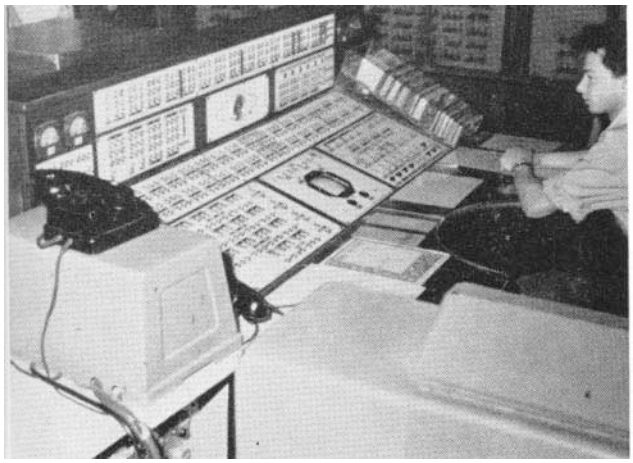


FIG. 14. Console, STRELA

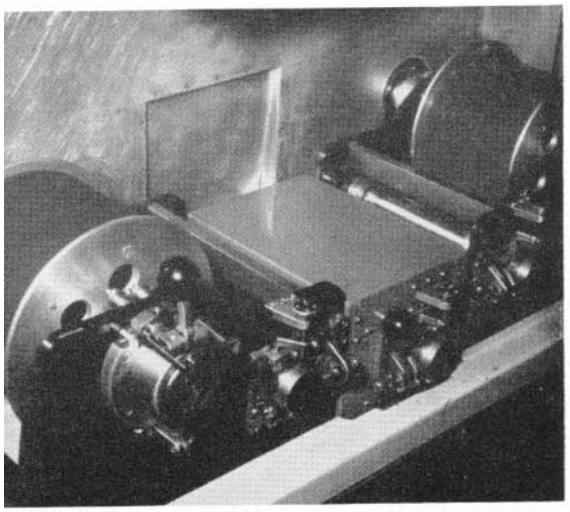


FIG. 15. Magnetic Tape Unit, STRELA

while a second STRELA had only one of each. The machine at the Computing Center operates seven days a week and requires a maintenance staff of three engineers per shift. About 18 hours per day of useful running time can be achieved; 3 to 4 hours per day is devoted to preventive maintenance, and the balance of the day is unscheduled maintenance. This machine was designed in 1948, although the installation at the Academy Computing Center was not made until 1957. The precise number of machines manufactured is uncertain but it was suggested that at most a few tens had been constructed.

The STRELA tape unit is approximately 4 inches wide (fig. 15). A word is written in parallel across the tape which is recorded at a linear density of 2.5 bits per millimeter. The reading rate is 1,000 numbers per second, and reading is in terms of a block. For reliability great emphasis is placed on programmed check sums.

The STRELA, like the BESM-I, also has some interchangeable wired subroutines which can be used for such things as sine, logarithm, etc. It also has about 10 groups of stored constants of 16 bits each. The card readers and card punches were quoted at about 60 cards per minute.

The inadequate reliability of the STRELA store leads users to program check sums into their problems. There is some possibility that a core store may be retrofitted to this machine.

SETUN

This base-3 machine being constructed at Moscow State University appeared to be in operation when we saw it (fig. 16). It was explained that the choice of base-3 was made because it can be shown that in some sense a base of 3 provides the most efficient utilization of equipment.[19] Since a base-3 electronic technique is not available, they decided to construct a base-4 machine and to utilize only 3 of the 4 possible states. The unused 4th state in each case is available for some form of checking. This machine is regarded as experimental, and as an educational training program for engineers. In part they felt that SETUN was a protest against the huge, complicated machines being built elsewhere. It was thought easier to operate a simple machine at their center. The machine contains 4,000 magnetic cores, 4,000 germanium diodes, approximately 100 transistors, and 40 vacuum tubes. It operates at a 200-kilocycle clock rate. It uses 1 MC transistors which are rated at 150 milliwatts dissipation at 25 degrees centigrade, but can tolerate a maximum of 100 degrees centigrade.

SETUN has only 81 words of storage and 27 different instructions. It is a single-address, fixed-point machine, with 18 ternary digits per word. The point is fixed between the second and third digits from the left. It is serial and contains two instructions per word. There is no divide instruction.

The ferrite core store can be regarded as having 162 9-digit words because the half-words can be addressed. The drum store contains 2,268 half words. Number representation of SETUN requires 2 binary digits per base-3 digit; therefore, a 9-digit, base-3 word, will require 18 tracks on the drum. There are three such groups of 18 tracks on the drum, or a total of 54 heads. In each band of 18 tracks there are 756 words recorded in parallel;

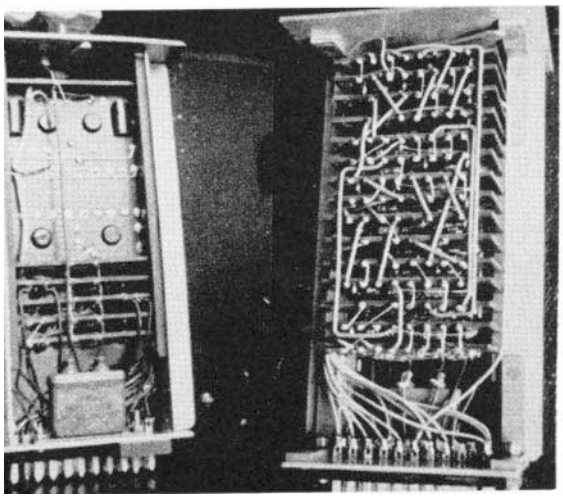


FIG. 16. Pluggable Package, SETUN

there are thus 756 bits around the 13-inch circumference. It is planned to add magnetic tapes to this machine at some later date.

Addition time is 180 microseconds, including all accesses. Fetching of the next instruction is overlapped with execution of the previous one. Multiplication time is 335 microseconds, and transfer of control is 100 microseconds. SETUN includes a normalizing instruction (shifting operations to facilitate programming of floating-point), one index register, and teletype input and output. The German type RFT teleprinter is partially base-9 and partially base-3. A 9-digit word is printed as two base-9 digits, then one base-3 digit, then two more base-9 digits. The characters used are:

Base-9	↻,Ɛ,Ƨ,I,0,1,2,3,4
Base-3	i,0,1

Five-level punched paper tape is used for the input and output.

KIEV

This machine is expected to be completed by December 1959; a substantial part is already operational (fig. 17). It is in five cabinets in a semi-circular arrangement and requires a floor area of approximately 20 × 35ft. It is truly asynchronous and operates at a speed of 5,000 to 6,000 operations per second. It uses static flip-flops, but diode-transformer gates. Pulse sources are blocking oscillators having two independent transformers in the plate circuit. One is for the regeneration required by the blocking oscillator itself; the other, for driving the output. The machine has arithmetic, logical and block-transfer instructions, is binary and has a word length of 40 bits. The arithmetic unit is capable of adding, shifting, multiplying and dividing.

The principal store is a 1,024 word ferrite store of the end-fire BESM-II type.[20]

The store is autonomous, and has separate checking, which suggests that there may be a wired-in independent test routine. There is also a 512-word read-only store which is based on a transformer technique; its read time is approximately 3 microseconds. This passive store, when expanded to larger size, will contain the automatic program and the binary-to-decimal and decimal-to-binary conversion routines. There are also 8 words of storage which can be set from switches. There will be 3 drums of the same type as the BESM-II; only one is presently installed. At the moment the input and output is paper tape.

There are seven types of standard circuits in this machine. Each cabinet of the machine contains its own power supply. Because of this modular construction and the truly asynchronous organization, it was observed that expansion and modernization is very simple. It was also stated that convenient marginal "conditions for prophylaxis" exist. An improved version of the KIEV machine is under way, and we noticed a substantial amount of BESM-II type equipment on hand for this purpose. In the modernized version, arithmetic operations might be automatically repeated under marginal conditions and the result compared; this is a type of checking being considered.

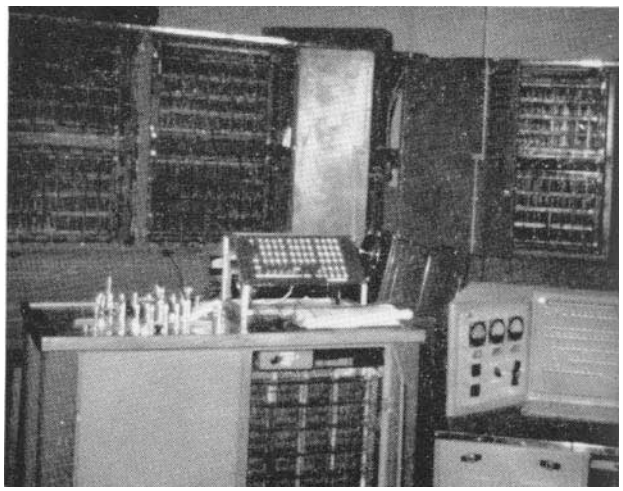


FIG. 17. General View, KIEV

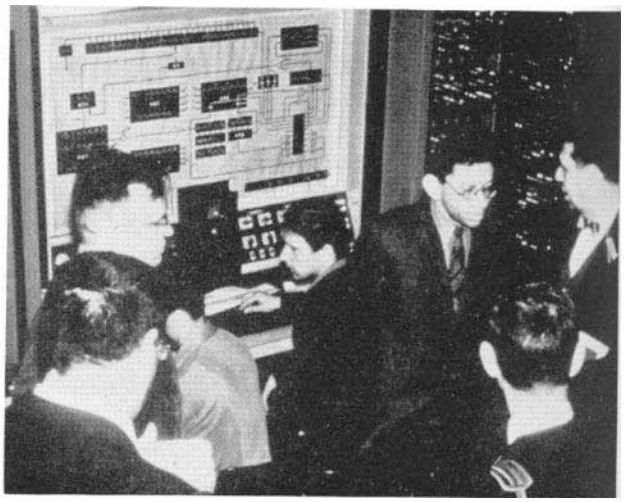


FIG. 18. General View, SESM

SESM

This machine (fig. 18) is a special-purpose digital computer which is intended to solve sets of linear equations of orders up to 120. The design is expandable to orders of 480 and is based on the Gauss-Seidel iteration technique. The solution time depends on the number of zero elements in the matrix and on the distribution of these elements. For an 18 × 18 matrix which was rather ill-conditioned, a solution had been achieved in 148 iterations and about 2 hours. A rough rule of thumb[21] for the time in seconds required for one iteration is: the number of non-zero elements divided by 20.

[20] This particular type of store is frequently referred to in Russia as the "Z" system.

[21] This rule-of-thumb does not agree with the previous example, but these were the data that were collected.