In Kiev, in November, 1970, a scientific-technical seminar was held on the general subject of improving and automating blast furnace production. This event was organized by the Ministry of Ferrous Metallurgy of the Ukrainian Soviet Socialist Republic (MChM USSR), the Automation Institute of the Ministry of Instrument Building of the Soviet Union, the USSR Exhibition of National Economic Achievements (VDNKh USSR), and the Republic Society "Knowledge." The seminar participants included responsible persons from the Ukrainian MChM and Gosplan, personnel from scientific-research and technical institutes, automation specialists, and blast furnace technologists from the steel plants.

In the reports and communications, a great variety of timely topics was presented, including: the status of new blast furnace projects; refinements in the preparation of various charge materials; application of combination blasts for increasing furnace productivity; development of theoretical bases for the algorithmation and automation of blast furnace operations; and the introduction of new systems of technology, based upon the theories, for optimizing and automating furnace operations.

Special attention was allotted to investigations which were concerned with the development, introduction, and commercial optimization of new automatic control systems for the basic parameters of the charging and blowing systems. Papers were given on the subjects of: new methods of control for all the solid materials entering the furnace; heating the lower part of the furnace in accordance with the average temperature of the tuyere zone; control of the ratio of the components in a combination blast; controlling the rate of stock descent in the lower portion of the furnace by regulated pulsation of the hot blast pressure; regulating the distribution of bosh gas around the circumference of the furnace.

In the paper presented by the Basic Isotope Laboratory of the MChM USSR and the Dneprodzerzhinsk Industrial Institute, the authors reported on their work in the area of research, development, and introduction of new methods and facilities for the radiisotopic automation of the processes of: continuous screening out of fine coke fractions, using vibrating and disc screens; continuous coke moisture control and continuous control of the size consist of the coke in the skip, directed toward the continuous correction of the coke charge, depending upon moisture content; monitoring instantaneous and totalized quantities of furnace flue dust; checking the level and surface contour of the furnace burden; determining the refractory thickness in critical areas of large furnaces, such as in the hearth and in the shaft.

In the report by G. Ya. Rutkovskii (Gosplan of the USSR), were set forth the technological requirements which must be satisfied in order to achieve a functioning system of automation, covering all the important operations and processes of smelting in new, high-capacity blast furnaces.

The paper by M. B. Kumer (UkrGipromez) was concerned with the timely questions of designing and building modern, high-powered blast furnaces having the ultimate in productivity, mechanization, and automation; the author directed special attention to the desirability of utilizing all of the accumulated positive experience of such progressive plants as Cherepovets, Novo-Lipetsk, Magnitogorsk and others.

"New Method of Predicting the Characteristics of Blast Furnace Operations Using a Combination Blast," a paper by Yu. V. Tsimbalyuk (MChM USSR), described a method of graphical-analytical calculation of the optimum values of 24 important melting parameters, using the "Minsk-22" computer. The calculations were performed on fifty blast furnaces in the steel plants of the Ukraine. As a result of these computations, it was demonstrated that,
depending upon the specific burden conditions and other factors, for each furnace there exists an optimum quantitative value for the rate of consumption of the constituents of a combination blast. The investigation yielded some very practical nomograms which enable the operator to determine the optimum conditions for blowing his furnace.

Many of the reports gave serious attention to the effects of the usage of natural gas, and to the influence of the blowing rate, the temperature, and the humidity of the blast, upon the optimization of the primary smelting reactions. The influences of tuyere diameter and tuyere protrusion (within the furnace) upon smelting reactions and bosh gas distribution were also studied in considerable detail.

M. A. Stefanovich's report (Magnitogorsk Mining-Metallurgical Institute) was a significant contribution to our knowledge of ways of lowering the coke rate to the lowest possible level (250–350 kg/ton of hot metal). He stressed the importance of burden preparation (screening out the fines and charging various size fractions of sinter in separate layers) and of achieving the proper ratio of direct and indirect reduction. He also emphasized the need for reliable data on the analyses of the various iron-bearing charge components and on the moisture content of furnace coke. The author pointed out that the internal furnace lines have a very important effect upon the efficiency of chemical processes and especially upon the rapid and uniform descent of the stock. The reason for disruptions of normal, smooth, furnace operations lies in the incompatibility of certain conditions of the two fundamental operating characteristics—of the charge and of the blast. In order to probe this incompatibility in greater detail, it will be necessary to develop sophisticated means for simultaneously monitoring the mass flow rate of both the hot blast and the furnace top gas.

V. M. Klempert (Moscow Institute of Steel and Alloys) delivered a paper having to do with the mathematical treatment of the fluid dynamics and the thermodynamics of basic furnace processes, based upon measurements of retention time of charge components and upon material balance relationships. Having a practical mathematical model of the furnace dynamics, it becomes possible to develop reliable algorithms for controlling the furnace and its thermal conditions with a control computer.

M. N. Abramovich (Kommunarsk Mining-Metallurgical Institute) stressed through his presentation the vital necessity of an industry-wide campaign to implement the algorithms which have been developed by the many research agencies and technical institutes for the purpose of controlling furnace thermal conditions. Practice has demonstrated that of all the algorithms which have been worked out for the furnace thermal conditions, the most effective one is that which originated with the Dnepropetrovsk Metallurgical Institute and which was so successfully adapted to the SM-3 computer at the Krivod Rog steelworks. This system deserves widespread application.

In the report from the representative of Central Project Construction Bureau (TsPKB), it was stated that in all the new blast furnace projects the installation of the control computer for controlling the overall process was compulsory. The control computer can be effectively employed in the automation system of the furnace provided that it receives reliable inputs concerning the most important parameters of the process. Unfortunately, however, many of the standard sensors and analyzers have significant functional errors, which decrease the effectiveness of the control computer. A good example of an instrument with poor accuracy is the type OA-0304 optical-acoustical gas analyzer, which was designed for the continuous automatic analysis of blast furnace top gas. Also, much more information is needed on the chemical composition of the charge materials and on the molten iron and slag.

M. S. Levin (Ul'yanovsk State Pedagogical Institute (UGPI "Metallurgavtomatika") gave a paper which stressed the importance of applying multiply connected automatic control systems, using the control computer, to the blast furnace. At the present time, in the plants coming under the MChM USSR jurisdiction, there are seven such systems in operation, and four more are committed for new furnaces or for those being rebuilt. The author indicated that one of the most badly needed advances is some kind of reliable temperature sensor for the domes of hot blast stoves which are capable of supplying blast heats of up to 1200°C.

The successful implementation of new, progressive technology requires well-organized staff groups and efficient management of these groups. We must create a truly effective working force for the development of new automation systems, and the group must be capable of achieving these objectives with relatively short testing periods.