.

A report on the first of these problems entitled "The Analytical Integration of the Differential Equation for Water Storage," which treats the outflow hydrograph from a breached dam, has been finished, and submitted to the sponsor. A second paper on this problem entitled "The Influence of the Negative Wave and the Effect of Flow Resistance on the Free Outflow Hydrograph of Rapid Openings in Bodies of Water" has been started.

A study of possible devices for obtaining the modification of the hydrograph as it passes downstream is in progress; in particular, a review of existing methods and procedures is under way.

RESEARCH ON SATELLITE ORBITS
Task 1104-12-5160/59-420

Origin: NBS
Sponsor: Office of Scientific Research, ARDC, USAF.
Manager: J. P. Vinti

Objective: (a) To examine the physical conditions for the existence of "quasi-elliptic", "quasi-circular" and "ballistic" stages of satellite motion, (b) to analyse the motion of a spherical satellite under the action of the inverse-square component of the earth's gravitational field and an assumed aerodynamic drag force, applying direct perturbation methods that may be feasible.

Background: The lifetime of a satellite orbit, except for meteoric collisions, depends on the drag exerted on the satellite by the tenuous atmosphere through which it moves. Calculations of this effect have been carried out by several authors, using various methods, including a method which amounts to averaging quantities over each revolution and then using difference methods for tracing the effects of drag through successive revolutions.

The possibility clearly exists, however, that the disappearance of orbits having apsides may be followed by a number of revolutions, perhaps hundreds or thousands, during which the satellite moves in a spiral of gradually diminishing radius, before it finally plunges to earth in a "ballistic" orbit. In general, one might expect: first, a "quasi-
elliptic" stage, characterized by the existence of apsides; second, a "quasi-circular" stage, characterized by the absence of apsides and possibly also by the approximate validity of the relation \( rv^2 = \mu \) satisfied by circular orbits; and last a "ballistic" stage, without apsides, with \( rv^2 \) markedly different from \( \mu \), and with large drag.

It is of interest to try to establish the conditions for the existence of all three stages, to estimate the number of revolutions in each stage, and to find the factors that govern the approximate validity of \( rv^2 = \mu \) in the second, quasi-circular stage. Any information about these matters would contribute greatly to our knowledge of the fundamental principles of satellite motion. These questions have already arisen in considerations about the effect of drag on the inclination of a satellite orbit.

Status: NEW. J. P. Vinti has set up a model for the theoretical study of the effect of drag on satellite orbits. On the assumptions that the drag is proportional to the product of the projected area, the density, the square of the speed \( v \), and that the density varies exponentially with altitude, the differential equations of the orbit of a spherical satellite are expressed in terms of the radius \( r \) and the quantity \( \mu = rv^2 \).

Restriction to the case of an initially small eccentricity of the orbit enables one to express the problem in terms of a simple system of two nonlinear differential equations. A perturbation theory is then appropriate. The theory of first-order perturbations then results in a single nonlinear differential equation of third order. Numerical solution is planned to find how the orbit varies with changes in the critical distance occurring in the density function and with changes in the initial altitude and in the initial eccentricity.
5. MATHEMATICAL AND COMPUTATIONAL SERVICES

1102-40-5126/54-13  AWARD OF PROCUREMENT CONTRACTS BY LINEAR PROGRAMMING
Origin and Sponsor: New York Quartermaster Procurement Agency
Manager: M. Paulsen
Full task description: Oct-Dec 1953 issue, p. 43
Status: Inactive.

3711-60-0009/54-30  SPECTRUM ANALYSIS
Origin: NBS, Division 4
Managers: C. D. Coleman, W. Bozman (4.1)
Full task description: Jan-Mar 1954 issue, p. 46
Status: Continued. A search for new atomic energy levels of Th I gave three new even levels and 15 new odd levels. Wavenumbers were computed for about 4000 unclassified lines of Hf I. Then a search for new odd levels was made, disclosing the important lowest known odd level at 10508.88 wavenumbers.

Work continued on the revision of Kayser's "Table of Wavenumbers." Eight hundred pages have been calculated, and the first volume, consisting of 500 pages, has been printed in a form suitable for publication.

3711-60-0009/54-38  EQUATION OF STATE OF REAL GASES
(formerly COMPRESSIBILITY FACTORS OF DRY AIR)
Origin: NBS, Section 3.2
Manager: M. Paulsen
Full task description: Jan-Mar 1954 issue, p. 48
Status: Continued. An editing and tape writing code has been prepared and is being checked out which will either create a library tape or update this tape. This enables the output of the partition functions program to be put on the above mentioned library tape, which in turn is used as input by the program which calculates the equilibrium properties of gaseous mixtures.

A polynomial substitution was written using Fortran. It has been checked out and is being used by the sponsor. Although it is a specific program, it can be used to the following extent: (a) Number (No) of sets of coefficients (Ai) can vary from 1 to 6; (b) The number of X's (M) can vary from 1 to 100; (c) The number of coefficients per set (N) can vary from 1 to 20; (d) A table of X's is calculated for X = 10(10)400; (e) The special heading may easily be changed. The y's (y = 1 + A_1X + A_2X^2 + ...) are printed eight to a line for each X given for each set of coefficients, with a heading for each set; finally, a table with (No + 1) columns is printed with the argument (X) varying from 10(1)400 and with a corresponding value of y as calculated using the (No) sets of coefficients.
Status of Projects

3711-60-0009/55-68  CRYSTAL STRUCTURE CALCULATIONS
Origin: NBS, Division 9
Managers: P. O'Hara, S. Block (9.7)
Full task description: Jan-Mar 1955 issue, p. 18
Status: Continued. Additional computations were undertaken to determine the structure of several crystals. Extensive use was made of the existing least squares and Fourier synthesis programs.

3711-60-0009/55-82  THERMOMETER CALIBRATIONS
Origin: NBS, Section 3.1
Manager: S. Prusch
Full task description: Jan-Mar 1955 issue, p. 20
Status: Continued. ITS constants and tables were computed for approximately 21 thermometers under test. A code for computing low temperature constants and tables was written and is being checked out.

1102-40-5126/55-88  STRESSES IN A WALL FOUNDATION
Origin and Sponsor: NBS, Section 10.1
Manager: I. Stegun
Full task description: Jan-Mar 1955 issue, p. 22
Status: Terminated.

1102-40-5126/55-121  ELECTRON PENETRATION
Origin and Sponsor: NBS, Section 4.8
Manager: S. Peavy
Full task description: Apr-June 1955 issue, p. 19
Status: Inactive.

1102-40-5126/56-162  STRESSES IN A WALL RESTING ON A FOOTING
Origin and Sponsor: NBS, Section 10.1
Manager: I. Stegun
Full task description: Jan-Mar 1956 issue, p. 26
Status: Inactive.

1102-40-5126/56-166  SCF-LCAO SOLUTION OF SOME HYDRIDES
Origin and Sponsor: NBS, Section 5.9
Managers: E. Haynsworth, P. Walsh
Full task description: Jan-Mar 1956 issue, p. 27
Status: Continued. The sponsor is using several of the codes prepared under this task for production runs.
1102-40-5126/56-186  MECHANICAL MEASUREMENTS OF GAGE BLOCKS
Origin and Sponsor:  NBS, Section 2.5
Manager:  S. Prusch
Full task description:  July-Sept 1956 issue, p. 33
Status:  Continued. Calculations were performed for eight laboratory sets of gage blocks.

1102-40-5126/57-209  TRAFFIC DISTRIBUTION
Origin and Sponsor:  Bureau of Public Roads
Manager:  S. Peavy
Full task description:  Jan-Mar 1957 issue, p. 32
Status:  Completed. Results were transmitted to the sponsor.

1102-40-5126/57-221  BESSEL FUNCTIONS FOR COMPLEX ARGUMENTS
Origin and Sponsor:  Diamond Ordnance Fuze Laboratories, Department of the Army
Manager:  R. Zucker
Full task description:  Oct-Dec 1956 issue, p. 31
Status:  Inactive.

1102-40-5126/57-222  ROOTS OF POLYNOMIALS
Origin and Sponsor:  Naval Research Laboratory
Manager:  J. P. Menard
Full task description:  Oct-Dec 1956 issue, p. 32
Status:  Inactive.

3711-60-0009/57-223  SELF-CONSISTENT FIELDS
Origin:  NBS, Section 3.2
Manager:  E. V. Haynsworth
Full task description:  Apr-June 1957 issue, p. 28
Status:  Continued. Data is being prepared by the sponsor for production runs.

3711-60-0009/57-229  APPLICATION OF ELECTRONIC DATA PROCESSING MACHINERY TO PAYROLL OPERATIONS
Origin:  NBS, Section 40.0
Managers:  M. Pauloisen, P. Ruttenberg
Full task description:  Jan-Mar 1957 issue, p. 36
Status:  Inactive.

1102-40-5126/57-234  PERSONNEL SURVEY
Origin and Sponsor:  Diamond Ordnance Fuze Laboratories, Department of the Army
Manager:  P. O'Hara
Full task description:  Jan-Mar 1957 issue, p. 37
Status:  Terminated.
Status of Projects

1102-40-5126/57-236 SELF CONSISTENT FIELDS--EIGENVALUES
Origin and Sponsor: NBS, Section 3.6
Manager: E. Haynsworth
Full task description: Apr-June 1957 issue, p. 30
Status: Continued. Data is being prepared by the sponsor for production runs.

3711-60-0009/57-247 MECHANICAL IMPEDANCE
Origin: NBS, Section 6.1
Managers: J. P. Menard, M. D. Burkhard (6.1)
Full task description: Apr-June 1957 issue, p. 32
Status: Continued. Production runs involving 24 samples of data were made directly by the sponsor. The program will continue in production under the sponsor's direction.

3711-60-0009/57-248 THE EVALUATION OF A TRIPLE INTEGRAL FOR THE SOLUTION OF NEGATIVE ION DETACHMENT
Origin: NBS, Section 4.6
Manager: S. Peavy
Full task description: Apr-June 1957 issue, p. 34
Status: Inactive.

3711-60-0009/57-250 AUTOMATIC REDUCTION OF SPECTROPHOTOMETRIC DATA
Origin: NBS, Section 2.1
Manager: W. C. Rheinboldt
Full task description: July-Sept 1957 issue, p. 31
Status: Continued. Production runs involving about 100 samples of data were made directly by the sponsor. The paper entitled, "Digital Reduction of Spectrophotometric Data," written jointly by K. J. Keegan, J. C. Schleter, D.B. Judd (all NBS 2.1), and W. C. Rheinboldt and J. P. Menard, was presented at the Forty-third Annual Meeting of the Optical Society of America, Detroit, Michigan, October 9.

1102-40-5126/57-251 CURRENT NOISE AND FIXED RESISTORS
Origin and Sponsor: NBS, Section 1.6
Manager: D. Sumida
Full task description: July-Sept 1957 issue, p. 32
Status: Inactive.

3711-60-0009/58-254 REPRODUCTION OF COLOR- AND SPECTRAL-ENERGY DISTRIBUTION OF DAYLIGHT AND OTHER ILLUMINANTS
Origin: NBS, Section 2.3
Manager: W. C. Rheinboldt
Full task description: July-Sept 1957 issue, p. 32
Status: Continued. The code for the computation of the energy distribution of a Planckian radiator has been extended to facilitate also the
evaluation of the trilinear color coordinates from this energy distribution using three different sets of extinction data. Approximately 80 cases have been run with this code, corresponding to temperature values between 1,600°K and 20,000°K. In addition, about 25 cases have been run with the original code under the immediate direction of the sponsor. The program will continue in production under the sponsor's direction.

1102-40-5126/58-263 GAS TUBE CHARACTERISTIC
Origin and Sponsor: Diamond Ordnance Fuze Laboratories, Department of the Army
Manager: W. F. Cahill
Full task description: July-Sept 1957 issue, p. 35
Status: Continued. The computer program has been generalized to distinguish between molecular gases and atomic gases. Runs are being made for neon, a neon-argon mixture, and hydrogen. Some of the results have been transmitted to the sponsor.

1102-40-5126/58-264 THEORY OF IONIZATION PROBABILITY
Manager: S. Peavy
Full task description: Oct-Dec 1957 issue, p. 30
Status: Continued. A code is being written to compute the first integral of the first equation (see full task write-up) for values of $r = 0(1)4$ and $\lambda = 0(1)4$.

3711-60-0009/58-266 DEPOLYMERIZATION, II
Origin and Sponsor: NBS, Section 7.6
Manager: L. S. Joel
Full task description: July-Sept 1957 issue, p. 36
Status: Inactive.

3711-60-0009/58-267 CONVERSION OF THE CIE-CHROMATICITY COORDINATES INTO THE MUNSELL COLOR SYSTEM
Sponsor: NBS, Section 2.1
Manager: W. C. Rheinboldt
Full task description: July-Sept 1957 issue, p. 37
Status: Continued. Production runs involving about 500 samples of data were made directly by the sponsor. A paper entitled, "Mechanized Conversional Colorimetric Data to Munsell Renotations" has been written jointly by W. C. Rheinboldt and J. P. Menard and was presented by W. C. Rheinboldt at the Forty-third Annual Meeting of the Optical Society of America, Detroit, Michigan, October 9.
1102-40-5126/58-269  MOLECULAR STRUCTURE, IV  
Origin and Sponsor: Naval Research Laboratory, USN  
Manager: P. J. O'Hara  
Full task description: July-Sept 1957 issue, p. 38  
Status: Continued. Several two-dimensional Fourier projections and least square refinements were computed for the Spurite crystal. A program was written to compute any of the several types of correction terms which must be applied to raw crystallographic data. These corrections are a function of the physical characteristics of the measuring equipment and also of the dimensions and configuration of the unit cell of the crystal. The observations from three sets of data were corrected and corresponding values from different sets were scaled and averaged. The results are now ready for use in various structure determination calculations.

1102-40-5126/57-270  MATHEMATICAL PROBLEMS RELATED TO POSTAL OPERATIONS  
Origin: NBS  
Sponsor: Post Office Department, Office of Research and Engineering  
Managers: B. Bender, A. J. Goldman  
Objective: To investigate those "operations research" problems encountered by the Post Office Department which are appropriate for mathematical analysis. In particular, (a) to determine how automatic mail sorting devices can be most effectively arranged and employed, and (b) to develop methods for studying the problem of optimal location of mail-processing organizations.  
Background: This task is being undertaken as part of a broader study of Post Office mechanization, involving the Data Processing Systems Division and Electricity and Electronics Division of the Bureau.  
Status: Analytical methods have been developed for the comparison of proposed configurations for automatic mail sorting equipment. In a specific numerical case, these methods yielded a sorting system which was proved to be within 4 percent of optimum. A report on this material is being prepared for the sponsor. In addition, the capacity requirement for an idealized version of a certain sorting device has been determined and found to be far lower than had been estimated. A paper on this subject will appear in the NBS Journal of Research.  

1102-40-5126/58-272  THERMODYNAMIC PROPERTIES OF REAL GASES  
Origin and Sponsor: NBS, Section 3.2  
Manager: J. P. Menard  
Full task description: Oct-Dec 1957 issue, p. 32  
Status: Inactive.
1102-40-5126/58-274  CALCULATIONS FOR d-SPACINGS, II  
Origin and Sponsor: NBS, Division 9  
Manager: R. Zucker  
Full task description: July-Sept 1957 issue, p. 38  
Status: Continued. About 100 calculations for d-spacings for orthogonal, hexagonal and orthorhombic crystals were carried out this quarter, and redetermination of unit cell constants by least squares fitting to a measured d-spacing was performed for about 12 crystals.

1102-40-5126/58-279  FIRE RESISTANT T-BEAM  
Origin and Sponsor: NBS, Section 10.2  
Manager: C. Wade  
Full task description: Oct-Dec 1957 issue, p. 33  
Status: Completed. Runs were made for an additional thickness of the T-beam for several combinations of time intervals and grid-block width. As before, the one- and two-dimensional cases were compared. The results have been given to the sponsor.

1102-40-5126/58-284  EPHEMERIS CALCULATIONS FOR SATELLITES  
Origin and Sponsor: Naval Research Laboratory  
Managers: W. F. Cahill, J. H. Wegstein  
Full task description: Oct-Dec 1957 issue, p. 34  
Status: Completed. Further work using programs developed under this task is being carried on under the direction of the National Aeronautics and Space Administration.

1102-40-5126/58-289  SCATTERING OF ELECTRONS BY HYDROGEN  
Origin and Sponsor: NBS, Section 3.6  
Manager: R. Zucker  
Full task description: Oct-Dec 1957 issue, p. 36  
Status: Completed. Results were submitted to the sponsor.

3711-60-0009/58-294  NUCLEAR SCATTERING OF PHOTONS  
Origin: NBS, Section 4.8  
Manager: J. P. Menard  
Full task description: Oct-Dec 1957 issue, p. 36  
Status: Continued. The existing code has been modified to print the value of the dispersion integral \( I(E) \) where

\[
I(E) = P \int_{\infty}^{\infty} \frac{G(E')}{\sqrt{E'^2 - E^2}} dE'.
\]

\( P \) denotes that the principal value of the integral is to be taken. The program will continue in production under the sponsor’s direction.
24  Status of Projects

1102-40-5126/58-298 ANALYSIS OF SPECTROCHEMICAL DATA
Origin and Sponsor: NBS, Section 5.10
Managers: S. Peavy, R. N. Varner
Full task description: Oct-Dec 1957 issue, p. 39
Status: Continued. An addition to change the final output has been made in the Fortran code. The same addition has been made to the two previous codes. The first two codes have been checked out, and checking of the Fortran code is under way. The sponsor has made several runs using the initial code.

1102-40-5126/58-299 TIME-DEPENDENT SCHROEDINGER EQUATION
Origin and Sponsor: NBS, Section 3.1
Manager: A. Schopf
Full task description: Oct-Dec 1957 issue, p. 39
Status: Continued. A new general code has been written and checked out. A first production run has been made and compared with earlier results. The differential equation has been solved by step-wise Taylor expansions. The solution obtained agrees well with the asymptotic series and also with the earlier Runge-Kutta solutions of Ostrowski.

1102-40-5126/58-300 LAMINAR MIXING IN BOUNDARY LAYERS
Origin: Polytechnic Institute of Brooklyn
Sponsor: Air Force Office of Scientific Research
Manager: W. C. Rheinboldt
Full task description: Oct-Dec 1957 issue, p. 40
Status: Inactive.

1102-40-5126/58-304 TRANSPORT PROPERTIES OF AIR AT ELEVATED TEMPERATURES
Origin and Sponsor: NBS, Section 3.2
Manager: P. J. Walsh
Full task description: Oct-Dec 1957 issue, p. 40
Status: Continued. The data have been assembled for production runs. One production run was made and the results were transmitted to the sponsor.

1102-40-5126/58-306 INTERPOLATION OF COLOR MIXTURE FUNCTIONS
Origin and Sponsor: NBS, Section 2.1
Manager: W. C. Rheinboldt
Full task description: Oct-Dec 1957 issue, p. 42
Status: Continued. Approximately 15 production runs have been made directly by the sponsor. The program will continue in production under his direction.
Status of Projects

1102-40-5126/58-307  STUDY OF SURFACE TENSION
Origin and Sponsor: NBS, Section 9.2
Manager: R. Arms
Full task description: Oct-Dec 1957 issue, p. 43
Status: Inactive

1102-40-5126/58-308  OSCILLATING SPHERE
Origin and Sponsor: NBS, Section 3.4
Manager: S. Prusch
Full task description: Oct-Dec 1957 issue, p. 43
Status: Continued. Small production runs were performed for the sponsor.

1102-40-5126/58-312  RESPONSE FUNCTION, II
Origin and Sponsor: NBS, Section 4.11
Manager: A. Beam
Full task description: Jan-Mar 1958 issue, p. 33
Status: Continued. The sponsor has made several runs on the 704.

1102-40-5126/58-314  APPROXIMATIONS FOR GAS MIXTURES
Origin and Sponsor: NBS, Section 3.2
Manager: R. Zucker
Full task description: Jan-Mar 1958 issue, p. 33
Status: Completed. The results have been submitted to the sponsor.

1102-40-5126/58-316  INTERSECTION CAPACITY STUDY
Origin and Sponsor: Bureau of Public Roads
Manager: S. Peavy, J. M. Cameron
Full task description: Jan-Mar 1958 issue, p. 33
Status: Continued. An auxiliary code has been written and checked out for the analysis of data related to the study of highway accident experience as related to control of access. Results have been transmitted to the sponsor. Work is being continued on the intersection capacity study.

1102-40-5126/58-321  TABLE OF THERMODYNAMIC FUNCTIONS OF SULFUR
Origin and Sponsor: NBS, Section 3.2
Manager: R. Zucker
Full task description: Jan-Mar 1958 issue, p. 34
Status: Completed. Results have been submitted to the sponsor.

1102-40-5126/58-322  PROPAGATION CONSTANT OF A SOUND WAVE
Origin and Sponsor: NBS, Section 6.1
Manager: R. J. Arms
Full task description: Jan-Mar 1958 issue, p. 34
Status: Inactive.
1102-40-5126/58-333  CALCIUM HYDROXIDE
Origin and Sponsor: NBS, Section 9.0
Manager: P. O'Hara
Full task description: Jan-Mar 1958 issue, p. 36
Status: Inactive.

1102-40-5126/58-336  HELICAL TRANSFORMS
Origin and Sponsor: National Institutes of Health
Manager: R. N. Varner
Full task description: Jan-Mar 1958 issue, p. 36
Status: Completed. Results have been transmitted to the sponsor.

1102-40-5126/58-337  GEORGETOWN LANGUAGE TRANSLATION EXPERIMENTS
Origin and Sponsor: Georgetown University
Manager: R. J. Arms
Full task description: Jan-Mar 1958 issue, p. 37
Status: Inactive.

1102-40-5126/58-339  COMPUTATION OF VISCOELASTICITY PROPERTIES OF MATERIALS
Origin and Sponsor: NBS, Section 3.4
Manager: H. Oser
Full task description: Jan-Mar 1958 issue, p. 38
Status: Continued. Investigations have been carried out in close cooperation with the sponsor.

1102-40-5126/58-343  MINIMIZATION PROBLEM
Origin and Sponsor: Naval Research Laboratory
Manager: S. Peavy
Full task description: Jan-Mar 1958 issue, p. 40
Status: Continued. The second order differential equation, due to its complexity, has been converted to include only portions of the original equation. A Fortran code has been written to evaluate this equation, and code checking and analysis of the results are now in progress.

1102-40-5126/59-348  RUSSIAN-TO-ENGLISH MACHINE TRANSLATION
Origin: NBS
Sponsor: Office of Ordnance Research, U. S. Army
Manager: I. Rhodes
Objective: To develop possible techniques for machine translation of technical material from Russian to English. To facilitate the development, attention is to be confined in the beginning to obtaining crude translation.
Background: Because of the limited number of linguists in this country familiar with the Russian language, a tremendous backlog of untranslated Russian technical literature has accumulated. The knowledge represented
is inaccessible to our engineers and scientists because of their inability to read the articles in the original language. It is in the national interest to provide translation means quickly.

Large-scale electronic digital computers have tremendous potential for use as mechanical translation devices. The proposed program is set up to develop the potentialities.

Status: The problem falls into two parts: (1) glossary lookup of individual source words in a sentence, and (2) organization of the separate target words into a meaningful sentence which renders correctly the intention of the original. The first part has been completed and is running on the IBM 704. The plan for the second part of the program has been completed, but coding has not yet been started.

1102-40-5126/58-358 REDUCED CROSS-SECTIONS
Origin and Sponsor: NBS, Section 3.2
Manager: R. J. Arms
Full task description: Apr-June 1958 issue, p. 30
Status: Terminated.

1102-40-5126/58-359 VELOCITY DISTRIBUTION IN BOUNDARY LAYERS
Origin and Sponsor: NBS, Section 11.4
Manager: W. C. Rheinboldt
Full task description: Apr-June 1958 issue, p. 32
Status: Inactive.

3711-60-0009/58-360 DIFFUSION COEFFICIENTS
Origin: NBS, Section 5.2
Manager: W. C. Rheinboldt
Full task description: Apr-June 1958 issue, p. 32
Status: Continued. A Fortran code has been written for the solution of the nonlinear diffusion problem

$$\frac{\partial c}{\partial t} = \frac{\partial}{\partial x} \left( D(c) \frac{\partial c}{\partial x} \right) \quad (-\infty < x < +\infty)$$

$$c(0,x) = c_0(x)$$

where $D(c)$ is given numerically. The problem is solved by employing a suitable difference method after approximating $D(c)$ with a polynomial or a stepfunction. $c_0(x)$ can be either a stepfunction, a polynomial or a numerically given function. The code has been completely checked out and gives very satisfactory results in the predicted stability region of the difference method. Approximately 75 production runs have been made by the sponsor. The program will continue under the direct supervision of the sponsor.
1102-40-5126/58-361  CALCULATIONS FOR SPECTRUM OF DIPOLE RADIATION
Origin and Sponsor: Naval Research Laboratory
Manager: R. J. Arms
Full task description: Apr-June 1958 issue, p. 33
Status: Continued. Tests are being conducted on the feasibility of estimating a multifold integral by random variable generation.

1102-40-5126/58-366  RADIATION PATTERNS OF ANTENNAS
Origin and Sponsor: U. S. Information Agency, Department of State
Managers: R. T. Moore, P. J. Walsh
Full task description: Apr-June 1958 issue, p. 35
Status: Continued. Part (1) (see full write-up): The code for table (a) has been completely checked out. Code checking on tables (b) and (d) is now in progress. The code for table (c) has been written and code checking will begin soon.
Part (2): Results for primary lobes for certain antennae have been calculated and submitted to the sponsor. Results for secondary lobes on a test case have been obtained from the machine and checking by hand calculation is now in progress. The parameters for 82 antennae have been submitted by the sponsor and have been prepared for production runs.

1102-40-5126/58-368  INTENSITY FUNCTIONS AND CROSS SECTIONS OF LIGHT SCATTERED BY SPHERICAL PARTICLES
Origin and Sponsor: U. S. Army Signal Research and Development Laboratories, Atmospheric Physics Branch, Belmar, N. J.
Manager: H. Oser
Full task description: July-Sept 1958 issue, p. 32
Status: Continued. A misprint occurred in equation (3), which should read

\[ Q_{\text{ext}} = \frac{2}{x^2} \sum_{n=1}^{\infty} (2n+1)(-1)^n \left\{ I(an) - I(bn) \right\}. \]

First production runs have been made, and the results have been submitted to the sponsor.

1102-40-5126/59-374  END-EFFECT IN THE CYLINDRICAL ROTATIONAL VISCOMETER
Origin and Sponsor: NBS, Section 7.1
Managers: A. Schopf, J. P. Menard
Full task description: July-Sept 1958 issue, p. 34
Status: Inactive.
1102-40-5126/59-376  VARIATIONAL CALCULATION OF SLOW ELECTRON SCATTERING BY HYDROGEN ATOMS

Origin and Sponsor:  NBS, Section 4.6
Manager:  L. S. Joel
Full task description:  July-Sept 1958 issue, p. 35

1102-40-5126/59-381  BOOLEAN FUNCTIONS AND PICTORIAL DATA PROCESSING

Origin and Sponsor:  NBS, Section 12.5
Manager:  B. Bender
Full task description:  July-Sept 1958 issue, p. 35
Status:  Continued.  A method has been devised and two programs written for SEAC to aid in simplifying truth functions of up to 14 variables.  The first of the programs obtains the core of truth function, i.e., lists all the prime implicants the alternation of which must appear in any simplest normal equivalent, and lists all clauses not subsumed by at least one prime implicant in the core.  The second program finds for each of these clauses all the prime implicants which subsume it.  (For a definition of unfamiliar terms, see W. V. Quine, "The Problem of Simplifying Truth Functions," Amer. Math. Month., Oct. 1952.)

A projected modification in the second program would enable a selection to be made among some of the prime implicants not in the core to obtain part of one (not necessarily unique) simplest normal equivalent, and a projected third phase would attempt to complete the process.

1102-40-5126/59-389  FREQUENCY ALLOCATION

Origin and Sponsor:  Civil Aeronautics Administration
Manager:  L. S. Joel
Objective:  To find if possible a systematic algorithm for optimizing frequency assignment (in the sense of making fewest changes).  An interim objective is to write a program to "automate" the present method of assignment.

Background:  The Civil Aeronautics Administration maintains a network of radio transmitters emitting signals at fixed frequencies which delineate lanes as navigational aids for aircraft making point-to-point flights.  A similar network is used for making "instrument landings" at airfields.

Frequencies for the transmitters are selected from a fixed set subject to a set of restrictions determined by the range of the transmitters and the selectivity of the receiving devices available in airplanes.  As new stations are added to the network frequencies are assigned to them, and if necessary existing frequencies are changed to accommodate the new stations.

The problem was transmitted by E. Estes (CAA).
Status:  New.  Two preliminary bookkeeping programs have been written and checked with sample data.
1102-40-5126/59-391  ION DISTURBANCE AROUND A SATELLITE
Origin and Sponsor: Naval Research Laboratory
Manager: W. F. Cahill
Full task description: July-Sept 1958 issue, p.37
Status: Completed. The results were transmitted to the sponsor.

3711-60-0009/59-393  HEAT TRANSFER IN THE PRESENCE OF MOISTURE
Origin: NBS, Section 10.6
Manager: F. L. Alt
Full task description: July-Sept 1958 issue, p.38
Status: Inactive. For status to date, see July-Sept 1958 issue.

1102-40-5126/59-394  VARIATIONAL CALCULATION OF SLOW ELECTRON SCATTERING
                     BY HYDROGEN ATOMS, II
Origin and Sponsor: NBS, Section 4.6
Manager: A. Beam
Objective: To apply the Kohn variational method to determine the symmetric
and antisymmetric scattering phase shifts for s-, p-, and d-wave electrons.
The trial function contains, in addition to the phase shift parameter, up
three linear parameters and one screening parameter which enters
nonlinearly. The variation of the stationary integral with respect to
the nonlinear parameter is to be accomplished by a systematic numerical
interpolation method. The dependence of the phase shifts upon the
number of linear parameters is also to be investigated to try to get
some idea of the degree of convergence of the procedure.
Background: This problem arises in the study of phase shifts in elastic
scattering of electrons by hydrogen atoms. While the prime objective is
still that of task 1102-40-5126/59-376, a more general approach in the
study of phase shifts, etc. is planned, allowing for changes in initial
values. The problem was proposed by S. Geltman (4.6).
Status: New. A Fortran code for the 704 was written for the s-wave, and
all desired results for this part of the problem have been obtained. The
code for the p-wave has been written and is being checked out.

1102-40-5126/59-403  COMPUTATION OF COLOR FADINGS
Origin and Sponsor: NBS, Section 2.1
Manager: W. C. Rheinboldt, J. P. Menard
Objective: (1) To write a revised program for the conversion of CIE-
chromaticity coordinates into terms of the Munsell renotation system,
which will store all necessary data directly in the core of the 704.
(2) To write a code for the computation of color difference.
Background: The Photometry and Colorimetry Section (2.1) is presently
engaged in a test-program for a commercial company. This program in-
volves the reduction of a considerable amount of spectrophotometric data
into terms of the Munsell renotation system and additionally the compu-
tations of color differences for the evaluation of the amount of fading
of given color samples.
The original program for the conversion of CIE-chromaticity
coordinates was written under task 1102-40-5126/57-267 and required that
the data of the Munsell Renotation System be stored on magnetic tape. For the present needs this code is too slow. The revised program will store all necessary data directly in the core memory and will incorporate other improvements in the method of computation including more generalized input and output.

The problem has been transmitted by H. Keegan (2.1)

Status: New. The revised code has been written and is in the process of being checked out.

1102-40-5126/59-412    DYNAMICS OF PNEUMATIC PRESSURE REDUCERS

Origin and Sponsor: NBS, Section 3.2

Manager: W. Gautschi

Objective: To solve numerically a set of nonlinear systems of six differential equations under given initial conditions and additional constraint conditions.

Background: The problem relates to the study of the dynamic behavior of pneumatic pressure reducers with respect to various design parameters and initial operating conditions. Of particular interest are the natural frequencies, damping, and the regions of stability. The dynamics of the reducers is governed by a system of six differential equations.

The dynamics of pneumatic pressure reducers (such as those used in the control systems of aircraft, rockets, etc.) is being studied in the NBS Thermodynamics Section (3.2) under the sponsorship of the Bureau of Aeronautics. The problem was transmitted by D. H. Tsai (3.2).

Status: New. A code for 704 has been written which integrates the simultaneous differential equations numerically taking into account the constraint conditions. The code is being checked with a set of parameters furnished by the sponsor.
6. STATISTICAL ENGINEERING SERVICES

COLLABORATION ON STATISTICAL ASPECTS OF NBS RESEARCH AND TESTING
Task 3737-60-0002/51-1

Origin: NBS
Managers: W. J. Youden, J. Cameron
Full task description: July-Sept 1950 issue, p. 60

Authorized 7/1/50

Status: CONTINUED. During this quarter members of the Section provided statistical assistance and advice to a number of Bureau personnel. The following are representative examples:

(1) Interlaboratory Transistor Measurement Experiment: Methods of "editing" data were developed to mitigate the effect of test-set bias discovered during the early stages of the experiment. Work on this project is being done for G. Conrad, Section 1.6.

(2) Measurement of Gage Blocks: Procedures for machine computation of measures of precision and for testing for possible systematic errors were worked out in collaboration with J. Beers, Section 2.4.

(3) Machine (704) analyses of data and/or the preparation of special codes were carried out for:

- H. B. Kirkpatrick, 9.4
- J. R. Crandall, 9.6
- M. J. Kerper, 9.2
- J. Mandel, 7.5
- R. E. Michaelis, 5.10
- F. M. Reinhart, 8.4
- H. C. Allen, 4.2
- D. R. Lide, 3.2

(4) An NBS in-hours course, "Design of Multi-factor Experiments," is being presented by W. S. Connor and M. Zelen. Twenty-three have enrolled for the course.

(5) Uniformity of Titanium: As a member of the NAS Materials Advisory Board Sampling Subpanel, W. J. Youden devised a method for selecting specimens from sheets of rolled titanium alloy to give valid estimates of the effect of nine factors on the mechanical properties of the metal. The schedule calls for a subset of 1/9th of the complete set of 7776 tests called for in the full factorial design using the nine factors.
Status of Projects

STATISTICAL SERVICES FOR COMMITTEE ON SHIP STEEL, NRC
Task 1103-40-5105/52-1

Origin and Sponsor: Ship Structure Committee, NRC  
Manager: W. J. Youden
Full task description: Oct-Dec 1951 issue, p. 58

Status: CONTINUED. Statistical studies on the relation between 
ductility transition temperature and several physical and chemical 
properties of two types of ship steel were begun.

MANUAL ON EXPERIMENTAL STATISTICS 
FOR ORDNANCE ENGINEERS
Task 1103-40-5146/55-93

Origin and Sponsor: Office of Ordnance Research  
Manager: C. Eisenhart
Full task description: Oct-Dec 1954 issue, p. 28

Status: CONTINUED. The major portions of Part II (Qualitative 
Data) and Part IV (Miscellaneous Topics) are being readied for distribution 
for final comments. Work proceeded on preparing examples for the sections: 
Regression, and Design of Experiments.

Publications:
(1) A note on the computation of $\chi^2$. Mary G. Natrella. To appear in 
The American Statistician.
(2) The relation between confidence intervals and tests of significance--a 
teaching aid. Mary G. Natrella. Submitted to a technical journal.

STATISTICAL SERVICES
Task 1103-40-5150/58-346

Origin and Sponsors: Various Agencies  
Manager: J. M. Cameron
Full task description: Jan-Mar 1958 issue, p. 45

Status: CONTINUED. Work was done during the quarter for the 
following agencies:
(1) Veterans Administration Hospital, Perry Point, Maryland: 
A "data preparation" code for the analysis of a new set of data on mental 
patients was written for use with the previously prepared analysis of 
covariance code.
(2) Bureau of Public Roads: See task 1102-40-5126/58-316, p.25, 
for report on this task done jointly with the Computation Laboratory.
(3) Chemical Corps: Analysis of a problem arising in the work of 
the Chemical Corps was begun in collaboration with A. J. Goldman of the 
Numerical Analysis Section (11.1).
# Application of Automatic Computer

The record of the use of the IBM 704 for the period October 1 through December 31 is as follows:

<table>
<thead>
<tr>
<th>Task No.</th>
<th>Title</th>
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<th>Code Checking</th>
<th>Code Production</th>
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<td>Research in mathematical physics</td>
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<td>Crystal structure calculations</td>
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<td>Reproduction of color-and spectral-energy distribution of daylight*</td>
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<td>Reduced cross-sections**</td>
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<td>Least squares fit*</td>
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<td>Mass weighing***</td>
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** Totals (NBS)... 1,255 4,797 8,994

OUTSIDE
5116/55-56 Research in mathematical topics applicable to numerical analysis 101 40
5126/53-45 Air defense tactics 172 93
5126/58-263 Gas tube characteristic 24 545
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<th>Checking</th>
<th>Production</th>
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<td>Fitting of exponential curves***</td>
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Totals (Outside).... 1,867 3,613 11,706

Total time for the quarter 3,122 8,410 20,700

*Problem programmed in the Computation Laboratory; production runs continued under direction of sponsor.
**Problem programmed by sponsor and run under his direction.
***Machine time provided under contract.
°Classified task.
Lectures and Symposia

Note: In general, copies of papers or talks listed in this section are not available from the National Bureau of Standards. If and when a paper is to be published, it will be listed in the section of this report on Publication Activities.

Applied Mathematics Division Seminars


Applied Statistics Seminar

YOUDEN, W. J. Interpreting interlaboratory tests. December 3.

Papers and Invited Talks
Presented by Members of the Staff
at Meetings of Outside Organizations


OLVER, F. W. J. Linear differential equations of the second order with large parameter. Presented at a Symposium on Asymptotic Expansions, held at Pomona College, Claremont, Calif., November 21.

OSTROWSKI, A. On Sylvester's law of inertia. Presented before the Mathematics Department, Westinghouse Corporation, Pittsburgh, Pa., in December.


RHEINBOLDT, W. C., and J. P. MENARD Mechanized conversion of colorimetric data to Munsell renotations. Presented at a meeting of the Optical Society of America, Detroit, Mich., October 9-11.


YOUDEN, W. J. (1) Problems of the experimenter. Presented before the Central Massachusetts Section, American Chemical Society, Worcester, Mass., October 6; before the Western Vermont Section, American Chemical Society, Middlebury, Vt., October 8; and before the Connecticut Chapter, American Statistical Association, New Haven, Conn., October 9. (2) Interpretation of chemical data. Presented before the American Chemical Society: before the Maine Section Brunswick, Me., October 4; and before the Rhode Island Section, Providence, R.I., October 10. (3) Graphical diagnosis of interlaboratory test results. Presented before the Statistics Department, Harvard University, Cambridge, Mass., October 7; and before the Connecticut Valley Section, American Chemical Society, Springfield, Mass., October 11.
(5) Interpreting interlaboratory tests. Presented before the Statistics Department, Virginia Polytechnic Institute, Blacksburg, Va., October 31.
(6) The reliability of estimates of physical properties. Presented before the Society for Experimental Stress Analysis, Albany, N.Y., November 12.
(7) Experimental designs. Presented at the Maryland Institute of Metals, Baltimore, Md., December 2.


* * * * * *


CONNOR, W. S. Some recent work on mixed fractional factorial designs.

YOUDEN, W. J. Measurements made by matching with known standards.

ZELEN, M. Factorial experiments in life testing.
Publication Activities

1. PUBLICATIONS THAT APPEARED DURING THE QUARTER

1.3 Technical Papers


2. MANUSCRIPTS IN THE PROCESS OF PUBLICATION DECEMBER 31, 1958

2.1 Mathematical Tables

(1) Tables of the bivariate normal distribution function and related functions. To appear as NBS Applied Mathematics Series 50.


2.2 Manuals, Bibliographies, and Indices

(1) Fractional factorial experiment designs for factors at three levels. To appear as NBS Applied Mathematics Series 54.

2.3 Technical Papers


(3) A theoretical foundation for the numerical evaluation of worth in subjective allocation problems. R. J. Aumann. Submitted to a technical journal.


(14) The exponential integral $\int_1^\infty e^{-xt}t^{-n}dt$ for large values of n. W. Gautschi. To appear in the Journal of Research, NBS.

Publication Activities


(19) Mechanized computation of thermodynamics tables at the National Bureau of Standards. II. Equilibrium compositions and thermodynamics properties of dissociated and ionized gaseous systems. J. Hilsenrath, M. Klein (NBS Thermodynamics Section), and D. Y. Sumida. To appear in the Proceedings of a Symposium of the American Society of Mechanical Engineers, to be held at Purdue University, Lafayette, Indiana, February 1959.


(28) On the derivative of Bessel functions with respect to the order. F. Oberhettinger. Submitted to a technical journal.

(29) Linear differential equations of the second order with a large parameter. F. W. J. Olver. Submitted to a technical journal.


(32) Un nouveau critere d'univalence des transformations dans un \( \mathbb{R}^n \). A. M. Ostrowski. Submitted to a technical journal.


(34) A note on commutators. M. Pearl. Submitted to a technical journal.


(38) The non-central \( \chi^2 \) as a test statistic. N. C. Severo. Submitted to a technical journal.


(49) Multi-variable experiments. M. Zelen and W. S. Connor. To appear in Industrial Quality Control.

(50) The weighted compounding of two probabilities from independent significance tests. M. Zelen and L. S. Joel. Submitted to a technical journal.

2.4 Reviews and Notes


THE NATIONAL BUREAU OF STANDARDS

The scope of activities of the National Bureau of Standards at its headquarters in Washington, D. C., and its major laboratories in Boulder, Colo., is suggested in the following listing of the divisions and sections engaged in technical work. In general, each section carries out specialized research, development, and engineering in the field indicated by its title. A brief description of the activities, and of the resultant publications, appears on the inside front cover.

WASHINGTON, D. C.


• Office of Basic Instrumentation.

• Office of Weights and Measures.

BOULDER, COLORADO


