NATIONAL BUREAU OF STANDARDS REPORT

7360

PROJECTS and PUBLICATIONS

of the

APPLIED MATHEMATICS DIVISION

A Quarterly Report

July through September 1961

For Official Distribution

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

THE NATIONAL BUREAU OF STANDARDS

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The functions of the National Bureau of Standards are set forth in the Act of Congress, March 3, 1901, as amended by Congress in Public Law 619, 1950. These include the development and maintenance of the national standards of measurement and the provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods and instruments for testing materials, devices, and structures; advisory services to government agencies on scientific and technical problems; invention and development of devices to serve special needs of the Government; and the development of standard practices, codes, and specifications. The work includes basic and applied research, development, engineering, instrumentation, testing, evaluation, calibration services, and various consultation and information services. Research projects are also performed for other government agencies when the work relates to and supplements the basic program of the Bureau or when the Bureau's unique competence is required. The scope of activities is suggested by the listing of divisions and sections on the inside of the back cover.

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A complete listing of the Bureau's publications can be found in National Bureau of Standards Circular 460, Publications of the National Bureau of Standards, 1901 to June 1947 ($1.25), and the Supplement to National Bureau of Standards Circular 460, July 1947 to June 1957 ($1.50), and Miscellaneous Publication 240, July 1957 to June 1960 (Includes Titles of Papers Published in Outside Journals 1950 to 1959) ($2.25); available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

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NBS PROJECT

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APPLIED MATHEMATICS DIVISION

July 1 through September 30, 1961

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Bernice K. Bender, M.A.
John R. Edmonds, M.A.
Lambert S. Joel, B.A.
Charles T. Zahn, Jr.

*Guest Worker °Temporary appointment **Part time

Contents

°Only unclassified material is included in this report.

*Established as a new section of the Applied Mathematics Division on July 1, 1961.

Status of Projects

September 30, 1961

1. NUMERICAL ANALYSIS

RESEARCH IN NUMERICAL ANALYSIS AND RELATED FIELDS
Task 1101-12-11110/55-55

Origin: NBS Authorized 8/29/54
Manager: P. Davis
Full task description: July-September 1954 issue, p. 1

Status: CONTINUED. O. Shisha has worked in the following areas: (i) Tchebycheff approximation by polynomials and by rational functions, particularly from the computational standpoint; (ii) a certain representation of the norm in Minkowski spaces; (iii) infrapolynomials, with and without prescribed coefficients and their generalizations. Location of zeros and structure problems; (iv) preparation of a report concerning the "predictive method" used in the machine translation of Russian.

P. Davis and O. Shisha are continuing their preparation of a survey on the theory of the transfinite diameter.

M. Marcus is preparing a manuscript with H. Minc on "Symmetry classes of tensors." The notes on "Integral matrices" by M. Newman have been read and corrected by M. Marcus, W.R. Gordon and F. May; however, the final typed form is not entirely complete. Some minor revisions have been made to the AMS·57 monograph "Basic Theorems in Matrix Theory."

S. Haber proposed a machine procedure for obtaining a rough estimate of the condition of a matrix. He also obtained a lower bound for the P-condition number of a positive definite matrix in terms of easily evaluated functions of the matrix entries.

F.W.J. Olver has continued work on error bounds for Airy-function expansions in turning-point problems. Results obtained for real variables are being extended to the complex plane.

N. Bazley has continued research in developing techniques for estimating eigenvalues and eigenvectors of self-adjoint operators. An investigation of methods for approximating expectation values and solutions to $Au = f$ has also been started.

Publications:

(1) Split integration methods for simultaneous equations. J.R. Rice. Submitted to a technical journal.

(2) Tchebycheff approximations by functions unisolvent of variable degree. J.R. Rice. To appear in the Transactions of the American Mathematical Society.

Status of Projects

(3) Regions containing the characteristic roots of a matrix. E. Haynsworth. Submitted to a technical journal.
(4) Best approximations and interpolating functions. J.R. Rice. To appear in the Transactions of the American Mathematical Society.
(5) Criteria for the reality of matrix eigenvalues. M.P. Drazin (RIAS) and E.V. Haynsworth. Submitted to a technical journal.
(6) A note on normal matrices. M. Marcus and N. Khan (Muslim University, India). To appear in the Canadian Mathematical Bulletin.
(7) The invariance of symmetric functions of singular values. M. Marcus and H. Minc (The University of Florida). Submitted to a technical journal.
(8) On the relation between the permanent and the determinant. M. Marcus and H. Minc (The University of Florida). To appear in the Illinois Journal of Mathematics.
(9) Lower bounds for eigenvalues of Schroedinger's equation. N.W. Bazley and D.W. Fox (Applied Physics Laboratory, JHU). To appear in the Physical Review.
(10) Linear operations on matrices. M. Marcus. In manuscript.
(11) Two matrix eigenvalue inequalities. S. Haber. In manuscript.
(12) A procedure for estimating eigenvalues. N.W. Bazley and D.W. Fox Applied Physics Laboratory, JHU). Submitted to a technical journal.

RESEARCH IN MATHEMATICAL TOPICS APPLICABLE TO NUMERICAL ANALYSIS
Task 1101-12-11411/55-56

Origin: NBS Authorized 8/13/54
Sponsor: Office of Naval Research
Manager: M. Newman
Full task description: July-September 1954 issue, p. 5

Status: CONTINUED. M. Newman is continuing his investigations of number theoretic properties of coefficients of modular forms. In particular the number of representations of integers by diagonal quadratic forms is being studied, with the aid of certain congruence subgroups of the modular group.

A new proof of M. Hall's theorem on multipliers of difference sets using incidence matrices alone was found by M. Newman. The method allows generalization of some of Hall's results.

Some investigations related to the Burnside problem have been undertaken by M. Newman. The results obtained shed light on the subgroups of the modular group generated by the mth powers of all the elements, and use the recent results of Novikov on this problem.

K. Goldberg investigated centralizers in matrix rings, and their connection with both incidence algebras and normal forms.

K. Goldberg and J. Gager continued their work on the proposed model for baseball.

Status of Projects

Publications:

(1) Congruence properties of the partition function to composite moduli. M. Newman. To appear in the Illinois Journal of Mathematics.

(2) Some geometrical theorems for abscissas and weights of Gauss type. P. Davis and P. Rabinowitz. Journal of Mathematical Analysis and Applications, 2, No.3, 428-437, June 1961.

(3) A comment on Ryser's "Normal and Integral Implies Incidence" theorem. K. Goldberg. To appear in the American Mathematical Monthly.

2. MATHEMATICAL TABLES AND PROGRAMMING RESEARCH

MATHEMATICAL TABLES

The following long-range mathematical table projects are being carried in the Computation Laboratory. Progress continues as dictated by the relative priority in the overall program of the Laboratory and by available funds. All of the table projects were inactive during the past quarter because priority was given to the preparation of the forthcoming "Handbook of Mathematical Functions."

1102-40-11112/47-2 TABLES OF COULOMB WAVE FUNCTIONS

1102-40-11112/51-8 TABLES OF POWER POINTS OF ANALYSIS OF VARIANCE TESTS

1102-40-11112/52-37 TABLES OF SPHEROIDAL WAVE FUNCTIONS

1102-40-11112/52-57 TABLES OF THE SIEVERT INTEGRAL

HANDBOOK OF MATHEMATICAL FUNCTIONS
Task 1102-40-11421/57-216

Origin and Sponsor: National Science Foundation Authorized 12/27/56
Manager: I.A. Stegun
Full Task description: October-December 1956 issue, p. 10

Status: CONTINUED. The galley proof of chapter 4 (Logarithmic, exponential, circular and hyperbolic functions) is being checked. Graphs are being prepared and illustrative examples verified for chapters 8 (Legendre functions) and 18 (Weierstrass elliptic functions). Chapters 25 (Numerical analysis) and 26 (Mathematical statistics) are in press and the remaining chapters are being reviewed for consistency of notation, updating of references, indexing, etc.

AUTOMATIC CODING
Task 1102-12-11120/55-65

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

Status: CONTINUED. Fifteen subroutines were written for the IBM 704 computer which perform the operations specified in the ALGOL String

Language. Using these subroutines, programs written in the String Language can readily be hand coded and tested on the 704 computer. Several of these programs were then tested on the computer which included the Yngve English-sentence generator and several translations from one artificial language to another. Some progress was made in learning what is needed in a language for describing symbol manipulations and artificial language translation as well as learning what is common to various artificial language translation procedures.

Publications:

(1) A status report on ALGOL 60. J. Wegstein. To appear in Datamation.

3. PROBABILITY AND MATHEMATICAL STATISTICS

MISCELLANEOUS STUDIES IN PROBABILITY AND STATISTICS
Task 1103-12-11131/51-2

Origin: NBS Authorized 7/1/50
Manager: C. Eisenhart
Full task description: July-September 1950 issue, p. 58

Status: CONTINUED. Churchill Eisenhart and Anna Glinski are studying the reduction in the effective level of confidence that would result if, when in fact σ is known, one were to compute both the normal- and t-based confidence intervals and then choose the narrower. They are also studying analogous situations for two-sided tests of significance, considering separately the case of an individual who is reluctant to reject H_o and the case of an individual who looks for an excuse to accept some alternative to H_o. They are preparing a joint paper entitled "On the price of double-dealing in data analysis" for presentation at the annual meetings of the American Statistical Association in New York in December 1961.

Mary C. Croarkin has prepared charts for the non-central t-distribution from the calculations on the non-central F tables. These charts depict the operating characteristic curve of the t-test as a function of the difference in means plotted against the number of observations for fixed Type I and II errors. Both the one-and two-sample cases are treated for all possible combinations of the Type I and II errors equal to .01, .02, .05, .10, .20 and .01, .05, .10, .50, .90 respectively.

A paper is being prepared jointly by Joan R. Rosenblatt and N.C. Matalas (U.S. Geological Survey), reporting their results on the use of regression estimates to augment incomplete sets of data. (This was previously reported under Task 1103-40-11625/58-346).

A paper is being prepared for publication to report the results of a study by Churchill Eisenhart, Ann D. Smith, and John Van Dyke on the evaluation of probability points of the coverage of Wilks' unbiased tolerance intervals in random samples of size n from a normal distribution. This material was presented by Dr. Eisenhart at the meeting of the Virginia Academy of Science in Lexington, May 13, 1961.

H.H. Ku, collaborating with S. Kullback and M. Kupperman (George Washington University), and I.J. Good (Admiralty Research Laboratory, England), completed the manuscript for an expository paper on the application of information theory to the analyses of contingency tables and Markov chains.

Publications:

(1) Probability inequalities of the Tchebycheff type. I.Richard Savage. Journal of Research NBS, 65B (Mathematics and Mathematical Physics), 211-222 (July-September 1961).

(2) Roger Joseph Boscovich and the combination of observations. Churchill Eisenhart. To appear in Actes du Symposium International Roger Boscovich 1961.

Status of Projects

(3) Boscovich and the combination of observations. Churchill Eisenhart. To appear as Chapter 9 in Roger Joseph Boscovich, Studies of his Life and Work. Edited by Lancelot Law Whyte, Allen and Unwin, Ltd., London 1961.
(4) On the pedestrian queueing problem. George Weiss. To appear in the Bulletin of the International Statistical Institute.

STUDIES IN THE MATHEMATICS OF EXPERIMENT DESIGN
Task 1103-12-11131/53-1

Origin: NBS Authorized 10/15/52
Manager: J.M. Cameron
Full task description: October-December 1952 issue, p. 60

Status: INACTIVE.

Publications:
(1) Fractional factorial designs for experiments with factors at two and three levels. W.S. Connor and Shirley Young. NBS Applied Mathematics Series AMS·58, September 1, 1961.
(2) Partial confounding in fractional replication. W.J. Youden. Technometrics, 3, 353-358, August 1961.
(3) Randomization and experimentation. W.J. Youden. To appear in Annals of Mathematical Statistics.
(4) A calculus for factorial arrangements. Badrig Kurkjian (DOFL) and M. Zelen. Submitted to a technical journal.
(5) Factorial designs and the direct product. Badrig Kurkjian (DOFL) and M. Zelen. Submitted to a technical journal.
(6) Physical measurements and experiment design. W.J. Youden. Le Plan d'Experiences, 110, Centre National de la Recherche Scientifique, Paris, August-September 1961.

STUDY OF NON-PARAMETRIC STATISTICAL TECHNIQUES
Task 1103-12-11131/56-170

Origin: NBS Authorized 12/15/55
Manager: J.R. Rosenblatt
Full task description: October-December 1955 issue, p. 14

Status: CONTINUED. Thomas A. Willke is studying the description of multivariate distribution functions by means of the values of various functions of the distribution function and the marginal distribution function.

Joan R. Rosenblatt is considering the properties of certain approximate non-parametric procedures for estimating confidence limits for the value of a functional of several distribution functions.

Status of Projects

MEASUREMENT OF RELIABILITY
Task 1103-12-11130/56-182

Origin: NBS Authorized 3/23/56
Managers: M. Zelen, J.R. Rosenblatt
Full task description: January-March 1956 issue, p. 13

Status: CONTINUED. David D. Prill completed the preparation of brief summaries of approximately 70 papers on reliability theory published in the USSR.

Joan R. Rosenblatt and Anna M. Glinski have continued their work on procedures for determining confidence limits for system-performance probabilities which are functions of several distribution functions.

4. MATHEMATICAL PHYSICS

RESEARCH IN MATHEMATICAL PHYSICS AND RELATED FIELDS
Task 1104-12-11141/55-57

Origin: NBS Authorized 9/1/54
Manager: W.H. Pell
Full task description: July-September 1954 issue, p. 27

Status: CONTINUED. A paper entitled "On Rayleigh's Non-linear Vibration Equation" was prepared by A. Ghaffari for the International Symposium on Non-linear Vibrations, Academy of Sciences of the Ukrainian SSR, Kiev, USSR, September 12-18, 1961. This summarizes an investigation of the behavior at infinity in the phase plane of the paths of Rayleigh's non-linear differential equation which is associated with acoustical phenomena and certain steady vibrations, and gives an analysis of the global qualitative description of the totality of the paths in the phase plane. This paper was not presented in person because of other commitments, but copies were distributed among the participants of the Symposium.

J.H. Bramble and L.E. Payne have completed a paper entitled "Pointwise Bounds in the First Biharmonic Boundary Value Problem." In this paper some inequalities for biharmonic functions are derived. These inequalities can be used in conjunction with the Rayleigh-Ritz technique to obtain close approximations (with known error) to the solution and its derivatives of the first biharmonic boundary value problem. Such problems arise in the theory of elastic plates, theory of slow viscous flows, etc.

Error bounds for the solution of the first boundary value problem are obtained by combining mean value inequalities and a priori mean square inequalities for biharmonic functions. Since the error is quadratic, the Rayleigh-Ritz technique may be used for their improvement.

Other biharmonic boundary value problems are under consideration.

Publications:

(1) A priori bounds in the first boundary value problem of elasticity. J.H. Bramble and L.E. Payne. To appear in the Journal of Research NBS, Section B (Mathematics and Mathematical Physics).
(2) Some higher order integral identities with application to bounding techniques. J.H. Bramble and B.E. Hubbard. To appear in the Journal of Research NBS, Section B (Mathematics and Mathematical Physics).
(3) Analyticity and probability properties of one-dimensional Brownian motion. A. Ghaffari. To appear in the Journal of Research NBS, Section B (Mathematics and Mathematical Physics).

Status of Projects

PLASMA RESEARCH
Task 1104-12-11140/59-422

Origin: NBS Authorized 6/30/59
Manager: C.M. Tchen
Full task description: April-June 1959 issue, p. 15

Status: CONTINUED. The continuing study of C.M. Tchen concerning the statistical mechanics of plasmas has now enabled him to obtain a kinetic equation which has the following two ranges of validity: (i) the range of rarified plasmas, where the mean spacing between particles is large compared to the Debye length. This range has been usually governed by the Vlasov equation; and (ii) the range of relatively dense plasmas with Debye shielding, where the mean spacing is smaller than the Debye length. This range is governed by the Fokker-Planck equation. The Debye interaction and the collective interaction were considered, and the time evolution of the correlations were investigated. Dr. Tchen presented the results of these investigations in a paper entitled "Kinetic Equation for Plasmas with Short and Long Range Interactions" which was presented at the Fifth International Conference on Ionization Phenomena in Gases, Munich, Germany, August 28-September 1, 1961.

The application of the above kinetic equation to study oscillations and Landau damping was pursued. This equation is expected to be more powerful than the Vlasov equation due to the inclusion of the collective effects in correlation functions. This is particularly important in the case of short wave lengths.

Publications:

(1) Kinetic equation for plasmas with collective and collisional correlations. C.M. Tchen. Accepted for publication in the Proceedings of the Fifth International Conference on Ionization Phenomena in Gases, Munich, Germany, August 28-September 1, 1961.

RESEARCH ON SATELLITE ORBITS
Task 1104-12-11440/59-420

Origin: NBS Authorized 12/19/58
Sponsor: Office of Scientific Research, ARDC, USAF
Full task description: October-December 1958 issue, p. 15

Status: CONTINUED. J.P. Vinti has continued his study of satellite orbits. The method of evaluating the ρ-integrals was developed in the paper entitled "Theory of an Accurate Intermediary Orbit for Satellite Astronomy," which appeared in the Journal of Research NBS, 65B (Mathematics and Mathematical Physics), 169-201, July-September 1961.

Status of Projects

Publications:

(1) Theory of an accurate intermediary orbit for satellite astronomy. J.P. Vinti. Journal of Research NBS, 65B (Mathematics and Mathematical Physics), 169-201, July-September 1961.

(2) Formulae for an accurate intermediary orbit of an artificial satellite. J.P. Vinti. To appear in the Astronomical Journal.

(3) Intermediary equatorial orbits of an artificial satellite. J.P. Vinti. To appear in the Journal of Research NBS, Section B (Mathematics and Mathematical Physics).

FOURIER TRANSFORMS OF PROBABILITY DISTRIBUTION FUNCTIONS
Task 1104-12-11626/56-154

Origin: NBS Authorized 9/30/55
Sponsor: Office of Naval Research
Manager: F. Oberhettinger
Full task description: July-September 1955 issue, p. 20

Status: CONTINUED. F.W.J. Olver has reviewed certain sections of the manuscript.

Publication:

(1) Tables of Fourier transforms of absolutely continuous distribution functions. Fritz Oberhettinger. To appear in the NBS Applied Mathematics Series.

5. OPERATIONS RESEARCH

The establishment of the Operations Research Section (11.05) of the Applied Mathematics Division has been authorized, effective as of July 1, 1961, with Dr. Alan J. Goldman as Chief. The new section, which incorporates certain of the previous activities of the Numerical Analysis Section (11.01) and the Computation Laboratory (11.02), has the following general functions:

> To conduct research in mathematical and computational techniques for the analysis, improvement or optimization of complex systems or activity-patterns. This includes: (i) research in specific relevant areas of mathematics, such as linear programming, the theory of linear graphs, and the theory of strategic contests; (ii) investigations in the art of constructing useful mathematical models of complex systems, and of obtaining information about the system by applying analytic or simulation methods; and (iii) application of these techniques to selected problems, of general methodological significance, arising in the work of the Bureau or of other government agencies lacking specialized personnel in this field.

OPERATIONS RESEARCH
Task 1105-12-11115

Origin: NBS Authorized 12/30/60
Manager: A.J. Goldman
Full Task Description: October-December issue, p. 3

Status: CONTINUED. Investigations were continued in various fields of operations research by the staff members of the Section. The following results were obtained:

(i) Bernice K. Bender continued work on the IBM computer Boolean simplification program. The version already available was used to obtain samples of the essential-cell content of Boolean functions of many variables. The results are being analyzed.

(ii) A.J. Goldman noted the fact that in chirp radars a linear FM signal of arbitrary envelope, when passed through a suitable network with linear delay characteristics, suffers a reversal of the linear FM and a Fourier transformation of the functional form of the envelope. Dr. Goldman proved that no other FM signal and delay network are related in this way, i.e., Fourier transformation of the arbitrary envelope, reversal of a summand of the input phase, and reproduction of the complementary summand.

(iii) Let a,b,c be positive integers with $b \leq \min(a, c-1)$. In a sequence of independent probabilistic trials with differing success probabilities, define a "run" to consist of $\underline{a}$ consecutive trials, and a "quota" to consist of no more than $\underline{c}$ consecutive trials which contain at least $\underline{b}$ successes. Bernice K. Bender and A.J. Goldman were able to derive a recursion formula

for the probabilities governing the appearance of the first run immediately preceded by a quota.

(iv) C.T. Zahn, Jr. performed computer experiments and recorded additional pertinent data concerning alternative methods of "black-box" maximization along the lines initiated by Gleason (A. Gleason, "A Search Problem in the N-Cube." Proceedings of the A.M.S. Symposium on Combinatorial Analysis).

(v) J. Edmonds is completing work begun with G. Dantzig on a method for selecting from a graph a largest subset of edges such that at most f_i meet vertex v_i. Its interest lies partially in being an efficient algorithm for a type of integer programming.

(vi) Mr. Edmonds has obtained a classification, based largely on finite fields, of regular maps whose skeletons are complete graphs. All but a finite number of these are counterexamples to the conjecture of Coxeter and Moser on the reflexibility of regular maps.

(vii) A graph is called 3-connected if the topological complement of any one or two vertices is connected except possibly for an additional component consisting of an open edge. The boundaries of the regions into which a plane is partitioned by an embedding of a 3-connected graph are precisely the circuits of the graph whose topological complements in the graph are connected. Planarity of other graphs can be reduced to the 3-connected case so that the theorem (by J. Edmonds) provides a practical method to identify planar graphs in general.

Publications:

(1) A property of linear frequency modulation. A.J. Goldman. In manuscript.
(2) The first run preceded by a quota. A.J. Goldman and B.K. Bender. In manuscript.
(3) On the range of a fleet of aircraft. A.J. Goldman. To appear in the Journal of Research NBS, Section B (Mathematics and Mathematical Physics).

AIR DEFENSE
Task 1105-12-11415

Origin: U.S. Army Authorized 9/30/61
Manager: A.J. Goldman

Objective: To cooperate in analytic and computational research concerned with the computer simulation of the NIKE-ZEUS defense system.

Background: This analysis and simulation should assist in certain choices concerning the disposition and employment of the system.

Status: NEW L.S. Joel and A.J. Goldman continued cooperation with members of Denver Research Institute in the construction of the simulation model. Related mathematical problems were investigated by B.K. Bender and A.J. Goldman.

Status of Projects

RADAR STUDY
Task 1105-12-11527

Origin: U.S. Army Signal Air Defense Agency Authorized 9/30/61
Manager: L.S. Joel

Objective: To develop mathematical and computational methods for determining the optimal-coverage siting of a specified number of radar installations.

Background: It is desirable that the limited target-detecting and target-tracking equipment available at a defended area be positioned to give the best possible protection to the area.

Status: NEW. Results of the computer experiments were analyzed, and preparation of the final report to the sponsor was begun.

6. MATHEMATICAL AND COMPUTATIONAL SERVICES

1102-40-11645/56-0166 SCF-LCAO SOLUTION OF SOME HYDRIDES
Origin and Sponsor: NBS, Section 5.9
Manager: P.J. Walsh
Full task description: January-March 1956 issue, p. 27
Status: Continued. Some code checking was done using the new integral programs for pentatonic tetrahedral molecules. These results are being analyzed by the sponsor.

1102-40-11645/56-0186 MECHANICAL MEASUREMENTS OF GAGE BLOCKS
Origin and Sponsor: NBS, Section 2.5
Manager: B.S. Prusch
Full task description: July-September 1956 issue, p. 33
Status: Continued. Computations were performed in order to verify various laboratory sets of gage blocks.

1102-40-11645/57-0236 SELF CONSISTENT FIELD--EIGENVALUES
Origin and Sponsor: NBS, Section 3.6
Manager: P. Walsh
Full task description: April-June 1957 issue, p. 30
Status: Continued. Production runs were made using the standard SCF program. Transformations of the type $Y(XAX^T)^TY^T$ were performed on a variety of matrices.

1102-40-11645/58-0339 COMPUTATION OF VISCOELASTICITY PROPERTIES OF MATERIALS
Origin and Sponsor: NBS, Section 3.4
Manager: H. Oser
Full task description: January-March 1958 issue, p. 38
Status: Continued. A comprehensive code has been written and tested which contains all previously written codes for steady state and transient functions in all relevant regions of frequency or time.

1102-12-11513/59-0348 RUSSIAN-TO-ENGLISH MACHINE TRANSLATION
Origin: NBS
Sponsor: Office of Ordnance Research, U.S. Army
Manager: Ida Rhodes (11.0)
Full task description: October-December 1958 issue, p. 26
Status: Continued. Research on "profiling", i.e. the determination of clause and phrase boundaries, continues. In the portion of the machine code dealing with the generation of morphological information, the mainline routine and a few subroutines have been finished; in the portion dealing with syntactic integration, a number of subroutines have been added. Compilation of inflectional forms of Russian nouns, verbs, and

adjectives is progressing; this is a first step in the preparation of a pilot dictionary of a few thousand stems, to be used for trial translations.

Publications: (1) Recognition of clauses and phrases in machine translation of languages. F.L. Alt and I. Rhodes. To appear in the Proceedings of the International Conference on Machine Translation of Languages and Applied Language Analysis, Teddington, England, September 6-8, 1961. (2) A new approach to the mechanical syntactic analysis of Russian. I. Rhodes. To appear in Mechanical Translation.

1102-40-11645/58-0366 RADIATION PATTERNS OF ANTENNAS
Origin and Sponsor: U.S. Information Agency, Department of State
Manager: P.J. Walsh
Full task description: April-June 1958 issue, p. 35
Status: Inactive.

1102-40-11645/58-0368 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-September 1958 issue, p. 32
Status: Continued. Production runs were made on the planned table project.

1102-40-11645/59-0394 VARIATIONAL CALCULATION OF SLOW ELECTRON SCATTERING BY HYDROGEN ATOMS, II
Origin and Sponsor: NBS, Section 4.6
Manager: A.E. Beam
Full task description: October-December 1958 issue, p. 30
Status: Continued. The coding was completed for the improved variational calculation of the s-,p-, and d-wave electron-hydrogen atom scattering. Some production runs were made. The code for the eigenvalues of the negative hydrogen ion was completed and run. A search for a higher bound state of H^- gave no sign of the existence of more than one bound state. A code was written for the calculation of the ionization cross section of hydrogen including exchange. This involves a four-fold numerical integration of analytic functions.

1102-40-11645/59-0414 INFINITE SYSTEMS
Origin and Sponsor: NBS, Division 3
Manager: Ruth Zucker
Full task description: January-March 1959 issue, p. 28
Status: Reactivated. Additional production runs were made and the results have been submitted to the sponsor.

Status of Projects

1102-40-11645/60-0465 CALCULATIONS IN MOLECULAR QUANTUM MECHANICS
Origin and Sponsor: NBS, Section 3.2
Managers: P.J. Walsh, J.D. Waggoner
Full task description: October-December 1959 issue, p. 26
Status: Inactive.

1102-40-11645/60-0466 ELECTRONIC PROPERTIES OF SIMPLE MOLECULAR SYSTEMS
Origin and Sponsor: NBS, Section 3.2
Manager: P.J. Walsh
Full task description: October-December 1959 issue, p. 27
Status: Inactive.

1102-40-11645/60-0476 GAS TUBE CHARACTERISTICS, II
Origin and Sponsor: Diamond Ordnance Fuze Laboratories, Department of the Army
Manager: H. Oser
Full task description: October-December 1959 issue, p. 30
Status: Continued. Additional production runs were completed, and the results transmitted to the sponsor.

1102-12-11122/60-0479 PROCESSING OF DIAGRAMS
Origin and Sponsor: NBS, Section 11.0
Managers: F.L. Alt (11.0), Sally T. Peavy, R.J. Herbold
Full task description: October-December 1959 issue, p. 30
Status: Continued. Statistical evaluation of the numerical experiments indicates that the characters of one particular alphabet can be safely identified by their moments up to the 5th order.

1102-40-11645/60-0506 COMMODITY PRICE INDICES
Origin and Sponsor: U.S. World Bank, Statistics Division
Manager: Jeanne M. Beiman
Full task description: October-December 1960 issue, p. 19
Status: Inactive.

1102-40-11645/60-0513 RADIATIVE ENVELOPES OF MODEL STARS
Origin and Sponsor: National Aeronautics and Space Administration
Managers: S. Haber (11.1) and P.J. Walsh
Full task description: July-September 1960 issue, p. 23
Status: Continued. Several solutions were obtained, using new values for certain parameters occurring in the equations.

Status of Projects

3911-61-39952/61-0528 ANALYSIS OF EXPERIMENTAL DATA ON TRANSISTOR AGING
Origin and Sponsor: NBS, Section 14.1
Manager: J.D. Waggoner
Full task description: July-September 1960 issue, p. 28
Status: Reactivated. The transistor aging studies were continued. A program has been written to aid in processing data by aging condition stress level for time series evaluation. A second program was written to generate six additional computed parameters using the ten measured transistor parameters for time series evaluation. A third program now in process will use the two above programs as input data and will generate a tabulation which will provide a history of the aging behavior of each transistor under test for any number of time periods.

1102-40-11645/61-0530 SPECIMEN WAVELENGTH
Origin and Sponsor: NBS, Section 9.4
Manager: L. Joseph
Full task description: July-September 1960 issue, p. 28
Status: Continued. A code was written to solve for the four parameters, n_λ, $E_{s\lambda}$, σ_o, β_o, using the results of measurements of $E_{sc\lambda o}$ for four different values of D. It was found that the values of the parameters obtained in this manner were extremely sensitive to changes in the measurement values. Thus, it is doubtful that this method can be used to determine n_λ, $E_{s\lambda}$, σ_o, β_o with sufficient accuracy. Other approaches are now being considered.

1102-40-11645/61-0531 HEAT TRANSFER IN CRYSTALS
Origin and Sponsor: NBS, Section 3.1
Manager: H. Oser
Full task description: July-September 1960 issue, p. 29
Status: Inactive.

1102-40-11645/61-0532 CALCULATION OF VIBRATIONAL ENERGY LEVELS FOR IONIC MOLECULES
Origin and Sponsor: Georgetown University
Manager: P.J. Walsh
Full task description: October-December 1960 issue, p. 21
Status: Continued. Codes were written to compute the vibrational energy levels associated with the Heither-London electronic energy for the hydrogen molecule. Several tests are being made and results are being compared with some hand-calculated values.

1102-40-11645/61-0538 SPECTRAL REFLECTANCE
Origin and Sponsor: NBS, Section 9.4
Manager: S. Haber (11.1)
Full task description: October-December 1960 issue, p. 23

Status of Projects

Status: Continued. An approach suggested by the sponsor was tested by hand calculations and found not to be feasible. Plans have been made for further work by a new method and a program is being written.

1102-40-11645/0540 DIFFUSION CALCULATIONS
Origin and Sponsor: Army Chemical Center
Manager: L. Joseph
Full task description: January-March 1961 issue, p. 21
Status: Continued. The next phase of the problem is being coded by the sponsor.

1102-40-11645/61-0542 STUDENT LOAN DATA
Origin and Sponsor: Department of Health, Education, and Welfare
Manager: Ruth Zucker
Full task description: October-December 1960 issue, p. 24
Status: Inactive.

1102-40-11645/61-0556 TCHEBYCHEFF APPROXIMATION BY RATIONAL FUNCTIONS
Origin and Sponsor: NBS, Section 11.1
Manager: P.J. Walsh
Full task description: January-March 1961 issue, p. 22
Status: Continued. Hand calculation was performed using results computed from the code. In all cases the solutions of the systems checked for a specific tolerance. Attempts were made to adjust the tolerances to attain more accuracy and several runs were made. The solutions obtained were more accurate. Some additional checks will be made before production runs are begun.

1102-40-11645/61-0557 STRUCTURE DETERMINATION
Origin and Sponsor: NBS, Section 13.5
Manager: Karen A. Bedeau
Full task description: January-March 1961 issue, p. 23
Status: Completed. Results have been transmitted to the sponsor.

1102-40-11645/61-0559 THERMOCOUPLE CALIBRATION
Origin and Sponsor: NBS, Section 3.1
Manager: Karen A. Bedeau
Full task description: January-March 1961 issue, p. 23
Status: Continued. The program for phases II and III has been completed and is now in production under the direction of the sponsor. Phase I has been postponed indefinitely, as the methods involved in collecting the data are to be changed. Preliminary analyses have been reviewed concerning a program which is similar to that for phases II and III.

Status of Projects

1102-40-11645/61-0560 MUSCLE FLEXING
Origin and Sponsor: National Naval Medical Center
Manager: H. Oser
Full task description: April-June 1961 issue, p. 22
Status: Inactive.

1102-40-11645/61-0562 CUBIC LATTICES
Origin and Sponsor: NBS, Section 7.06
Manager: L. Joseph
Full task description: April-June 1961 issue, p. 22
Status: Continued. Another one hour production run was made on the 704. Results were given to the sponsor.

1102-40-11645/61-0566 ELECTRONIC DETECTION OF LAND-MINES
Origin and Sponsor: Fort Belvoir
Managers: L. Joseph, S. Haber
Full task description: April-June 1961 issue, p. 24
Status: Terminated.

1102-40-11645/61-0567 RADIOACTIVITY ESTIMATIONS
Origin and Sponsor: National Institutes of Health
Manager: R.A. Arms
Full task description: April-June 1961 issue, p. 25
Status: Terminated.

1102-40-11645/61-0568 TRANSIENT HEAT FLOW IN FLUID AMPLIFIERS
Origin and Sponsor: Diamond Ordnance Fuze Laboratories
Managers: H. Oser, Maxine L. Paulsen
Full task description: April-June 1961 issue, p. 25
Status: Terminated.

1102-40-11645/61-0571 NMR SPECTRUM
Origin and Sponsor: NBS, Section 15.07
Manager: H. Oser
Full task description: April-June 1961 issue, p. 25
Status: Continued. Preparations have been made to run a number of spectra with the programs supplied by Livermore and the Mellon Institute.

Status of Projects

1102-40-11645/62-1009 MONTE CARLO NEUTRON STUDIES
Origin and Sponsor: NBS, Section 4.3
Manager: Sally T. Peavy
Full task description: April-June 1961 issue, p. 21
Status: Reactivated. Several subroutines have been written. These subroutines involve the input and output of the problem, and a general sampling subroutine. This project was formerly classified as project 1102-40-11645/61-555.

1102-40-11645/62-1016 POST OFFICE OPERATION RESEARCH
Origin and Sponsor: NBS, Section 12.5
Manager: A.E. Beam
Objective: To sort and transform two post office files into a form suitable for the test installation of Rabinow Engineering Company. The two files of information are the local and outgoing files for Washington, D.C.
Background: The IBM 704 programs are used in conjunction with a codesorting system. Codesorting is a general technique of sorting letter mail by abbreviating the address and comparing the binary-coded abbreviation with a computer stored sorting "scheme". This table look-up procedure, performed by an on-line special-purpose computer, yields a "codesort number" which determines the sorting pocket or "bin" corresponding to the particular address. Essentially the procedure transcribes, translates, and edits the manual sorting schemes to sorting computer format and language. The computer language is an 8-bit character representation of alphanumerics, upper case alphabetics, and special symbols interpreted as computer instructions. The data organization of the manual schemes and the language restrictions of available data processing equipment necessitate the use of two computers during the procedure. The first codes and sorts the data while the second edits it to conform with restrictions imposed by the control computer.

The problem was transmitted by Peter C. Tosini (12.05).

Status: New. The IBM 704 codes have been written, checked, and preliminary runs have been made.

1105-40-11645/62-1017 MATHEMATICAL PROBLEMS RELATED TO POSTAL OPERATIONS
Origin: NBS
Sponsor: Post Office Department, Office of Research and Engineering
Managers: Bernice K. Bender, A.J. Goldman
Full task description: October-December 1958 issue, p. 22
Status: Reactivated: B.K. Bender participated in the evaluation of simulation models for automatic mail-sorting. This project was formerly classified as project 1102-40-11645/58-270.

Status of Projects

1102-40-11645/62-1025 OPERATING SYSTEMS

Origin and Sponsor: NBS, Section 11.2

Manager: G. Ziegler

Objective: To expedite the processing of jobs on the Bureau's IBM 704 as efficiently as possible, taking full advantage of the existing computer hardware.

Background: In the fall of 1959 a modified version of the Bell Telephone Laboratories monitoring system (BESYS2) was obtained from David Taylor Model Basin and, after some modification, was placed into operation at NBS. A year later the task of rewriting BESYS2 was started. This new system was appropriately called BSBEL and was in full operation early this year. BSBEL incorporates many additional features not available in its predecessor.

Status: New. The system is updated and modified as needed.

1102-40-11645/61-1027 NEW SYSTEM

Origin and Sponsor: NBS, Section 11.2

Manager: J.H. Wegstein

Objective: To place an automatic operating system in service coincident with the acquisition of an IBM 7090 and IBM 1401 computer combination at the Bureau of Standards.

Background: For efficiency, modern high speed computers are not operated by programmers but rather by a staff of experts who specialize in computer operation. For further efficiency, tape unit switching, reading of signal lights, setting of switches, and loading special control cards into the computer are eliminated as much as possible. This is accomplished by keeping supervisory codes in the computers. These codes cause the 1401 to act as a secretary computer for the 7090. Programs, data, and instructions for computer operation from several programmers at a time are punched on cards, read by the 1401 and written on magnetic tape which is then read at high speed by the 7090 computer. The 7090 prints instructions for the operators on a monitor printer concerning changing magnetic tapes. The 7090 writes results on an output magnetic tape. This tape is then read by the secretary computer which prints results and punches cards for the programmers. This task involves planning a system suited to the NBS problems and hardware configuration, preparing a supervisory code, and preparing an instruction manual for programmers.

Status: New. In order to save time and effort it was decided to adapt a supervisory code to NBS needs from some other 7090 installation. Several systems were considered and it was decided to adapt the system currently in use at the Bell Laboratories, Murray Hill, N.J. A minor amount of recoding is being done by Guy Ziegler. One of the advantages in adapting the Bell System is that the manual has simply been reproduced for use by NBS programmers. Another advantage is that the Bell system is similar to the system previously used on the IBM 704 computer which also was adapted from Bell Laboratories. A second system, the IBM Fortran Monitor system, will also be made available for the convenience of IBM 7090 users from outside the Bureau.

Status of Projects

1102-40-11645/62-1030 ELECTROCARDIOGRAPHIC ANALYSIS
Origin: NBS, Section 12.5
Sponsor: Veterans Administration
Manager: R. Herbold
Full task description: April-June 1959 issue, p. 29
Status: Reactivated. Anticipating the installation of an IBM 7090 computer at NBS, the programs have been rewritten in Fortran for greater versatility, and they are now in process of being checked out. Several additional statistical programs have been written. This project was previously classified as project 1102-40-11645/59-435.

1102-40-11645/62-1074 CONTOUR PLOTTING
Origin and Sponsor: Diamond Ordnance Fuze Laboratories, Department of the Army
Manager: R.J. Herbold
Objective: To set up a 704 program to read in matrices and find cross-section averages.
Background: In order to expedite the plotting of a composite magnetic-field contour map from nine individual magnetic-field maps, it was decided to use a high speed digital computer.
The problem was transmitted by Philip H. Winter (DOFL).
Status: New. The program has been written and checked. Production runs are being made whenever the input matrices are sent in.

7. STATISTICAL ENGINEERING SERVICES

COLLABORATION ON STATISTICAL ASPECTS OF NBS RESEARCH AND TESTING
Task 3911-61-39951/51-1

Origin: NBS Authorized 7/1/50
Managers: W.J. Youden, J. Cameron
Full task description: July-September 1950 issue, p. 60

Status: CONTINUED. Members of the Section provided statistical assistance and advice to numerous Bureau personnel. The following are representative examples:

(i) Electric meters. A report to the American Standards Association, Committee C 12 on Revision of the Code for Electricity Meters, was prepared by Anna M. Glinski and Mary G. Natrella. The report was entitled "Some Recommendations for Statistical Quality Control of Electricity Meters Based on Sample Testing," and was a revision of an earlier draft prepared for F.K. Harris of the Electrical Instruments Section.

(ii) Isotopic ratio and atomic weight of chlorine. The uncertainties in the determination of the isotopic ratio and the atomic weight of chlorine were worked out by H.H. Ku for W.R. Shields, Ernest Garner, and V.H. Dibeler of the Mass Spectrometry Section.

(iii) Calibration of angle standards. A statistical analysis of the precision of the calibration of polygons used for angular standards was carried out for the Engineering Metrology Section. Records for the past two years were analyzed and recent data on a new method of calibration were used to derive precision and accuracy statements for these measurement procedures.

Publications:

(1) Experimentation and measurement. W.J. Youden. To appear in the Vistas of Science book series, National Science Teachers Association.
(2) Statistical problems arising in the establishment of physical standards. W.J. Youden. To appear in the Proceedings of the Fourth Berkeley Symposium on Mathematical Statistics and Probability, 1960.
(3) Systematic errors in physical constants. W.J. Youden. Physics Today, 14, 32-42, September 1961.
(4) Variability of spectral tristimulus values. I. Nimeroff (Photometry and Colorimetry), J.R. Rosenblatt, and M.C. Dannemiller. To appear in the Journal of Research NBS, Section A (Physics and Chemistry).
(5) The interpretation of preliminary measurements. W.J. Youden. To appear in Materials Research and Standards.
(6) What is the best value? W.J. Youden. To appear in the Journal of the Washington Academy of Sciences.
(7) Systematic errors. W.J. Youden. Ordnance, XLVI, 299-301, September-October 1961.

(8) Experimental design and ASTM committees. W.J. Youden. To appear in Materials Research and Standards.
(9) Distribution of total service time for a fixed observation interval. W.S. Connor and Norman C. Severo. Submitted to a technical journal.

STATISTICAL SERVICES
Task 1103-40-11625/58-346

Origin and Sponsors: Various Agencies Authorized 3/31/58
Manager: J.M. Cameron
Full task description: January-March 1958 issue, p. 45
Status: INACTIVE.

Current Applications of Automatic Computer

The record of the use of the IBM 704 for the period July 1 through September 30, 1961, is as follows:

Task No.		Title	Assembly	Checking	Production
NBS SERVICES:			(M I N U T E S)		
51-0002	11.3	Statistical engineering	15	15	137
54-0030	13.1	Spectrum analysis**	370	311	843
54-0031	13.1	Spectrum analysis**	11	37	86
54-0033	13.1	Spectrum analysis**	382	190	239
54-0034	13.1	Spectrum analysis**	2	0	107
55-0055	11.1	Research in numerical analysis	462	158	2450
55-0056	11.1	Research in mathematical topics	0	116	887
55-0065	11.2	Automatic coding	47	79	0
55-0082	3.1	Thermometer calibrations*	0	0	149
56-0131	2.2	Calculations in optics**	0	0	58
56-0166	15.0	SCF-LCAO solution of hydrides	7	105	0
56-0171	3.8	Transport theory integrals**	158	201	318
57-0219	3.2	Thermal properties*	107	42	30
57-0236	3.8	SCF eigenvalues	0	0	50
57-0250	2.1	Spectrophotometric data*	0	0	117
57-0252	4.4	Neutral meson experiments**	221	46	230
58-0256	10.6	Composite wall studies**	229	135	187
58-0260	12.5	Prototype accounting**	5	38	112
58-0272	3.7	Equation of state**	0	0	52
58-0294	4.4	Nuclear scattering of photons*	0	0	1
58-0314	3.7	Approximations for gas mixtures*	371	431	387
58-0339	6.5	Viscoelasticity properties	64	24	11
59-0372	11.3	Statistical analysis*	30	9	12
59-0394	13.6	Scattering by hydrogen atoms	29	28	1049
59-0403	2.1	Computation of color fadings*	0	0	42
59-0414	30.8	Infinite systems of equations	0	0	1
59-0418	11.2	P-wave equation*	11	0	0
59-0430	15.4	Rotating body problem*	0	0	35
59-0433	2.1	Color of signals**	0	0	18
59-0440	82.1	Mapping**	61	119	729
60-0474	2.5	Gage block stability*	0	0	12
60-0489	3.1	Inversion of line probe data*	3	0	46
60-0493	3.8	Poisson distribution function**	123	52	927
60-0499	3.7	Equilibrium calibration*	0	19	0
61-0523	4.7	Neutron cross section studies**	52	7	65
61-0526	3.0	Crystal field calculations**	0	41	0

Current Applications of Automatic Computer

Task No.		Title	Assembly	Checking	Production
NBS SERVICES:			(M I N U T E S)		
61-0528	14.1	Transistor aging study	197	129	135
61-0530	9.4	Specimen wavelengths	18	15	1
61-0546	11.1	Optimization techniques	36	15	161
61-0556	11.2	Chebychev approximations	0	43	5
61-0557	13.5	Structure determination	0	0	41
61-0559	3.1	Thermocouple calibration	5	29	21
61-0562	7.6	Cubic lattices	0	0	59
61-0564	5.0	Complexity constants*	0	0	7
61-0571	15.7	NMR spectrum	0	10	107
61-0574	4.4	Cross section studies**	153	77	201
61-0995	11.2	Error user	0	6	202
62-1000	12.5	Post office operations study**	239	125	0
62-1003	15.4	Molecular spectroscopy	21	29	111
62-1005	4.3	Radiation interaction**	539	240	1478
62-1006	4.3	Radiation interaction**	149	11	0
62-1007	4.3	Radiation shielding**	741	167	578
62-1008	4.3	Gamma ray penetration**	137	358	683
62-1011	13.5	Dispersion integrals**	30	0	14
62-1012	12.5	Quantitative model research**	13	18	85
62-1013	7.0	Statistical methods**	110	24	2
62-1015	5.9	Thermal functions**	15	26	2
62-1019	41.0	NBS personnel report**	7	111	254
62-1020	3.3	Eigenvalues*	0	0	35
62-1025	11.2	Operating systems	0	0	8
62-1028	11.2	General subroutines	23	3	43
62-1029	9.7	D-spacing calculations*	0	0	43
62-1033	9.7	Crystal structure calibration**	76	0	878
62-1034	30.0	Photo ionization cross section**	118	0	516
62-1035	7.7	Creep data analysis**	41	19	3
62-1036	7.7	Film thickness**	2	0	49
62-1037	11.2	Black box computer service*	54	0	185
62-1038	7.5	Interlaboratory standardization**	0	0	52
62-1043	9.0	Maxima and minima	14	0	4
62-1064	2.4	Gage block studies**	0	0	75
62-1065	15.4	Flame spectra**	0	0	46
62-1066	1.2	Standard cells**	0	0	36
62-1068	5.2	Spectrochemical analyses**	0	0	10
62-1077	2.5	Frustrated total reflection**	0	0	16
62-1085	11.2	Mathematical subroutines	7	2	2
62-1087	3.8	Virial coefficients	16	21	2
62-1089	9.6	Elastic constants**	33	27	0
62-1105	2.4	Roots of polynomials**	11	0	22
62-1106	3.0	Gas properties**	0	0	4
62-1107	6.5	Oscillating sphere**	0	0	8
62-1112	12.5	Directory data**	7	0	0

Current Applications of Automatic Computer

Task No.		Title	Assembly	Checking	Production
NBS SERVICES:				(M I N U T E S)	
62-1118	13.4	Heat transfer**	5	10	0
62-2003	11.2	Training	10	0	0
62-2005	11.2	Research	83	10	75
		Totals (NBS Services)	5670	3728	15646
NON-NBS SERVICES:					
57-0216	NSF	Handbook of mathematical tables	27	17	58
58-0269	NRL	Molecular structure, IV*	0	8	204
58-0276	ARC	General kinetics, I**	0	0	3364
58-0348	OOR	Machine translation of Russian	9	17	2
58-0368	SC	Light scattering by particles	3	0	574
59-0407	DOFL	Fourier coefficients*	17	8	21
59-0409	FSLIC	Bank board reports**	34	183	1707
59-0425	CU	Molecular orbitals	3	32	251
59-0434	GC	Petrological computations*	0	0	2
59-0441	USRED	Systems engineering**	0	27	478
60-0450	ACC	Chemical warfare*	20	49	20
60-0457	PHA	Public housing data**	0	10	460
60-0458	CAB	Airline traffic survey*	0	0	924
60-0476	DOFL	Gas tube characteristic II	0	0	138
60-0481	SC	Radar study°	52	0	1629
60-0486	U ONT	Morse wave function	0	0	22
60-0492	IMF	Monetary research reports**	258	20	168
61-0506	WB	World bank reports**	6	0	10
61-0513	NASA	Orbiting studies	0	7	60
61-0532	GU	Vibrational energy levels	24	5	0
61-0540	ACC	Diffusion calculations	56	0	0
61-0542	HEW	Student loan survey	0	11	146
61-0545	WH	Nuclear reactor design**	0	0	6719
61-0550	GWU	Logistics research**	55	19	186
61-0560	NNMC	Muscle flexing	14	0	107
61-0561	GIT	Zone refinements for quartz**	0	0	214
61-0569	AGO	Human factors research**	57	45	91
61-0570	SC	War games**	210	44	149
61-0572	NIH	Heart studies**	123	176	36
62-0829	BPR	Highway traffic studies**	41	55	1121
61-0849	BPR	Highway traffic studies**	3	127	241
61-0853	DTMB	DTMB**	0	0	727
61-0865	BPR	Highway traffic studies**	0	0	1968
61-0872	BPR	Highway traffic studies**	0	0	35
61-0902	BPR	Highway traffic studies**	0	0	257
61-0903	BPR	Highway traffic studies**	0	21	2094

Current Applications of Automatic Computer

Task No.		Title	Assembly	Checking	Production
NON-NBS SERVICES:			(M I N U T E S)		
61-0904	BPR	Highway traffic studies**	18	0	325
61-0945	WB	Forecasting**	0	0	112
62-1001	ATA	Air transport studies**	0	2	181
62-1002	UOC	Self-consistent fields*	2	0	461
62-1004	BUS	Rhombic antennas*	0	0	20
62-1014	NIH	Metabolic diseases**	185	577	213
62-1016	PO	Post office operation research	116	104	241
62-1018	NRL	Hydromagnetic problems*	185	32	1185
62-1021	DCH	Highway studies**	112	368	1215
62-1022	NRL	Spectrum of dipole radiation	24	0	743
62-1023	NSF	Image processing**	105	62	82
62-1030	VA	Electrocardiographic analysis*	849	359	541
62-1032	QM	Supply programming problems**	166	14	995
62-1039	DOFL	Black box computer service*	126	0	225
62-1044	FCC	Radio intensities**	0	0	273
62-1045	BPR	Inter-area travel**	35	11	1399
62-1046	BPR	Traffic prediction**	32	56	339
62-1048	DOFL	Trajectory calculations**	21	47	70
62-1056	DOFL	PD engineering°	8	24	206
62-1067	NIH	Cancer studies	1505	1721	3447
62-1071	DOFL	Rhinitis studies**	0	0	18
62-1073	DOFL	Complex legendre functions**	182	0	212
62-1074	DOFL	Contour plotting	17	0	12
62-1075	DOFL	Trajectory computations*	13	6	15
62-1076	NAS	Evaluation of applications*	0	0	23
62-1086	NIH	Health studies**	0	0	70
62-1098	DOFL	Statistical data analysis**	8	1	5
62-1099	COENG	Nuclear reactor studies**	0	0	325
62-1114	DOFL	Radiation effects**	5	1	10
		Totals (Non-NBS Services)	4726	4266	37146
		Total time for the quarter (MINUTES)....	10,396	7,994	52,792
		Total time for the quarter (HOURS).....	173	133	880

* Problem programmed in the Computation Laboratory; production runs continued under direction of sponsor.

** Problem programmed by sponsor and run under his direction.

° Classified task.

Lectures and Technical Meetings

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 Lectures

LOWAN, A.N. (National Bureau of Standards and Yeshiva University). Stability and convergence of numerical schemes for solution of partial differential equations. This series of five lectures considered the stability and convergence of various difference and iterative schemes used in the numerical treatment of problems of heat conduction, wave motion, and potential theory. Part I, August 7. Part II, August 9. Part III, August 11. Part IV, August 15. Part V, August 17.

TAMOR, S. Adiabatic invariants in periodic systems. General Electric Company, Schenectady, New York.

Mathematical Statistics Seminar

SYSKI, R. (University of Maryland). A special queueing problem. August 14.

TURNER, Malcolm E. (Medical College of Virginia). A series of three lectures on path analysis: (i) The origin and varieties of path analysis. September 13; (ii) Problems of identification and confidence regions. September 14; (iii) Non-linear path analysis. September 15.

WEISS, George H. Problems in traffic delay. August 4.

ZELEN, Marvin. The role of restraints in the Gauss-Markov theorem. July 28.

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

ALT, F.L. (i) Planning and management of a mathematical research and service facility. Presented at the Naval Research Reserve Seminar on Planning and Management, Princeton University, Princeton, New Jersey, August 25. (ii) Some new developments in automatic language

translation. Presented at the Association for Computing Machinery, Los Angeles, California, September 5-8.

EISENHART, C. Fundamentals of precision and accuracy. Presented before the Chemical Division, American Society for Quality Control, Charleston, West Virginia, September 28.

LOWAN, A.N. Operator approach to problems of stability and convergence of solutions of differential equations and the convergence of iteration procedures. Presented before the David Taylor Model Basin Mathematics Colloquium, Washington, D.C., August 29.

RHODES, I. The teacher's role in the age of automation. Presented at the Summer Institute sponsored by National Science Foundation, College of William and Mary, Williamsburg, Virginia, July 31.

TCHEN, C.M. Kinetic equation for plasmas with collective and collisional correlations. Presented at the Fifth International Conference on Ionization Phenomena in Gases, Munich, Germany, August 29.

VINTI, J.P. Classical theories of satellite orbits. Presented at the Institute on Evidences for Gravitational Theories, Scuola Internazionale di Fisica, Varenna sul Lago di Como, Italy, July 1.

WEGSTEIN, J.H. Report on ALGOL 60. Presented to the Washington Chapter of the Association for Computing Machinery, Lisner Auditorium, Washington, D.C., September 21.

WEISS, G. (i) A series of three lectures presented at the Solid State Physics Conference for College Teachers of Physics: (1) Current problems in lattice dynamics; (2) Specific heat and other thermodynamic properties of solids; and (3) Introduction to lattice dynamics in the harmonic approximations. Temple University, Philadelphia, July 25-26. (ii) On the pedestrian queueing problem. Presented before the International Statistical Institute, Paris, France, September 1.

YOUDEN, W.J. (i) Physical measurements and experiment design. Presented to the Colloques Internationaux du Centre National de la Recherche Scientifique, Paris, France, September 1. (ii) Test programs for the statistical evaluation of materials. Presented at the Séminaire sur les applications industrielles de la statistique, University of Paris, France. September 4-5.

ZELEN, M. (i) A calculus for factorial arrangements. Presented at the Statistical Summer Seminar, Lexington, Massachusetts, July 14. (ii) The robustness of statistical life testing procedures. Presented at the Gordon Research Conference in Statistics, New Hampton, New Hampshire, August 7-11.

Publication Activities

1. PUBLICATIONS THAT APPEARED DURING THE QUARTER

1.2 Technical Notes, Manuals, and Bibliographies

(1) Fractional factorial designs for experiments with factors at two and three levels. W.S. Connor and Shirley Young. NBS Applied Mathematics Series-AMS·58. Issued September 1, 1961; v+66pp. price 40¢. Available from Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

1.3 Technical Papers

The following papers appeared in the Journal of Research NBS, 65B (Mathematics and Mathematical Physics), July-September 1961:

(1) Some results on non-negative matrices. M. Marcus, H. Minc, and B. Moyls. Pp. 205-209

(2) Probability inequalities of the Tchebycheff type. I. Richard Savage. Pp. 211-222

(3) Theory of an accurate intermediary orbit for satellite astronomy. J.P. Vinti. Pp. 169-201

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(4) Some geometrical theorems for abscissas and weights of Gauss type. P. Davis and P. Rabinowitz. Journal of Mathematical Analysis and Applications, 2, 428-437, June 1961.

(5) Partial confounding in fractional replication. W.J. Youden. Technometrics, 3, 353-358, August 1961.

(6) Physical measurements and experiment design. W.J. Youden. Le Plan d'Experiences, 110, Centre National de la Recherche Scientifique, Paris, August-September 1961.

(7) Systematic errors. W.J. Youden. Ordnance, XLVI, 299-301, September-October 1961.

(8) Systematic errors in physical constants. W.J. Youden. Physics Today, 14, 32-42, September 1961.

2 MANUSCRIPTS IN THE PROCESS OF PUBLICATION

2.1 Mathematical Tables

(1) Tables of Fourier transforms of absolutely continuous distribution functions. Fritz Oberhettinger. To appear in the NBS Applied Mathematics Series.

2.2 Technical Notes, Manuals, and Bibliographies

(1) Handbook of Mathematical Functions. To appear in the NBS Applied Mathematics Series.

(2) Experimentation and measurement. W.J. Youden. To appear in the Vistas of Science book series, National Science Teachers Association.

(3) Experimental statistics. Mary G. Natrella. To be published as ORDP 20-110, 111, 112, 113, 114 by the Army Research Office, Durham, Duke Station, Durham, North Carolina.

(4) Boscovich and the combination of observations. Churchill Eisenhart. To appear as Chapter 9 in Roger Joseph Boscovich, Studies of his Life and Work. Edited by Lancelot Law Whyte, Allen and Unwin, Ltd., London 1961.

2.3 Technical Papers

(1) Digital pattern recognition by moments. F.L. Alt. Submitted to a technical journal.

(2) Safety levels in military inventory management. F.L. Alt. Submitted to a technical journal.

(3) Recognition of clauses and phrases in machine translation of languages. F.L. Alt and I. Rhodes. To appear in the Proceedings of the International Conference on Machine Translation of Languages and Applied Language Analysis, Teddington, England, Sept. 6-8, 1961.

(4) A procedure for estimating eigenvalues. N.W. Bazley and D.W. Fox (Applied Physics Laboratory, JHU). Submitted to a technical journal.

(5) Lower bounds for eigenvalues of Schroedinger's equation. N.W. Bazley and D.W. Fox (Applied Physics Laboratory, JHU). Submitted to a technical journal.

(6) On the evaluation of the function $\phi(\lambda)=\frac{1}{2\pi i}\int_{\sigma-i\infty}^{\sigma+i\infty} e^{u \ln u+\lambda u}du$ for real values of λ. W. Borsch-Supan. To appear in the Journal of Research NBS, Section B(Mathematics and Mathematical Physics).

Publication Activities

(7) Some higher order integral identities with application to bounding techniques. J.H. Bramble and B.E. Hubbard (University of Maryland). To appear in the Journal of Research NBS, Section B (Mathematics and Mathematical Physics).

(8) A priori bounds in the first boundary value problem in elasticity. J.H. Bramble and L.E. Payne. To appear in the Journal of Research NBS, Section B (Mathematics and Mathematical Physics).

(9) The reflection of logistics in electronic computer development. E.W. Cannon. To appear in the Proceedings of the Logistics Research Conference, held at the George Washington University, Washington, D.C., 1960.

(10) Distribution of total service time for a fixed observation interval. W.S. Connor and N.C. Severo. Submitted to a technical journal.

(11) Advances in orthonormalizing computation. P.J. Davis and P. Rabinowitz. Submitted to a technical journal.

(12) Criteria for the reality of matrix eigenvalues. M.P. Drazin (RIAS) and E.V. Haynsworth. Submitted to a technical journal.

(13) Roger Joseph Boscovich and the combination of observations. Churchill Eisenhart. To appear in Actes du Symposium International Roger Boscovich 1961.

(14) Precision and accuracy--experiment design aspects. C. Eisenhart. To appear in Conference on Applications of Statistical Methods in the Chemistry Industry.

(15) Analyticity and probability properties of one-dimensional Brownian motion. A. Ghaffari. To appear in the Journal of Research NBS, Section B (Mathematics and Mathematical Physics).

(16) A comment on Ryser's "Normal and Integral Implies Incidence" theorem. K. Goldberg. To appear in the American Mathematical Monthly.

(17) On the range of a fleet of aircraft. A.Goldman. To appear in the Journal of Research NBS, Section B (Mathematics and Mathematical Physics).

(18) Regions containing the characteristic roots of a matrix. E.V. Haynsworth. Submitted to a technical journal.

(19) Radiation field from a circular disk source. J.H. Hubbell, R.L. Bach, and R.J. Herbold. To appear in the Journal of Research NBS, Section C (Engineering and Instrumentation).

Publication Activities

(20) On a direct method in the calculus of variations. A.N. Lowan. Submitted to a technical journal.

(21) On the determination of the eigenvalues and eigenvectors of certain matrices. A.N. Lowan. Submitted to a technical journal.

(22) Stability criteria for the Peaceman-Rachford difference scheme. A.N. Lowan. Submitted to a technical journal.

(23) Stability criteria for various difference schemes associated with the problem of the vibrating bar. A.N. Lowan and R.J. Arms. Submitted to a technical journal.

(24) A note on normal matrices. M. Marcus and N. Khan (Muslim University, India). To appear in the Canadian Mathematical Bulletin.

(25) On the maximum number of zeros in the powers of an indecomposable matrix. M. Marcus and F. May. Submitted to a technical journal.

(26) On the relation between the permanent and the determinant. M. Marcus and H. Minc (The University of Florida). To appear in the Illinois Journal of Mathematics.

(27) The invariance of symmetric functions of singular values. M. Marcus and H. Minc (The University of Florida). Submitted to a technical journal.

(28) Inequalities for the permanent function. M. Marcus and M. Newman. To appear in Annals of Mathematics.

(29) The sum of the elements of the powers of a matrix. M. Marcus and M. Newman. Submitted to a technical journal.

(30) Congruence properties of the partition function to composite moduli. M. Newman. To appear in the Illinois Journal of Mathematics.

(31) Modular forms whose coefficients possess multiplicative properties (II). M. Newman. To appear in Annals of Mathematics.

(32) Note on the partition function. M. Newman. Submitted to a technical journal.

(33) Variability of spectral tristimulus values. I. Nimeroff, J.R. Rosenblatt, and M.C. Dannemiller. To appear in the Journal of Research NBS, Section A (Physics and Chemistry).

(34) A new approach to the mechanical syntactic analysis of Russian. I. Rhodes. To appear in Mechanical Translation.

Publication Activities

(35) Best approximations and interpolating functions. J.R. Rice. To appear in the Transactions of the American Mathematical Society.

(36) Split integration methods for simultaneous equations. J.R. Rice. Submitted to a technical journal.

(37) Tchebycheff approximation by exponentials. J.R. Rice. Submitted to a technical journal.

(38) Tchebycheff approximations by functions unisolvent of variable degree. J.R. Rice. To appear in the Transactions of the American Mathematical Society.

(39) Convergence to normality of powers of a normal random variable. N.C. Severo and L.J. Montzingo. Submitted to a technical journal.

(40) Kinetic equation for plasmas with collective and collisional correlations. C.M. Tchen. Accepted for publication in the Proceedings of the Fifth International Conference on Ionization Phenomena in Gases, Munich, Germany, August 28-September 1, 1961.

(41) Formulae for an accurate intermediary orbit of an artificial satellite. J.P. Vinti. Submitted to a technical journal.

(42) Intermediary equatorial orbits of an artificial satellite. J.P. Vinti. To appear in the Journal of Research NBS, Section B (Mathematics and Mathematical Physics).

(43) A status report on ALGOL 60. J.H. Wegstein. To appear in Datamation.

(44) On the pedestrian queueing problem. G.H. Weiss. To appear in the Bulletin of the International Statistical Institute.

(45) Experimental design and ASTM committees. W.J. Youden. To appear in Materials Research and Standards.

(46) The interpretation of preliminary measurements. W.J. Youden. To appear in Materials Research and Standards.

(47) Randomization and experimentation. W.J. Youden. To appear in Annals of Mathematical Statistics.

(48) Statistical problems arising in the establishment of physical standards. W.J. Youden. To appear in the Proceedings of the Fourth Berkeley Symposium on Mathematical Statistics and Probability, 1960.

Publication Activities

(49) What is the best value? W.J. Youden. To appear in the Journal of the Washington Academy of Sciences.

(50) A calculus for factorial arrangements. B. Kurkjian (Diamond Ordnance Fuze Laboratories) and M. Zelen. To appear in the Annals of Mathematical Statistics.

(51) Factorial designs and the direct product. B. Kurkjian (Diamond Ordnance Fuze Laboratories) and M. Zelen. To appear in the Bulletin of the International Statistical Institute.

USCOMM-DC-NBS

U. S. DEPARTMENT OF COMMERCE
Luther H. Hodges, *Secretary*

NATIONAL BUREAU OF STANDARDS
A. V. Astin, *Director*

THE NATIONAL BUREAU OF STANDARDS

The scope of activities of the National Bureau of Standards at its major laboratories in Washington, D.C., and Boulder, Colorado, 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 of the front cover.

WASHINGTON, D.C.

Electricity. Resistance and Reactance. Electrochemistry. Electrical Instruments. Magnetic Measurements. Dielectrics. High Voltage.

Metrology. Photometry and Colorimetry. Refractometry. Photographic Research. Length. Engineering Metrology. Mass and Scale. Volumetry and Densimetry.

Heat. Temperature Physics. Heat Measurements. Cryogenic Physics. Equation of State. Statistical Physics.

Radiation Physics. X-ray. Radioactivity. Radiation Theory. High Energy Radiation. Radiological Equipment. Nucleonic Instrumentation. Neutron Physics.

Analytical and Inorganic Chemistry. Pure Substances. Spectrochemistry. Solution Chemistry. Standard Reference Materials. Applied Analytical Research.

Mechanics. Sound. Pressure and Vacuum. Fluid Mechanics. Engineering Mechanics. Rheology. Combustion Controls.

Organic and Fibrous Materials. Rubber. Textiles. Paper. Leather. Testing and Specifications. Polymer Structure. Plastics. Dental Research.

Metallurgy. Thermal Metallurgy. Chemical Metallurgy. Mechanical Metallurgy. Corrosion. Metal Physics. Electrolysis and Metal Deposition.

Mineral Products. Engineering Ceramics. Glass. Refractories. Enameled Metals. Crystal Growth. Physical Properties. Constitution and Microstructure.

Building Research. Structural Engineering. Fire Research. Mechanical Systems. Organic Building Materials. Codes and Safety Standards. Heat Transfer. Inorganic Building Materials.

Applied Mathematics. Numerical Analysis. Computation. Statistical Engineering. Mathematical Physics. Operations Research.

Data Processing Systems. Components and Techniques. Computer Technology. Measurements Automation. Engineering Applications. Systems Analysis.

Atomic Physics. Spectroscopy. Infrared Spectroscopy. Solid State Physics. Electron Physics. Atomic Physics.

Instrumentation. Engineering Electronics. Electron Devices. Electronic Instrumentation. Mechanical Instruments. Basic Instrumentation.

Physical Chemistry. Thermochemistry. Surface Chemistry. Organic Chemistry. Molecular Spectroscopy. Molecular Kinetics. Mass Spectrometry.

Office of Weights and Measures.

BOULDER, COLO.

Cryogenic Engineering. Cryogenic Equipment. Cryogenic Processes. Properties of Materials. Cryogenic Technical Services.

Ionosphere Research and Propagation. Low Frequency and Very Low Frequency Research. Ionosphere Research. Prediction Services. Sun-Earth Relationships. Field Engineering. Radio Warning Services. Vertical Soundings Research.

Radio Propagation Engineering. Data Reduction Instrumentation. Radio Noise. Tropospheric Measurements. Tropospheric Analysis. Propagation-Terrain Effects. Radio-Meteorology. Lower Atmosphere Physics.

Radio Standards. High Frequency Electrical Standards. Radio Broadcast Service. Radio and Microwave Materials. Atomic Frequency and Time Interval Standards. Electronic Calibration Center. Millimeter-Wave Research. Microwave Circuit Standards.

Radio Systems. Applied Electromagnetic Theory. High Frequency and Very High Frequency Research. Modulation Research. Antenna Research. Navigation Systems.

Upper Atmosphere and Space Physics. Upper Atmosphere and Plasma Physics. Ionosphere and Exosphere Scatter. Airglow and Aurora. Ionospheric Radio Astronomy.


NBS