Instrument Corporation, New York, as a flexible and practical tool for solving ordinary linear and nonlinear differential equations. In addition, the speaker illustrated the capabilities of the machine components and showed the various techniques involved in solving such representative problems as flutter, electron flow, automatic pilot design, Fourier analysis, engine control, integral and boundary value equations. "An electronic storage system" by E. W. BIVANS and J. V. HARRINGTON, Air Force Research Laboratories, Cambridge, Mass., described the RCA Radechon (a barrier grid storage tube) which is being used in a digital storage system. The secondary collector system is not used; instead, the reading signals are measured at the back plate, the same electrode on which the write signals are impressed. Deflection voltages are generated by a weighted addition of the plate voltages of a binary counter. Read and write operations are asynchronous with a 12-μ sec minimum time between operations. An application of the theory of correlation functions used in the determination of the transfer functions of linear and nonlinear systems was presented next by J. B. WIESNER and Y. W. LEE, M.I.T. In the paper, "Measurement and analysis of noise in a fire-control radar" by R. H. EISENGREIN, Sunstrand Machine Tool Company, Rockford, Illinois, an "instantaneous subtraction" method of optically measuring radar noise in order to analyze the unwanted portion of the signal return from an airborne target was discussed. Finally, H. E. SINGLETON, M.I.T., described a new electronic correlator which is capable of accepting inputs covering a wide frequency range and which evaluates correlation functions for arguments from 0 to 0.1 seconds. In order to obtain a high degree of accuracy and stability, the signals are sampled and converted to binary numbers, and the storage and computation are carried out digitally.

OTHER AIDS TO COMPUTATION

BIBLIOGRAPHY Z–XII

9. D. P. ADAMS & H. T. EVANS, "Developments in the useful circular nomogram," *Rev. Sci. Instruments*, v. 20, 1949, p. 150–154.

A circular nomogram for $W = UV$ with the U, V scales on the circumference and the W scale on a diameter is described, with a discussion of the most advantageous choice of scales.

10. J. A. BRONZO & H. G. COHEN, "Note on analog computer design," *Rev. Sci. Instruments*, v. 20, 1949, p. 101–103.

This note proposes that partial differential equation problems be attacked by transforming them into difference-differential systems and then into systems of linear equations. The characteristic roots of the matrices of the latter are to be investigated by a change of coordinate system. The choice of the new coordinate system is not specified but is dependent on the ingenuity of the investigator.

F. J. M.

11. J. H. FELKER, "Calculator and chart for feedback problems," I.R.E. *Proc.*, v. 37, 1949, p. 1204–1206.

The chart consists essentially of constant-magnitude and constant-phase loci of z in the complex plane of $\gamma = z/(1 + z)$. A calculator based on this chart is available commercially.

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12. Phillip G. Hubbard, "Application of electrical analo y in fluid mechanics research," *Rev. Sci. Instruments*, v. 20, 1949, p. 802–806.

Fluid flow problems are solved approximately by the measurements on the electric potential in a suitably shaped electrolytic tank. The electric potential is analogous to the velocity potential of the flow, inasmuch as both satisfy Laplace's equation and analogous boundary conditions can be obtained. Two techniques are described. In one of these, lucite models are immersed in a tank to simulate the flow pattern around the model and in the second, a tank segment with triangular cross sections was used to determine boundary pressures for a flow confined by various surfaces of revolution. A graphical comparison is made with experiment and the discrepancies analyzed.

F. J. M.

13. J. Lyman & P. V. Marchetti, "A device for facilitating the computation of the first four moments about the mean," *Psychometrika*, v. 15, 1950, p. 49–55.

The device consists of a box with a number of endless tapes in it, arranged so that a chosen line on each tape can be read through a window in the box. A given distribution is divided into equally spaced intervals. Each tape corresponds to an interval x and each line corresponds to a possible frequency f for this interval. On this line f, fx, fx^2, fx^3, and fx^4 are typed and thus when each tape has been adjusted to the correct frequency for the given distribution, one can immediately read off the various terms which appear in expression for the first four moments.

F. J. M.

14. M. W. Makowski, "Slide rule for radiation calculations," *Rev. Sci. Instruments*, v. 20, 1949, p. 876–884.

This paper describes a special slide rule for making calculations connected with Planck's radiation formula. By setting the cursor to a given temperature there may be found on the stock the total radiant energy and photon flux densities and the wave length of their maxima per unit wave length and per unit frequency as well as the values of their maxima. By setting the slide for a given temperature and the cursor for a given wave length, values of the ratios of the densities at any wave length to their maxima and of the integrated energy or number of quanta below or above that wave length may be read on the slide—Wien's law makes this possible. It is then simple to obtain actual densities and total fluxes within wave length ranges. Scales relating wave length, wave number, and electron volts are on the back of the stock. The accuracy is estimated by the inventor at from a few tenths of a per cent to five per cent, being of the order of one per cent in most ranges.

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15. R. E. Meyerott & G. Breit, "Small differential analyzer with ball carriage integrators and selsyn coupling," *Rev. Sci. Instruments*, v. 20, 1949, p. 874–876.

This article describes a small differential analyzer built at Yale University around three ball carriage type mechanical integrators. The advantages of this type of integrator are that it has a good output torque, the input and output shafts are mechanically convenient, and the units are readily available as war surplus equipment. Coupling between integrators and input or output devices is by means of selsyns instead of shaft couplings, which makes the equipment very flexible and minimizes the set up time for new problems. The selsyns rotate at high speed (2500 to 1 to the integrator) to eliminate selsyn error. The analyzer also includes three input or output devices (called "function units") and an "adder" consisting of two selsyns coupled to a mechanical differential.

A test problem set in to generate a pure sine wave gave an increase of amplitude of 0.2 per cent per cycle, which compares favorably with results obtained with more elaborate machines. The device has proved satisfactory and convenient for the solution of problems with a nominal accuracy of one per cent.

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16. Cyril Stanley Smith, "Blowing bubbles for a dynamic crystal model," *Jn. Applied Physics*, v. 20, 1949, p. 631.

This communication deals with the development of a certain type of analogue solution for problems in crystal structure and describes an improved method, using a nozzle, for obtaining the bubble rafts used by Bragg and Nye for metal crystal study. (*Cf.* R. Soc. London, *Proc.*, v. 190 A, 1947, p. 474–481.)

F. J. M.

NOTES

116. On finding the square root of a complex number.—There are two classical methods used for finding x and y in

$$(a + bi)^{1/2} = x + yi. \tag{1}$$

The first of these is based on DeMoivre's theorem. One computes in succession

$$R = (a^2 + b^2)^{1/2} \qquad \phi = \arctan (b/a)$$
$$x = R \cos \tfrac{1}{2}(\phi + 2K\pi) \qquad y = R \sin \tfrac{1}{2}(\phi + 2K\pi), \qquad (K = 0, 1).$$

The second method is derived from purely algebraic considerations. From (1) it follows that

$$x^2 - y^2 = a, \qquad 2xy = b \tag{2}$$
$$R = x^2 + y^2 = (a^2 + b^2)^{1/2}$$
$$x = \pm\, ((R + a)/2)^{1/2}$$
$$y = \pm\, ((R - a)/2)^{1/2}. \tag{3}$$