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No. 20

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No. 20

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STATE NETWORK OF COMPUTER CENTERS, DEVELOPMENT PROSPECTS IN 10TH FIVE-YEAR PLAN DISCUSSED

Moscow KLASSIFIKATSIYA I KODIROVANIYE in Russian No 8-9, 1977 pp 14-15

[Article by V.N. Kvasnitskiy, candidate of technical sciences, V.S. Makkaveyev, and G.M. Belash, All-Union Scientific Research Institute of Problems in Systematization and Control: "Prospects for the Development of the State Network of Computer Centers in the 10th Five-Year Plan; Questions Relating to Employment and Handling of OK TEI's [All-Union Classifiers of Technical and Economic Information]"]

[Text] Creation and development of the State Network of Computer Centers (GSVTs) is foreseen as a gradual growth in components of the network and in the amount of services offered to users.

At the first stage in 1976-1980 seven VTsKP's [multiple-user computer centers] must be created, whose total computing capacity will be 3.14 million operations per second, and whose total data bank volume will be approximately 1×10^5 megabytes.

Included among the number of services offered to users at the first stage will be the creation and introduction of a data base for users of the GSVTs. Creation of a data base for the GSVTs should make it possible to minimize the cost of gathering, storing, and issuing data for accounting, planning, and controlling the national economy by eliminating unwarranted duplication in gathering and storing data and by reducing the cost of language interaction between man and the computer and between various ASU's [automated control systems] and users of the network.

The data bank for the network, as suggested, will be formed on the basis of the development principle, taking into account the capabilities of existing hardware and software and also the degree of preparedness of data and the reference equipment necessary for systematization of data storage and retrieval. At the first stage the VTsKP data bank will be formed by creating multiple-user files which will contain chiefly auxiliary and reference data, as well as data used for problem solving, and a set of individual files for individual users.

The fundamental principle of organization of information in multiple-user banks for the GSVTs is the creation of data bases; therefore, the role of all-Union classifiers in creation of the data base for the GSVTs is quite important. OK TEI's contain a lexicon of the formalized language of GSVTs data bases and comprise the language for entering the system's data into the bank, as well as the language whereby information interaction between users of the GSVTs and individual VTsKP's is accomplished. OK TEI's in the data base of the GSVTs are the prerequisite for making multipurpose use of GSVTs data bases possible.

Therefore, much attention is being devoted to questions relating to the use and handling of OK TEI's in the GSVTs in creation of the GSVTs. One of the first VTsKP multiple-user banks to be created will be a reference information bank based on access to OK TEI's.

At the present time an experimental VTsKP (EVTsKP) is being created in Moscow, which will serve three groups of users: Subdivisions of GKNT [Central Committee on Science and Technology]; subdivisions and organizations of the Ministry of Petroleum and Gas Industry Construction; and rayon organizations of Moskvoretskiy Rayon, Moscow.

At the first stage in creating the EVTsKP, for a formalized description of users' data use will be made of intrasystem classifiers and access to OK TEI's, as provided for by plans for creation of individual ASU's (the ASU of GKNT and the ASU of the Ministry of Petroleum and Gas Industry Construction). At the second stage group data banks will be created for the EVTsKP, with systematization of information in data base form. The language for describing data at this stage will consist of descriptor languages, including dictionaries of terms, classification and nomenclature systems or thesauruses, rules of grammar, and user reference equipment. It is suggested that the lexicon for these languages be formed on the basis of OK TEI's.

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CYBERNETICS, COMPUTERS AND AUTOMATION TECHNOLOGY

UZBEK SSR REPUBLIC AUTOMATED CONTROL SYSTEM, DEVELOPMENT PROGRESS

Moscow KLASSIFIKATSIYA I KODIROVANIYE in Russian No 8-9, 1977 pp 34-36

[Article by Academician V.K. Kabulov, Institute of Cybernetics of the Uzbek SSR Academy of Sciences Computer Center: "Problems in Standardization for the RASU [Republic Automated Control System]"]

[Text] The main purpose of developing and introducing the RASU is to improve planning and control of our socialist economy for the purpose of efficient utilization of all material and labor resources and of increasing the efficiency of social production on the basis of extensive use of computer facilities.

The Republic Automated Control System of the Uzbek SSR consists structurally of ASU's [automated control systems] at the republic, oblast, city, and rayon levels, and at the association and enterprise level. Within the RASU are realized functions of administrative and economic management, and of control of technological processes, planning and design operations, and scientific research.

The RASU is a complex consisting of all automated systems for planning and controlling the republic's socialist economy which function on the basis of a unified computing and information network providing software, hardware, information, and systems compatibility of all functional subsystems.

The main function of the RASU is to make possible compatibility and interaction between all ASU's functioning within the territory of the republic. Consequently, in designing the RASU it is necessary to ensure unity in methodology and hardware and information and software compatibility of ASU's for all components.

A set of function tables forms the basis for functional compatibility. These tables are put together for each component of the RASU and goals of planning and control are indicated on them with time divisions and an indication of who is to perform the work. Then these goals are tied in together, taking into account the sequence in which they are to be realized, and they are also tied in with the tables for other components. In this way a network model is created for ASU's at all levels of control. Function tables are put together for all organizations at the republic level (Uzbek SSR Council of Ministers, interdepartmental planning and control agencies, ministries and departments), and also for typical oblasts, cities, rayons, and enterprises.

Such a clear representation of interrelated goals by means of function tables has made it possible to proceed to standardization of subsystems, in particular to begin creating plans for standard ASU's for ministries and enterprises.

Interrelating RASU problems at the initial stages of planning by means of function tables has made it possible to determine the scope of information flows and to make a correct determination of the necessary capacity of computer facilities.

At this stage in planning problems relating to phase one of the RASU were singled out, which includes combinations of interrelated problems which make their thorough solution possible at all levels of control, such as the Uzbek SSR Council of Ministers, the Uzbek SSR Gosplan, the Uzbek SSR Central Statistical Board, the Central Supply Administration, and ministries and departments representing different sectors of the republic's socialist economy.

Phase one is based mainly on goals to be realized in ministries and departments during the 10th Five-Year Plan.

Making possible implementation and efficient functioning of phase one of the RASU required completion of work on uniting problems in functioning at the local level into a unified system making it possible to tie them together both vertically and horizontally. The chief difficulty here consisted in providing for compatibility of functioning modes of all systems connected with phase one of the RASU.

The effectiveness of interaction between related ASU's is determined to a great extent by the level of unification, normalization, and standardization of their component parts. Application of methods of normalization and standardization in designing an ASU for the republic makes it possible to shorten the time required to develop it and to relieve developers of the necessity of carefully checking data on ASU's to be created. The development process proceeds much more rapidly, since the most labor-intensive aspects of planning are utilized in ready form. In this case a set of tasks is performed only to relate standard design solutions to specific conditions.

The subjects of standardization for the ASU are component parts of both functional subsystems and the set of enabling subsystems. Analysis of a number of republic ASU's has shown that enabling subsystems possess a set of components which have multiple applications, i.e., they are subjects for standardization. Of great importance in this regard is creation of a set of standards making possible effective interaction between linked ASU's.

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UZBEK SSR GOSPLAN'S AUTOMATED PLANNING ESTIMATE SYSTEM (ASPR), DEVELOPMENT IN 10TH FIVE-YEAR PLAN PERIOD

Moscow KLASSIFIKATSIYA I KODIROVANIYE in Russian No 8-9, 1977 pp 36-38

[Article by G. Sh. Zakirov, candidate of technical sciences, Uzbek SSR Gosplan's Computing and Information Center: "Prospects for Development of the Uzbek SSR Gosplan's ASPR in the 10th Five-Year Plan Period"]

[Text] An effective solution to problems in improving national economic planning is inseparably connected with development of the automated planning estimate system (ASPR).

In April 1976 an interdepartmental commission made up of representatives of the USSR's Gosplan, GKNT [State Committee of the USSR Council of Ministers on Science and Technology], the Uzbek SSR's Council of Ministers, the Uzbek SSR Academy of Sciences, and ministries and departments of the republic adopted phase one of the Uzbek SSR Gosplan's ASPR.

It was composed of more than 20 subsystems for making estimates, including "Capital Investments," "Supply of Materials and Equipment," "Oblast ASPR," "Automated Norm-Setting System," "Industry (Overall)," "Food Industry," "Light Industry," "Building Materials," "Local Industry," "Agriculture," "Education and Culture," "Irrigation and Land Reclamation," "Software," and "Hardware."

Included in phase one were a number of optimization problems which have undergone experimental verification. Experimental tests were also made of the interrelationship between problems of ASPR subsystems and problems of other automated systems, in particular of the OASU [industrywide automated control system] of the Uzbek SSR Ministry of the Ginning Industry and the ASU [automated control system] of the Uzbek SSR's Central Supply Administration.

Work done on creating and introducing phase two of the Uzbek SSR Gosplan's ASPR has demonstrated the high effectiveness of the system. This is evidenced by the example of problems relating to the Uzbek SSR's fuel and energy balance and its equipment balance in cost and physical terms. Solution to these problems involves conversion of data of an interindustrial nature, resulting in the necessity of creating a unified methodology for exchanging information between computer centers of different ministries and departments, within the scope of different hierarchies of control. In this connection introduction of all-Union classifiers has become of primary importance.

The IVTs [computing and information center] of the Uzbek SSR Gosplan has been oriented toward the use of all-Union classifiers at the stage of introducing phase two of the Uzbek SSR Gosplan's ASPR.

The IVTs of the Uzbek SSR Gosplan, the head organization in charge of all-Union classifiers in the republic, has assigned 15 head organizations in republic ministries and departments as subscribers to the system for handling OK TEI's [all-Union classifiers of technical and economic information].

The IVTs of the Uzbek SSR Gosplan will carry out work on the handling and introduction of all-Union classifiers in conjunction with these organizations and VNIIKI [All-Union Scientific Research Institute of Classification of Information] of the USSR's Gosstandart [State Standards Committee].

This work should ensure unity in coding discipline for industrywide ASU's making up the RASU [republic automated control system], whose central link is the Uzbek SSR Gosplan's ASPR.

Industrial classifiers should also play an important role in the automated data bank created in the ASPR.

Unity of the classification system will make it possible to issue any information by means of a specially developed retrieval system, not only information in the ASPR's data bank, but also in industrywide ASU's. The equipment base for performing this job will be a multiple-user computer center furnished with terminal equipment, which will be created in 1979 on the basis of the IVTs of the Uzbek SSR Gosplan. At its phase-one stage it will have 30 ministries and departments as subscribers.

A unified methodological approach to developing and creating large automated systems is of prime importance for systematization and performance of these tasks.

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INFORMATION EXCHANGE BETWEEN A REPUBLIC AUTOMATED SYSTEM FOR HANDLING ALL-UNION CLASSIFIERS (RASVOK) AND THE MAIN CENTER FOR HANDLING ALL-UNION CLASSIFIERS (GTsVOK)

Moscow KLASSIFIKATSIYA I KODIROVANIYE in Russian No 8-9, 1977 pp 51-53

[Article by L.A. Vykhodtsev, candidate of technical sciences, A.M. Margulis, Ye.S. Shikhman, Scientific Research Institute of Planning of the Latvian SSR Gosplan, L.M. Gorbachev, candidate of technical sciences, I.P. Perstnev, and S.V. Sinyutina, All-Union Scientific Research Institute of Classification of Information: "Questions Relating to Information Exchange Between a RASVOK and the GTsVOK"]

[Text] Information exchange between components of the ASVOK TEI [automated system for handling all-Union classifiers of technical and economic information], one of which is the RASVOK TEI [republic ASVOK TEI], is regulated by a number of documents.

Of great importance here is exchange of information regarding classifiers at the machine carrier (MN) level, since this relieves users of the GTsVOK of the necessity of themselves duplicating preparation and monitoring of data on machine carriers, a highly labor-intensive process in the procedure for automated handling of classifiers.

Let us consider a possible variant of these formats for different types of MN's. These formats are used for experimental transmission of data on VKG OKP [expansion unknown] from VNIIKI [All-Union Scientific Research Institute of Classification of Information] of the USSR Gosstandart [State Standards Committee] to the RASVOK of the Latvian SSR.

It is suggested that the appropriate heading descriptor for the structure of the entry be isolated in the data file to be prepared for the classifier.

For the case of preparation of data on magnetic tape (ML), for example, it is possible to recommend setting up a file with a maximum module length of 4096 bytes and a variable entry length owing to the differing length of the text portion (designation of the subject of classification) of classifier positions. Thus, each entry corresponding to a specific classifier position consists of fields, logically indivisible entry elements. The descriptor of the structure of the entry is formed as the first file entry and represents the set of descriptors of all particulars making up the entry. It is feasible to determine the descriptor for an individual particular by the following equation:

$$\langle \text{Descriptor of particular} \rangle ::= \langle P_0\rangle\langle P_1\rangle\langle P_2\rangle\langle P_3\rangle\langle P_4\rangle\langle P_5\rangle\langle P_6\rangle\langle P_7\rangle,$$

where P_0 is a 3-byte field containing a classifier code in symbolic format in accordance with the OK TEI classifier; P_1 is a 2-byte field containing the number of the particular in the entry; P_2 is a 3-byte field, containing the address of the first byte of the particular in the entry; P_3 is a 3-byte field containing the value of the length of the particular, and in the case of a field of variable length contains the symbol "VAR." This applies to a textual particular (designation of the subject of classification), which is replaced by this in the data entry. P_4 is a 1-byte field determining the type of representation of data (symbolic, packaged decimal, or binary field, digital symbolic with a modulo-2 control digit, etc.). P_5 is a 1-byte field containing a character for the necessity of a field in the entry. For example, Y indicates the particular is obligatory; N indicates the particular is not obligatory; and U indicates the character for obligatoriness has not been determined. P_6 is a 3-byte field containing the code for the particular in symbol form. P_7 is a 24-byte field set aside for the possibility of expansion. It can contain a full designation for the corresponding particular or sets of special characters associated with specifics for subsequent processing of data.

For the case of preparation of data on punched tape (PL) a similar solution is used for determining the heading descriptor for the structure of the entry. The structure of data on PL presupposes an indefinite module length and a variable entry length. The entry corresponds to a specific position of the classifier. The end of the entry and the end of the module are identified on the PL via the symbols C and $\breve{\underset{\frown}{o}}$, respectively. The end of a file on PL is standardly indicated by a separate module which follows the last data module and is made up of /* symbols. Each reel of PL should have a marking containing its sequence number and the title of the classifier.

Data on ML and PL is prepared in DKOI-2 code.

For an exchange file set up on punched cards (PK's) it is also possible to employ the principle of using descriptors. But it is necessary to take into account the 80-byte length of the physical entry. As a rule a set of entries will correspond to an individual position of the classifier in this case. In connection with this, for a file on PK's it is necessary to introduce the concept of a descriptor for the structure of a set of entries. This descriptor can be entered into the computer in the processing procedure individually for a specific PK file. In simulating, for data control purposes it is a good idea to mark off the identification field and data field on the PK's.

The identification field is fixed and can contain a classifier identifier (code), a registration number for the position of the classifier, the number of the entry within a set of entries for the position, and the number of entries required for the position. The data field reflects the particulars of the classifier's position.

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BRIEF ABSTRACTS OF KEY ARTICLES IN 'PRIBORY I SISTEMY UPRAVLENIYA' No 4, 1977

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 4, 1977 p 64

[Text] Brief Abstracts of Key Articles in This Issue

UDC 681.32.06.003.12

"Method of Estimating the Cost of the KTS [Hardware Complex] of an ASUP [Automated System for Controlling an Enterprise]"

PRIBORY I SISTEMY UPRAVLENIYA No 4, 1977 p 3

Grayfer, R.S., and Mayzus, R.I.

A method of estimating the cost of the KTS at the planning stage of creating an ASUP, making it possible to arrive at the approximate cost of the KTS by calculation, without first completing planning of the KTS's structure. Calculation of cost on the basis of taking into account the characteristics of the enterprise and quality parameters for solving problems for an ASUP which are determined when developing the engineering problem for the ASUP. A technic for obtaining raw data and making estimates. Figures 1; references 7.

UDC 581.5.004:62-52

"Analysis of Necessary Precision of Control Computer Computations When Controlling an Industrial System"

PRIBORY I SISTEMY UPRAVLENIYA No 4, 1977 p 5

Shumskiy, V.M.

A method of analyzing the influence of rounding-off errors by simulating the operation of a control computer with a specific algorithm for a universal digital computer, consisting in multiple repetition of the solution to the problem while reducing the bit configuration of computations and thus determining the "critical" bit configuration. An illustrating example of the determining influence of the computing characteristics of problems on the "critical" bit configuration. Figures 1; references 7.

UDC 681.3.06.003.12

"Experimental Study of the Structure of the Labor Intensiveness of Programming Economic Problems"

PRIBORY I SISTEMY UPRAVLENIYA No 4, 1977 p 6

Ivanov, A.P.

Prerequisites for standardizing processes of programming economic problems; systematization of factors influencing the labor intensiveness of developing programs; experimental data on the effectiveness of software (symbolic coding language, library of standard programs, Cobol) for the "Minsk-32" computer. Figures 1; tables 6; references 6.

UDC 681.32

"The M-7000 Long-Life Control Computer Complex"

PRIBORY I SISTEMY UPRAVLENIYA No 4, 1977 p 8

Gomon, L.V., et al.

The M-7000 control computer complex, representing a two-processor computer complex with a memory field common to both processors and with common input-output units, the long life of whose computer complex is made possible owing to the capability of redundancy of any module (the processor, core storage, channel, etc.) and independent switching on or off of individual unit modules without stopping the operation of the system, and in which provision has been made for protection from commutation of the power main, making it possible to maintain the working capacity of the system with a drop in voltage in one or two phases of the power network. Figures 3.

UDC 681.326

"Capabilities of an M-7000 Multiplex Channel"

PRIBORY I SISTEMY UPRAVLENIYA No 4, 1977 p 10

Soltan, L.M.

Setting up a multiplex channel making it possible to increase the efficiency of the M-7000 system; the feasibility of controlling the channel by means of two computer complexes (one imperative M-7000). Algorithms for working with the control computer's memory; link with input-output units. Figures 3.

UDC 681.327

"Digital Data Console"

PRIBORY I SISTEMY UPRAVLENIYA No 4, 1977 p 12

Stryuchenko, G.N., et al.

Classification of manual entry consoles. Key technical parameters. Description of structural layout of the console and variants of its application in an ASU [automated control system] based on the ASVT-M system. Figures 4.

UDC 681.327

"Add-On Digital Data Entry Modules for the M-6000 Control Computer Complex"

PRIBORY I SISTEMY UPRAVLENIYA No 4, 1977 p 13

Sokolov, A.V., et al.

New modules for entering MVvImS [multiple entry pulse signals] pulse signals and MVvChIS-2 [multiple entry number pulse signals] and MVvChIS-3 number pulse signals, by means of which it is possible to receive and store pulses of short length, to store pulses from several inputs simultaneously, and to store a preset number of pulses. Figures 3; references 2.

UDC 389.14

"Estimate of the Metrological Safeguard Level of Instrument Making Production"

PRIBORY I SISTEMY UPRAVLENIYA No 4, 1977 p 15

Golovashkin, M.A., and Patrichnyy, V.A.

A quantitative estimate of the metrological production safeguard (MOP) level of the instrument making industry. Introduction of a number of metrological indicators and formulas for calculating them. A synthesizing MOP indicator as a composite of metrological indicators with coefficients determined by the method of expert evaluation. Figures 1; references 7.

UDC 681.121:53.088

"Metrological Model of a System for Reproducing and Measuring the Flowrate of a Fluid"

PRIBORY I SISTEMY UPRAVLENIYA No 4, 1977 p 20

Biryukov, B.V., et al.

Description of a unified metrological model of systems for reproducing and measuring the flowrate (SVIR's) of a fluid. Analysis on the basis of this model of metrological characteristics (range of reproducible flowrates, conversion and error functions) of SVIR's of different types. Figures 1; references 5.

UDC 681.121.8.53.082.32:53.088.6

"Pneumatic System for Automatic Correction of the Flowrate of a Gaseous Stream"

PRIBORY I SISTEMY UPRAVLENIYA No 4, 1977 p 27

Rumyantsev, V.V., and Dubinskiy, Ya.I.

Questions relating to structure and realization on the basis of mass-produced pneumatic devices, based on using logarithmic relationships of a computing system for correcting the flowrate of an industrial-process gaseous stream according to variable parameters. Figures 1; references 3.

UDC 62-523.2

"Elements for Tolerance Monitoring of Electrical Magnitudes Based on Magnetic Current Comparators"

PRIBORY I SISTEMY UPRAVLENIYA No 4, 1977 p 29

Rozenolat, M.A., and Tsaregradskiy, F.I.

Operating principle and specific structure of elements for tolerance monitoring of current, voltage, and resistance, based on magnetic current comparators. Technical and functional characteristics of specific elements. Sensitivity of a basic 10 μA circuit; output signal--pulsating alternating current, 12 and 6 V, 100 mA; measuring period 0.3 ms. Figures 4; references 4.

UDC 621.317

"Meter-Type Converter of Physical Magnitudes into a Unified Frequency Signal"

PRIBORY I SISTEMY UPRAVLENIYA No 4, 1977 p 30

Gutnikov, V.S., et al.

Operating principle and basic results of testing a meter-type frequency converter designed to convert direct voltage and current, and also resistance, into a unified frequency signal. Figures 2; references 2.

UDC 681.382

"Special Application Hybrid Film-Type Integrated Circuits for ASKR [Automated System for Monitoring and Regulating] Complex Apparatus"

PRIBORY I SISTEMY UPRAVLENIYA No 4, 1977 p 35

Kruglov, V.F., and Doshchatov, V.V.

Circuit diagrams and key electrical parameters of a system of specific application hybrid film-type integrated circuits designed for use in monitoring and regulating hardware. Some features of their design.

UDC 621.317

"Ferromagnetic Summary Counter"

PRIBORY I SISTEMY UPRAVLENIYA No 4, 1977 p 43

Likhttsinder, B.Ya., et al.

Questions relating to practical realization of multistable ferromagnetic storage elements with magnetic control of the storage coefficient by means of a permanent fine-adjustment magnet. Figures 2; references 4.

UDC 658.512.4.011.56

"Structural Principles and Functional Structure of Automated Process Design Systems"

PRIBORY I SISTEMY UPRAVLENIYA No 4, 1977 p 46

Tsvetkov, V.D.

Structural principles of automated process design systems determining the conditions for effective functioning of the system within the structure of the enterprise and for its structure; structure of algorithms and programs in individual subsystems. Figures 3.

UDC 62.278:621.983.5

"Study of the Elastic Characteristics of a Corrugated Diaphragm During Molding"

PRIBORY I SISTEMY UPRAVLENIYA No 4, 1977 p 50

Voshchinskiy, V.S., and Smaga, I.G.

Results of an experimental study of the influence of thinning of the original thickness of the process stock material in the process of molding a corrugated diaphragm with different specific pressures for the flange clamp on the elastic characteristics of a diaphragm with a sinusoidal profile and a nonuniform corrugation depth. Figures 2; references 6.

UDC 656.512.4.011.56

"Forecasting Development of Automated Process Design Systems in the Instrument Making Industry"

PRIBORY I SISTEMY UPRAVLENIYA No 4, 1977 p 51

Gmoshinskiy, V.G.

Estimating on the basis of engineering forecasting methods (numbered parameter method, strategy method) the future of automated design systems (SAPr's). Technic for forecasting the required number of SAPr's (method of engineering program informative forecasting) for specific trends in the development of instrument making technology. Figures 1; tables 2; references 5.

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SCIENTIFIC POTENTIAL OF THE UNIVERSITY EXAMINED

Riga SOVETSKAYA LATVIYA in Russian 20 Jul 77 p 2

/Article by Prorector, RKIIGA on Scientific Work, Docent, Candidate of Technical Sciences N. Vladimirov/

/Text/ The improvement of training of highly qualified specialists, maximum use of the potential of science in the university for further advancement of industrial production efficiency is one of the vital links in the work of the collective of our college. We have vast possibilities for carrying it out successfully. The material and technical base is being expanded constantly and the volume of scientific research is increasing. It is sufficient to say that the institute allocated more than 2 million rubles to scientific work this year and this is almost twice the amount allocated 5 years ago. We established a problems laboratory with sectoral laboratories.

The plan of the Constitution of the USSR gives a new impetus to creative work. This plan guarantees an education to each Soviet individual, the extensive development of scientific research and inventive and efficiency activity. Article 26 of the plan of the Constitution of the USSR states: "In accordance with the needs of society, the state guarantees the systematic development of science and the training of scientific personnel and the organization of the introduction of the results of scientific research into the national economy and into other spheres of life." It seems to me that this article may add the words: "... on the basis of creative collaboration of scientists and enterprises, the realization of joint plans for the development and introduction of the new technology."

As our experience and that of other colleges show, it is precisely collaboration and mutual responsibility of science and production that will provide positive results. Now, in discussing the plan of the new Constitution of the USSR, we will attempt to analyze whether all reserves are used for the increase of scientific potential and whether the output and efficiency of our work are always great.

Basic trends of scientific research of the institute include: provision by science of safety and regularity of flights and operational reliability of aviation technology and prospects for the development of civil aviation aircraft and their power components and equipment. Our contacts with other sectors of the national economy are being expanded. The fulfillment of contractual scientific research alone annually involves participation of nearly 20 persons with a Doctor of Sciences degree and professors, more than 120 Candidates of Sciences and docents and graduate students and more than 300 students of the institute. Within the past 5 years RKIIGA has been the scene of nearly 120 major studies, nearly 90 of which were introduced at enterprises and into Aeroflot organizations and into the national economy. The current economic impact constituted more than 15 million rubles. More than 140 certificates for an invention were obtained from the results of scientific research.

Applications have been found already for many of our developments. The majority of the civil aviation maintenance plants which have data computer centers at their disposal are putting into operation a system of statistical analysis of defects of airplane airframe power units. There has been developed a device which permits the calculation for each aircraft, individually, of loadings imposed on each of the separate parts and this provides advance information concerning the expenditure of the resource. This assists in the analysis and prediction of the reliability of aircraft.

A series fighter trainer plane for training and refresher training of flight personnel was developed at the institute and already is being produced. Studies conducted at the institute have resulted in development of a heat generator for the centralized preheating of aircraft and engines in the winter. Experimental operation of it began last year.

Considering the ever-growing volume of use of aviation in the national economy, the institute, in collaboration with leading developers, is conducting systematic studies on the improvement of aircraft for use in agriculture as fertilizer spreaders. We were able to develop a new wide-span pulverizer which permits an increase in productivity of 25-30 percent. Now, the pulverizer is being produced in series production. The problems laboratory of the institute is conducting several studies of national economic importance.

Scientists of the institute maintain close association with several enterprises and organizations of our republic. We are concluding economic agreements, agreements concerning scientific and technical collaboration concerning dissemination of results of scientific developments for introduction into production, we are planning conferences and seminars and are inviting scientists of other scientific institutes of the republic.

In collaboration with VEF /State Electrical Engineering Plant/, the institute is conducting scientific research involving statistical study and modelling of vocal communications of dispatchers of the air control tower service, which ensures flight control of airplanes. The placing in operations of these developments at airports of the country will permit a significant increase of flight safety.

Now we are working intensively on the realization of a complex agreement concerning collaboration with the Latvian Civil Aviation Control. A plan has already been compiled and a program developed for improvement of the scientific organization of the work of civil aviation enterprises, the equipping of it with the most modern equipment and improvement of passenger service.

Plants of our republic face the problem of evaluation of the reliability of their products under operational conditions. Scientists of the institute have developed programs which will permit, with the assistance of electronic computers, an explanation of the nature of breakdown, the probability of its occurrence and the mean-cycles-to-failure. These programs presently are being prepared for transmission to the Riga Railroad Car Construction Plant and the Diesel Construction Plant, the RZz /Riga Electrical Machinery Plant/ and several others with which creative collaboration treaties have been concluded.

Naturally, students participate a great deal in scientific research. For example, a special photo-analyzer was developed and introduced at the Student Design Bureau at the "Kometa" Match Plant. The SKB /Special Design Bureau/ is dealing with interest with the problem of completely equipping the helicopter GAI /State Automobile Inspection/ of the Republic with means of communication and super-powerful loudspeakers. It is engaged in analogous work on the equipping the Mi-2 /Mil'/ helicopter with a sound broadcasting outfit and communication apparatus for the Ministry of Forestry of the Republic for use in control of forest fires.

However, in spite of the results achieved, the institute collective is not always satisfied with the effectiveness of the studies themselves or with their utilization. There are still considerable shortcomings in the organization and performance of scientific research projects. Regrettably, we do not always succeed in avoiding fragmentation and unimportant subjects in research. At times, there is duplication of developments in neighboring colleges. We must adjust information concerning the investigations being conducted for interested organizations. Calculation of the expected economic effect of completed research is still carried out inadequately.

The elimination of these deficiencies requires, first and foremost, the improvement of coordinations of scientific studies between colleges of the republic and parts of planning agencies, the expansion of scientific communications between departments of institutes. We must increase the role of institutes of the Academy of Sciences of Latvia in problems of determining the subjects of scientific research of colleges and give them comprehensive assistance. We must also give attention to problems of improving the material and technical supply of colleges with modern scientific equipment produced in the Soviet Union and abroad.

In order to reduce the terms of introduction of completed development, it is necessary, in our opinion, to create at major colleges large scientific-industrial complexes which will permit production of models of new devices, testing and refining of them, without distracting industrial enterprises from fulfillment of their own immediate tasks.

To struggle for efficiency in science means to increase the effectiveness of scientific research itself. This is presently and precisely the goal of the rectorate and the Party Committee of the institute, which is preparing to honor the occasion of the 60th Anniversary of the October Revolution.

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MORAL OBLIGATIONS OF SCHOLARS DISCUSSED

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[Article by Academician L. Vereshchagin (deceased), hero of Socialist Labor, Lenin Prize Laureat, transcribed by A. Smagin]

[Text] Speaking at the 25th CPSU Congress about the most important problems of the development of our economy at the present stage, Comrade L. I. Brezhnev, General-Secretary of the CPSU Central Committee, stated that the first of them is the acceleration of the scientific-technological progress.

The term itself asserts the indissoluble connection and unity of science and technology, and implies a rapid realization of new scientific ideas. Science has become the most important productive force of society.

Very significant words sounded from the rostrum of the Congress: "there is nothing more practical than a good theory." And the party is always concerned about the development of "big" science which we call fundamental. In fact, fundamental science predetermines the future qualitative changes in the engineering and technology in all branches of the national economy, to say nothing of the fact that it has a direct outlet to the practice of social productions.

On the other hand, practice stimulates fundamental studies. The direct connections and feedback of science and practice have many forms. The acceleration of the scientific and technological progress depends in many respects on the improvement of these relations, on how harmoniously we can combine the interests of "big" science with the interests of the so-called applied ("small") science and the needs of industry.

I would like to express my views on some aspects of the problem of the "introduction" of the achievements of fundamental science which developed as a result of my work in the USSR Academy of Sciences in the course of many years.

Criteria First of All

Starting any new extensive study, scientists apply to our planning establishments for funds which are often quite large. It is understandable that society is inclined to finance primarily the most promising, roughly speaking, "useful" directions of science.

Once I happened to present a report to the USSR People's Control Committee, and, of course, I touched upon this subject. Someone asked me directly: "by what should one be guided in checking the activities of scientific establishments? Are there any criteria of practical value of a job?"

To the above question I replied the following: imagine that in a scientific research institute whose work you are investigating a certain scientist keeps experimenting with an ordinary photographic plate. He is simply watching the gelatin swell under the effect of light. The topic of his project is "effect of light on gelatin tanning." Any of you will consider it necessary to draw the attention of the administration to this "obviously useless" work. Is it not so?

Everybody agreed with me.

I continued: however, not too long ago such experiments made it possible to approach the creation of the technology of color cinematography. They proved to be exceptionally necessary. But many narrow specialists talked at that time about total alienation of researchers from practice, and their opinion coincided with the opinion of dilettantes.

At one time, Jonathan Swift, who had his own scores to settle with scientists, put them in the pillory, as he thought. Do you remember the Laputa Island in "Gulliver's Travels" inhabited by scientists? Do you remember how Swift ridiculed the nonsensical enterprises in which they were engaged? But 200 years have elapsed...

Swift mocked at scientists who were engaged in extracting sunbeams from cucumbers. But from our point of view, it is nothing else but a study of photosynthesis. Swift ridiculed scientists who thought of converting sewage into nutritive substances.

But we can assume that we are dealing here with the so-called closed ecological systems. Their study is important for the preparation for long space flights.

Toward the end, curious Gulliver was shown a machine created for "improving speculative knowledge by means of technical and mechanical operations..." But this is a rough likeness of a computer!

Everything changed in our days, becoming simpler and more complicated. Now we realize more or less clearly the potentialities of science. Now, it is clear to everyone how dangerous the attempts are to limit the sphere of studies of fundamental science and to divide scientists into those who are directly concerned with the needs of the country and those who, supposedly, lost touch with practice and production. On the other hand, science itself has become so specialized that even representatives of its related areas often do not not find a common language.

Unfortunately, there still are some pseudoscientists among us who parasitize in science, thinking only about their personal gains. Of course, we are not talking about them, and not about those subjectively honest people who are obsessed by ideas which have nothing in common with true science. Disregarding the laws of nature, they are inventing "perpetual engines," mystical "power sources," etc.

However, no matter how difficult it is to select a criterion, it still exists. It is social practice in the broadest sense which realizes both applied and fundamental studies.

It is from this point of view that society examines the plans of scientific establishments and coordinates them. And nobody believes that organizers of our science hinder the scientific and technical progress when they limit sometimes certain investigations. Although mistakes are possible here too; experience, particularly that of the last decades, has made all of us particularly careful in evaluations.

For example, investigations of N. I. Lobachevskiy, an outstanding Russian mathematician, and K. E. Tsiolkovskiy, the founder of astronautics, were not understood because they were ahead of their time. The contemporaries simply were unable to appraise the practical value of these fundamental studies.

Sometimes the founders of new directions in science themselves are beset by doubts. Heinrich Hertz, "father of radio engineering," and one of the leading figures in nuclear physics, Ernest Rutherford, stated categorically that their discovery would not find any practical application during the visible time period. It is interesting that Rutherford stated this in 1935, i.e., just 4 years before the fission of uranium nuclei was discovered, and seven years before the appearance of the first nuclear reactor.

I believe that Heinrich Hertz and Ernest Rutherford were afraid that scientists, having rejected the most important fundamental studies of processes whose essence was just beginning to be clear, would rush to engage in the practical realizations of ideas which were not sufficiently ripe. Ideas can be compromised, and vanity hurts science just as much as art.

Other attempts to guess the "advantages" of some new discoveries and rashness in searching for these "advantages" can harm the development of scientific studies. Let me say that, for fundamental science, a bird in the hand is worth two in the bush. Ultrautilitarian opinions about fundamental studies and insistent demands for immediate applied effect can inflict (and have inflicted!) serious damages to the scientific and technical progress.

The whole point is that true science always serves man. There are no scientific discoveries that have not been used by industry and agriculture. All fundamental studies produce a good yield sooner or later. Practical areas get what they need.

However, both for the national economy and for scientists engaged in complex and profound investigations, it is extremely important to use scientific recommendations for the industry as soon as possible. It is necessary to be concerned about this without sacrificing the interests of the future.

About the Moral Obligations

Louis Pasteur said, "Of course, science is international, but every scientist must know in what country he lives!" Pasteur, who had enriched the world's fundamental science by his great discoveries, constantly thought about the welfare of his fellow citizens, about the flourishing of his native France.

Soviet scientists see even a deeper meaning in his statement. Soviet science serves the people paving the road to the future. It serves the socialist society and, in the final analysis, the entire humanity.

When fundamental science is concerned, the Soviet State does not enter into "contractual" relations with scientists. But there are moral obligations of scientists, a kind of a promissory note which they have to pay.

In our time, the expenses on the needs of science grow faster than the state income. Science is getting more and more expensive. This is the result and requirement of progress.

Being aware of this, researchers are trying to return at least a part of the means spent on "academic" science to society immediately in the form of some applied studies. Many economic problems can be solved by using the equipment and results of scientific projects which have not even been completed.

I am not contradicting myself. I am not talking about the curtailment of long-range research programs for the sake of immediate interests, but about economic utilization of intermediate results obtained by teams of scientists. Moreover, the experience of the Second World War and the national economic construction indicated that the use of equipment and technical facilities of research laboratories in industry help correcting fundamental studies themselves and to suggest new routes for experiments, and expand the range of ideas and methods.

For example, an "intermediate" utilization of one of the most remarkable discoveries of physics of the twentieth century is that of laser radiation. Without waiting for the final results of studies on the so-called induced radiation, scientists created modifications of laser (quantum generators) which could be immediately utilized for equipping many sectors of the national economy, from the medical industry to geodesy. But the fundamental work continued, and in the course of it there appeared more new types of lasers and new substances capable of laser radiation were studied. All this was immediately put into practical use.

The strong connection of fundamental science and practice, sometimes unexpected aspects of the utilization of extensive scientific studies, and applied use of the most complicated equipment, for example, equipment of nuclear physics laboratories were discussed at the 25th CPSU Congress.

Let us recall the dialogue of Comrade L. I. Brezhnev and Academician A. P. Aleksandrov, president of the USSR Academy of Sciences and director of the Institute of Atomic Energy imeni I. V. Kurchatov. Anatoliy Petrovich Aleksandrov said that nuclear equipment is used widely in medicine for diagnosing and treating a number of diseases. "Some 'bomb' for the flu?" -- said Leonid Il'ich Brezhnev jokingly. "For the flu?" -- asked A. P. Aleksandrov. "Leonid Il'ich, I can answer you right away. The Institute of Nuclear Physics in Gatchina has developed a vaccine against the flu in cooperation with the Institute of the Ministry of Health... There, in Leningrad, industrial production of the vaccine is now being discussed."

These examples illustrate the situation very well. Scientists engaged in studies which seem to be divorced from real life help to solve very practical problems. There are also some examples from the experience of academic institutes studying the structure of matter.

The laboratory of nuclear reactions of the international Joint Institute of Nuclear Research (Dubna) and the Institute of Nuclear Physics of the Siberian Branch of the USSR Academy of Sciences developed unique devices--particle accelerators and achieved most important theoretical results for which they were awarded the Lenin Prize. These discoveries alone justified the large amount of expenses on fundamental science.

However, the Dubna nuclear physicists are not forgetting their moral obligations. Using particle accelerators, they create original specific filters which are necessary for microbiologists, chemists, and biochemists for filtering very thin mixtures. These filters are also used for purifying water. Industry puts out this kind of devices, but they are too crude and expensive. In the Dubna accelerator, a beam of fast microparticles goes through the cloth forming even, smooth, and very small holes in it. Such ideal filters were not known in our industry before.

Some part of the expenses on their accelerator is also covered by the scientists of the Novosibirsk Academic City. For example, fulfilling very important orders of agriculture, they disinfect organic fertilizers, in other words manure. As is known, manure contains a large amount of organisms and impurities which harm agriculture. Before organic fertilizers are introduced into the soil, it is necessary to prepare and disinfect them. This is the requirement of modern agricultural practices. In Novosibirsk, this process is done by a powerful accelerator, which is a unique case. In my opinion, physicists of the institute directed by academicians G. N. Flerov and A. M. Budker did a good job, and their example should be followed.

It is important that even representatives of most abstract branches of science search for and find a direct route to practical application. The help of science is accepted gratefully in practical areas regardless of the stage of readiness of the main theoretical studies.

A group of researchers in the department of physics of the Kazakh State University has been studying the luminescence of living organisms and plants in the process of cell division. This process is extremely complex and causes many conjectures and assumptions. In the course of their experiments, the physicists developed an interesting theory of this process and established that specially selected laser beams activate the hidden mechanisms of plants accelerating their development. Their laser devices were used in the fields of one of the kolkhozes, and there have been record harvests for several years. The chairman of this kolkhoz said that, although he does not know how these devices work, he is all for using them.

These successful experiments in the fields were followed by the designing of laser devices based on the methods proposed by the scientists. And research in the department continued.

Since the first days of the existence of our state, the opinions of scientists have been taken into consideration in planning the development of the national economy at all levels. More and more frequently, particularly now, during the time of the scientific and technological revolution, opinions of scientists are decisive.

Comrade L. I. Brezhnev said at the 25th CPSU Congress: "Revolution in science and technology requires... a true respect for science, ability and desire to consult with it, and to take it into consideration."

Scientists must not forget their responsibility to society. If some recommendation is not based on a profound analysis of all possible aftereffects, then the best intentions are not worth much. Now, making a proposal, the scientists must be careful as never before. Particularly, if the human environment, the biosphere, is concerned.

Let us recall the discussions of recent years connected with "global" projects for the construction of large canals, water reservoirs, diverting rivers, melting the ice of the Arctic, etc. In some of these projects, the future "advantages" were calculated perfectly. However, their ecological aftereffects were not fully taken into consideration. And the initiators of these projects were justly blamed for not being sufficiently cautious. The systems of the biosphere, in spite of their apparent stability, are extremely sensitive. Their balance, which had been developed during millions of years of evolution, can be disturbed by touching the hidden mechanisms of nature. Scientists must foresee everything, even the most remote aftereffects of our interference in the life of the biosphere. Engels said the following about this in his "Dialectics of Nature":

"However, let us not flatter ourselves too much with our victories over nature. It takes revenge on us for each such victory. It is true that each of these victories has, first of all, those aftereffects which we expected, but, secondly and thirdly, it has quite different unexpected aftereffects which often wipe out the significance of the first ones." He added further: "... Facts remind us at every step that we do not rule over nature as a conqueror rules over the conquered people... that all our supremacy over it consists in the fact that we, unlike all other creatures, know how to understand its laws and apply them correctly... Particularly, since the time of the tremendous achievements in natural sciences of our century, we are becoming more and more capable of considering also more remote natural aftereffects of at least the most usual of our activities in the area of production and thus control them."

More than 100 years have elapsed since Engels wrote this. This is a tremendous period for the development of science. But even now, people are often amazed at the all-embracing connections of various natural phenomena.

To illustrate this, I shall give a recent geographical curiosity. This happened in Siberia. Foresters discovered that the taiga started getting sparse at one section without any obvious cause. Huge trees started falling here and there, trees which should have stood years and years. It was found that their roots got weak. Why? The reason was that a hydroelectric power plant was built 1000 kilometers from that place. Its huge water reservoir changed the water regime in a large area. The level of subsoil waters raised. The root system of the trees was getting excessive moisture which was harmful to it.

Let us recall the unsightly appearance of some of the "artificial seas"--blue and green duckweed on the water and fish dying from lack of oxygen... but much could have been foreseen, as the designers themselves acknowledged when it was too late.

In short, scientists must thoroughly examine their scientific and technical projects and consider all possible aftereffects when their materialization can affect the health of people or the environment. However, if the prognosis is, for some reason, impossible (this happens), it must be said honestly.

Science can do a lot. It has many potentialities, but much is demanded of it.

For example, starting such a construction project of the century as Baykal-Amur Trunk line, we are not only concerned about the new engineering and the most perfect technological methods, but also about the fact that the future industrial complexes in the BAM zone will be organically connected with the nature of Eastern Siberia and that our creative work would be, at the same time, an example of careful treatment of the biosphere. In the meantime, there have been some sufficiently alarming signals. Geographers are reminding the builders that the ecological balance can be disturbed very easily here, and that it restores very slowly in the specific climatic conditions of Eastern Siberia.

Scientific discoveries inspire researchers. If a researcher succeeds in solving another mystery of nature, it is possible to understand his urge to make his theoretical conclusions available to practice. At this time, it is sometimes necessary to cool him off. Recommendations of scientists cannot always be checked by production workers and sometimes they are accepted without realizing the entire complexity of the problem. This is followed by natural bewilderment and even distrust toward science in general. I think that it is good for scientists to be skeptical when practical utilization of their discoveries is in question, particularly, with regard to a new technology or new systems affecting an entire branch of the national economy.

This is not a paradox. Healthy skepticism is an important characteristic of a true naturalist. Skepticism, or even conservatism, is very useful in contacts of science with production. Any innovation in the sphere of production requires discretion, thorough consideration, and rigid and unbiased criticism. Mistakes have to be corrected, which sometimes is very expensive.

Experiments, even the most daring ones, must be welcomed, but conclusions from them must be made extremely carefully.

I would not undertake to formulate fully the moral code of a scientist engaged in fundamental studies, but if such a document is to be compiled, the most obvious points must be stipulated in it. There are three main points:

1. The scientist must think of the practical advantages for the national economy which his research can yield at each stage.

2. The scientist must be extremely careful when he decides to recommend something new to the practical sphere, particularly when the realization of this innovation could in some way influence ecological systems.

3. And, finally, no matter how tempting the prospects of the practical application of his research may be, before publicizing and advertising them, the scientist must check himself hundreds of times and become a merciless opponent to himself.

Today, Tomorrow, and the Day after Tomorrow

It is not the first year that I am heading the Institute of Physics of High Pressures of the USSR Academy of Sciences. Our members are studying the behavior of various substances in unusual, extreme conditions (superstrong magnetic fields, superlow temperatures, superhigh pressure). Since these conditions are, generally speaking, unique, it is natural to ask to what extent our fundamental studies are connected with practice and what is our contribution to the national economy of the country.

In the last 15 years, the institute conducted two extensive research projects: artificial diamonds have been synthesized, and solid hydrogen has been obtained by a special method.

These theoretical discoveries, which won a high appraisal by the world's science, are not equivalent from the viewpoint of practical application. Artificial diamonds are already used widely in industry, but solid hydrogen is still of interest only to scientists themselves as a curious phenomenon characterizing the increased potentialities of modern physical experiments.

How did it come about that we undertook to solve a purely applied technological problem of obtaining a material with prescribed properties occurring only in nature in an artificial way? The answer is simple: this problem was given by the national economy, and the institute had the necessary conditions for solving it. By the beginning of the 1960's scientists had a sufficiently good knowledge of the peculiarities of the behavior of various substances subjected to high pressures. It was known, that natural diamonds develop under pressure. Roughly speaking, we only had to "simulate" a natural process by means of specially developed equipment, new experimental methods, etc. Of course, before starting this work, it had to be economically substantiated. We calculated that artificial diamonds would be relatively inexpensive, otherwise it would not pay to produce them.

It took some time, but we designed a special unit, adjusted it, and obtained the desired results. With respect to their hardness, our diamonds are superior to natural diamonds.

The production methods and specimens of the unique equipment were given by us to the appropriate enterprises of the country. The artificial diamonds produced by industry are not any inferior than those obtained in our laboratory. I am making a point of this because sometimes it happens differently. Sometimes it happens that series products do not resemble the first specimens at all produced by scientific establishments and experimental shops.

At the October (1976) Plenary Session of the CPSU Central Committee, Leonid Il'ich Brezhnev mentioned the good results achieved by the party organizations and scientists of the Ukraine who created a number of complexes uniting scientific research institutes and enterprises.

Having introduced the method of manufacturing artificial diamonds, we, in essence, organized such a complex and are maintaining relations with the plant. Whenever necessary, we give them our advice and help them in every way. We continue to maintain our friendly relations with industry. In Kiev alone, a new diamond instrument is used at 130 enterprises of many sectors of industry, and thousands of specialists consult us in connection with the introduction of supersolid synthetic materials... Such is the chain reaction of fundamental studies of various states of matter.

This old research of ours has become a technical basis for studies which finally led to the creation of a new modification of matter in our laboratory -- metallic hydrogen, which was created by us for the first time in the world. As soon as the newspapers published the first reports about this, I was showered with questions. I was asked where solid hydrogen could find application and what role it will play in technology.

It is quite possible that solid hydrogen will prove to be an excellent superconductor maintaining its unique properties at relatively high temperature which promises wonders to power engineering.

Everything will be fine if only we will be able to preserve solid hydrogen under these conditions. But so far no one can say when scientists will achieve this. When? It could be tomorrow or maybe after many decades. However, I am fully confident that some day there will be applied aspects even in this strictly fundamental research and that it will be beneficial to the practical area.

Not Advertising, but Information

I shall not touch upon the interrelations of the national economy and purely applied science which is directly connected with production. I shall be talking only about practical application of the achievements of fundamental science.

If we look at the register kept by the Committee on Inventions and Discoveries of the USSR Council of Ministers, we can readily see how diversified the interests are of our scientists who brought fame to our country by their remarkable discoveries. In many branches of science we are ahead of the world's standards, and in some we are at their level. Unfortunately, not all of our achievements become available to industry as rapidly as we would like them to be. The results of the work of a scientist at his desk and in the laboratory are a report, an article, and a paper. The job started by fundamental studies must be continued by others. Among them are applied sciences and industry. Here, the situation is not very good: some scientific discoveries lie dormant for a long time.

A very important discovery of the phenomena of superplasticity made by Academician A. A. Bochvar, specialist in the metallurgical science, and his colleague Z. A. Sviderskaya is one of them. They discovered that under certain conditions (most frequen ly at high temperatures) metals and alloys become amazingly pliable, and can be easily worked on and shaped. Materials which acquire superplasticity and are processed in this state restore their initial properties later under normal conditions. But the technology of their processing becomes considerably simpler. It seems that the advantages of the methods are obvious. However, 30 years have passed since the completion of the work of A. A. Bochvar and Z. A. Sviderskaya, but they are just beginning to use the phenomenon of superplasticity in metallurgy.

It is possible to give a long list of very interesting innovations which are still waiting acceptance by industrial enterprises. For example, they include methods for processing materials by means of explosions developed by a group of scientists headed by Academician M. A. Lavrent'yev. These remarkable methods are being introduced into production with great difficulties. Why is this so?

Recently, at a meeting of the Department of General Physics of the USSR Academy of Sciences, we were discussing scientific projects of the institutes and laboratories which have already found their application in industry. We discussed various conflicting situations arising in connection with their introduction into industry.

As far as I know (as I said at this meeting), no particular difficulties arise if the director of a scientific establishment is able to win the confidence of the workers of the national economy in advance. And, on the other hand, any good relations (and they are not established by themselves) can be ruined easily if our words and deeds are at variance.

Everything would be fine if our scientists could always visualize clearly all variants of the realization of their ideas and discoveries. But this is daydreaming. No one requires, and will not require, that scientists should know even superficially all the needs of modern national economy. Any relationship is bilateral. The searching in the sphere of introduction must also be bilateral. Interesting scientific ideas aiming at practical applications must be recognized and met halfway by industrial workers.

Perhaps, industry must have specialists especially connected with the fundamental science in all its breadth and scientists of various orientations. Constant interrelations of this kind will also help financing scientific investigations. Investing tremendous amounts of money in their development, the government, of course, does not count on their rapid reimbursement. Commercial profit is not planned in distributing budgetary allotments on "science." However, there are hidden reserves of profitability which should be used. I shall refer to practices abroad. There, fundamental studies are also conducted by applied institutes financed by large firms, and these firms spend large amounts of money on the development of topics whose practical utility cannot be predicted in advance. As you can see, even the leaders of the capitalist industry have realized the significance of "big" science on which the overall progress of technology depends.

In recent years, as I have already mentioned, the so-called complex projects are being established in our country. According to all indications, it is a very promising organizational form of business relations of science with the industry. I think that in these complex projects, it is also necessary to have provisions for the financing of theoretical studies by the industry. This will make the scientists more aware of the interests of the industry, and the production workers will understand the needs of science better.

Let me remind you that before the war, very important theoretical studies in our metallurgy developed parallel and in interconnection with the progress of production. Practical workers picked up the ideas of scientists even before their reports were completed. At that time, the Institute of Metallurgy of the USSR Academy of Sciences was headed by a remarkable Soviet scientist and engineer, Academician I. P. Bardin, who also held important positions in the Ministry of Ferrous Metallurgy. The interconnection of the metallurgical science and technology was almost ideal.

Of course, this is not an example that has to be followed directly, because it is difficult for one person to have such a load. However, this close cooperation of practical metallurgists and academic scholars typical of that time was very fruitful. While solving the most urgent technical problems during the prewar years, scientists were also developing the "pure" theory just as successfully.

Now, the intercommunication of theoreticians and practical workers can be improved by stimulating and encouraging in every possible way those complex projects which I have mentioned. But what is there to do if science is "foreign" to production workers and they cannot even imagine what it can bring them? Really, what sober-minded agronomist could ask scientists to find a way of disinfecting manure by means of an accelerator of elementary particles? What technologist could imagine that the Dubna Laboratory of Nuclear Reactions could develop the precision filter which was of interest to him?

It follows that the tremendous potentialities of equipment created by physicists would have been left unutilized if not for the initiative of the physicists themselves. What is the way out of this situation, how can we give production workers access to the "secrets" of scientific laboratories?

I have already spoken about the successful use of lasers in all sectors of the national economy. Evidently, this was due not only to purely technical needs which had developed long time ago, but also to information. Immediately after the discovery of laser radiation, there was a flood of specialized and popular articles in newspapers and journals. Lasers were discussed on the radio and on television. As a result of this, representatives of various fields -- from geologists to surgeons -- started thinking of using this remarkable devices. The discovery became widely known.

But many achievements of science are not known to industrial workers, although we try to spread widely scientific and technical information and are publishing various reference books, bulletins, and abstracts. It is not so much the amount but the quality of information and its effectiveness that are important. So far, the quality of information leaves much to be desired. There are instances when information about various innovations, even those which concern production workers directly, is obtained by the latter only from popular articles in newspapers and literary journals.

Once our institute was visited by an industrial executive who had learned quite by accident that our researchers participated in the designing of diamond saws and that these saws could easily cut marble. Having ascertained that it was so, he left, and reported to us after a while that, by using diamond saws, it was possible to increase labor productivity in cutting marble plates by eight times.

In order to adopt a scientific innovation which does not directly pertain to their narrow specialization, ministries, departments, and industrial enterprises must have full, convincing, well-reasoned and accessible information about it. I think that this is obvious.

I never met any staunch conservatives among the leaders of our industry. But I consider their skeptical attitude toward various innovations which are characteristic of our time quite natural. Business people are convinced by facts and by well-substantiated calculations supported by the demonstration of devices, instruments, and technological processes. (I am not mentioning the economic factors, because this is a different topic which is outside my competence.)

I believe that it is the first duty of the scientist to show his initiative in acquainting the representatives of the industry with new discoveries and to explain to them how to utilize the wealth acquired in the process of scientific searching.

The level of popularization itself depends on scientists, but many of us, unfortunately, have a very cautious attitude toward it. Why? It is not at all the advertising of uncompleted studies and not broadcasted promises of all kinds. True popularization is the best kind of information. It helps science to be accessible to all and acquaint broad sections of the public with its achievements.

In this connection, it seems to me that creative cooperation of writers, journalists, and scientists is absolutely necessary.

Marietta Shaginyan, Konstantin Paustovskiy, Oleg Pisarzhevskiy, Daniil Danin, and other writers gave much of their time and efforts to the popularization of the achievements of science and technology. I am mentioning this with a feeling of gratitude. Their books contributed to the acceleration of the scientific and technological progress. Incidentally, when good talented writers having studied the subject thoroughly will start writing systematically about science, there will be no room in our newspapers and magazines for careless publications which distort the essence of scientific discoveries in favor of being entertaining.

Thus, well-organized information greatly facilitates the penetration of scientific ideas into various spheres of the national economy. Although, even the press does not always help. I have already mentioned about the slow penetration of methods developed by a group of scientists headed by Academician M. A. Lavrent'yev. "Creative Explosion," "Explosion Helps Technologists," "Peaceful Explosions" -- such headlines have been appearing for more than 15 years in various newspapers and magazines. It seems that in this case there was more than a sufficient amount of information, popularization, and even advertising in this case. However, this did not do much good. Explosions are still not used sufficiently. They are used only in those instances when there is no other way, as it was during the construction of the famous mud dam protecting Alma-Ata. This strange attitude to the useful innovation can be explained both by conservative thinking of some administrators and by objective difficulties, because it is not so easy to start producing large amounts of explosives. But explosions are an exception. In other instances, it is the absence of information that was the main reason for the sad disregard of the latest achievements of science and technology...

Nobody will, probably, raise an objection to an obvious fact. Factors affecting the acceleration of the scientific and technical progress (economic, organizational, and even psychological) are varied, and accessible and broad interdepartmental information is not the last among them. It seems to me that the time has come to improve it earnestly. Perhaps, it will be worth while to publish a handbook listing the possible variants of the utilization of scientific achievements with short annotations. Perhaps, it is necessary to popularize the achievements of science at special exhibits, as it is done, for example, in the pavilions of the VDNKh [Exhibition of Achievements of the National Economy of the USSR]... This is a complicated problem, and it is difficult to propose definite formulas how it should be done. But I am convinced that it is necessary to make radical changes in the system of broad scientific and technical information.

It was stressed at the 25th CPSU Congress that it is only under the conditions of socialism that scientific and technical revolution takes the right direction which corresponds to the interests of man and society. Only on the basis of accelerated development of science and technology it is possible to solve the final problems of social revolution -- the building of a communist society.

Therefore, we must have a careful attitude toward fundamental science. Comrade L. I. Brezhnev expressed this idea very well: "We know it very well that the intensive flow of scientific and technological progress will stop if it is not fed constantly by fundamental studies."

The Tenth Five-Year Plan was called by the party a five-year plan of effectiveness and quality. This also refers directly to the work of Soviet scientists engaged in fundamental studies. Quality is the depth of investigations. Effectiveness is rapid introduction of their results into the national economy.

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SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

COOPERATION BETWEEN UNIVERSITY RESEARCH AND INDUSTRY

Moscow SOVETSKAYA ROSSIYA in Russian 9 Aug 77 p 2

[Article by Corresponding Member of the Academy of Sciences of the USSR, Director of the Scientific Research Institute of Mechanics and Applied Mathematics, I. Vorovich]

[Text] Our institute was established within the system of the North Caucasus Center of higher schools 6 years ago. Fundamental studies of applied mechanics and methematics occupy a leading place in its operations.

The volume of work is great. However, even at the beginning, it became clear that it was impossible to include in its activity, all of those national economic problems which involve the vast regions of the North Caucasus. They, of course, assume a deserved place both in the plans and in the practical activity of the institute. Such an approach to the construction of the subjects of study found support in the State Committee of the Council of Ministers of the USSR on Science and Technology and also in union and republican ministries of higher and secondary special education. The subjects of study were approved by the Department of Mechanics and Control Processes of the Academy of Sciences of the USSR. Thus, two trends of scientific pursuit were fused. In many of the theoretical studies, new accents and solutions to new problems were found on the basis of applied research. Some applications, in their turn, were applied in practice due to the fundamental work done in anticipation previously.

One of the most important national economic questions of the kray is mining construction in the Eastern Don Basin, specifically the problem of reinforcing mine shafts. In the Department of Soil Mechanics, headed by B.N. Kuzin, candidate of Technical Sciences, a method of solution of this complex problem was found. Today, 4 mines have been newly reinforced, 16 were repaired and 5 mines are in the process of preparation for cutting. Now, it is clear to all that the question has arisen concerning the introduction of promising developments on a sector-wide scale since the economic effect is highly significant.

An original method of creating underground reservoirs by the use of explosives was proposed in this same department. It is astonishing that the walls of such reservoirs are extremely strong and require practically no additional working. The new method reduces the duration of underground construction considerably and permits large savings of labor and material.

The institute is the site of a detailed study of materials obtained from rocks of the waste piles themselves which are found in great numbers at mines throughout the Don Basin. Scientists have proposed several interesting "recipes" for processing them and new materials with optimum physico-mechanical properties have been constructed. The results are delightful. It appears possible to use these wastes to produce materials which can be used extensively in civil engineering, industrial construction and road construction.

An essential part in planning science is the combination of basic and applied research. It is absolutely clear that, in some cases, theoretical studies should transcend into applied studied. But where is the dividing point at which it is beneficial to stop in scientific institutions of our type? How can you plan the work so that an idea is more quickly applied practically?

Practice at the institute showed that it is beneficial to proceed as follows: at the first stage, when the basic aspects of the subject predominate, investigations are conducted by the institute. But, at later perfecting stages, representatives of industrial design bureaus or higher technical colleges are directly involved in the development. Economic or other forms of agreements here do little to stimulate cooperation of science and practical activity. In some cases, it is beneficial to send materials into sectoral research institution.

Regrettably, in real life, there arise underestimations of fundamental general developments. Customers unanimously insist upon the solution of particular, narrow problems which interest them only in the high enthusiasm of the moment. As a result of this, business executives are responsible for deficiencies of funds for general posing of a problem and its fundamental development. However, considerable time passes and that same customer is faced with the same problem and asks for a similar investigation but under other conditions and with different data. Now, the scientists must begin anew. Of course the best methods and efforts are wasted. However, if the problem had been given a general hearing from the very beginning, it would have been solved with a minimal expenditure of funds from which both theory and practice would gain. Here are some small examples.

Under the direction of V.A. Babeshko, Doctor of Physico-Mathematical Sciences, we conducted a complex of studies which, although they were distinguished by exceptional depth and community of approach, they were oriented from the beginning only upon the needs of foundations construction. Here it was soon ascertained that these studies may constitute a basis for the solution of several problems in vibroseismic prospecting, theory of electro-elastic materials, etc.. It deserves to be stated how much trained labor was saved. This example, as many others, shows that the fundamental character and generality of a scientific development and its applied aspects by no means are opposing aspects of a creative search but, on the contrary, are two of the most meaningful indicators of research at a rather high level.

For the college research institute there is still one other specific and responsible aspect of activity -- participation in the teaching and training process. In the Northern Caucasus, the scientific center provided wide development of the system of scientific-educational complexes. For example, our institute is part of a complex: a mechanico-mathematical department of Rostov University -- the NII /Scientific Research Institute/ a computer center. Nearly 20 of our associates lecture at the department on different problems of experimental mechanics and its theory. Many other teachers of the department are conducting research activity at the institute and providing instructions, voluntarily, at its individual subdivision. A considerable volume of degree work and course work is being carried out directly in laboratories and divisions of NII.

However, there are problems, the solution of which will promote even higher efficiency of university research. This concerns, first of all, the material and technical base, which requires specific modernization. It is understood that it should conform to the contemporary level of experimental science. While university specialists frequently must make many experimental devices by their own efforts and, if they succeed in obtaining orders on the side, there is no guarantee that these orders will be filled. One of the methods of solving a problem is the creation of regional scientific and experimental production associations, which simultaneously may serve several colleges of similar types. The time has come to think of the improvement of supply of college NII, to expand for them the means necessary for providing materials and equipment for promising research.

Serious difficulties in the work are due to the absence of a position concerning scientific research institutions in a college. This leads, especially, to a large number of controversies and sometimes conflicts both internally and in respect to customers. A new position on one hand should reflect the distinguishing features of the research institute at the college, its indissoluble connection with teaching and rearing of students and, on the other hand, should guarantee maximal independence in the solution of financial production and organizational problems.

Today, thousands of talented researchers work in colleges of our country and their numerous scientific subdivisions. Isn't it really important to create conditions which ensure maximal effectiveness of the research conducted?

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SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

KAZAKHSTAN SCIENTIFIC FACTS AND FIGURES

Moscow NAUKA I ZHIZN' in Russian No 6, 1977 pp 10-12

[Article: "The Science of Kazakhstan, Facts and Figures"]

[Text] Now working at the 27 scientific subdivisions of the Kazakh SSR Academy of Sciences are 52 academicians and 77 corresponding members of the republic's Academy of Sciences, 184 doctors of sciences and over 1500 candidates of sciences. Over 10,000 associates are working in all in the academy's organizations.

Studies on 511 subjects were completed during the years of the Ninth Five-Year Plan at the scientific institutions of the republic's academy. Some 365 monographs were published--an average of one monograph every 5 days. Kazakhstan scientists had 307 works put into production. The saving from their use in industry and agriculture was over 200 million rubles.

In 5 years the scientists of Kazakhstan obtained 650 authorship certificates for inventions. The republic's academic institutes obtained about 70 patents in foreign countries. Among the states purchasing the patents were the United States, England, the FRG, France and Italy.

The Kazakhstan Academy of Sciences holds a leading place in the country with respect to a number of scientific specializations. Many Kazakh scientists have been awarded the titles of Hero of Socialist Labor, Lenin and State Prize Winners, Kazakh SSR State Prize Winner and Prize Winner imeni Chokan Valikhanov.

The international ties of the Kazakhstan scientists are developing and being reinforced. The republic's academy is engaged in joint research on 20 subjects with the scientists of fraternal socialist countries and developed capitalist states. In 1975 alone, 300 foreign scientists visited Kazakhstan on the invitation of the academy.

In the past five-year plan the Institute of Metallurgy and Ore Dressing of the Kazakh SSR Academy of Sciences put into production 78 scientific research projects with a total economic effect of over 20 million rubles. Mexico, the

FRG, and Spain acquired licenses for the right to use the developments created by the institute's scientists. The results of the patented works were exhibited at three international exhibitions abroad.

The Institute of Zoology of the republic's Academy of Sciences published a fundamental five-volume monograph on "The Birds of Kazakhstan." It was a collection of information on the distribution, ecology and economic importance of 473 species of feathered creatures inhabiting the territory of Kazakhstan.

The scientists of the republic academy's Institute of Physiology made a substantial contribution to solving the problem of vascular and tissue permeability, forming the basis of the metabolic changes and processes of lymphopoiesis. The results of these studies may be successfully used, for example, to explain the mechanism by which medications work in the organism.

The republic's Academy of Sciences is taking a great part in the preparation of the 12-volume Kazakh Soviet encyclopedia. The total volume of the publication is 520 printed pages. The encyclopedia includes about 50,000 articles on various sectors of the economy, culture, science and technology. Each volume contains over 2000 illustrations.

The book collection of the Central Scientific Library of the Kazakh SSR Academy of Sciences comprises over 3,765,000 volumes, including over 600,000 in foreign languages. The library carries on an exchange of literature with 858 scientific institutions in 64 countries of the world.

The republic's Nauka publishing company publishes yearly over 200 titles of books, monographs, practical manuals and reference books. The results of the research of Kazakh scientists are printed in six scientific journals.

The collaboration of science and production is being expanded in Kazakhstan. The collectives of the Ust'-Kamenogorskiy Lead and Zinc Combine and the All-Union Scientific Research Institute of Mining and Metallurgy of Nonferrous Metals, in implementing jointly the plan drafted for the long-range technical development of the combine, have achieved an increase in the production volume, an improvement in the technical and economic indicators for the enterprise's work. An automated production control system for the Alma-Ata Heavy Machine Building Plant is being developed with the aid of scientists from the Kazakh SSR Academy of Sciences Institute of Economics. The Kazakh Polytechnical Institute is maintaining close production relations with dozens of enterprises. The scientific research organizations of Karaganda have made many valuable recommendations on working sloping and steep coal beds.

The first institute of higher education in Kazakhstan--the Pedagogical Institute imeni Abay--was opened in 1928 in Alma-Ata. In 1976, about 450,000 persons were being instructed in 49 VUZ's and 210 secondary specialized educational institutions. In the Ninth Five-Year Plan, 426,000 specialists were trained, including 152,000 with higher education. Six new VUZ's and 18 secondary specialized educational institutions were opened. Last summer the Institute of Railroad Transport Engineers began to operate in Alma-Ata.

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SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

SCIENTIFIC PROGRESS IN KAZAKHSTAN DISCUSSED

Moscow NAUKA I ZHIZN' in Russian No 6, 1977 pp 10-15

[Article by A. Kunayev, president of the Academy of Sciences, Kazakh SSR, corresponding member of the USSR Academy of Sciences: "Science in Kazakhstan"]

[Text] Up until the Great October Revolution, Kazakhstan remained a huge blank spot on the map of the Russian Empire. No one had made systematic studies, even though the depths of the earth in Kazakhstan contained extremely rich raw material resources, and the people had their own ancient history, represented by valuable monuments of physical and spiritual culture. Only a few enthusiastic scholars--including the first Kazakh scientist, Chokan Valikhanov--studied the history and ethnography of the "steppe region." They could, however, gather only the most elementary information on the natural wealth of the region and its geography, and on the way of life of the Kazakh people, their language and trades.

The development of science in Soviet Kazakhstan is a vivid example of the wisdom and far-sightedness of Lenin's national policy, and an example of the triumph of the ideas of brotherhood and friendship among the peoples of our country. In April 1918, Vladimir Il'ich Lenin, in the "Outline of the Plan for Scientific-Technical Work," laid down a broad program to involve scientists in the solution of the fundamental questions of the development of the country's productive forces and a comprehensive study of its natural resources. In accordance with this plan, as early as the 1920's, the study was begun of the Embenskiy oil-bearing region, the Karagandinskiy Coal Basin, the Golodnaya Steppe and the Muyun Kumy, which subsequently played an exceptionally important role in the development of the republic's national economy.

In 1926 the USSR Academy of Sciences established the Special Committee for the Study of Natural Resources of the Union and Autonomous Republics, and formed a special Kazakhstan expedition, which took up the study of problems of the statistics, economics, geology and hydrology of the republic.

On 14 March 1932 the Presidium of the USSR Academy of Sciences adopted a resolution on organizing a Kazakhstan base for the USSR Academy of Sciences in Alma-Ata, and in a relatively short time it became the organizing scientific center of the republic. In 1938 it became the Kazakhstan branch of the USSR Academy of Sciences. At the end of the 1930's and beginning of the 1940's, eminent scholars went to the distant region of Kazakhstan on travel orders from the USSR Academy of Sciences in order to train national scientific personnel.

During the war years, Kazakhstan scientists were engaged in prospecting for iron ore and manganese deposits and deposits of other minerals, and developed efficient methods of dressing ores, smelting steel, copper, lead and zinc, and extracting petroleum. The science of the young republic contributed to the development of power engineering and chemistry and sought and found ways to intensify agricultural production, particularly of irrigated farming.

On 31 May 1946 the Central Committee of the Communist Party of Kazakhstan, the Presidium of the Supreme Soviet of the Kazakh SSR and the Council of People's Commissars of the Kazakh SSR adopted a joint decree "On Establishing the Academy of Sciences of the Kazakh SSR." Kanysh Imantayevich Satpayev, an eminent Soviet geologist, son of a Kazakh nomad, was elected the first president of the republic's academy.

The organization of the Kazakhstan Academy of Sciences was the beginning of a qualitatively new stage in the development of science in the republic. The USSR Academy of Sciences and the leading scientific centers in the country gave tremendous assistance in establishing the young academy.

Today all of our scientists' work is subordinated to solving the problems posed for Soviet science by the party and the government, directed toward satisfying the numerous demands of the national economy, efficient use of natural resources and the distribution of the republic's productive forces. We consider the main factor in our work to be a further increase in the efficiency of scientific research and concentrating efforts on the most important and decisive directions of scientific-technical progress.

The breadth of today's research at the Kazakh SSR Academy of Sciences may be judged by the structure of its scientific institutions. Five departments have now been established, in the following fields: physical-mathematical sciences, earth sciences, and industrial-chemical, biological and general sciences. The characteristic feature of their scientific work is the performance of primarily comprehensive research. The scientists work in close creative collaboration with the production workers--geologists, metallurgists, mining engineers, petroleum engineers, chemists and agricultural workers. The academy's institutes are taking part in solving 22 extremely important scientific technical problems, coordinated by the State Committee of the USSR Council of Ministers on Science and Technology. Among them are the conservation and comprehensive use of water resources, protection against air pollution, the design and introduction of fire-proof materials, electrochemical generators, new metallurgical processes, protecting the soil against erosion, and a number of others.

We will discuss the basic directions of scientific research.

This year the republic's Institute of Nuclear Physics marks its 20th anniversary. Its laboratories are engaged in research on nuclear physics, radiation physics and the physics of solids and semiconductors.

The institute's experimental base is represented by the VVR-K nuclear reactor with a flow of thermal neutrons in the center of the active zone of the order of 3×10^{14} n/cm^2-sec.; an isochronic cyclotron with regulated ion power, which makes it possible to obtain beams of charged particles with maximum powers of 25, 30, 50 and 60 Mev. The cyclotron is equipped with cryogenic units, a neutron generator, mass spectrometers with high resolving power and other extremely modern instruments.

With the aid of this modern equipment, the nuclear physicists study the properties of matter. Specifically, experiments are being made on determining the conformities to principle of the changes in the structure, physical-chemical and mechanical properties of a number of metals and nonmetals during their "bombardment" with nuclear particles. The scientists are trying to ascertain the actual nature of radiation defects and processes taking place in crystals during their irradiation.

Studies are being made of the electron structure and nature of the interatomic relations of transitional materials, as well as of such interesting phenomena as, for example, anomalous photoconductivity in semiconductors. Widely used in electronic spectroscopy of low-energy particles are the analyzers designed by Kazakh physicists, the functioning of which is based on the focus and dispersion action of an electrostatic field on a beam of charged particles, directed at an oblique angle toward the axis of symmetry of the electrodes.

The scientists of the institute have made their contribution to working out one of the main problems of modern nuclear power engineering--designing high-efficiency thermal emission transformers. Regular reactor study of promising multi-element thermal emission electrogenerating systems is performed on an all-purpose looping unit.

The main direction of the work at the Institute of High-Energy Physics is the study of the nuclear reactions of particles of high and super-high energy, using modern computer equipment.

This research is done in close collaboration with the leading Soviet and foreign scientific centers. At the laboratories of the institute and at its high-mountain scientific cosmic ray station, one finds scientists from the United Institute of Nuclear Research, the Institute of High-Energy Physics and the Physics Institute imeni P.N. Lebedev of the USSR Academy of Sciences, and the European Center for Nuclear Research in Geneva.

Research is being carried out within the framework of Soviet-French collaboration on proton-nucleon and antiproton-nucleon high-energy collisions, using the Mirabel' bubble chamber, in conjunction with Polish scientists, the Pamir experiment is being made, and interesting results are promised by the processing and analysis of nuclear emulsions irradiated in the United States, within the framework of the collaboration between Alma-Ata, Leningrad, Moscow and Tashkent.

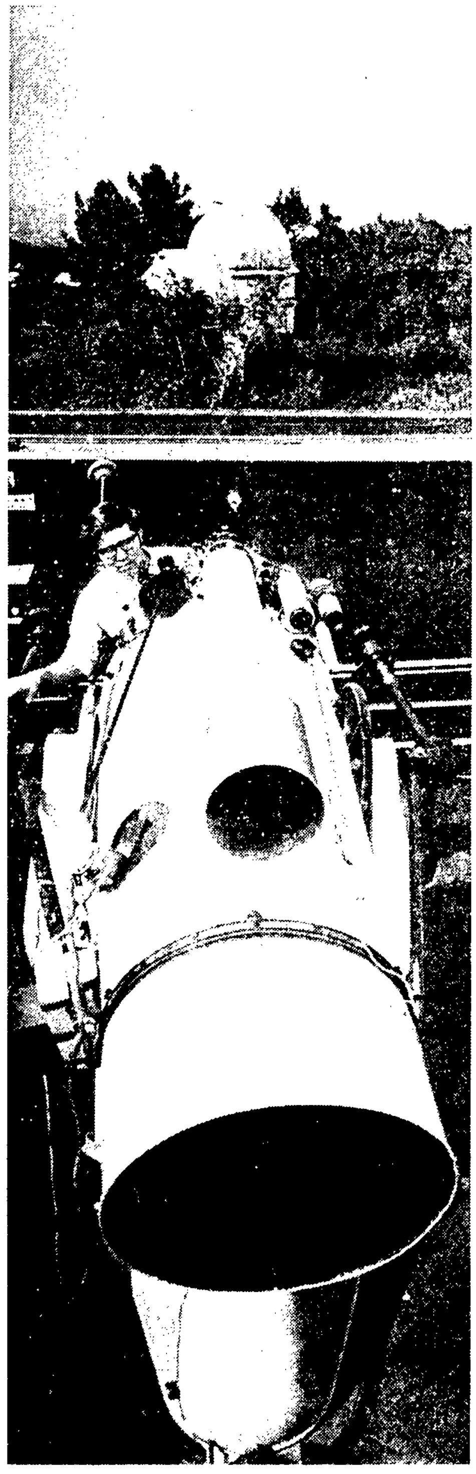
Work on the automation of scientific research, not completely, as is indicated, according to the specialty, but nevertheless successfully, is being done at the Institute of High-Energy Physics. A measuring and computation complex based on the BESM-4 and BESM-6 electronic computers has been designed and is in operation to process the photographs from the bubble chambers. It is based on both the equipment produced by industry and on original devices designed at the institute. In the future the complex will be an integral part of an automated system for examining, measuring and machine-analyzing film information (ASPIMA). The module programs of the software of the computation and measuring complex have been used to solve economic problems in the republic's gosplan.

Important results were obtained during the last few years at the Institute of Mathematics and Mechanics of the Kazakh SSR Academy of Sciences in the theory of infinite systems of differential equations, and in the study of various critical and special cases of certain problems in mathematical physics.

Studies have been made of the problems of the theory of graphs and the theories of systems as applied to networks and models, of methods of decision-making based on algorithms of the game theory and vector optimization and of solving mathematical problems of the structural description of information systems and coding information.

The applied research of the mathematicians is being used on an increasingly broad scale to solve pressing problems of the development of the national economy. The republic's scientists have worked out the mathematical theory of rock creep in small and large deformations, which is the scientific basis of designing props and places to locate underground structures. This theory is widely used in engineering calculations of mining pressure at all the country's coal basins. The mathematical theory, formed at the institute, of fold formation in the crust of the earth makes possible the efficient use of quantitative methods and computer methods in geological prediction.

The research of the astrophysicists, who have long selected Alma-Ata for their scientific observations and experiments, is connected extremely closely with the work of the physicists and mathematicians. The southern location of the mountain masses, the dry climate and the relatively large number of clear days in the vicinity of the Kazakhstan capital have created exceptionally favorable conditions for astronomical observations.



In the photograph: F. Raspayev, scientific associate of the division of astrophysics of the Astrophysical Institute of the Academy of Sciences, Kazakh SSR, at the meniscus 50-centimeter telescope. Photo by Ye. Grabilin.

As early as the first postwar years, construction of an astrophysical observatory was begun at Kamenskoye Plateau near Alma-Ata, 1500 meters above sea level. In 1950, on the initiative of Academician V.G. Fesenkov, the first domestic wide-aperture-lens telescope of D.D. Maksutov's system, with a meniscus diameter of 50 centimeters, was installed here. It became one of the basic instruments of the organized Astrophysical Institute of the Academy of Sciences of the Kazakh SSR. Then the AZT-8 70-centimeter reflector was put into operation, and substantial development of planetary observation was achieved on the basis of it. Beginning in 1972 the institute became the coordinating scientific institution of the USSR on the problem of "Study of the Physical Properties of Giant Planets." Astrophysical research is carried out in collaboration with the special astrophysical observatory of the USSR Academy of Sciences and the State Astronomical Institute imeni P.K. Shternberg. Joint work is being performed with the astronomists of the Paris-Medon and Milan observatories on the spectrum of the galaxy.

In operation in the area of Lake Alma-Ata, at an elevation of 2600 meters, is the Koronal'naya Station, which is taking part in regular observations of the phenomena of solar activity in accordance with all-union and international programs. In the last recent few years, the stock of the astrophysicists has been augmented by a 40-centimeter Schmidt camera and a 60-centimeter reflector, manufactured in the GDR.

Today Kazakhstan's astrophysicists are studying the stars and interstellar nebula, are attempting to figure out the riddle of their interrelations and origin and are doing fruitful work on such fundamental problems as the cosmology of the solar system and the structure and dynamics of the stellar systems. The institute has established conformances to principle in the atmospheric dispersion of light, has found efficient methods to determine the general transmittance of the atmosphere and the criterion of its optic stability, and has developed unique methods for indirect probing of the optic properties of various atmospheric layers. A spectrophotometric catalogue of over 100 gaseous dust nebula has been compiled, and the spectra of most of them have been obtained for the first time. High-frequency optical observations of high-speed manmade satellites of the earth and space stations launched to the moon and the planets have acquired broad scope.

The associates of the ionosphere sector have three well-equipped comprehensive magneto-ionosphere observatories. At an elevation of 3340 meters above sea level, by means of a neutron supermonitor and a cubic telescope, they are studying the intensity of the variations in cosmic rays, and at an elevation of 2700 meters--the radio emission of the sun. Last year construction was begun on a support-building for the Orbit type 12-meter radio mirror, which is also designed for studies of the sun's radio emissions.

Major fundamental work was done during the last five-year period by the subdivisions of the Academy of Sciences of the Kazakh SSR in earth sciences. The scientists of the Order of the Red Banner of Labor Institute of Geological Sciences imeni K.I. Satpayev established a number of important conformances to principle of the distribution of deposits of ore, oil and gas and nonmetalliferous minerals, worked out scientific principles for metallogenic regionalization--the bases of long-range planning for research work in various regions of Kazakhstan. Series of tectonic maps were compiled.

At one of the oldest scientific research institutions in the republic--the Institute of Mining Affairs of the Kazakh SSR Academy of Sciences--a highly productive technique is being designed for open-pit and underground ore extraction, based on widescale use of mechanisms and automated equipment, and the theoretical bases are being worked out for choosing methods of controlling the mine pressure when working deposits, as well as promising devices for complete mechanization of the basic and auxiliary processes at the mines.... The institute's scientists are linked by traditional friendship with the miners of Rudnyy Altay and Central and Southern Kazakhstan.

One of the recent and most efficient works in this specialty is the design of a technique, new in principle, for underground extraction of ore, using power-driven equipment, at the Dzhezkasgan mines. Under the direction of the scientists, the first models, and then experimental batches of the power-driven machines were developed, and made possible a 100-200 percent increase in the miners' labor productivity.

In the Ninth Five-Year Plan, the saving from putting into production the results of the research of the Institute of Mining Affairs was almost 26 million rubles.

The research done in the last few years by the geographers is interesting and important for practical work. They studied the present characteristics of the glaciers of Zailiyskiy and Dzhungarskiy Ala Tau and Altay, and revealed the relation between the processes of glaciation and the thermal balance of the atmosphere. The data obtained formed the basis for the strategy of developing the high-mountain regions of the republic. Large-scale maps were drawn up of the avalanche danger of the river basins on the northern slope of Zailiyskiy Ala Tau. The compilation of the comprehensive geographical Atlas of the Kazakh SSR was completed. The studies, recently begun, related to solving the economic-geographical problems of the efficiency of using the waters of Siberian rivers for water supply and irrigation of the arid regions of Kazakhstan are of great practical interest.

Over two-thirds of the huge territory of Kazakhstan is in the arid zone, where the average yearly precipitation is not over 100-200 mm. There are, though, still "underground seas," where foresighted nature prepared huge reserves of fresh water. For comprehensive study of the sources of accumulation and regions where artesian waters are distributed, and for determination of their hydrochemical composition and hydrodynamic nature, an Institute of Hydrogeology and Hydrophysics was established in the system of the republic's academy, the only major scientific research institution in an area of arid hydrogeology in the country. The research done at this institute made a fundamental change in the previously held ideas of the resources of ground waters in the desert territories.

The Institute of Metallurgy and Ore Dressing of the Kazakh SSR Academy of Sciences has become a major scientific center for the country in the field of nonferrous metallurgy. Seventeen of its laboratories are now working on the physical-chemical bases of metallurgical processes, and are designing new advanced methods to produce nonferrous, light, alloying and rare metals, which specify comprehensive use of raw materials and environmental protection.

The scientific research being done here is closely connected with practical work. In conjunction with other scientific research institutions in the country, the Kazakhstan metallurgists have designed a production system and planned units to process complex polymetallic ores. The so-called "Kivtsetnyy" method of processing has been successfully introduced at the Irtyshsk Metallurgical Combine. The industrial process and units developed were patented in 16 countries.

The Order of the Red Banner of Labor Institute of Chemical Sciences is doing active work on the chemistry and technology of obtaining monomers and polymers on the basis of petroleum- and coke by-product raw materials and the chemistry of natural and synthetic biologically active compounds.

Research related to the problem of comprehensive use of the raw materials of the Kara Tau Basin is in an important position. There has already been development of the scientific bases for obtaining concentrated phosphoric acid by the extraction method, of the industrial process for producing new fodder resources and efficient fertilizer--melted calcium polyphosphate--as well as of the physical and chemical bases of synthesizing complex fertilizers in the form of condensed phosphates with the properties assigned in advance.

A scientific school on catalysis, which has obtained all-union recognition, has been established in Kazakhstan. The scientists of the Institute of Organic Catalysis and Electrochemistry have suggested four basic mechanisms for catalytic hydrogenization, which include the reactions for unsaturated compounds with hydrogen, used for catalysts of varying nature. The basic premises have been formulated for the theory of catalysis by ligands, and on the basis of them, a number of results have been achieved which make possible the quantitative prediction of the activity of complex compounds in reactions of the oxidation-reduction type and the transeffect values. The institute is taking part in work on bilateral (United States) and multilateral (SEMA) agreements with foreign countries.

Kazakhstan scientists have obtained important results in the biological sciences. The Institute of Soil Science, awarded the Order of the Red Banner of Labor for its active participation in developing virgin soil and long-fallow lands, is successfully developing the bases for efficient use and improvement of the Kazakhstan soils. A new soil map of the Kazakh SSR has been published, making it possible to estimate more precisely the republic's resources and obtaining high praise from specialists at the 10th International Congress of Soil Science in Moscow. The institute has compiled a mathematical model of the soil salinization-desalinization processes, which affords the possibility of predicting this process by means of a computer.

The associates of the academy's Institute of Botany are now doing research on 24 subjects, which may be combined into three basic directions: the plant world of Kazakhstan and efficient use of its resources in the national economy; plant physiology and biochemistry; the genetic bases of selection for agricultural plants.

Studied here during the last few years are the biology and ecology of a number of feed plants, the productivity of communities and ways to change the composition and productivity of pastures and hay fields in the republic's arid zone. Biologists have obtained promising mutants and new hybrid forms of spring wheat and corn.

The Central Botanical Gardens of the Kazakhstan Academy of Sciences has become truly a green outdoor laboratory, where important research is being done on studying and using the flora and plant resources of the republic. Its collection numbers several thousand varieties and strains of plants from 40 of the world's countries. They are, however, not only a collection asset: over 700 plants have been turned over here for various needs of the national economy. The Central Botanical Gardens coordinates the scientific work of its five "young colleagues," located in various soil-climatic zones of the republic. By the way, one of them--the Karagandinskiy Botanical Gardens, which for a number of years has been studying problems of improving the environment in the industrial area--was recently invited to participate in the World Exhibition in the United States, devoted to environmental protection.

Other subdivisions of the republic's academy of sciences also are in advanced scientific positions in their field of biological sciences. The Institute of Zoology is making a substantial contribution to protecting the animal world of Kazakhstan, the Institute of Physiology has become the leading one in the country on problems of the physiology of the lymphatic system, the Institute of Experimental Biology is studying the conformances to principle of heredity and the mutation of biological traits and productive qualities of animals in hybridization and cross-breedings, and interesting studies are being made at the Institute of Microbiology and Virusology.

Considerable progress has been achieved in the social sciences. The Institute of History, Archaeology and Ethnography imeni Ch. Valikhanov, organized in 1946, has become the center for the scientific study of the republic, with its wealth of historical events. Summaries have been made up here on the history of the October Socialist Revolution in Kazakhstan, which took a step toward socialism, by-passing the capitalism stage. Problems of the industrial development of the republic, the history of the working class and the fundamental socio-economic changes in agriculture are being studied.

The planning organs, ministries and departments make wide use of the recommendations and methods of the Institute of Economics of the Kazakh SSR Academy of Sciences to increase national production efficiency and improve the economic mechanism.

The scientists of the Institute of Philosophy and Law are working on the key problems of Marxist-Leninist philosophy. Its collective has advanced it to one of the leading positions in the country with respect to problems of the theory of dialectics and methodology of science. The monographs published here during the last few years, "Dialectic-Logical Principles of Building a Theory," and "The Dialectics of the Empirical and Theoretical in the Historical Conception" obtained recognition by major specialists.

Of the recent works of the Institute of Literature and Art imeni M.O. Auezov, one may mention the monograph, "Future Summits," awarded the State Prize of the Kazakh SSR, and the monograph, "The Kazakh Heroic Epos," which received the Prize imeni Chokan Valikhanov. The second volume of the "History of Kazakh Literature" in the Russian language is ready to go to press. A monograph is being prepared that is devoted to the modern literary process and interaction of the literatures of the peoples of Central Asia and Kazakhstan. A notable event in the cultural life of the republic was the publishing of the first volume of the 10-volume "Explanatory Dictionary of the Kazakh Language."

The great Kazakh poet and educator, Abay Kunanbayev, once wrote: "Are we really doomed to eternal suffering and backwardness? Or will there finally come, for the Kazakh people, wonderful days, illumined with science and education?" These wonderful days have come. In the 33 scientific institutions of the Kazakh SSR Academy of Sciences, research is being done today in many fields of modern science. The grandchildren of the nomads know the secrets of the atomic nucleus, are gazing at far-off astral worlds and are sorting out the keys to underground storehouses of nature. The fact that the Soviet space ships are launched from Kazakhstan soil is a symbolic one.

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SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

SCIENCE PROGRESS IN ESTONIA

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 9 Sep 77 p 3

[Article by V. Maamyagi, Vice-President of the Estonian SSR Academy of Sciences: "The Path to the Stars"]

[Text] There are tens of scientific institutions operating in Estonia which have more than 6,000 scientific workers. Forty percent of those workers have the scientific degree candidate or doctor of sciences. The number of specialists with a higher and secondary education in the republic's national economy after 1940 grew by 11 times. Five times as many students as in 1940 are now studying at the VUZ's of the republic. The number of students at secondary specialized teaching institutions has increased during that time by 12 times.

Our academy is comparatively young--two years ago the republic celebrated its 13th anniversary. But the maturity of collective thought is far from always determined by the age factor. The experience of Soviet Estonia's scientists provides convincing proof of that fact. Incidentally, that experience has not been the exception, but rather a confirmation of the rule whose essence is that it is only the socialist system that has proven itself to be capable of accelerating literally tenfold the developmental rate of the economy, culture and scientific thought. All of the fraternal republics which have formed the indestructable Union of Soviet Socialist Republics could prove that assertion from their own history. Estonia's example is also instructive.

A little more than three and one half decades ago some Western politicians used to call little Estonia the "backwoods of Europe." Those were the dark years of dictatorial rule by nationalist bourgeois circles.

That regime, anti-popular in essence, was donned in the garb of a "classic" democracy. The double-dyed reactionary backwoods and farmstead obscurantism needed an intelligent facade--and this was the "mirror of civilization." Therefore, on the eve of its inglorious collapse, the bourgeois nationalist regime "half-opened," as was then said in Estonia, the Academy of Sciences, thereby giving a European gloss to the dictatorship. But the "concern" of the bourgeois circles for science did not go beyond that gloss. So it was only after the Great Fatherland War that a start was made in the difficult years of economic reconstruction in Estonia to create fundamentally new scientific institutions.

It was with paternal generosity that the socialist state provided us with all the essentials for fruitful scientific activity--from a guaranteed way of life to the very latest technology. Reliance on the mighty scientific potential of the Union played a considerably significant role and the assistance rendered by an entire plethora of brilliant Soviet scientists was invaluable. All of this permitted our scientists to attain significant progress in various scientific directions, and particularly enabled them to join the front ranks of space researchers. Today Estonia has become a genuine center for the study of stellar evolution and structure as well as stellar systems. The Tyravereskaya Observatory imeni V. Struve of the Institute for Astrophysics and Atmospheric Physics has gained world notoriety. It has become possible for Estonian scientists to explain the most mysterious riddles of nature.

Scientists of many countries for a half century have been trying to solve the "paradox of masses" of galaxies--the connection, unexplained by well-known theories and not amenable to computation, between the masses of luminous stellar systems and their velocity. Associates at the Tyravereskaya Observatory, headed by Doctor of Physical-Mathematical Sciences Ya. Eynasto, have established that galaxies are not isolated stellar systems but are part of inter-connected aggregates whose mass is almost 10 times greater than the galaxy itself. Galaxies, together with the inter-galactic substance surrounding them, constitute unified systems--hypergalaxies, whose integral components are inter-connected to gravitational forces. A more detailed study was made of the hypergalaxy's structure which includes our own galaxy. It turns out that it rotates in a fashion similar to that of the Earth. But, in contrast to the "cradle of humanity" it has the form of a plain disc.

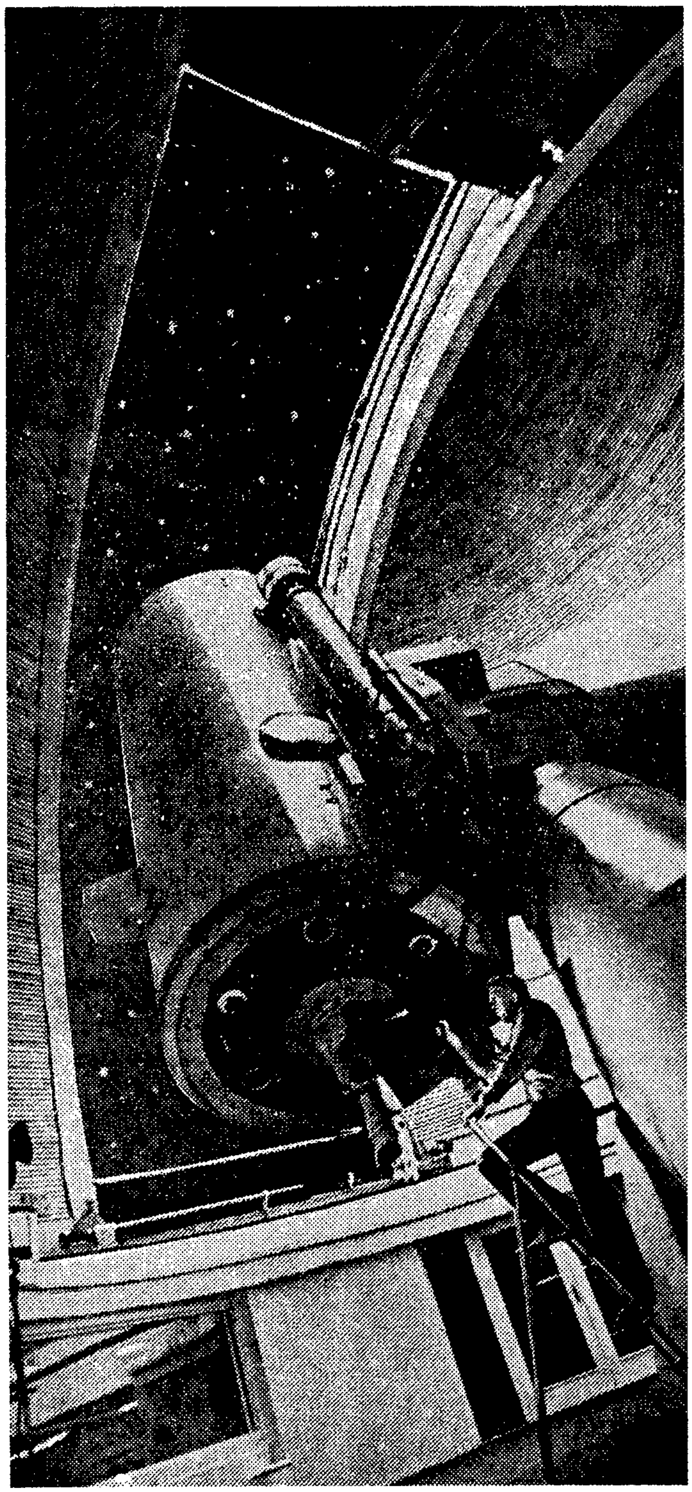
That in short, is the essence of the discovery which has now taken the form of an orderly theory. The work of the Tyravereskaya astrophysicists has evoked exceptionally great interest on the part of a broad world public. Observations which have been made confirming the correctness of Estonian scientists are being conducted in many observatories with the aid of very powerful telescopes.

This "breakthrough to the stars," which is the way several correspondents have characterized the scientific research of my countrymen, is particularly symbolic for us. Little Estonia is today able to think in terms of galaxies, and is able to place itself on an intimate basis with infinity both in time and space. In thinking about this, one cannot help but recall the searchlight beams of the Red Star cruiser "Aurora" which cut through the fog of the Petrograd shore on the nights of 7 and 6 November 1917, and the first victorious volley of the revolution.

The evolution of galactic aging is merely one of the problems in space research in which Estonian scientists are engaged. The silvery clouds are being studied at the very same Institute for Astrophysics and Atmospheric Physics together with colleagues from Moscow. The hypothesis that those clouds constitute formations of cosmic dust around which ice crystals freeze was confirmed in space flight observations made from the scientific space station "Salyut-4." Data which for the first time offered humanity a concise conception of those clouds' structure and distribution at high altitudes in our planet's mesosphere, were obtained through the collective efforts of scientific associates and space explorers as well as workers at academy SKB [special design offices].

I am not devulging any secrets when I say that the successful development of science at the contemporary level would have been impossible without the precise planning, coordination and concentration of efforts and funds aimed at resolving global problems in both fundamental and applied research. All of our current programs are either completely or partially parts of corresponding programs of the USSR AN [Academy of Sciences] and the USSR Council for Ministers Committee on Science and Technology. Those efforts encompass the efforts not only of academy collectives but those at the republic's higher teaching institutions and plant scientists. In a word, one of the principal advantages of the socialist method of management is future planning--and that too is in operation here. In addition to co-participation in the All-Union program of space research, on the ledger of our scientists are many other activities, each one of which is noteworthy. Characteristically, many of those programs are not at all duplicative but are inter-connected and are mutually complementary. The program "semiconductor heterojunctions" is being successfully fulfilled. Concentrated here are the efforts of specialists at the Institute for Physics, the Institute for Thermophysics and Electrophysics, and Tartu University. The implementation of the obtained research results is connected to the further development of scientific instument manufacture and computer technology. Therefore, the development of unique analytical and preparative chromatographs is underway at a special design office of the ESSR AN.

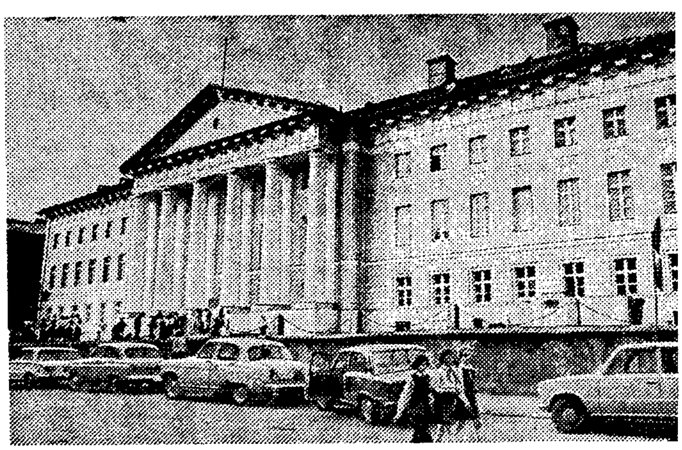
Today it is not very easy to provide one with a complete picture of research being undertaken in all of the subdivisions of academic science.



In the observatory of the Institute of Astrophysics and Physics of the Atmosphere, Academy of Sciences Estonian SSR

But the basic guidelines do indicate one thing. One level is comprised of research aimed at environmental development and conservation--from the earth's natural resources to the heights beyond the clouds. The second level of research deals with all topics connected with the integral development of the republic's national economy. This includes research on basic economic and social problems, laws of socialist society, and the development of a theory and method for socialist economy planning and management. Use is made of dynamic modeling of regional productive systems and personal services. We are working out charts for the development and disposition of the republic's productive forces and we are developing a system of mathematical models for forecasting socioeconomic structures--for one and a half decades ahead as well.

Particularly significant is the contribution made by the new generation of Estonian sociologists. They are having their say on an All-Union scale. Many projects are being completed in cooperation with the USSR AN Institute for Sociological Research and the Komsomol Central Committee. Our sociologists have joined in All-Union research, conducted at the USSR AN Institute of Ethnography imeni Miklukho-Maklay, whose purpose is to study the optimization of national development and the confluence of nations in the Soviet land. Cooperation with the Economics Institute of the Urals Science Center is yielding fruitful results.



Main Building of Tartu State University

The scientific profession of Soviet Estonia approaches the glorious October anniversary at the peak of its creative forces and possibilities, at the zenith of its civil maturity, by utilizing the only precise compass of all those that history has ever known--the teaching of Marxism-Leninism. But still there are those among Western woeful politicians who are set on continuing as before. One even hears some foreign "voice," filled with malicious slander. But now the question is posed in a quite different manner: they say that we in Estonia are achieving certain successes not because of, but inspite of our union with the fraternal peoples of the great Soviet country, and in defiance of the socialist system. Of course, we are working for ourselves, for our own people, and not for the purpose of refuting such chatter for the umpteenth time. But the scientists of Soviet Estonia are perfectly aware of the fact that each one of their contributions to the storehouse of science is one more impressive response to those persons who as yet have been taught nothing by modern human history.

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