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THE DEVELOPMENT AND INTRODUCTION OF COMPUTER ENGINEERING
IN THE NATIONAL ECONOMY OF THE USSR

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FOREWORD

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Following is a translation of an article by B. Del Rio in Mekhanizatsiya i Avtomatizatsiya Proizvodstva (Mechanization and Automation of Production), No 12, Moscow, December 1960, pages 52-54.7

This summer in Kiev the VTs (Vychislitel'nyy Tsentre -- Computer Center) of the AN UkSSR (Academy of Sciences Ukrainian SSR) conducted the Second Scientific Conference on Computer Mathematics and Computer Technology. At the Conference were heard reports on work completed in the VTs AN UkSSR and also several works completed in other research organizations.

The Conference was opened with a report by corresponding member of the AN UkSSR, V. M. Glushkov, which set forth a series of new questions relating to the theory of automatic machines. The emergence of a theory of automatic machines is connected with the stormy development of computer techniques in recent years and with a whole series of questions on cybernetics. Theoretical research in this direction will allow the creation of new and effective methods for designing digital computers which will fulfill even more complicated functions. The speaker spoke of methods of analysis and synthesis of abstract computers devised by him which have great scientific interest and important practical application.

Corresponding member of the Academy of Sciences USSR, L. V. Kantorovich (Siberian Department of the Academy of Sciences USSR) noted in his report the great significance of the application of mathematical methods to the solution of problems of efficient organization of production and optimal planning. In particular he dwelled on the uses of methods of linear programming for the solution of problems of economics, transportation and optimal cutting, etc. Candidate of technical sciences, B. N. Malinovskiy, spoke of the uses of digital computers for the automation of industry. Maximal uniformity in the principles of their construction and service must be observed in using control computers. To attain the aims of automation of control of industry a standard series of control computers with different parameters must be created. One of the ways of creating such a standard series is to reassemble machines with variable parameters, i.e., to fix separate sub-assemblies. This guarantees serial production of control machines and economical use of the means invested in control techniques.

Three sections participated in the conference; the section for control and digital computers, the section on numerical methods in programming and the section on analog computers.

At the section concerning control and digital computers V. N. Malinovskiy, A. G. Kukharchuk, L. A. Korytnaya, G. S. Zabara, N. N. Pavlov, Ye. S. Oreshkin and F. N. Zykov and other scientific co-workers in the Computer Center AN UkSSR delivered a series of contemporary reports dedicated to the principles of building interchangeable parts for a UMShN (Upravlyaushchaya machina shirokovo naznacheniya -- control machine of broad applicability) and the field of its application. UMShN is destined for control and direction of complicated industrial processes and units and for the study of production processes in the period of their preparation for work under conditions of automatic control. UMShN perhaps can also be used for solving complicated mathematical computations in scientific-research and construction organizations. The distinctive feature of UMShN is the block principle of its construction. Depending on the demands of the user, the control machine UMShN can be completed with different capacities of operating and passive memory and with varying quantities of blocks for computation of data, etc. UMShN has great speed of computation. The computer works steadily under a large range of temperatures. UMShN can be used for automation of control of technological processes in the metal, chemical and other branches of industry.

V. N. Potrashkov and A. B. Tyutyunnikov dedicated their report to the methods of analysis of technological processes of a soda industry with the aim of modifying the task for the design of a control computer. For the automation of control a process must be formulated in economic terms and expressed in the form of mathematical relationships. The goal of automation is directed toward the accomplishment of maximum (not lower than planned) productivity and a minimum of specific losses of raw material and energy. A definite economic effect can be received with control of the specified sectors of the technological framework by means of changes in value of the specified technological indices. In the production of soda such a sector is the complex of work stations of the ammoniac production cycle (the work stations of absorption, distillation and carbonization). The guiding technological indicator is the co-efficient of utilization of sodium with a calculation of the control limits which are imposed on the process by the characteristics of the apparatus and the conditions of work of sectors adjacent to the control sectors. In the first stage the control equipment will be used for the study of processes for the issuance to the comptroller of recommendations about appraisals of routines. For the program control of the process of gas cutting in ship construction a special computer structure was modified -- the interpolater. This was communicated in a report presented by a group of co-workers of the Computer Center AN UkSSR (N. K. Babenko, L. K. Golyshev, F. N. Zykov, U. T. Kotsyuba, G. A. Mikhaylov). This arrangement guarantees an even speed of cutting. Activated by single impulses the working equipment of the system masters shifts along curves at a 0.2 millimeter step. The interpolater is easily altered by the processing of volumetric components along three coordinates.

The automation of production processes at the present time is proceeding not only along the path of creating large control computers, but also of designing small digital program systems using methods and means of the discrete technique. V. I. Skurikhin, V. N. Nikulin and A. G. Kukhorchuk spoke about the digital program system for contact welding machines. At the base of this system is the principle of transformation of a graph of welding current changes, expressed in the form of a binary code, into impulses moving in phase relative to zero of a sinusoid of the voltage grid, or into a stepped potential flow graph. A program system consists of a synchronization block, a programming block and a block for forming an output signal. The narrow Ohm circuits employed in programming block improve the stability of the system and increase its reliability while working jointly with the welding apparatus.

G. A. Spynu, V. I. Skurikhin, V. Ye Gizyla and V. G. Tyupa in their report informed about the work preceeding at the Institute For Automation of the Gosplan of the USSR and the Computer Center of AN UkSSR on large-scale automation of the manufacture of ship-hull components. The components of a ship have a complicated curvilinear form. The preparation of cutting templates and copper sheets by hand is intricate and labor-consuming work. The copper sheets are used one or two times. The essence of the proposed method of program control is that the trajectory of movements of the working parts of the gas-cutting automatic machine and the technological processing routine are calculated beforehand and fixed on magnetic tape. The automatic control process itself leads to the reproduction of the program and process, written on the magnetic tape, on a special gas-cutting machine. For the preparation of the magnetic tapes an interpolater and digital computer are used. The latter produces an estimate of the lines of the theoretical working diagrams and calculates the scaled templates of the parts of the ship's hull with the aid of which optimal size templates are made up. A system of program control can also be used for control of metal-cutting machines which process parts having an intricate, curvilinear form.

The electronic digital computer "Kiev" runs at the Computer Center of the AN UkSSR. The computer "Kiev" is set aside for the accomplishment of computing work concerning solution of complicated scientific and technical problems. The mean speed of calculation of this machine is 10,000 arithmetic and logical operations a second. At the base of construction of the machine was laid broad usage of the principle of working autonomy of all its functional parts. S. V. Pogrebinskii, V. D. Losev and N. E. Korol reported on the operational reliability of the computer, and several problems of its programming (otladka) were reported by L. N. Dashevskii, M. M. Abalyshnikov and A. G. Zubatenko.

In the section meetings a series of reports were heard on individual computer systems and the results of working out new components in experimental trials, and also of the possibility of their application. Information presented in the form of experimentally received graphs is translated into cipher form for processing on the computer. Preparation of the information bearer (for example, punched cards or punched tape)

in word or numerical form is a laborious process which is still done by hand. V. A. Kovalevskiy, V. L. Nikiiforov and I. T. Parkhomenko told about their creation of a system for automatic loading of graphs (from working drawings or oscillograms) into computers. The model designed by them allows the automatic loading into the computer of graphs at an approximate speed of one thousand ordinates per second and with a precision of about one percent. V. A. Kovalevskiy and A. G. Semenovskiy presented a report on an automatic reader unit for discerning letters and numbers. The automatic reading machine must correctly distinguish the symbols irrespective of displacement and typing defects. Experimental research on the constructed model has given favorable results.

At the section meeting on numerical methods and programming a series of reports were given by colleagues at the Computer Center of the AN UkSSR and other institutes on mathematical methods and their application in solving industrial problems on computers. Several reports were devoted to mathematical linguistics (by Prof L. A. Kaluzhin of Kiev State University and colleagues of the Computer Center of the UkSSR, A. A. Stogniy, L. S. Stoykova and others). The results of this research have a bearing not only on machine translation but also to the working out of a general method of information compression and the elaboration of principles for constructing large-memory information computers with rapid access to desired data. Research results on mathematical linguistics have important applicability in the fields of automation of production, automation of statistical computations, etc.

In recent years new mathematical methods have appeared which have great practical application for finding optimal solutions of many planning problems of the national economy, production organization and planned projects. Colleagues V. S. Mikhalevich, V. M. Yermol'yev and others at the Computer Center AN UkSSR devoted their report to a survey of these methods. By the method of dynamic programming it is possible to solve problems in which change at each step depends on the preceding state and on the long-term behavior of the object up to the termination of the problem. This method can be used for the most advantageous conduct of a control routine and for finding an optimal variant amidst a number of possible ones in the solution of engineering problems. Using this method of dynamic programming, a program was worked out on the computer "Kiev" for selecting the optimal design lines for a highway (report by A. N. Sibirko, V. V. Shkurba and N. Z. Shor). A series of reports were heard on the automation of planning and control of railroad transportation (B. Fel Rio, I. Ya. Yanovich, A. A. Letichevskiy and L. D. Shakhpaychuk). A unified system of control computers for automation of the control of operational activity in railroad transportation was examined. Operational demands impart a host of peculiarities to the structure of these control computers. One of the arrangements in railroad transportation which can guarantee effective use of control computers is the substitution of punched cards for the travel documents which accompany the railroad car. This makes possible the rapid machine-loading of information on rolling stock. Programs are devised for the solution of a series of such operational problems on electronic computers. A program was compiled on the "Kiev" computer for

construction of a single track non-parallel graph of train traffic. This program was formed for automation of control of traffic in a sector equipped with a system for dispatcher contralization; thus a graph of traffic is made up as initial data on a general-purpose computer and the same information is thereby used which is made available to the railroad dispatcher working at the sector. A standard program has been devised in formulating a plan for formation of single-group technical routes. In this problem the order of formation of railroad car flows into trains is defined, guaranteeing minimal demurrage of cars at the marshalling yards.

At the section meeting on analog computers Prof G. Ye Pukhov in his report stated a series of problems in the theory of synthesis of quasi-analog mathematical computers and systems. These computers can be constructed according to different schematics: by grids, by electronic tubes on large scale components, by electronic tubes with use of inertial links of a type of integrators; by a computer schematic of a hybrid type with a quasi-analog on components of continuous action and a digital arithmetic arrangement.

At the Computer Center there is an electronic computer EMSS-7 which is used for computation of pivotal systems (of beams and frames). G. Ye Pukhov, V. V. Vasil'yeva and others devoted a report to the principles of the electrical fashioning of pivotal systems and the construction of EMSS-7. The EMSS-7 has successfully passed industrial experimental tests at a series of designing organizations and has been accepted for serial production.

At the concluding session the director of the Computing Center of AN UkSSR, V. M. Glushkov, told the participants of the conference about the products completed at the computer Center AN UkSSR and of the intended directions of growth of scientific research and applied work.