recording speed and direction of sea currents, and so on.

Chief Astronomical Observatory, Pulkovo (G. N. Neuimin).

Work has suffered considerably from the dispersion of the scientific personnel to various places: Tashkent, Leningrad, Alma-Ata, Abastuman and Kitab. Detailed plans have been worked out for the reconstruction of the Pulkovo Observatory and its subsidiaries at Nikolaev and Simeis. With the view of encouraging development in astrophysics, the Simeis Observatory is being reorganised as an independent Crimean Astrophysical Observatory.

G. A. Shajn[19] has completed an investigation of the systematic movements in the rarefied atmospheres of the white super-giants of the α-Cygni type. A peculiar stratification in the distribution of elements was shown to occur, and the particle velocities in the various layers were found to be variable.

G. A. Tikhov[20] has developed a method of measuring stellar temperatures without the use of terrestrial comparison sources, by choosing as a basis of reference the hottest star visible, and treating its temperature as infinite. An important advantage of the method is its independence of the selective absorption of light in the earth's atmosphere.

V. B. Nikonov, using antimony-cæsium photo-cells, has determined the colour equivalents of class *B*8—*B*9 stars, with a precision greater than that of the known American catalogues.

O. N. Melnikov has completed a spectrophotometric investigation of δ Cephei, η Aquilæ and the *K*-effect in Cepheids. The results throw light on the flow of atoms from the outer parts of Cepheid atmospheres.

J.P. = *Journal of Physics* (Acad. Sciences U.S.S.R.)
C.R. = *Comptes Rendus de l'Acad. des Sci. U.R.S.S.*

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THE ENIAC, AN ELECTRONIC CALCULATING MACHINE

THE news has recently been released of a major advance in the development of equipment for extensive numerical calculations, in the successful completion of a large calculating machine based on the use of electronic counting circuits. This machine, known as the ENIAC (Electronic Numerical Integrator and Automatic Calculator) is the invention of Dr. J. W. Mauchly and Mr. J. P. Eckert, of the Moore School of Electrical Engineering of the University of Pennsylvania, Philadelphia, where it was designed and constructed. Its development was sponsored by the Ordnance Department of the U.S. Army, through the interest of Col. P. N. Gillon and Capt. H. H. Goldstine. It was designed primarily for the step-by-step integration of the equations of external ballistics, but it includes a flexible control so that it can be applied to many other kinds of calculations within its capacity.

The machine operates by the counting of electrical pulses produced at the rate of 100,000 per second. These are fed to the counting circuits by electronic switching circuits, according to the operation (addition, multiplication, etc.) to be carried out. These circuits count in scale of 10, to ten-figure accuracy. The units in which addition is carried out provide a 'memory' with a capacity of about twenty numbers, results of previous operations, to which immediate access can be had in the course of further calculations; use of punched cards provides an indefinitely large 'memory capacity' for data, intermediate results, or operating instructions, though with much slower access. Final results are delivered on punched cards.

A multiplication table is built into the machine by the connexions of a set of electronic valves. The machine also has three function tables, on each of which a set of values of any function required in the calculation (for example, the resistance-velocity relation for a projectile) can be set by hand switches so as to be immediately accessible to the machine, which can at any stage read a group of function values and interpolate between them in accordance with an interpolation formula specified by the operating instructions furnished to it. An addition of two numbers held in the machine takes about 0·2 millisecond; the multiplication of two numbers of ten decimal digits takes a few milliseconds.

Control of the programme of the operation of the machine is also through electrical circuits. The sequence of operations is supplied to the machine by the interconnexions made between its different units through plug-and-socket connexions and through hand-set switches, and by coded instructions supplied to a programme control unit; the machine then operates automatically according to the sequence of operations so specified. A certain amount of 'judgment' can be included in these operating instructions, in that the machine can be set to select between two alternative courses of procedure at some particular stage of the work, according to the result of a previous operation.

The machine is built up in the form of a number of units each consisting of one or more vertical panels about 8 ft. high and 2 ft. wide, of which there are altogether forty. Each panel carries, at the back, racks of valves, relays, etc., and, at the front, switches, indicating lamps, plugs, sockets, etc. The different units are interconnected by two sets of lines, one set carrying signals expressing numerical information and the other set for control signals; connexions to and from these sets of lines can be plugged into the various units.

The whole machine comprises about 18,000 electronic valves, 3,000 indicating lamps, and 5,000 switches, and takes about 150 kW. in operation. Its flexibility and speed of operation will make it possible to carry out many numerical calculations, in many fields of investigation, which without its assistance would have been regarded as much too long and laborious to undertake.

D. R. HARTREE.