A new section, Numerical Analysis, has been established July 1, 1954 by the National Bureau of Standards in Washington; at the same time, the Machine Development Laboratory has been replaced by a section Mathematical Physics.

The new organization of the National Applied Mathematics Laboratories will be as follows:

F. L. ALT, Acting Chief, E. W. CANNON, Assistant Chief

1. Numerical Analysis, J. TODD, Chief
2. Computation Laboratory, M. ABRAMOWITZ, Acting Chief
3. Statistical Engineering Laboratory, C. EISENHART, Chief
4. Mathematical Physics, E. W. CANNON, Chief

OTHER AIDS TO COMPUTATION

BIBLIOGRAPHY Z

1139. R. R. BENNETT, "Analog computing applied to noise studies," I. R. E., *Proc.*, v. 41, 1953, p. 1509–1513.

A problem of great importance in modern communication engineering is the analysis of noise in linear and nonlinear systems. For a linear system the weighting function (impulsive response, Green's function) completely characterizes the system and is a necessary tool in spectrum shaping analysis. The author discusses the analog simulation of the weighting function using the concept of the adjoint system (cf. H. H. LANNING, JR. & R. H. BATTIN, *MTAC*, v. 7, 1953, p. 125). For nonlinear systems the author briefly describes how the amplitude distribution may be shaped using a function generator. Finally, statistical methods—using the concept of confidence levels—are discussed for determining the accuracy, say of the standard deviation, of a number of identical runs on the same physical system.

K. S. MILLER

New York University
New York, N. Y.

1140. M. B. COYLE, "An airflow analogy for the solution of transient heat conduction problem," *British Jn. Applied Physics*, v. 2, 1951, p. 12–17.

The airflow analogy parallels closely the familiar electrical resistance-capacity analogy for transient heat conduction phenomena. Quantity of heat and temperature in the heat conduction system are represented in the airflow system by mass of air and pressure respectively. The continuous thermal system is considered replaced by a lumped system which is simulated by a network of air reservoirs, each containing a mass of air which is a function of the air pressure within it, inter-connected by capillary tubes through which the mass airflow is proportional to the pressure difference between the ends. The air reservoirs are in the form of U-tubes with a confining fluid, all the U-tubes having one leg in common. With this arrangement, the capacity (taken in the electrical sense to mean the mass of air discharged for unit fall in pressure) of a reservoir may be made a function of pressure by constructing it with variable cross-sectional area. Therefore, a problem involving variable thermal properties may be set up with appropriately

constructed reservoirs and a solution obtained with no further manipulation required during the test.

This appears to be an advantage of the air-flow analogy relative to the electrical analogy since in the latter variable thermal properties are simulated by varying circuit elements in the course of a test, either manually or automatically. However, the electrical analogy appears to possess far greater flexibility and inherent experimental accuracy.

J. H. WEINER

Columbia University
New York, N. Y.

1141. LEONARD J. CRAIG, "The magnetic amplifier as an analog computer component," I. R. E., *Proc.*, v. 41, 1953, p. 1477–1482.

It is shown that the load voltage of a parallel-connected magnetic amplifier is a gate whose width is directly proportional to the control current, when a square wave source voltage is applied. Tests indicate that this relationship holds to within 0.1 percent over a wide range of source voltage (except for scale factor), load resistance, and temperature, provided the magnetic material used has reasonably ideal characteristics.

This phenomenon is utilized in several circuits: a linear pulse width modulator, a linear pulse-position generator and a square-wave phase shifter. The phase shifter was applied to a DC multiplier which achieved product accuracies of 3 percent, without the use of high precision components.

JOHN B. WALSH

Department of Electrical Engineering
Columbia University
New York, N. Y.

1142. W. A. MCCOOL, "An AM-FM electronic analog multiplier," I. R. E., *Proc.*, v. 41, 1953, p. 1470–1477.

A multiplier is described wherein an AM signal whose index of modulation is proportional to an input voltage is applied to an attenuator whose gain is proportional to frequency deviation (an FM discriminator). Frequency deviation is made proportional to a second input, so the discriminator output, with the carrier subtracted, is the product of the inputs. Feedback techniques stabilize the AM and FM modulation indices. Although basically a two-quadrant multiplier, it is arranged, by a conventional method, for four-quadrant operation.

A total of 24 tube envelopes is used. Performance is limited primarily by stability of discriminator parameters, and is independent of tube characteristics. A long time multiplication error of less than 1 percent of maximum output is reported. Usable bandwidth (flat amplitude response and less than 15 degree phase shift for highest frequency component) is approximately 0.1 percent of carrier frequency (1 percent was reported, apparently erroneously).

JOHN B. WALSH

Department of Electrical Engineering
Columbia University
New York, N. Y.

1143. JAMES C. ROBB, "A calculator for aiding matrix calculations," Faraday Soc. *Trans.*, v. 50, 1954, p. 8–12.

Twelve Curta Calculators are mounted on a base and have their working mechanisms geared together and centrally controlled. The operations (1) shift carriage, (2) clear and (3) enter multiplier, activate the twelve calculators simultaneously. Complete constructional details are given. The capacities are, of course, those of the Curta—6D multiplier, 8D multiplicand and 11D product. Provision for positive and negative multiplier and multiplicand is possible.

The device is well suited to problems involving many simultaneous multiplications and addition. As an example, matrix multiplication is described. The writer claims the equipment is suitable for use with inversion schemes like those of Crout, but no further explanation is given. For twelfth order matrix by vector multiplication with 4D elements, a time of 17 minutes is cited.

A. OPLER

The Dow Chemical Company
Pittsburg, Calif.

1144. O. J. M. SMITH, "Economic analogs," I. R. E., *Proc.*, v. 41, 1953, p. 1514–1519.

The possibility of using electronic analog computers for problems in economics is discussed. Several circuits are given for specific simple problems and economic terms are interpreted in terms of electrical networks; for example, if the supply (outcome) influences the demand (input) then there is feedback in the system. The author points out that the concepts of closed loop system, Nyquist diagrams and vector diagrams are now being used by economists to interpret and analyze a variety of economic problems. A list of forty references is included.

K. S. MILLER

New York University
New York, N. Y.

1145. G. W. SWENSON & T. J. HIGGINS, "A direct-current network analyzer for solving wave-equation boundary-value problems," *Jn. Appl. Phys.*, v. 23, 1952, p. 126–127.

The authors discuss the solution of the partial differential equation

$$\nabla^2\varphi + (\omega/c)^2\varphi = 0$$

on the function $\varphi(x, y)$ by means of a resistance network. This network is analogous to the usual network for the Laplacian, except that the term $(\omega/c)^2$ requires the introduction of a "negative resistance" involving an amplifier between each node and ground. This "negative resistance" must be readjusted manually by an iterative method in the course of the problem. Both characteristic value problems and forcing function problems are considered.

F. J. M.

Columbia University
New York, N. Y.

1146. G. H. VINEYARD, "Simulation of trajectories of charge particles in magnetic fields," *Jn. Appl. Phys.*, v. 23, 1952, p. 35–39.

The author sets up an equivalence between the motion of a charged particle in an electric and magnetic field and the motion of a sphere rolling on a rotating surface, subject to gravity and viewed from an independently rotating coordinate system. A variety of interesting special cases corresponding to the betatron and magnetron are discussed. In addition an experimental technique involving a rotating glass surface and multi-exposure photography for obtaining the orbits is described. A preliminary setup was made with immediately available components and the author considered the results satisfactory.

F. J. M.

Columbia University
New York, N. Y.

NOTES

163.—ANOTHER UNRECORDED PITISCUS ITEM. In my article on BARTHOLOMÄUS PITISCUS (1561–1613), to whom our word Trigonometry is due (1595) (*MTAC*, v. 3, p. 390–397, 1949), I referred to one of his tables, "unlisted in any of the ordinary bibliographic or historical sources" (p. 396), entitled

SINUUM/TANGENTIUM/et/SECANTIUM/Canon Manualis/*Accomodatus ad trigo/nometriam/BARTOLOMAEI*/Pitisci/Grünbergensis Silesij./[Decoration]/HEIDELBERGAE,/*Typis Iohan Lincelloti, Acad Typo.*/Imprensis Ionaê Rosaê./MDCXIII./Signatures A^{12}–H^{12}, I^4 [200 p.].

It contained 5D tables for all six of the trigonometric functions in the quadrant, at interval 1′. Opposite pages record the values for 30 minutes of each function; but both pages are headed "sinus," "tangens," "secans." The angles on the right-hand pages being complementary to those on the left, the values on the right-hand pages are really those of cos, cot, csc for the angles on the left-hand page. Thus 180 pages, A^2 *verso*–H^8 *recto*, are occupied with the tables. "Explicatio numerorum hujus Canonis" occupies pages A^1 *verso* to A^2 *recto*. A^1 *recto* is the title page. H^8 *verso*–H^{12} *recto* are devoted to text explanations; H^{12} *verso* and I^1 *verso* blank; I^1 *recto* comment on the following 230 Errata (sin and cos 46; tan and cot 86; sec and csc 96; 2 others): I^2 *recto*–I^4 *recto*.

The little pages are of size 7.3 × 13.2 cm. A film copy of this table for the Library of Brown University was made from a copy of the original at the University of Illinois.

In the summer of 1953 the bookshop Old Authors Farm, R.R. 1, Harrisburg, Ontario, Canada, offered an extraordinary collection of mint copies of old books—duplicates from the Vatican Library. Among these was a second edition of the Pitiscus volume described above. The displays of the title pages, down through the word HEIDELBERGAE, except for a new decoration, are identical; then follows in the new volume: Typis Joan. Georg. Geyder. Acad. Typ. Imprensis Jonaê Rosaê./MDCXX./A^{12}–H^{12}. This volume, acquired by Mr. ALBERT E. LOWNES of Providence, R. I., further