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TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY
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CONTENTS

PAGE

CYBERNETICS, COMPUTERS, AND AUTOMATION TECHNOLOGY

Exhibit of Microcomputers and Microcircuits at VDNKh (SOTSIALISTICHESKAYA INDUSTRIYA, 21 Dec 76)	1
Computer Use in the Construction Industry (M. Chentemirov, V. Mastachenko; SOTSIALISTICHESKAYA INDUSTRIYA, 29 May 77)	5
Need for Computerized Systems for Production Management (S. Petrovskiy; IZVESTIYA, 28 May 77)	9
Automatic Control Systems in Rail Transportation (V. I. Denisov; AVTOMATIKA, TELEMEXHANIKA I SVYAZ, Mar 77)	13
Reliability of Rail Automation and Remote Control (N. Ya. Men'shikov, et al.; AVTOMATIKA, TELEMEXHANIKA I SVYAZI, Mar 77)	19

ELECTRONICS AND ELECTRICAL ENGINEERING

Scientist Highlights Soviet Achievements in Laser Research (MUSZAKI ELET, 15 Jul 77)	20
A Television Camera Based on a Matrix of Charge Coupled Devices (V. Yu. Berezin, et al.; TEKHNIKA KINO I TELEVIDENIYA, Jun 77)	22
Miniature Kinescopes With Fiber Optic Screens (L. L. Sivers, et al.; TEKHNIKA KINO I TELEVIDENIYA, Jun 77)	34

CONTENTS (Continued) Page

GEOFYSICS, ASTRONOMY AND SPACE

Radiation Anomalies in Circumterrestrial Space (L. Razorenov, I. Tindo; NAUKA I ZHIZN', No 6, 1977)	38
USSR, GDR Cooperate in Interkosmos Space Program (B. Gerasimov; SOVETSKAYA ROSSIYA, 14 May 77).....	49

SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

List of Works Competing for Lenin, State Prizes in Science and Technology (IZVESTIYA, 21 May 77)	53
Socialist-Competition Pacemaker Candidates for Lenin, State Prizes (IZVESTIYA, 21 May 77)	65
Work of Siberian Department of Academy of Sciences Discussed (M. V. Lomonosov; TEKHNIKA I NAUKA, No 5, 1977)	70

PUBLICATIONS

Coding Handbook for the ASU (Automatic Control System) Safety (L. M. Burdina; RUKOVODSTVO PO KODIROVANIYU INFORMATSII OB AVIATSIONNYKH PROISSHESTVIYAKH I PREDPOSYLKAKH K NIM, 1977)	80
--	----

CYBERNETICS, COMPUTERS, AND AUTOMATION TECHNOLOGY

EXHIBIT OF MICROCOMPUTERS AND MICROCIRCUITS AT VDNKh

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 21 Dec 76 p 4

[Article: "Science and Technology News"]

[Text] An exhibit entitled "Microelectronics Serving the Nation's Economy" continues to be on display in the Radio Electronics pavilion at the Exhibit of Achievements of the National Economy of the USSR. Items on display include mini- and microcomputers, microcircuits -- the basis on which these computers are built -- and various instruments and devices employing integrated circuits.

"Designing" a Memory

Memory units capable of storing information for an extended time are widely employed not only in computer devices but also in numerically-controlled machine tools, monitoring-measuring equipment [test equipment] systems, in telephone and telegraph communications. In each concrete case a specific memory volume is required. Quite understandably it is not very economical to design and build a specially-tailored storage device each time.

With the aid of electrically-reprogrammed external memory modules, storage volume can be changed by varying the number of modules. This approach considerably simplifies the designing of systems or individual items, improves their performance characteristics and reduces the cost of debugging programs. The modules boast high reliability, high speed, and extremely modest power requirements.

Information on the Screen

Visual display devices greatly facilitate "dialogue" between man and computer. Various types of displays, presenting alphanumeric and graphic information on a screen, offer broad possibilities for solving the most diversified problems. One such device -- the "Elektronika NTs-DM" -- is on display at the exhibit (see following photograph).



With the aid of a 29-key keyboard, one can employ 2,048 symbols, displaying them on the screen, removing or correcting them. Letters, numbers and drawings are produced on the CRT screen with electron beam traces. The design of this unit permits easy change in the set of symbols. The display can operate on two modes -- duty and dialogue.

A modified model -- the "Elektronika NTs-DM" -- is equipped with built-in magnetic tape storage, which greatly increases display information capacity.

Crystal for Computer

The K145IP7 integrated circuit can successfully handle all arithmetic operations, computation of logarithmic and trigonometric functions. This IC contains a four-digit adder, main memory registers, I/O and control circuits, and a memory with a set of microprograms.

These integrated circuits are the "brain" of miniature 8-digit key-operated calculators with floating decimal for engineering calculations.

In Place of a Pencil

Is it possible to pack the electronic "stuffing" of several television sets into a little box scarcely larger than a pack of cigarettes? This is a purely rhetorical question for the designers of the Elektronika B3-04 microcalculator -- the calculator's large integrated circuits hold about 6,000 electronic components -- 7 times more than the normal television set. And not only an engineer, economist or college student, but a schoolchild as well can operate this calculator.

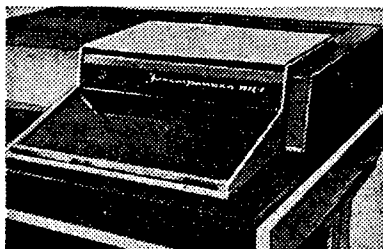
The Elektronika B3-04 (see photo) performs the four arithmetic operations and operations with a constant. It operates at least 50 hours on a one and a half volt battery.

For Control

The Elektronika-NTs-01 microprocessor is the main component part of the Elektronika NTs-02 microcomputer. Its large integrated circuits contain a device for processing and main-memory information storage and an internal storage unit. Operating speed of the microprocessor is 250,000 operations per second. Because of its small weight -- only half a kilogram -- and large internal storage capacity -- 1,000 bytes -- the microprocessor can be utilized separately from the other component parts of the computer: the Elektronika NTs-01 can be built into manufacturing process, measuring and test equipment as a control unit.

Mini and Micro

The Elektronika NTs-1 minicomputer and Elektronika NTs-02 microcomputer are designed to control manufacturing processes and equipment, monitoring and test equipment, and for solving engineering and technical problems. Their principal "building blocks" are large integrated circuits, 1 square millimeter of which can contain more than 1,000 electronic components. The Elektronika NTs-1 (see photograph) can solve a broad range of problems, can control a great many devices, and can help conduct complex scientific experiments. The 5-kilogram Elektronika NTs-02 weighs one tenth as much as its "big sister" and is somewhat inferior in operating speed, storage capacity, and number of peripherals. This difference is not particularly significant if one considers the narrower range of tasks performed by the microcomputer.



Series K

The principal computing units of digital data analyzers and computer devices for control and automatic control systems can be constructed with K502 series integrated circuits. The area of application of these units includes navigation, control of power systems, machine tools, and manufacturing processes.

The capabilities of K555 series solid-state logic integrated circuits make it possible for them to be employed in building the most diversified devices, from high-speed monitoring units to systems for numerical control of machine tools.

3024

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CYBERNETICS, COMPUTERS, AND AUTOMATION TECHNOLOGY

COMPUTER USE IN THE CONSTRUCTION INDUSTRY

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 29 May 77 p 2

[Article by M. Chentemirov, Deputy-Chairman of Gosstroy USSR, and V. Mastachenko, Assistant Director of TsNIPIASS for Scientific Work, in the column "Technical Progress--The Mandate of Time": "Khulman's EVM"]

[Text] If 1975 is used as a reference point for planning and surveying operations, then their volume must almost double in the years immediately ahead. Statistics show that the conventional method of increasing the output of planning organizations is able to ensure a growth rate of no more than 50 percent. At the same time, the number of architects and design engineers must increase by no less than 300,000 people. Training such a large number of highly-qualified specialists is no simple problem, even for as wide-spread a system of higher education as our own. And it must also be considered that as construction becomes more industrialized, the requirements of engineering work and contracting organizations will grow.

Consequently we are confronted with the necessity of intensifying the process of developing planning and estimating material. One of the fundamental methods for solving this problem is wide use of electronic computers and automated design systems. This operating trend has already been put into practice. In many institutes of Glavpromstroyproyekt [Main Administration for Construction Planning] of Gosstroy USSR, and of Gosgrazhdanstroy [State Committee of the Council of Ministers, USSR for Civil Construction], a significant part--as much as 80-90 percent--of all engineering computations and estimates are carried out by machine methods. In a number of institutes, programming systems for "man to machine" communication have been installed to accomplish such important planning functions as basic designing, lay-out and the working out of volume-planning for buildings and structures.

As experience shows, using EVM's to solve this sort of problem will make it possible to increase the labor productivity of designers by a considerable amount, in specific instances by 8 to 9 times, and, at the same time, to put into production the very best design modifications. In this way, the multi-faceted TEO system at the Oskol'skiy Electrometallurgical Combine

enabled specialists from "Gipromez" [State All-Union Institute for the Planning of Metallurgical Plants] to reduce expenditures, due to optimization of the determinations of the general plan, by 6.4 million rubles. From the experience of "Goskhimproyekt" [State All-Union Institute for the Planning of Special Structures, Buildings and Sanitary-Engineering and Power Installations for Chemical Industry Establishments], of the Leningrad "Promstroyproyekt" [All-Union Trust of Construction Planning of Industrial Establishments and Structures of Ferrous and Nonferrous Metallurgy and Machinery Manufacture] and other institutes, it may be concluded that automated development of basic designs, volume-planning and construction determinations will permit the reduction of expenditures for materials and structures by as much as 10-12 percent. This means that, in principle, we could build every eleventh home, school or plant from materials saved by economizing.

Automated processing lines for planning ensure even greater efficiency. One of the first lines of this sort is in operation in the Kiev ZNIIEP Gosgrazhdanstroy. Its base is the EVM "BESM-6" and two subordinate mini-EVM's of the "M-6000" type which are equipped with graphics and microfilm units and also a display unit for in-line "dialogue" between man and machine. One statistic will suffice to illustrate the changes which automation inserts into the character and rhythm of the designers' job. The processing line that we are discussing speeds up the process of designing the construction for the framework of a building by 10-20 times. The computed output of the line is 250 completed projects per year.

Last year, technical programs were developed for the creation of automated planning systems in a number of institutes. Analysis showed that, for the development of a technical base (purchasing the EVM, graph plotters, displays and so on), expenditures at the rate of two to three thousand rubles for one designer were required. But in this area, one must proceed boldly since, as early as 1980, this solution will make it possible to increase the volume of design work by approximately 25 percent with the same number of designers.

From this, it is clear how important it is to find efficient forms of management for automated systems. The primitive, in essence, way in which the technical base for automation has developed is unacceptable for large-scale installation. If each institute would attempt to create its own computing center, the utilization factor for the high-output equipment would prove extremely low. In our opinion, the necessary computing capacity for each planning and surveying system must be managed on the principle of judicious concentration of technical equipment, software and, corresponding to this, qualified personnel.

The most ideal form of organization appears to be automated planning centers for collective use, which will operate under the direction of planning institutes on the basis of economical subcontracting agreements. Depending on the desires of the management, these centers will perform both a consulting and a procedural function along with direct engineering of the individual elements and sections of the planning.

It is necessary, obviously, initially to set up automated planning centers on the basis of the functioning computing centers of large planning institutes with these subdivisions having a certain status as territorial and sectional computing centers. We emphasize, of course, that such independent subdivisions must be associated with interdepartmental units in some degree of subordination or other. In order to avoid diffusion and the inefficient use of expensive equipment, rigorous interindustry supervision is necessary in the allocation of computer equipment not only according to sectional but also according to territorial characteristics.

As is apparent, the solution of the whole set of problems related to further development of automation in the planning area requires concerted efforts on the part of the many ministries and departments involved in addition to the outline of the construction. Here, a lot depends on the State Committee of the USSR Council of Ministers for Science and Technology, Gosplan USSR, the institutes of the USSR Academy of Sciences, the USSR Ministry of Higher Education and many others.

It doesn't seem difficult to calculate that, for the automation of a fifth part of the entire volume of planning operations, it is necessary to have on the order of 5,000 cybernetics specialists for each 100,000 designers. And this means specialists primarily in the area of construction design automation. No one is undertaking their training today. Workers at Gosstroy USSR and the RSFSR Ministry of Higher Education presented suggestions about this almost a year ago; however, things are still moving slowly in the USSR Ministry of Higher Education.

Let us suppose, anyhow, that the entire set of problems were already solved. There is personnel; there is software available in sufficient quantity; a group of programs for accomplishing various tasks is ready for use. Has the scope of the designers' responsibility then been exhausted? By no means.

This, we could say, is the kind of example we have. In the process of working, scientists are all the more actively resorting to the services of computing equipment, but the results of research come out, as a rule, looking like the conventional records. Workers at computer centers devote a large amount of time and effort to translating these into machine language. But, in fact, there does exist a real possibility for simplifying and accelerating the process of the unceasing supplementing and updating of data processing and programming software. For this, the conventional records of the results of scientific research and experimental construction work must be submitted in the form of suitable "machine" specifications, programming modules and so on. It is quite obvious that the realization of this idea will make it possible to speed up the introduction of technical innovations into the practice of design and construction.

It should be remembered that the development of automated planning systems is not limited to construction. As is known, because of its features, it

is proving useful for scientific and technical progress in many fields. That is why the problem of the interdependence of science and planning is assuming an interdepartmental significance. But in its own turn, this is resulting in the need for more exacting and in-depth coordination of scientific research and practical developments in the area of design automation.

Statements made by participants at the All-Union Conference on Automated Design Systems for Machine Building, which was held in March, were convincing that such a necessity is about to arise. At this representative forum which was set up on the initiative of the presidium of the USSR Academy of Sciences, the question of interdepartmental coordination under the aegis of the State Committee of the USSR Council of Ministers for Science, Technology, and academic institutes was placed in the first order of importance.

The wide use of automated systems in construction planning is one of the most important ways in the improvement of planning and estimating procedures for further increasing the quality and economy of planning decisions. Considering the complexity and the varied character of the problems arising on the road to realization of this complex task, the development of special programs, expected in 10-15 years, seems expedient to us. Gosplan USSR, State Committee for Science and Technology, and Gosstroy USSR must take part in its realization. The practical accomplishment of such a program is an important contribution to the fulfillment of the large tasks set before capital construction by the 25th Party Congress and the October (1976) Plenum of the Central Committee CPSU.

8945

CSO: 1870

CYBERNETICS, COMPUTERS, AND AUTOMATION TECHNOLOGY

NEED FOR COMPUTERIZED SYSTEMS FOR PRODUCTION MANAGEMENT

Moscow IZVESTIYA in Russian 28 May 77 p 2

[Article by S. Petrovskiy, General Director of the "Elektron" Industrial Association, L'vov: "The EVM [Computer] Serves Quality"]

[Text] Computer-based automated industrial process control systems, that is, control of machine tools, machinery and production lines, have been more and more widely used in recent years. These are somewhat different from automated organizational control systems where the object of information or control is the collective of the shop, shift, section, brigade or individual worker. Here the scale of introduction of computer technology is considerably more modest. Nevertheless, this problem is very important since it is a means of substantially improving labor organization for direct manufacture of products and thereby activating major reserves for raising effectiveness and quality. The "Elektron" experience points this out.

Ten years ago, in cooperation with the U [Ukrainian] SSR Academy of Science's Institute of Cybernetics, the "L'vov," one of the country's first automated production control systems, was developed. At that time, work stations were equipped with computer peripherals. The television set traffic controller's usual personal stamp was replaced by the "stamp-sensor of the computer."

Those who were in the assembly shops of the pilot plant and our association's branches could see the sensor with a lead on the benches of the assemblers, traffic controllers and OTK [technical control department] workers. This is the "nerve" through which information on the quantity of the manufactured product or on its delivery from the first presentation enters into the machine's brain. Another type of device is on the presses. The machine operators use it to report the reasons for stoppages of the machinery or some kind of delay in their work to the computer. Large scale displays with information on shift task performance, which the computer puts out immediately, became customary in the shops.

Active use of computer technology helped us to certify our own products for the State Mark of Quality, and to raise labor productivity, output-capital ratio and product yield per square meter of production area.

We pay special attention to the use of modern computer technology for automation of product quality control. The computer now puts out, at any moment and to all elements, data on the quality factor achieved by them and by which we now evaluate activity of the collectives. The causes, which have lowered this quantitative indicator, are also pointed out. In addition to the usual enterprise standards, machine-oriented standards, which organize labor under the conditions of widespread computer use, have also been developed. The automated assembly process quality diagnostics, now being introduced, should also be included among the changes. It is worth dwelling on their value at greater length.

The color television set is controlled by a set of meters. Sometimes, however, the accuracy of one of them has deteriorated and the probability of a defect has increased. This means that the number of errors may increase and the outlays to correct them may amount to, for example, 100 and even more rubles per shift. The production worker has no time while working to note the extent of the number of such malfunctions and to find out what caused them.

Previously, trouble-shooting consisted of gathering data for a month and analyzing it. But this was a delayed exposure of the malady. Only a computer is capable of providing the necessary immediacy to process quality diagnostics. It is enough to program it to "catch" frequent repetitive defects and it will report on the process status at any moment. For example, on the shop chief's console has appeared the signal: "Attention! Defects have increased!" This means the problem has to be urgently investigated and eliminated. The steps taken--be it a replacement of an inaccurate instrument or some kind of repair--will cost the collective much less than if it did not have an electronic assistant.

Our automated diagnostics at the work station are based on an important condition of complex control--planning of quality, as well as on rigid mathematical models. Their parts are a subject for a specialized article. I shall note only the novelty of their principle, which is the opposite of that which has been embedded into the majority of organizational ASUP [automated control systems for enterprises]. It is not the man addresses the machine, not ("computer give me a list, a summary; respond to the query"), but on the contrary--the machine calls the man ("tear yourself away from the small workflow, your intervention is required here, I, the machine, am saying this, not waiting until you ask me").

Before the technical concept became a reality, a lot of spade-work had to be done. Creative research helped the specialists solve the problem of timely acquisition of complete and reliable data and input of it into the machine. The "Ritm" [Rhythm] device was developed for this. Such devices have been installed at the most important points of the entire assembly operation, and they are used by the television set traffic controllers, maintenance workers, and OTK specialists. About 1,000 production workers were trained in advance. They attended lectures on rules of operation with

computer peripherals, on organization of input of data into the machine, and on classification of defects for machine analysis. This has played its part. Electronic diagnostics has won recognition.

Do not get the impression that all the problems have been solved in our system of diagnostics. While performing millions of mathematical operations, the computer puts out 36 standard diagnoses to the shop. And how is the industrial process to be treated? Even though the computer will never completely replace a man, it should prompt him what to do in every specific situation. The association is developing standard control solutions for this.

Of course, use of electronics for production process diagnostics is not the last operation in the subsequent conversion of a complex quality control system to an automated basis enlisting a computer. Using the machine's capabilities permits rapid and objective evaluation of the quantitative and qualitative aspects of each worker's labor contribution. And this is very important for carrying out the pledged terms of socialist competition: publicity, operativeness and concreteness.

One should not forget still another aspect of placing computer technology in the worker's hands. This is the social aspect. Work with a computer compels the ordinary worker to raise his vocational mastery and education. One of many examples can be referred to here. About 10% of our ASUP department specialists are former trouble-shooters, mechanics, inspectors, traffic controllers and fitters. V. Kordyukov, L. Meylikhan, V. Fildchenko and V. Tantsyura became machine chiefs; A. Kravchuk, A. Kazachok, I. Krupskiy, O. Peleshak and L. Malysheva became engineers and a former radio equipment trouble-shooter, N. Val'ko, is a candidate of engineering science and deputy chief of the ASUP department. Another group of workers is attending VUZ's and preparing to transfer into this department. And even in the shops, the engineering and technical staff is being enriched by those who have completed training institutions without disrupting production.

It would not be out of place to touch upon that which is restraining development and expansion of intra-shop and intra-shift automated control, directly concerning hundreds and thousands of the rank and file. I shall begin with the various peripherals which connect the work station to the ASUP. They, as a rule, have to be developed and made with our own efforts. Such home-bred creativity is not economical. But it thrives because up to now, series output of all-possible devices of shop assignment for a computer has not started.

About 10 types of small computers are now being produced or prepared for production in the country. Their unification, and also at the same time development of a standard series of shop control systems with standard software should be engaged in without delay. It is necessary to more actively meet halfway those who, while carrying out the decisions of the 25th party congress, are trying to march in step with scientific and technical progress, and thereby create conditions for fulfillment of the five-year plan ahead of schedule.

Practice and experience are convincing us more and more that modern computers can be and should become a permanent tool in the hands of the worker. This is advantageous to everyone. This is effective in all respects.

8545

CSO: 1870

CYBERNETICS, COMPUTERS AND AUTOMATION TECHNOLOGY

AUTOMATIC CONTROL SYSTEMS IN RAIL TRANSPORTATION

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZ in Russian No 3 Mar 77 pp 2-4, 22

[Article by V. I. Denisov, Deputy Head of the Main Administration of Computers in the USSR Ministry of Railroads]

[Text] The main task of the Tenth Five-Year Plan in rail transportation is meeting as fully as possible the demands of the national economy and the population for rail traffic and in making all operations more efficient and more competent. Broad use of electronic computers and automatic control systems plays a vital role in performing this task. This implies further expansion of the automatic traffic control systems based on road computer centers, expansion of the introduction of automatic systems for controlling technological processes, strengthening scientific and design work aimed at upgrading the system of controlling rail transportation overall and raising the effectiveness of computer use.

As we know, one feature of the operation of rail transportation is the presence of subdivisions dispersed over large distances, functionally controlled by a single central agency. At the same time there is a time-tested structure of control and existing technology. The latter promotes the introduction of the most powerful means of control--automatic systems for data collecting and processing essential for optimizing the control of the appropriate subdivisions.

Work to expand the branch automatic control system ASUZhT [automatic control system in rail transportation] and in setting up road automatic control systems [ACS] has been underway for a number of years in rail transportation. At all railroads of the country computer centers were organized; during the years of the Ninth Five-Year Plan the centers gained practical experience in performing the tasks of the first stage of the ASUZhT. Through the work done, the technical base of the ASUZhT was set up and highly qualified cadres were trained in the railroad computer centers and the project-planning technological office of the ASUZhT.

At the present time railroad computer centers number more than 100 medium-capacity computers; more than 1200 stations have been equipped with devices for data reduction, transmission and reception; 38 different kinds of ACS were introduced. The total volume of data processed each day is about 150 million characters.

Included in the ASUZhT system are means for data acquisition and collection, for the transferring of data from documents to intermediate carriers (punched tape, punched cards, magnetic tape and so on) and the automated and automatic obtaining of data both in filling out primary documents and in altering the situation in sections and stations.

Definite results were attained in recent years in breaking down a certain mental block in using computers in rail transportation; this helps draw in larger and larger groups of specialists capable of properly developing and introducing the tasks with allowance for available equipment and technological feasibilities.

Computers are used heavily in scheduling and technical norm-setting of the transportation process, recording the presence, utilization and analysis of the status of facilities, automating technological processes in the marshaling yards and other rail transportation enterprises and in processing data of a report and statistical nature. Multivariant traction calculations are performed with computers; traffic schedules are set up, along with schedules for making up trains and so on. Based on computers, information service systems are being put together for feeding directors reliable and full information needed in making operational decisions. All told, there are already more than 800 functions of 70 different types being performed in rail transportation.

When ACS are brought onto the scene, the primary documents setting the norms for operations are retained--the train traffic schedule, the train-classifying schedule, technical norms and so on. However, these documents become more flexible and meaningful thanks to greater scientific soundness in the variant selected with computer assistance, the timely insertion of corrections owing to changes in working conditions and recommendations forthcoming on preventing possible difficulties in the work of a department and railroad.

In the Southwest Railroad, train traffic schedules for double-track lines, using the technique of the Central Scientific Research Institute of the USSR Ministry of Railways, were drawn up with the help of computers. During 1976, the movement of trains on the Bryansk-Zhdobunov route was organized under the new type of schedule. A check gave favorable results--the sectional speed was found capable of being raised 1-1.5 km/hr and traffic intensity could be increased.

Technical norms of the operation of roads and departments are calculated regularly in the computer centers of the Kuybyshev, Moscow, Donetsk and Central Asian railways. From their experience similar operations are being successfully introduced at the South Urals, Eastern Siberian, Western Siberian, Sverdlovsk, Odessa-Kishinev, Belorussian, Transbaykal and Far Eastern railways.

The technical plan drawn up for computers can be operationally updated when there is a large change in the volume of railcar traffic or in the operating status or when additional assignments are received in shipping national-economic freight. The capabilities of computers permit regulating the railcar park by monitoring loading by railway of destination, in this case relying on predictions of the performance of the railways and the network overall.

The information for making the predictions is the reporting data on the presence of loaded cars by railways of destination and about loading and unloading. With reference to the norms in car traffic, all data for prediction over a period from one to seven days are processed on a computer. The intra-railway plan for making up single-group trains is calculated for the L'vov, Southwest, South, Baltic, Donetsk, Transbaykal and Far Eastern railroads.

Recently there have been marked increases in the rates of developing information service systems needed for operational control of the rail transportation process. This control can be viewed both at the level of the department, railroad and the level of the USSR Ministry of Railways. The information service system provides for the operation of computers in the man-machine dialog mode, obtaining a certain complex of reporting and accounting data and the necessary and sufficient analysis of these data; from the results an individual makes a decision. The system lets the director, by resorting to the computer, to detail the data and deepen or broaden the information obtained. For example, by obtaining data on the overall operation of the network in loading and unloading, the availability to railroads of loading resources for coal, ore, timber, agricultural and other high-priority freight can be examined.

Marshaling yards are called train factories. The better the operating procedures of the entire marshaling yard and its base--the gravity yard, the shorter the car downtime and the faster new trains are put together.

There are two direction in the introduction of automatic systems for the control of a marshaling yard.

The first is the system of scheduling the operation of the yard on the computer of the railroad computer center. This system gives information about the expected approach of trains to the marshaling yard, the procedure and order of railcars by destinations and the availability of locomotives and locomotive brigades of made-up trains by schedule routes. This system was introduced at more than 40 stations of the network. Here information is sent to the road computer centers from all stations where trains are put together and the results of the decision are sent over the data transmission network to the marshaling yard and to the railroad department.

The second direction presupposes decentralizing the technical facilities and amount to installing a minicomputer directly at the marshaling yards. Depending on the volume of work at the yards, three types of computers are installed: Nairi-K, YeS-1010 and YeS-1022. The computer at a marshaling yard

is intended to draw up marshaling lists for arriving trains, send out cumulative reports on the routes of the suburban railroad yards and by routes of destination, full-scale lists for trains dispatched, for making operational and statistical reports on the marshaling yard's performance, organizing the information service system for the yard as such using displays and for linking the road computer center with the stations where trains are put together and dispatched.

Calculations of the monthly freight-handling plans are made at all railroads with computer assistance; this enables the USSR Ministry of Railways to put together a composite plan from the monthly plans.

The large Ekspress-1 computer system was installed at the Moscow railway junction to upgrade passenger service; it sells tickets for long-distance trains. Covered by the Ekspress-1 system today are more than 500 ticket booths, in 30 ticket sales locations (railway stations, agencies and offices). The system has a common data bank for 3 million places, operationally used by all its subscribers. Ekspress-1 completely makes out through tickets for all classes of trains and reserves places in advance and departure-day sales and takes orders for transit passengers with reserved-seat tickets to 50 cities of the country.

The system's productivity reached 15,000 orders an hour; as high as 140,000 tickets were sold in one day. A special building is going up in Moscow for the continued expansion of this system on a new technical footing. Data transmission devices and terminal sets are under development.

Favorable experience and the high efficiency of the Ekspress-1 system led to a decision to improve it further and construct a network-wide version. To this end, model Ekspress-2 systems are to be installed in railroad lines, linked together and forming a single network-wide system for controlling sales of tickets and reservations.

Systems keeping track of the use of car and locomotive parks serve to make more efficient use out of rolling stock. Just the first stage of recording, computer-aided, the dislocation and status of ganged refrigeration rolling stock, aimed at speeding the shipment of perishable freight and making better use of refrigerator trains saved more than 6 million rubles. Trial runs of this system showed the large possibilities for improving the control of this kind of shipment.

An analogous system was introduced also in keeping track of large-tonnage transit containers. Participating in it are computer centers of ten railroads. The system lets the USSR Ministry of Foreign Trade meet the requests of foreign companies on the location and approximate time of arrival of their containers at their final destination.

Also of high value is the performance by computers of functions such as making recommendations on clearing up the separation of freight bills and

freight; automating the processing of freight bills in the junction accounts offices (URTK) (this job is the first step in the integrated processing of road reports and its receipting); calculating the density of freight traffic; integrated processing of information with the engineer's route; calculating the wages of workers in the locomotive depots and making all kinds of financial and bookkeeping reports; calculating the arrangements of optimal routings for freight flows by kinds of freight; finding nonoptimal shipments; traction calculations and so on.

From the first year of the Tenth Five-Year Plan computer centers began to be equipped with third-generation computers. These machines have superior capabilities.

In 1976 15 railroads received these computers. A model technical assignment for railroad ACS was sent to all computer centers for coordinating operations; on the basis of this assignment each railroad must work out its own technical assignment with allowance for its differences. The fastest possible mastery of the new equipment was the reason for enlisting the collectives of computer centers in the Moscow, Oktyabr'skaya, Sverdlovsk and other railroads in socialist competition.

Well-trained cadres are needed for the fullest use of the high technical capabilities of third-generation computers. Computer center personnel are in retraining at special courses to raise their qualifications. In 1976 alone about 200 electronics engineers, mathematicians and technologists. But this is clearly too few. So retraining of specialists goes on right in the computer centers without work leave.

When the third-generation computers came on the scene, centralized distribution of developments among railroad specialists grew much more critical. The Main Administration of Computers is taking steps to prevent duplication in developments, to plan integrated developments and to draw up model programs.

Developing an ACS for a marshaling yard aided by a YeS-1010 computer is an example of this effort. The work is headed by the PKTB of the ASUZhT, while each computer center of the railroad for which the marshaling yard ACS is being planned for is working out its part of the program. And it has responsibility for both schedules and quality of developments. This way of organizing the development process helped resolve in one year highly involved problems of the mathematical, technical and technological areas; in turn, this meant that the marshaling yard ACS, first stage, could be mastered at six marshaling yards.

Similar work goes on in setting up the information service system of the USSR Ministry of Railways, DISKOR; it will go on-line in 1977. This system shows on displays installed in the offices of railway ministry directors the analysis of the performance of the network and of individual railroads in terms of very important indicators for the day.

Developing and introducing the data transmission system is proceeding at four organizational levels: data transmission in the sections State Computer Center-Railroad Computer Center, Railroad Computer Center-Section Computer Center and Railroad Computer Center-railroad enterprises (stations); organizing of the message-switching centers; combining the data transmission system with systems for automated and automatic reading and acquisition of information; and setting up a system to support a reliable dynamic model (dynamic data bank).

A lot has been done and still is being done in developing and introducing into rail transportation automatic control systems. Nonetheless, there are weighty failings in this effort: working out of model missions goes on slowly; the labor productivity of technologists and mathematicians is not high; a lot of time is spent in matching up essential documentation; and converting to third-generation computers is not moving ahead fast enough.

In Dec 1976 the staff of the USSR Ministry of Railways examined problems of expansion and raising the effectiveness of automatic control systems and the road computer centers. The staff favorably evaluated the work done and at the same time noted the need to carry out, as top priority, the steps promoting an acceleration in railcar turn-around time and in organizing the integrated development and stage-by-stage introduction at all railroads of the necessary calculations for acting on Order No 28Ts of the railways minister.

The collectives at the computer centers are exerting their best efforts for a further introduction of computers, making computer use more effective and performing the tasks set before railroad transportation in the Tenth Five-Year Plan by the Communist Party.

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CYBERNETICS, COMPUTERS AND AUTOMATION TECHNOLOGY

RELIABILITY OF RAIL AUTOMATION AND REMOTE CONTROL

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZI in Russian No 3 Mar 77 p 22

[Review of the book "Nadezhnost' zheleznodorozhnykh sistem avtomatiki i telemekhanika" (Reliability of Rail Automation and Remote Control Systems), by N. Ya. Men'shikov, A. I. Korolev, and R. Sh. Yagudin, Izdatel'stvo Transport, 1976, 215 p]

[Text] This book shows the significance of the reliability of automatic and remote control devices and stresses systems underlying safety and interruption-free running of trains. Methods of selecting and determining criteria for the reliability of components and systems of rail automation and remote control are presented; principles for setting up logic circuits for calculating the reliability of these systems are put forth. The effect of various factors on the reliability parameters is shown; methods are presented for making the systems more reliable.

Much attention is given to ways of determining the optimal schedules for preventive maintenance and servicing of components. Service schedules are given for components, along with information on the necessary number of spare parts. Questions of shortening the trouble-shooting time are examined, as well as ways of scheduling operations to raise operating reliability.

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ELECTRONICS AND ELECTRICAL ENGINEERING

SCIENTIST HIGHLIGHTS SOVIET ACHIEVEMENTS IN LASER RESEARCH

Budapest MUSZAKI ELET in Hungarian 15 Jul 77 p 3

[Excerpts] An exhibition demonstrating the new possibilities for the uses of lasers which had been found by Soviet physicists was held between 20 June-10 July in Budapest. There was also a symposium on 29 June which dealt with Soviet achievements in new uses for lasers.

Yuriy Popov, professor, doctor of physical-mathematical sciences, deputy director of the quantum radiophysics laboratory of the Lebedyev Institute took part in the organization of both events. He also spoke about optoelectronic research being conducted at his institute. In the course of his stay in Budapest, the professor described current, and in some cases already successful, research being conducted in the field of quantum electronics in the USSR. This area is of personal concern to Professor Popov since quantum electronics and more directly optoelectronics are his particular fields of research. He and his research team were awarded the Lenin Prize for discovery and development of semiconductor lasers.

According to Popov, quantum electronics are developing in two directions: the first is fabrication of various new kinds of lasers. One of the most important categories are the "eleons" or electron ionizing lasers. In addition, intensive work is being conducted on developing the parameters of already known lasers--their divergence, effectiveness and output--to their theoretically attainable limits. In the case of lasers still in the research stage, establishment of such theoretical limits remains to be clarified.

The other main research trend is discovery of ways of utilizing lasers in science, medicine and engineering.

A Soviet achievement of this sort of special importance is the development of the glissade system for airports. Several Soviet flight engineering institutes cooperated with the Lebedyev Institute in evolving it. Used as a guide to landing, the system consists of setting up light sources which emit laser beams at various specific points on the landing field. The laser beams penetrate the thickest fog and are visible from a great

distance. They thus serve to orient the pilot as to his position in relation to the landing field. The glissade has proved highly effective in the USSR and is protected by patent in 16 other countries.

Increasing uses are being found for lasers in the field of optical communications. According to Popov, very great results have been achieved in developing the production technology of fiber optics. Reduction of laser intensity within an optical fiber has been decreased to an exceptionally great extent. Under laboratory conditions the ratio of loss is now one decibel per kilometer. Even in the case of fibers produced under industrial conditions and therefore of standard quality the level of loss was nearly 10 decibels per kilometer.

The carrier frequency of optical fibers is about 100,000-fold that of cable transmission. This means that theoretically it has become possible to transmit simultaneously about 1 million telephone conversations or 10 television programs along an optical fiber having a diameter of 50-100 microns with the aid of a 10 milliwatt laser. This task has been carried out with complete success at the experimental level. At present the Laboratory is working with the Institute of Radioelectronics of the Academy of Sciences to extend the lifetime of the light sources on the one hand and to find ways of solving technical problems involved in wide-spread actual use on the other.

The use of extremely high-intensity lasers in controlled thermonuclear reactions could be illustrated only in pictures at the exhibition. This differs from other means of thermonuclear energy production in that it involves efforts to use the energy of micro-explosions occurring in an enclosed space. More specifically, the goal is to produce a micro-explosion approximately every second with the aid of a laser so that thermal energy produced in this way can be transformed into a different type of energy after it has been shunted.

This is a problem of international interest today. However, it seems that much work will be needed before the goal is attained. It is true that such micro-explosions were produced in the USSR 8 years ago, and since then this result has been achieved by several other laboratories. However, the ultimate solution is a function of whether or not a laser can be built which can emit an impulse of at least 10^5 joules within a single nanosecond. This is the prerequisite for a thermonuclear reaction which produces more energy than is required to bring it about. In other words, this means transforming an energy consuming process into an energy producing one. "However, to the best of our knowledge," says Popov, "such a laser has not yet been prepared anywhere in the world."

Professor Popov maintained that the current symposium would be of help in the work of his laboratory; it would provide guidance as to the kind of work distribution with which future research should be conducted. New Hungarian research results will greatly facilitate the work of Soviet scientists, he feels. For example physicists of the Central Physics Research Institute achieved results in the theoretical explanation of multi-photon processes brought about with lasers which are unique even on an international basis.

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A TELEVISION CAMERA BASED ON A MATRIX OF CHARGE COUPLED DEVICES

Moscow TEKNIKA KINO I TELEVIDENIYA in Russian No 6, Jun 77 pp 54 - 59

[Article by V. Yu. Berezin, B. A. Kotov, L. Yu. Lazovskiy, S. A. Levin, F. P. Press, and D. I. Rubinshteyn]

[Text] Introduction.

Charge coupled devices [1] take the form of a system of electrodes applied on top of a thin oxide layer on a semiconductor substrate with small spacings (Figure 1a). The application of a voltage to the electrodes which depletes the layer of the semiconductor near the surface of majority carriers, leads to the creation of a surface potential relief in it: Potential wells, which store photogenerated minority carriers. When the voltage at the electrodes changes in a set manner (Figure 1b), the charges of the minority carriers are captured by the potential wells and are shifted in the semiconductor along the separation boundary with the dielectric in a direction perpendicular to the orientation of the electrodes (Figure 1c). After a certain time has elapsed, called the saturation time, the potential wells are filled with minority carriers, the potential relief disappears and the steady state sets in. In the absence of illumination, this occurs due to minority carriers which arise as a consequence of thermogeneration at the semiconductor boundary, in the depleted regions, and in the semiconductor itself.

An average dark current of 10 na/cm^2 has been achieved in the better devices at room temperature. When silicon is cooled, the dark current decreases two times for each 10° .

Completely solid state transmitting cameras have recently been created, which have a high sensitivity, a good contrast-frequency characteristic, and in terms of the number of resolution elements approach broadcast television quality [2]. To be numbered among the fundamental merits of the new cameras are the absence of persistence, the high level of geometric precision in image transmission, mechanical strength, and operational reliability, as well as low size, weight, and power consumption.

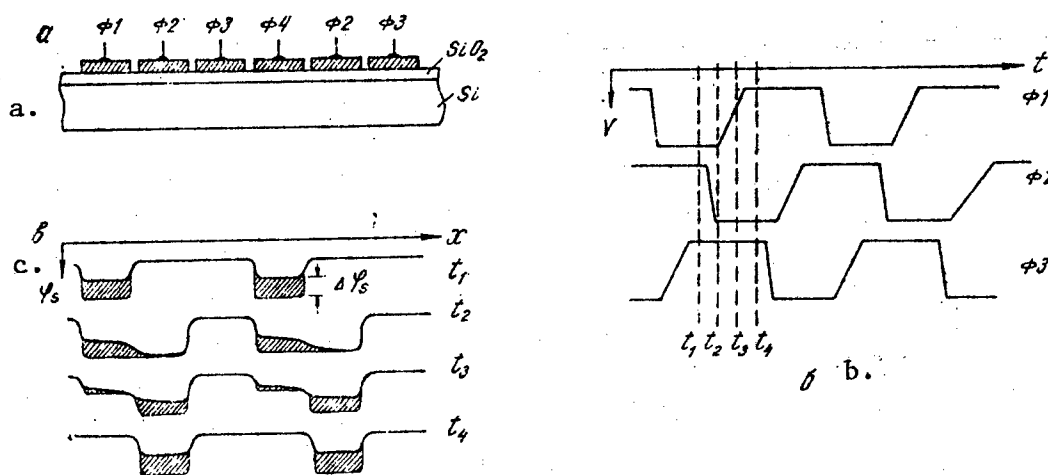


Figure 1

The structure of a three cycle charge coupled device (a); the timewise diagrams of the timing pulses (b); and the distribution of the surface potential (c).

Considered below are the operational principles and design of a photosensitive PZS [charge coupled device] matrix with 288 x 232 elements, as well as the questions of designing a TV camera around it.

The Design and Operational Principle of the Matrix

The PZS matrix developed here employs the principle of surface charge transfer and is organized based on a three phase power supply circuit with interframe transfer of the stored information (Figure 2). A system of semitransparent overlapping electrodes is formed by three levels of doped polysilicon. Used for insulation between the different levels was thermally grown silicon dioxide, which permits obtaining good electrophysical characteristics and a low level of defects over a large crystal surface.

The matrix crystal contains a photosensitive storage section, consisting of 144 x 232 elements with dimensions of 27 - 21 μm^2 , a memory section, consisting of 144 x 232 elements with dimensions of 21 x 21 μm^2 , a 235 element output register and an output device (Figure 3), consisting of an auxiliary register which is needed to compensate for interference from the timing pulses, two reset transistors intended for setting the output diffusion regions in the initial state, and two preamplifier stage transistors. The dimensions of the image projection region are 3.89 x 4.83 mm^2 , and the size of the crystal chip is 7.6 x 6.4 mm^2 . The chip was built up in a 24 lead metal-ceramic package with an optical window (Figure 4).

In projecting the image onto a storage section, photogenerated charges are accumulated under the electrodes of each element proportionally to the illumination. To realize interlace scanning during the odd fields, the charges are accumulated under the electrodes of the first phase, and during the even ones

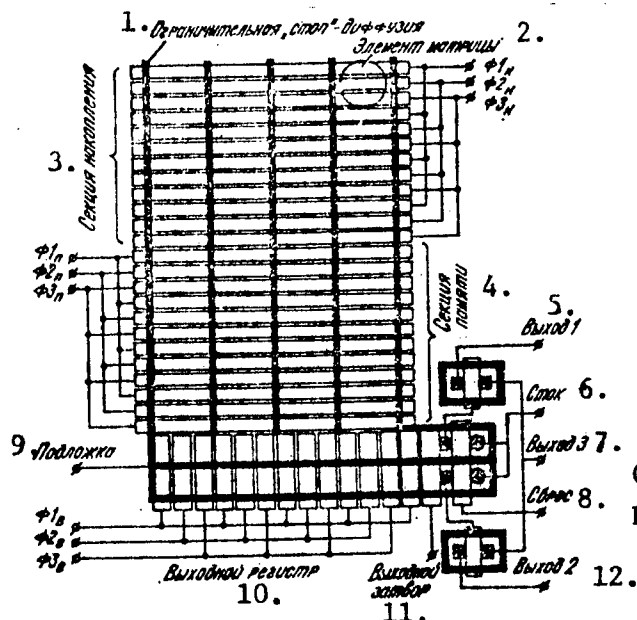


Figure 2

Schematic of a charge coupled device matrix.

Key: 1. Limiting "stop" diffusion;
 2. Matrix element;
 3. Accumulation section;
 4. Memory section;
 5. Output 1; 6. Drain;
 7. Output 3; 8. Reset;
 9. Substrate; 10. Output register;
 11. Output gate; 12. Output 2;
 ϕ = phase.

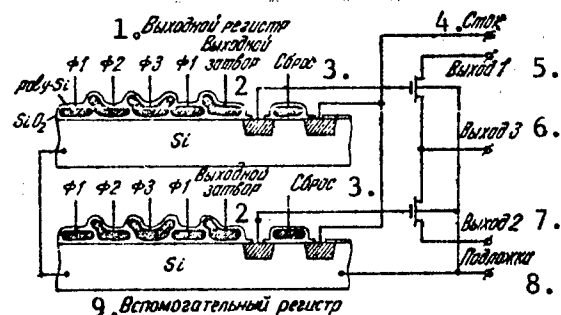


Figure 3

Circuit of the matrix output device.

Key: 1. Output register; 2. Output gate;
 3. Reset; 4. Drain; 5. Output 1;
 6. Output 3; 7. Output 2; 8. Sub-
 strate; 9. Auxiliary register.

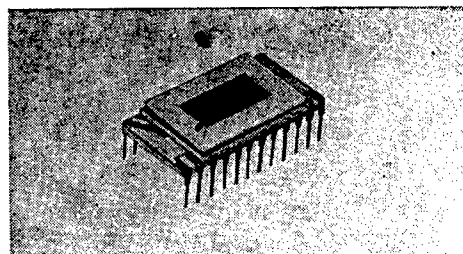


Figure 4

A phot sensitive charge couple device matrix, built-up in a metal ceramic package with an optical window.

under the electrodes of the second phase. During the time of the frame blanking pulse, the stored charges undergo a parallel shift to a memory section, upon the completion of which, the storage section begins a new operational cycle, and in the memory section, the charges undergo a parallel shift into the output register at the line frequency. The shift of each information line occurs during the time of the line blanking pulse, after which, during the forward horizontal line scanning trace, these charges are sequentially brought out of the output register and the signal is fed through the output device to an external video amplifier.

Specific Operational Features of the Matrix in a Camera

To increase the efficiency of charge transfer in a PZS matrix, and to correspondingly improve the contrast-frequency characteristic, it is necessary to introduce a background charge which decreases the influence of signal charge capture by surface states at the semiconductor-dielectric separation boundary. Employed in the camera is optical injection of the background charge, realized in the near infrared region of the spectrum by means of two longitudinal radiators, positioned between the matrix and the objective, and designed around gallium arsenide, the radiation spectrum of which is maximally matched to the spectral sensitivity of silicon. Passing a current of 1 ma through two series connected radiators makes it possible to introduce a background charge at a level of up to 20% of the saturation level, and to obtain a product of the ineffectiveness by the number of transfers in each direction of no worse than 0.3.

In the initial applications, photoelectric converters based on PZS matrices had a linear light response characteristic. With local illuminations which exceed the saturation level, the light generated charge overflowed the potential well and flowed out via adjacent elements, causing blooming of the image. For example, there arose in connection with the sensitivity of silicon radiation in the near infrared region when transmitting the image of a man with a lighted cigarette a bright vertical white band. To combat these phenomena, it was proposed in [3] that in the accumulation section upon completing the frame blanking pulse, the electrodes of one or two phases which were not used for storage in the given field be kept in the majority carrier enrichment state of the semiconductor near-surface. The excess minority carriers arising in the case of optical overload do not have time to diffuse into neighboring elements, since they rapidly recombine with the majority carriers due to the increased concentration of the latter in the accumulation region. An illustration of the action of such protection against the optical overload effect is shown in Figure 5.

The mechanism considered here for protection against image blooming leads to the appearance of a sharp break in the light response with the transition into the saturation region. It is natural that in this case the image details in regions of high illumination are not reproduced. The lost information can be transmitted by means of placing a stop on the objective, which, however, causes a decrease in the signal/noise ratio in the dark portions of the image.

A method is known [4] which permits obtaining a nonlinear light response with $\gamma < 1$ in PZS matrices, and transmitting bright details without degradation of the transmission quality of the dark portions. This problem is solved by changing the capacitance of the potential well in the process of accumulating a light generated charge.

Camera Circuit

To demonstrate the possibilities of photoelectric converters based on PZS matrices, an experimental model of a TV camera was built, made entirely of solid state components. The primary problem in the construction of the camera was the creation of a circuit combining maximum simplicity and minimum power consumption, and which does not limit the characteristics of the matrix being used. The camera should operate with standard TV equipment and be an independent unit. A standard peak-to-peak video signal should appear at its output with the blanking and sync pulses present in it. The camera circuit is shown in Figure 6.

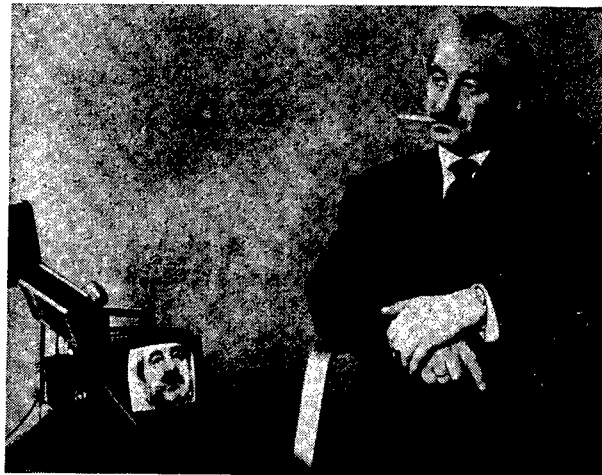


Figure 5. An illustration of the protection against blooming of the image with a local optical overload.

For the case of synchronization from the camera, the reproducing unit operates without interlace scanning. The rasters of both fields coincide with each other and contain 288 lines each in the forward trace of the frame sweep and 24 lines each in the retrace. The difference of the frame of line frequencies from the standard frequencies amounts to no less than 0.2%. For image transmission, odd lines are used in the first field, while the even lines are blanked, and in the second field, vice-versa. During the frame scan retrace, 144 charge transfers are made from the accumulation section to the memory section. Information output from the memory section is realized at an interval of 2 lines during the line scan retrace. In this case, the speed of all transfers in these two sections is identical and amounts to approximately 94 KHz.

Shown in Figures 7 and 8 are the timewise diagrams of camera operation, given for the case of control of the matrix designed around p-type silicon. When using n-type silicon, only the polarity of the controlling pulses and the video signal is changed.

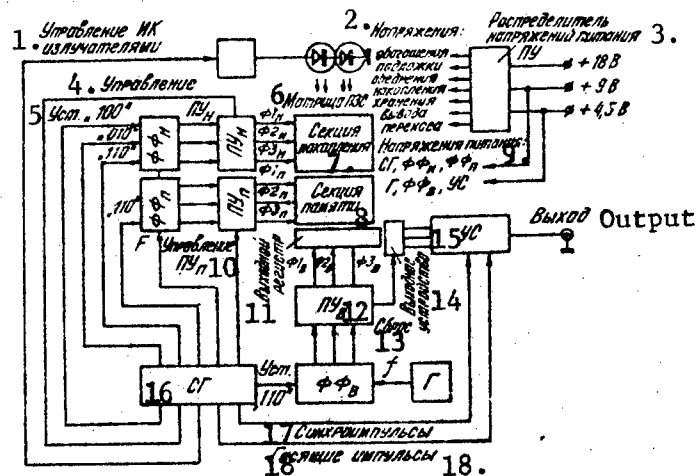


Figure 6. A functional schematic of a camera based on a charge coupled device matrix:

Key: 1. Control of the infrared radiators; 2. Voltages: [in order from top to bottom] enrichment, substrate, depletion, accumulation, storage, output, transfer; 3. Power supply voltage distributor for the level converter; 4. Control; 5. "100" set; 6. PZS matrix; 7. Accumulation section; 8. Memory section; 9. Power supply voltages: sync generator, accumulation section phase voltage driver, memory section phase voltage driver, generator, output register phase voltage driver, amplifier-mixer; 10. Memory section level converter control; 11. Output register; 12. Output register level converter; 13. Reset; 14. Output device; 15. Amplifier-mixer; 16. Sync generator; 17. Sync pulses; 18. Blanking pulses; $\phi\phi_B$ = output register phase voltage driver; ΨY_H = accumulation section level converter.

Design of the Sync Generator and Control of the Accumulation and Memory Sections

The sync generator contains a master oscillator (with crystal control or tied to the mains frequency), a divider designed around D-flip-flops, and a simple logic device, intended for generating the control pulses for other assemblies of the camera. The master oscillator operates at three times the pulse frequency for transfer of the accumulation and memory sections, which in turn is six times higher than the line scan frequency. The line frequency pulses are divided by 312, forming the field frequency. The division is completed with the derivation of the frame frequency necessary for controlling the accumulation in the matrix in the different fields. The requirements placed on the logic portion of the sync generator are primarily determined by the design of the generator circuits for the phase voltages (Figure 9), which are necessary for deriving the transfer pulse trains, shifted with respect to each other by 1/3 period.

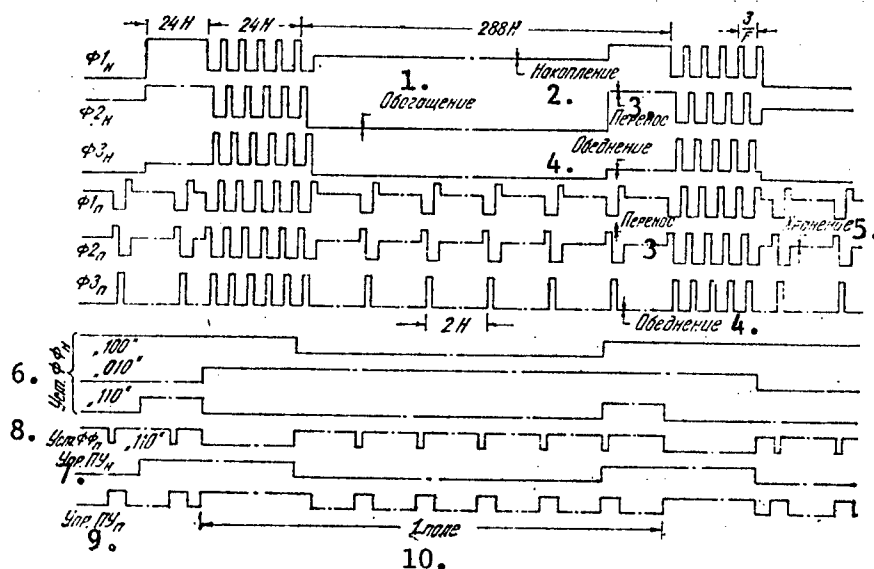


Figure 7. Timewise diagrams of the control pulses for the storage and memory sections.

Key: 1. Enrichment; 2. Accumulation; 3. Transfer; 4. Depletion; 5. Storage; 6. Accumulation section phase voltage set; 7. Accumulation section level converter control; 8. Memory section phase voltage driver set to "110"; 9. Memory section level converter control; One field.

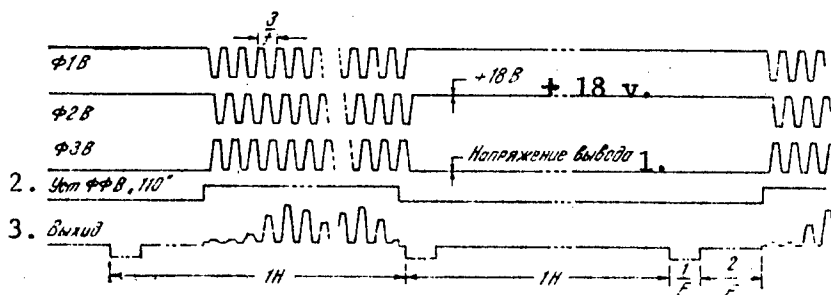


Figure 8. Timewise diagrams of the output register control and output signal pulses.

Key: 1. Output voltage; 2. Output register phase voltage driver set to "110"; 3. Output.

The phase voltage drivers are designed in a pulse distributor ring circuit configuration using D-flip-flops, and permit the initial setting in three states: "10", [SIC], "010", and "110".

a state exists for which the entire charge is concentrated under one electrode. The overall capacity of all electrodes of the storage and memory sections reaches 6,000 pF, while the power consumed by the corresponding converter amounts to no more than 50 mW.

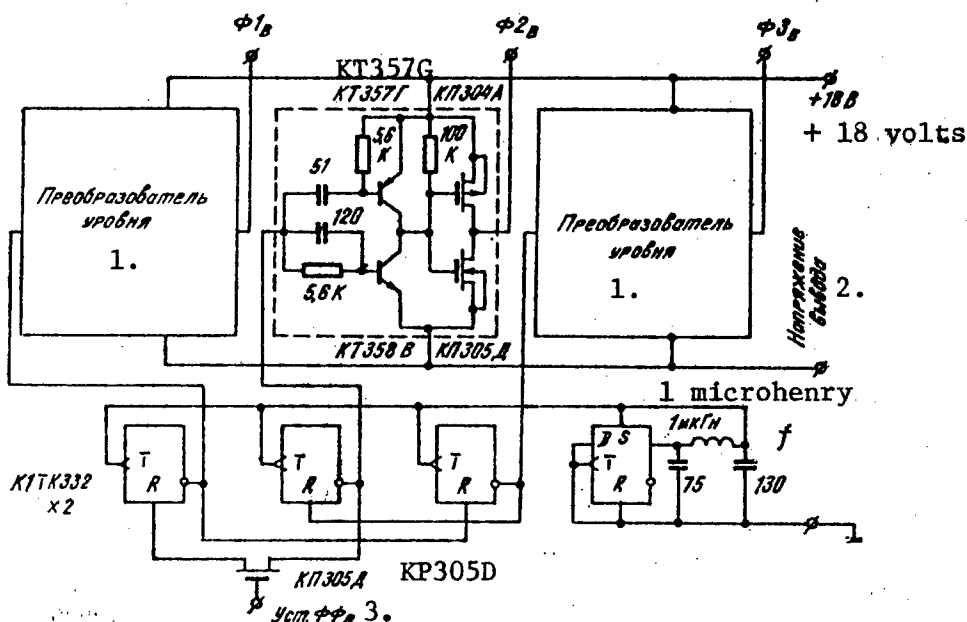


Figure 10. Control circuit for the output register.

Key: 1. Level converter; 2. Voltage output lead; 3. Output register phase voltage driver set.

Control of the Output Register and Generating the Video Signal

During the line scan forward trace, it is necessary to interrogate the 235 elements of the output register. Consequently, the interrogation frequency should amount to no less than 4.6 MHz. The master oscillator controlling the phase voltage driver of the output register, operates at a frequency three times higher. The phase voltage driver (Figure 10) is designed around the circuit considered here based on three D-flip-flops of the 133 series, while the LC oscillator uses an inverter belonging to the fourth flip-flop. The entire circuit uses 150 mW when powered from the 4.5 volt source.

To decrease the perceptibility of the digitization in a horizontal direction, the high frequency oscillator operates independently of the sync generator, i.e. asynchronously. In this case, only the setting of the phase voltage driver to the "110" state is realized during the line scan retrace, which is necessary for transmitting the charge from the memory section to the output register.

Fed to the gate of the reset transistor is a pulsed voltage for the second phase. In this case, a depletion is likewise established underneath the output gate which is deeper than under the other electrodes of the output register. Additionally, the necessity of a high operational speed requires an increase in the gradient of the surface potential in the edge fields under the electrodes of the output register, and a correspondingly greater peak-to-peak value of the transfer pulses than in the matrix section. To convert the levels at the output of the TTL integrated circuit to the voltages necessary for controlling the PZS register, a circuit is used [5], the first stage of which is designed around two bipolar transistors, KP357 and KT358, with forcing of the transient processes, while the second stage is designed around a complementary pair of MOS transistors, KP304 and KP305. This circuit permits obtaining leading edges of the pulses on the order of 20 nanoseconds into a capacitance of 80 pF with an amplitude of up to 15 volts, and uses no more than 20 mW of power in controlling the three-phase register at a frequency of 4.6 MHz.

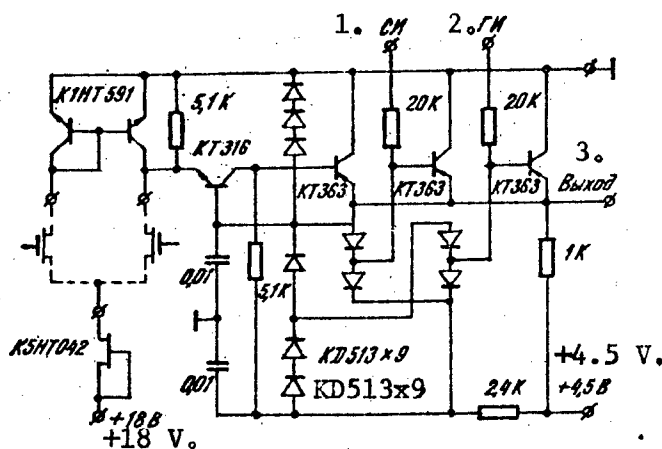


Figure 11. Circuit of the output amplifier-mixer.

1. Sync pulses; 2. Generator pulses;
3. Output.

nizing and blanking pulses into the video signal is a current switching circuit, combined with an emitter follower output. The entire amplifier uses a power of 50 mW from a 4.5 volt source.

Conclusions.

The camera design based on a circuit with two generators made it possible to isolate the control block for the accumulation and memory sections, operating at frequencies below 280 KHz, containing the equivalent of up to 800 little transistors and providing for practically the entire multiplicity of control signals for the camera, and the control block for the output register of the matrix, operating at a frequency of 14 MHz, containing no more than a few tens of transistors and coupled to the main block by one control channel at the line sweep frequency. For this reason, the first block

Used for amplifying the signal from the matrix is a differential circuit configuration placed on MOS transistors, placed directly on the chip, a dynamic load with current reflectance based on K1NT591 transistors, and a matching stage designed in a common base configuration using a KT316 transistor (Figure 11). In this case, the signal gain with respect to voltage will be equal to the product of the slope of the MOS transistors times the load resistance in the common base stage. The DC bias is determined by the magnitude of the resistance at the input to this stage. Used to insert the synchro-

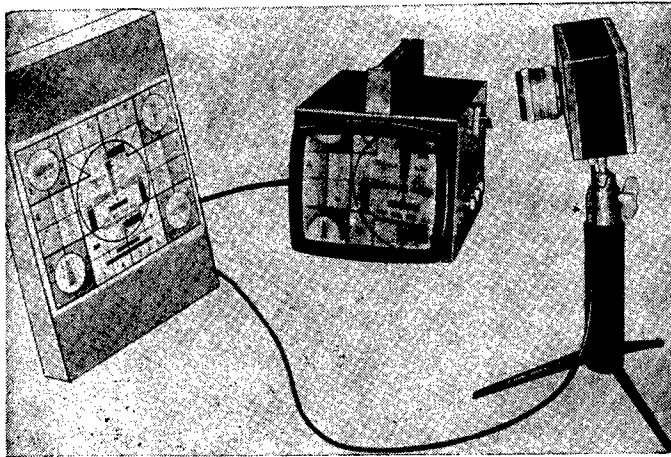


Figure 12. The transmission of a portion of a television test pattern by the camera.

was primarily designed around CMOS integrated circuits, and the second block was designed around TTL IC's and discrete transistors.

The camera circuitry is placed on two printed circuit boards taking up approximately half of the volume of the housing shown in the photographs. The converter for the power supply voltages of +4.5 volts, +9 volts, and +18 volts is built into the housing of the "Elektronika VL-100" television set and operates from a regulated voltage source of 10.5 volts.

The first experimental models of the TV camera based on a PZS matrix have a sensitivity of no worse than 2 lux for a video signal passband of 2 MHz, transmit all the shades of a television test pattern (Figure 12), use 0.5 watts of power and are capable of working with any TV unit.

V. K. Kornakov participated in the development of the camera design, and A. V. Veto and M. M. Krymko took part in the design and fabrication of the PZS matrices.

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MINIATURE KINESCOPIES WITH FIBER OPTIC SCREENS

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 6, Jun 77 pp 60-61

[Article by L.L. Sivers, I.S. Lebedinskaya and S.N. Makhanova]

[Text] The use of fiber optic screens (VOE) as the face glass of CRT's is significantly expanding the applications area of the tubes, permits operation under conditions of considerable illumination, and makes it possible to realize contact photorecording from the CRT screen. The use of VOE's as the face glass of CRT's in systems for contact photorecording increases the light power of the system by several tens of times, something which permits an increase in the writing speed, a decrease in the exposure time, and the use of less sensitive photo-layers. In this case, the weight and dimensions of the recording system are substantially reduced [1, 2].

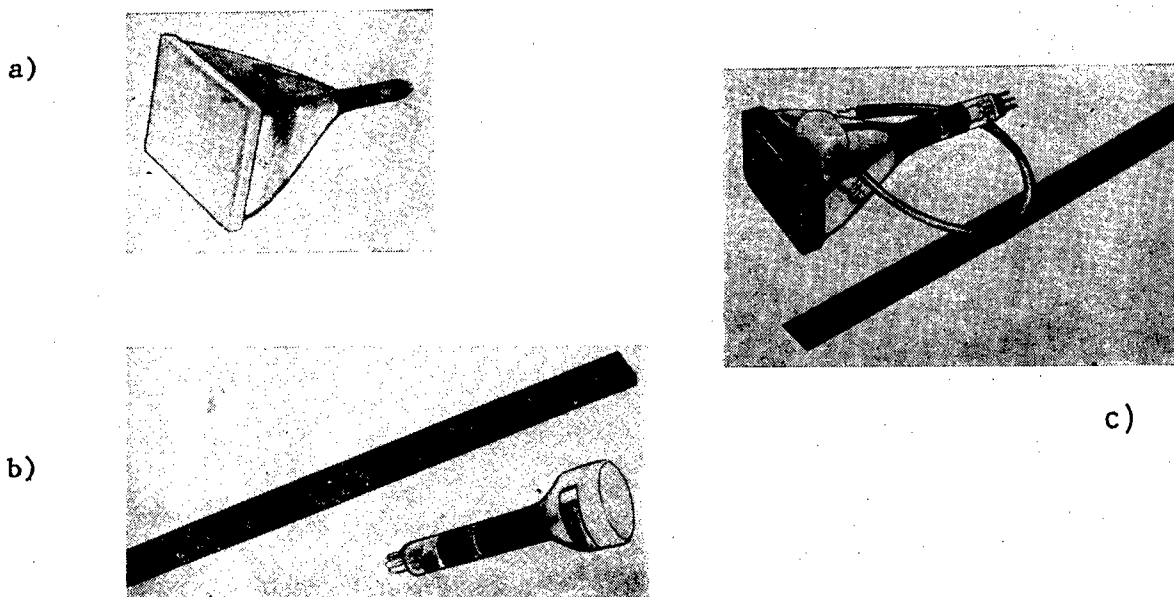


Figure 1. Miniature kinescopes with fiber optic screens.
a: A type 11LK CRT; b: A type 3LK CRT; c: A type 6LK CRT.

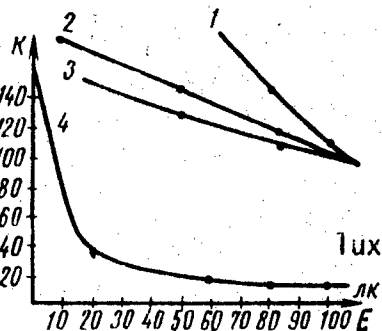
TABLE

Type of Device	Тип люминофора	U_a , KV	U_H , V.	U_y , V.	U_ϕ , V.	U_{zap} , V	B , кд/м ²	Разрешение 4. строк	Контраст при $E=100$ лк
3ЛК 3ЛК	Б-3ЖВ-3Zh K-67	6	1,36	300	200-400	15±10	100	500	—
6ЛК 6ЛК	K-57	6	1,36	300	200-400	10±4	100	500	не менее 100
11ЛК	K-67	6	1,36	300	200-400	10±4	100	500	no less than 100
11ЛК	КТБ КТБ	9	1,36	300	200-400	10±4	200	400	

Key: 1. Type of phosphor; 2. U_{zap} in volts (? $U_{blanking}$?); 3. Screen brightness in кд/м²; 4. Line resolution; 5. Contrast at $E = 100$ Lux.

Given in the table are the characteristics of miniature kinescopes with fiber optic screens.

Two types of devices — the 11ЛК and 3ЛК (Figures 1a and b) — are intended for contact photorecording, and type 6ЛК devices (Figure 1c) are intended for video monitors, operating with considerable ambient illumination. Used as the face glass were VOE's of types PV-1 OST [All-Union Standard] 3-776-72. For the purpose of increasing image contrast in the presence of external illumination, used in 6ЛК devices was an additional thin fiber optic plate with absorbing jackets of elementary light guides and with low light transmittance, which were glued to the CRT screen by means of optical glue. In view of the fact that the index of refraction of this glue corresponds to the index of refraction of the cores of the elementary VOE light guides, the presence of a gap due to the production process has practically no effect on the coefficient of contrast transmission of the screen assembly, however, somewhat of an increase was noted in the macrostructural noise of the screen. The image contrast with ambient CRT illumination, in the case of such a combination screen, exceeds the image contrast of structurally similar CRT's having a glass screen by several times (Figure 2).



Key:

1, 2, 3. Image contrast on the screens of different models of CRT's with VOE's;

4. Image contrast on a CRT screen with a monolithic screen, for a screen brightness of 100 кд/м².

Figure 2. Image contrast on the CRT screen as a function of the level of external lighting;

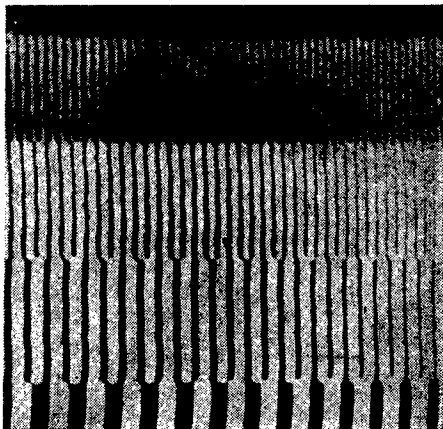


Figure 3.

Recording of a test pattern from a CRT screen with a VOE.

The 3LK and 1LK type devices were tested in a contact photorecording system. A photograph was taken using a L1-6 set-up, by means of a specially built photographic camera. Included in the complement of the photography unit was a frame isolation circuit, in which a bias lighting pulse was generated, equal to the duration of one frame, and was fed to the CRT modulator. After exposing one frame, the photographic film was manually advanced, and so forth.

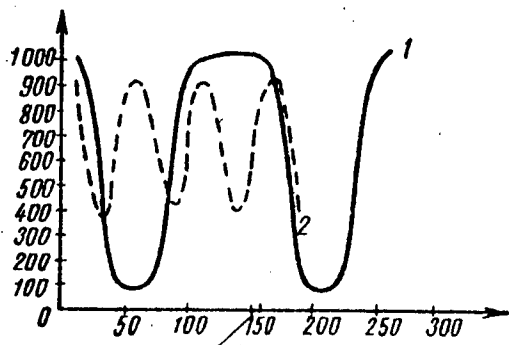


Figure 4. Microphotogram of the blackening density distribution in a test pattern image on the negative.

1. CRT of the 1LK type;
2. CRT of the 3LK type.

replaced by a photomultiplier, and the 12 watt illuminating lamp was replaced by a more powerful one (40 watts).

Photographs were taken from the CRT screen at different image brightnesses and different electron beam scanning rates across the screen using different types of photographic materials: "Foto-65", "Foto-130", KN-1, KN-2, "Mikrat-300" as well as on UF photographic paper. Shown in Figure 3 is a sample recording of a test pattern from a CRT screen with a VOE, obtained from a special generator using 35 mm "Mikrat-300" photographic film. A microphotogram of the blackening density distribution in the image on the negative is shown in Figure 4. Microphotometry was performed on the negatives using a set-up designed around the MF-4 microphotometer, in which the light receiver -- a photoelectric cell -- was

As studies showed, when the number of distinguishable elements in the line and frame of the CRT were 500 x 300 respectively, 500 x 300 elements were recorded on the photographic film negative with a contrast of 0.5 - 0.6. The contrast was computed from the formula:

$$k = \frac{t_{\max} - t_{\min}}{t_{\max}},$$

where $t_{\max}$ and $t_{\min}$ are the readings of the microphotometer galvanometer, corresponding to the light flux passing through the light and dark lines of the test pattern for the negative.

In the course of the work, experiments were conducted in photographing images from the CRT screen in real time on UF photographic paper. The experiments showed that for a plate voltage of $U = 6 - 8$ KV, and a beam current of $I = 30 - 40$ μ A, it is possible to obtain high recording of a sinusoidal signal at a frequency of up to 4 MHz on carriers with a dry exposure and developing process.

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GEOPHYSICS, ASTRONOMY AND SPACE

RADIATION ANOMALIES IN CIRCUMTERRESTRIAL SPACE

Moscow NAUKA I ZHIZN' in Russian No 6, 1977 pp 50-55

[Article by Candidates of Physical and Mathematical Sciences L. Razorenov and I. Tindo]

[Text] The altitudes of 200-300 km above the earth's surface are the most studied, "mastered" regions of near space. It is here that flights are made by manned orbital stations and spaceships and many automatic satellites. A good study has been made of the chemical composition of the rarefied atmosphere at these altitudes, its temperature and degree of ionization. Important information has been accumulated on short-wave solar radiation, whose effect determines the state of the earth's upper atmosphere.

But here also, at the very threshold of space, there are still many phenomena whose nature is not thoroughly understood; near space has brought and will continue to bring us more than a few surprises. For example, there was the discovery at an altitude of 200-300 km of zones of intensive penetrating radiation -- radiation "anomalies," closely associated with the radiation belts situated at greater altitudes.

The experiments carried out on satellites and distant space probes demonstrated that interplanetary, and especially circumterrestrial space beyond the limits of the atmosphere by no means is "empty." It is filled with plasma, different kinds of fields and waves, and is permeated by flows of high-energy particles. The interaction between the "solar wind," the flows of hot gas ejected from the solar surface, and the plasma held near the earth by its magnetic field generates a diversity of processes determining, in particular, the "weather" on space trajectories. We register the echoes of these space storms on the earth as magnetic disturbances, auroras and impairments of radio communication in the high latitudes. At times they are manifested in the form of electric breakdowns in the antennas and many other unexpected phenomena.

Magnetic Traps Near the Earth

One of the most outstanding discoveries of the space era up to the present time is the discovery of the earth's radiation belts in 1958 by the Soviet scientists S. N. Vernov and A. Ye. Chudakov and the American researcher

J. Van Allen (Fig. 1). These belts are enormous magnetic traps filled with high-energy charged particles -- with energies of about hundreds of MeV for protons and hundreds of keV for electrons. Such particles were investigated long ago in terrestrial laboratories. Moving in a gas, such as the air, they ionize its molecules, so that these particles are called "ionizing radiation." That, incidentally, is where the radiation belts get their name.

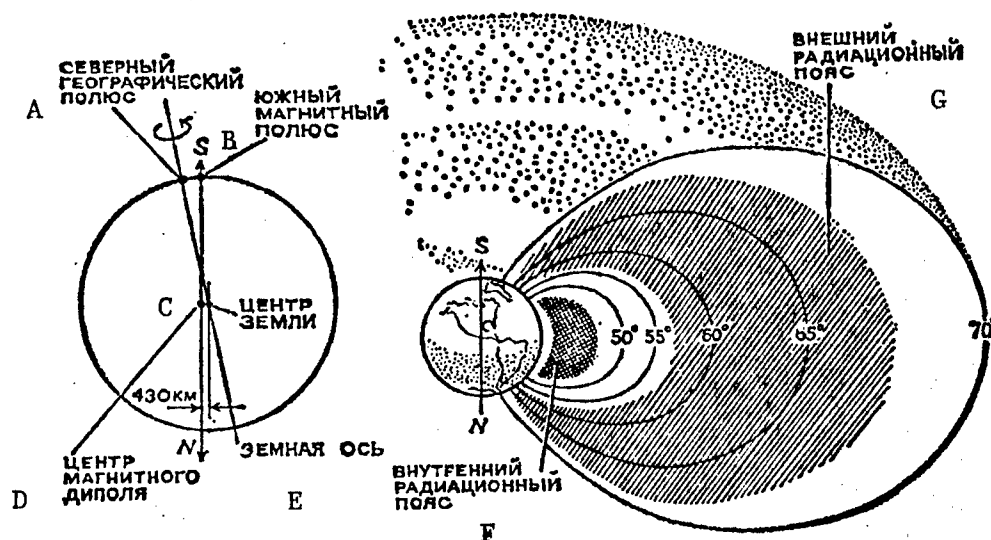
We will examine briefly the peculiarities of motion of the charged particles in the radiation belts. In a uniform magnetic field a charged particle moves under the influence of Lorentz force in a helical line whose configuration is characterized by the radius and the pitch of the helix (Figure 2). The radius ρ -- it is usually called the Larmor radius -- increases with an increase in particle energy and decreases with an increase in magnetic field strength. On the average, the Larmor radius for protons in the inner belt is tens and hundreds of kilometers, whereas for electrons in the outer belt it is tens of meters. The pitch of the helix is determined by the velocity component of the particle along the field direction. In a nonuniform field the Larmor radius and the pitch of the helix naturally change. For example, if a particle moves from the region of the equator to one of the earth's poles, the radius of the helix decreases because in the polar latitudes the magnetic field strength is greater than in the equatorial latitudes. At the same time there is a decrease in the pitch of the helix and the velocity component directed along the field line, that is, the particle moves forward ever more slowly. Under definite conditions the particle can in general turn back and begin motion into the region of lesser magnetic field strengths.

Such a "mirror reflection" of a particle in a slowly increasing magnetic field can be explained by examining its motion in a small segment of its path as rotation in a Larmor circle and movement of this circle itself along the field line. In a uniform field the Lorentz force acts on a particle strictly along the radius of the circle and cannot change the longitudinal velocity component. In an increasing field, where the lines of force converge, the Lorentz force exhibits the component F_{brake} , which is directed perpendicular to the plane of the Larmor circle. Precisely this component brakes the motion of the particle in the region of a stronger magnetic field.

A particle entering into the trap of the earth's magnetic field performs a complex motion in it. It relatively rapidly rotates about a field line and more slowly oscillates along it, that is, it moves from one polar region into another. But this is not all: the particle participates in still another form of motion. It "drifts" -- gradually moving across the field lines in a direction from west to east or from east to west, depending on the sign of its charge.

Figure 3 explains the reason for the drift in a nonuniform field. We will assume that the field lines are directed perpendicular to the plane of the figure and in regions closer to the earth (lower part of figure, below the line AB) the field is stronger, that is $H_2 > H_1$; above and below the line

AB the field is uniform. Then motion above and below the line AB will be in semicircles of different radii, as shown in the figure. As a result, the particle will gradually move in the direction from A to B.



A) North Geographic Pole; B) South Magnetic Pole; C) Earth's Center; D) Center of Magnetic Dipole; E) Earth's Axis; F) Inner Radiation Belt; G) Outer Radiation Belt

Fig. 1. Diagram of arrangement of earth's radiation belts. The figures denote the geomagnetic latitude at which a particular line of force of the earth's magnetic field intersects the earth's surface. The lower boundary of the inner belt passes over the equator at altitudes 500-1,000 km. The zone is filled with protons with energies of the order of 30-100 MeV and electrons with energies of several tens of keV. At the center of the belt the proton flux attains 10^4 particles/cm²/sec; the electron flux attains 10^5 - 10^6 particles/cm²/sec. The outer belt approaches the earth to 400 km in the high latitudes; in the equatorial region its altitude is 10,000-12,000 km. In the makeup of this belt there is a predominance of electrons with an energy of hundreds of keV; at the center of the belt their flux attains 10^6 - 10^7 particles/cm²·sec.

Even those who do not wish to delve into the details of motion of charged particles in the earth's magnetic field will undoubtedly be surprised by the figures characterizing the rate of these motions. Here are the figures -- in the geomagnetic field a proton with an energy of several MeV as a result of drift performs an "around-the-world" journey in a few minutes. Its flight from one polar region to another occurs in a fraction of a second. However, motion in a Larmor circle (one revolution) requires a time interval at least a hundred times less. The particles which over a long period of time perform this complex motion are precisely those which form the earth's radiation belts.

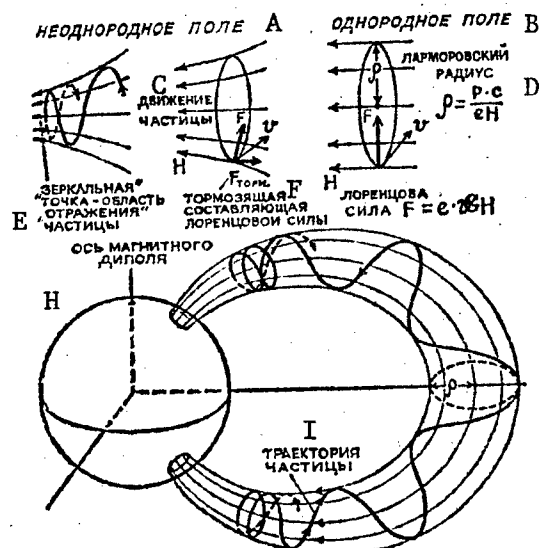


Fig. 2. Particle trapped in the trap of the earth's magnetic field. It performs an oscillatory motion along a line of force, being reflected near the poles, at the so-called mirror points. The reflection is attributable to the fact that a braking component of the Lorentz force arises and this hinders the motion of particles in the region of a stronger field. A) nonuniform field; B) uniform field; C) particle motion; D) Larmor radius; E) "mirror point" — region of reflected particle; F) braking component of Lorentz force; G) Lorentz force; H) axis of magnetic dipole; I) particle trajectory

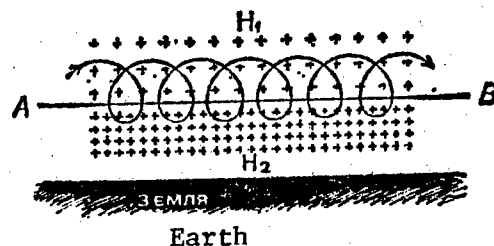


Fig. 3. Diagram of drift motion of charged particle in nonuniform magnetic field. The field lines of force are directed perpendicular to the plane of the figure. The field strength H_2 below the line AB exceeds the field strength H_1 above this line.

The time of presence of protons in the radiation belts is limited in the first place to the energy losses during their collisions with atmospheric atoms. For electrons it is more important that in such collisions there is a change in the direction of particle motion and as a result of this there can be an impairment in the "mirror reflection" condition. Most frequently the collisions occur in the lowest parts of the drift trajectory, near the so-called mirror points.

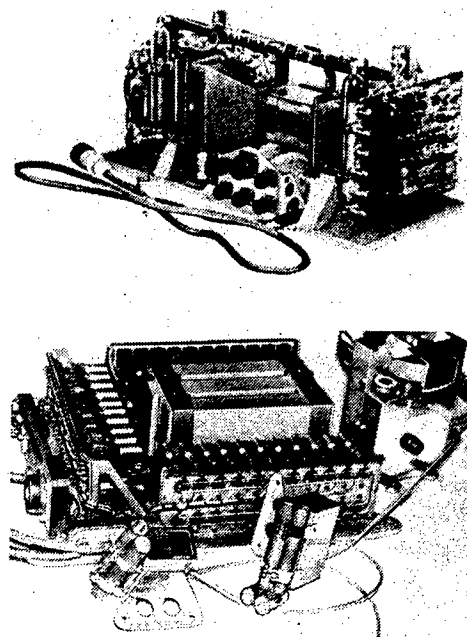


Fig. 4. Instruments which were carried aboard the second and third Soviet satellite ships. Using these instruments specialists discovered the South Atlantic and Southern radiation anomalies. The upper figure shows an instrument for analyzing the charge makeup of cosmic rays, whereas the lower photograph shows an X-ray photometer. In the lower part of this photograph one can see the X-ray and background units of the sensors mounted on the outside of the ship on a platform of the solar orientation system. At the right of the photograph is the unit with the X-ray counters mounted on the ship's skin. At the center is the unit with the electronic recording apparatus.

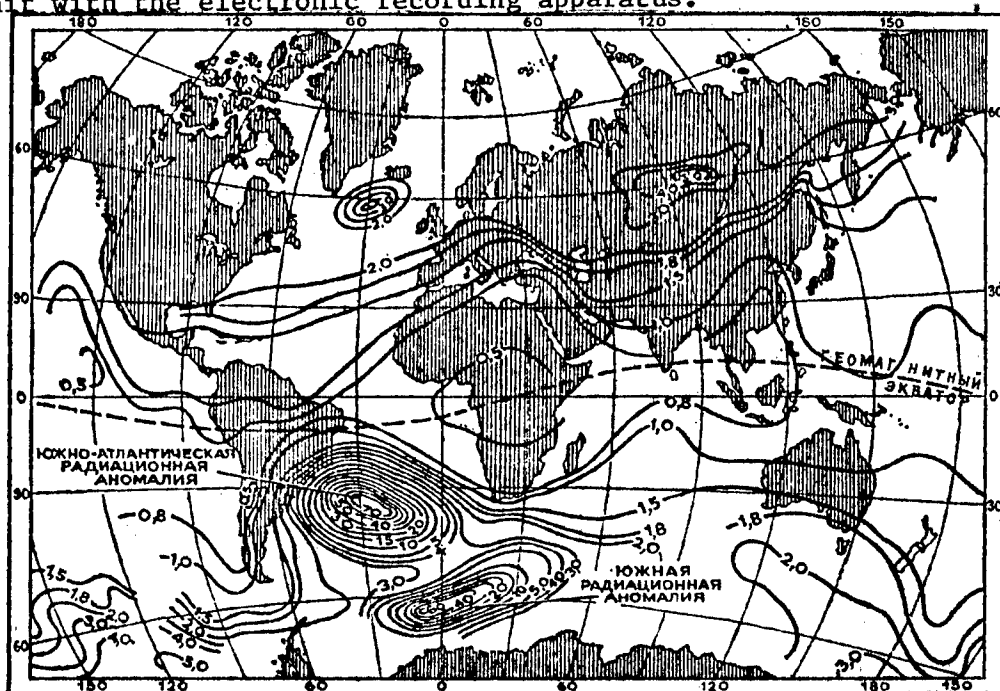


Fig. 5. Distribution of intensity of "trapped" radiation and cosmic rays at an altitude of 300 km (according to data from the third Soviet satellite ship). The figures on the lines of equal intensity show the number of readings of the gas-discharge counters of the cosmic ray telescope per second.

If the geomagnetic field was strictly symmetric relative to the center of the earth, the drift phenomenon would not change the altitude of the mirror points. The lower boundary of the radiation belt would coincide with the upper boundary of the atmosphere. In actuality, the center of the magnetic dipole, which in the first approximation reflects the earth's magnetic field, is displaced relative to the earth's center by approximately 430 km and is situated in the eastern hemisphere. Therefore, with the drift of a particle around the earth it approaches the earth at different longitudes and to different degrees.

In order to visualize more graphically the picture of drift motion of particles in the real geomagnetic field it is convenient to introduce the concept "drift shell" — the surface along which the center of the Larmor circle of the trapped particle moves. It is clear that the drift shells are symmetric relative to the center of the magnetic dipole but not symmetric relative to the center of the earth. For example, the shells which pass in the eastern hemisphere (Europe, Asia, Africa) at altitudes 200-800 km in the western hemisphere (America) are submerged in the atmosphere and even reach the earth's surface. With drift in such a shell a particle must perish; disappear from the radiation belt, not making even one revolution around the earth. Proceeding on the basis of such considerations, an estimate was made of the altitude of the lower boundary of the inner radiation belt in the equatorial region -- approximately 500 km in the western hemisphere and 1,000 km in the eastern hemisphere.

The particle concentration in the radiation belts on the average is invariable and this means that there must be sources replenishing the loss of particles. The Soviet scientists S. N. Vernov, A. I. Lebedinskiy and A. Ye. Chudakov have demonstrated a possible source replenishing the loss of high-energy particles in the inner belt -- the mechanism of neutron albedo of the atmosphere. Albedo (this word is translated as "whiteness," "degree of reflection") in this case denotes the flux of neutrons arising during nuclear interaction of the main component of cosmic rays -- relativistic protons -- with atoms in the upper atmosphere. High-energy cosmic protons freely penetrate within the magnetic trap of the radiation belts, but are not held in the drift shells. At the same time, with their interaction with the atmosphere a considerable quantity of neutrons is generated; these have an energy less than that of a primary proton. These neutrons are propagated without obstacle in circumterrestrial space and soon break down into protons and electrons. Some of these particles are trapped in the trap of the geomagnetic field, replenishing the natural loss of high-energy particles in the inner radiation belt.

Radiation Anomalies and Lifetime in the Belts

The hypothesis of filling of the inner radiation belts with protons and electrons forming during the decay of neutrons has one weak place: the intensity of the postulated source of particles scarcely suffices,

according to computations, for replenishing their natural loss. The situation was still further complicated when three groups of Soviet physicists, directed by V. L. Ginzburg and S. L. Mandel'shtam (Physics Institute USSR Academy of Sciences) and S. N. Vernov (Nuclear Physics Institute Moscow State University), discovered stable zones of intensive radiation at altitudes of 200-300 km (Figure 5). This discovery was made in August and December 1960 using instrumentation carried on the second and third Soviet spaceship satellites. The region of intensive radiation situated over the southern part of the Atlantic Ocean and associated with the inner radiation belt was given the name South Atlantic or Brazilian radiation anomaly. Another region, situated along the shores of Antarctica and associated with the outer radiation belt, has been given the name Southern radiation anomaly.

Atmospheric density at the altitudes of about 200 km is 500-1,000 times greater than at an altitude of 500-1,000 km and the entry of radiation belt particles into regions with a denser atmosphere means their rapid destruction as a result of collision with atmospheric atoms. Therefore, the lifetime of particles in the belt is almost 50 times less than was expected earlier and the source replenishing the losses of particles accordingly must be more powerful.

What are the reasons for the formation of zones of intensive radiation at such low altitudes? The fact is that the earth's real magnetic field is close to the field of a magnetic dipole only at great distances of the order of several earth radii from the earth's center. At the earth's surface there are several gigantic regions -- magnetic anomalies, where deviations from the dipole field are particularly great. The largest "negative" anomaly is situated in the southern part of the Atlantic Ocean: the magnetic field strength here is less than at any other point on the earth's surface. Accordingly, even at altitudes of 200-300 km the magnetic field over the South Atlantic is minimum. As shown by computations of the trajectories of particles, this leads to a lowering of the mirror points to altitudes of about 200 km. However, the drift shells which pass through this region still remain closed since the trajectories of the drifting particles do not graze the dense atmosphere at other longitudes.

Due to drift, most of the radiation belt particles, regardless of the place of their capture in the trap, with the course of time enter into the region of the magnetic anomaly. The existence of the South Atlantic radiation anomaly reduces the lifetime of particles in the inner belt from tens of years to one year. Moreover, during magnetic storms, when the geomagnetic field experiences sharp changes, the stationary regions of trapping are displaced and the particles frequently "leak" to lesser altitudes, where they are naturally decelerated and escape from the radiation belts still more actively. Such "leakage" of particles from the outer radiation belt is frequently observed in the high latitudes. The particles of the more stable inner belt "leak" only during strong magnetic storms. Marked increases in the intensity of radiation at an altitude of 40 km in the stratosphere, observed by Brazilian scientists at the time of flights

of high-altitude balloons in the region of the South Atlantic anomaly, owe their appearance precisely to this sort of "leakage."

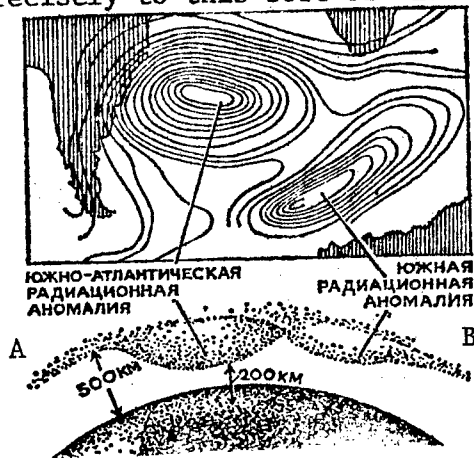


Fig. 6. Diagram of location of radiation anomalies in southern hemisphere. A) South Atlantic radiation anomaly; B) Southern radiation anomaly

Thus, even without allowance for "leakage," the intensity of the mechanism of neutron albedo, it would seem, is considerably less (approximately by a factor of 50) than that necessary for maintaining a constant number of particles in the inner radiation belt. And nevertheless the most recent data on albedo neutrons has shown that the number of these neutrons is adequate for filling the belt with protons with an energy greater than 30 MeV. These data were obtained in experiments with high-altitude balloons. It was found that the flux of albedo neutrons was sufficiently great; it is only necessary to take into account the neutrons moving in a horizontal direction whose flux is 20 times greater than the earlier measured flux of vertically moving neutrons. The first observations of the total flux of neutrons carried out in space quite recently on the Indian satellite "Ariabata" also confirmed this conclusion. The satellite was launched in accordance with the joint Soviet-Indian program for the exploration of space within the framework of the "Interkosmos" program.

There is also another mechanism for the filling of the radiation belts: due to the particles of interplanetary plasma entering into the earth's magnetosphere and accelerated during movement into the depths of the magnetosphere. This mechanism makes it possible to explain the appearance in the radiation belts of particles of relatively low energies.

Flares and Composition of Belt Particles

The discovery of zones of intensive radiation at the altitudes where the orbits of manned spaceships pass made it necessary to carry out a serious study of the problems of radiation safety of flights.

Fortunately, a satellite rapidly passes through the region of the anomalies and at the same time enters into it on two or three revolutions of a 17-revolution daily flight. In addition, a considerable fraction of the

particles in the anomalies does not have a sufficient energy to pass through the ship's skin. Nevertheless, in the South Atlantic anomaly it was possible to observe definite effects of the influence of radiation on cosmonauts. Here it is necessary to mention the direct influence of high-energy charged particles on the human eye. The entry of such a particle into the eye causes a sensation of a weak light flash (see NAUKA I ZHIZN', No 9, 1973).

In space this type of light flash was first noted by American astronauts during the flight of the "Apollo" ship to the moon. It can be postulated that the flashes should have been discovered earlier, during the time of other flights; the only reason that this did not occur was probably because the total adaptation of the eyes to the darkness is necessary for observation of the flashes. In circumterrestrial space the flashes were observed for the first time by N. N. Rukavishnikov during flight of the "Soyuz-10" ship.

Figure 6 shows the results of observation of the flashes registered by the crew of the "Skylab-4" orbital station, during flight over the South Atlantic anomaly, and also in the region of the high latitudes where the intensity of cosmic rays increases. In this experiment for the first time it was possible to establish reliably the dependence of the number of observed flashes on the cosmic ray flux. A close correlation was unexpectedly discovered between the flashes and the number of "trapped" particles during flight through the region of the South Atlantic radiation anomaly.

The nature of the observed flashes is still not entirely clear. The experiments carried out in space and in accelerators indicate that a charged particle, leaving an ionization track in the retina, is perceived as a weak light flash. But the flashes evidently can also be caused by Cerenkov radiation arising during the flight of a particle through the crystalline lens and the vitreous body of the eye.

Far from the earth, beyond the outer boundary of the radiation belts, the flashes can be caused by multiply charged nuclei present in the composition of cosmic rays. The value of the particle charge is important because the intensity of the Cerenkov radiation and the ionization created by the particle are proportional to the square of the charge. Therefore, the iron nucleus (nuclear charge +26), for example, should create a flash a thousand times stronger than a singly charged particle. To be sure, a sufficiently high energy (velocity) of a particle is also important for the appearance of flashes. Thus, Cerenkov radiation is given only by particles with a velocity exceeding the speed of light in this medium.

In the radiation belts it is primarily singly charged particles, protons and electrons, which enter the retina. They can cause only "flashes" whose intensity falls below the threshold of ocular response. However, the eye adapted to the darkness nevertheless registers light flashes during flight through the anomalies. What particles create them? For explaining the

phenomenon a detailed count was made of the number of secondary nuclei with a charge greater than 2 which can be formed in the spaceship skin and in the observer's eye during flight through the South Atlantic anomaly. The computed value was 5-7 times less than the registered number of flashes. So that this explanation of the observed effect was refuted. It is possible that the flashes are caused by particles with a charge greater than 2 present in the form of a small admixture in the radiation belts, but this version can be confirmed only by precise measurements.

Twenty Years Later

During the passing years space has brought man many surprises. One of these was the discovery of radiation anomalies in the region of the South Atlantic, gigantic "sacks" filled with high-energy ionizing particles situated on the path of spaceships and orbital stations. But even outside the region of the anomalies on days when there are powerful flares on the sun, near-space is permeated by powerful fluxes of cosmic ray particles of solar origin. Therefore, the choice of the trajectory for a manned ship and the time of its launching is made with careful allowance for the location and configuration of regions of radiation anomalies and the prediction of solar activity.

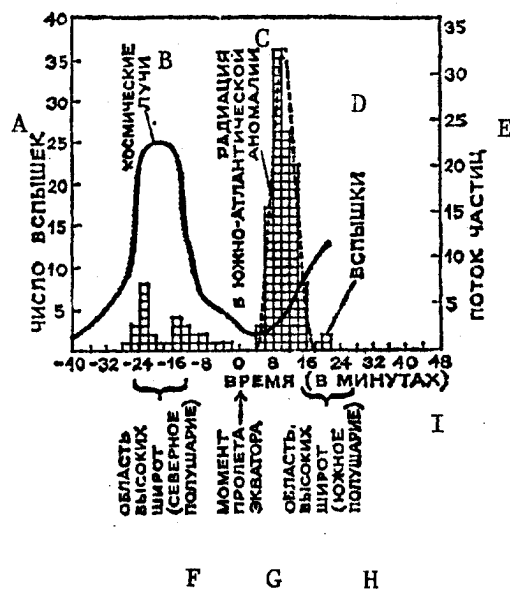


Fig. 7. During flight through the South Atlantic anomaly the number of light flashes observed by an astronaut (each flash is represented by a square) changed proportionally to the intensity of the trapped particles registered by the instruments. In the northern latitudes (flight time from -28 to -8 minutes relative to the time of flight over the equator) there is a correlation between the number of flashes and the counted number of cosmic particles with a charge $z = 2$. A) Number of flashes; B) Cosmic rays; C) Radiation in South Atlantic anomaly; D) Flashes; E) Particle flux; F) High-latitude region (northern hemisphere); G) Time of equatorial transit; H) High-latitude region (southern hemisphere); I) Time (in minutes)

On the other hand, study of the radiation anomalies and the dynamics of their changes still retains great importance for an understanding of the principal processes transpiring in the earth's magnetosphere and in the radiation belts: the "leakage" of particles from the magnetic trap and the effect of a powerful source of high-energy particles again filling the trap after days of intensive "leakage." Here there is still much to investigate. In particular, still unclarified are important details of the mechanism of acceleration of particles of solar origin during their motion in the magnetosphere. It has been postulated, for example, that this mechanism has much in common with the acceleration of particles in the process of solar flares.

And in all cases the magnetosphere remains a unique plasma astrophysical laboratory. In it specialists can make a direct and detailed study of the physical processes which for the time being cannot be reproduced in terrestrial laboratories. Understanding the importance of a multisided approach to study of the phenomena transpiring in the radiation belts and magnetosphere, the scientists of 20 countries have planned for 1976-1978 a broad research program, the "International Magnetospheric Experiment," providing for not only the launching of special satellites and rockets, but the organization of a broad network of ground observations. It can be hoped that as a result of these joint efforts, in the next few years new light will be cast on the problem of the origin and life of the radiation belts.

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GEOPHYSICS, ASTRONOMY AND SPACE

USSR, GDR COOPERATE IN INTERKOSMOS SPACE PROGRAM

Moscow SOVETSKAYA ROSSIYA in Russian 14 May 77 p 3

[Article by Special Correspondent B. Gerasimov: "The Stars of Interkosmos on Earth"]

[Text] Circumterrestrial space is becoming an arena of international scientific-technical cooperation of continually greater scope. The "stellar" achievements of socialist countries which have united their efforts within the framework of the Interkosmos program are highly indicative.

"Bulgaria, Hungary, the GDR, Cuba, Mongolia, Poland, Romania, and the USSR are participating in joint orbital research," states USSR Academy of Sciences Academician D. N. Petrov, chairman of the Interkosmos Council. "Scientists and specialists of these countries are developing apparatus for artificial satellites and geophysical rockets, as well as various ground systems and instruments to support particular experiments. Science has been considerably enriched with information on the Sun and the Solar System as a result of joint research. Our concepts about Earth itself have also broadened noticeably. This pertains first of all to our understanding of the complex physical processes which literally seethe in the ionosphere and magnetosphere. Joint study of the planet's natural resources 'from on high' is also producing good results. It all began with the Raduga experiment conducted in September of last year by cosmonauts Bykovskiy and Aksenov using original apparatus developed jointly by specialists of the USSR and the GDR and manufactured at the national Carl Zeiss (Jena) firm."

The countries of the socialist fraternity are naturally interested in space. Prestige has nothing to do with it. What is important is the substantial scientific and practical payoff of each successive orbital experiment. The results of the recent flights by Bykovskiy and Aksenov aboard the Soyuz-22 spacecraft are noteworthy in this aspect.

Academician Klaus Grote, general secretary of the GDR Academy of Sciences, described this experiment, pridefully displaying a number of fabulous color photographs of the country's northern regions taken from space by the Soviet crew.

"These photographs," the academician explained, "have provided new information on what seemed to have been known regions of the country, roamed and studied far and wide by our specialists. But such is the uniqueness of information gathered from space; it allows us to 'see the big picture from afar.' As we know, the MKF-6 multizonal camera, which works in six bands of the spectrum, was tested aboard the manned Soyuz-22 spacecraft. By synthesizing the photographs taken in these bands we were able to obtain highly informative color images of the regions we were studying. Sharpness of the photographs was insured by correcting for "blurring" of the Earth's surface due to the spacecraft's tremendous speed (8 km per second) above our planet. The objectives of the MKF-6 in a sense hovered motionless above the target of photography. The coverage of the photographs is also remarkable, since each section was photographed with a certain overlap (a stereo pair effect).

"Analysis of what has been 'seen' from space and of photographs taken from airplanes during the preliminary tests of the camera," K. Grote continued, "permitted us to reveal so-called tectonic faults on the territory of the GDR. In the opinion of specialists, such formations offer considerable promise to mineral prospecting. In other words we know our country better now than we did before. Moreover, this knowledge carries with it the promise of a significant economic impact. Let me explain this with a concrete example: Drilling of exploratory gas wells has been started in the northern regions of the GDR. Consider that we must drill deep--on the order of 5 km. Of course this is expensive--each well costs about 10 million marks. Thus we now select the well sites on the basis of the recommendations of scientists taking account of information obtained from space. It is entirely probable that the number of 'empty wells' will decrease, meaning a savings of tens of millions of marks."

A special commission representing the "cosmic" interests of not only geologists but also farmers, hydrologists, geophysicists, oceanographers, foresters, and other specialists is already operating successfully today under the GDR Academy of Sciences. All of these specialists place great hopes on the prospects presented by photographing the Earth's surface within narrow bands of the spectrum.

"We are grateful to the Soviet Union," said Academician K. Grote, "for the possibility for such fruitful scientific-technical cooperation, and for the high evaluations given to German instruments and apparatus for satellites and manned spacecraft by Soviet scientists, engineers, and cosmonauts. Around 80 instruments manufactured at our enterprises have already traveled in space. To this we should also add 50 ground devices also created in the GDR under the auspices of the Interkosmos program."

Every new instrument is developed in close, friendly contact with Soviet specialists. Thus creative ties have been in existence for many years between the Institute of Space Research of the USSR Academy of Sciences and the Institute of Electronics of the GDR Academy of Sciences. Other organizations of the fraternal countries are cooperating fruitfully as well.

Worthy of note is the fact that the weight and size restrictions on satellite equipment at first seemed too rigid to our German friends. But this problem was solved during the very first years of development of space instrument making by laying out the apparatus in a better way and using new, effective components. Today, specialists of the GDR note with satisfaction the positive influence of space on purely terrestrial instruments as well; these instruments have become more compact, reliable, and economical. Moreover, and this is especially important, consumption of materials and raw materials in short supply has been decreased. Working jointly with scientific research institutes and VUZ's, the GDR Academy of Sciences is broadly publicizing the achievements of space technology and is recommending introduction of the best methods into industry.

Instruments intended for space are making their way into the design offices of major plants everywhere. Thus the republic's machine builders became interested in remote control systems (developed by the GDR for the Interkosmos-16 satellite) and began using them to design and test new diesel engines. The miniature radio transducers of these systems are "working" today in the moving units of high-power engines, making it possible to keep the entire structure under constant control and providing highly precise information on loads and deformations. Such "space diagnosis" guarantees creation and fast introduction of the most advanced technological principles into practice. Telemetric transducers are also often used in medicine as well as in the frontiers between different sectors of science and technology.

One can gain a sufficiently graphical acquaintance with the work done by the GDR within the framework of the Interkosmos program at the Carl Zeiss (Jena) firm. Its history is inseparably associated with the history of the workers' movement; it reflects the development and decline of capitalism, and it attests to the tremendous advantages of the socialist economic system, the foundation of which had been laid by the Great October Revolution.

Not long before the collapse of Hitler's Germany, Anglo-American bombers severely destroyed the Zeiss plant. Then in April 1945 monopolies of the USA took from the plant dozens of its most prominent specialists, unique equipment, and 180,000 invention patents and descriptions.

But under the party's guidance and with considerable support from friends from the Soviet Union, the workers and engineers of the GDR managed not only to rebuild the largest national enterprise but also to significantly expand it and adapt it to support scientific-technical progress in optics and precision mechanics, the foundations for development of many of the leading industrial sectors.

"The workers and engineers of our enterprise," said Dr Myuller, the plant's director for special developments, "understand quite well the importance of progress in scientific instrument making, which contributes actively to development of chemistry, cybernetics, astronomy, and atomic energy. Our main goal is to produce high-quality products and to continually broaden their scientific and technical capabilities."

The enterprise collective worked with great inspiration to complete the order for the Raduga project. The MKF-6 multizonal camera is the pride of German workers and engineers, who have embodied in metal a highly complex unit designed by specialists of the USSR and GDR. Scientists from Moscow and Berlin regularly visited the Jena plant as the apparatus was assembled and adjusted; they made improvements upon certain parameters of the system and noted with satisfaction the high quality of all of its units. Then the MKF-6 underwent hard examinations on the ground and in the air, and it was tested in the presence of accelerations, temperature changes and other factors that might be encountered along the flight path in space. The MKF-6 behaved faultlessly in all conditions, and soon it was given the green light it deserved to proceed to the (Baykonur) space launching complex.

I met Gerd Vol'fel'dt, the foreman of the experimental shop, in Jena. The workers of this shop were assembling space apparatus for a Soviet craft with great love.

"Our collective wished Bykovskiy and Aksenov a successful flight with all of our hearts," Vol'fel'dt said. "We are also very happy with the evaluation the cosmonauts made of the new camera. Soon after the flight, the crew visited the enterprise as our guests and made a number of proposals to make the next instruments we design for space even better. Our shop teams take pride in the fact that the collective is trusted to implement the most progressive ideas of scientific-technical progress. We are working in the present jubilee year with special enthusiasm. After all, the holiday of Great October is also our holiday. This is why the entire plant collective began a socialist competition in honor of the approaching noteworthy anniversary and adopted new, higher pledges."

Portraits of comrades Leonid Il'ich Brezhnev and Erich Nonecker hang in many of the enterprise's shops and laboratories. The workers speak with great warmth about the everlasting friendship which binds the laborers of the Soviet Union and the GDR together, and they lovingly recall CPSU Central Committee General Secretary Comrade L. I. Brezhnev's speech at a plant meeting.

"Your plant," Leonid Il'ich said, "is an example of what laborers can do when they become the masters of their own enterprise.... Today, the fruits of your work belong to the people, to the socialist state. They serve the cause of peace and scientific-technical progress."

The cause of peace, the cause of progress. These concepts are inseparable from one another. Cooperation of growing strength among socialist countries laying the highway into space is an example of this.

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SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

LIST OF WORKS COMPETING FOR LENIN, STATE PRIZES IN SCIENCE AND TECHNOLOGY

Moscow IZVESTIYA in Russian 21 May 77 pp 4-5

[List of works: "From the Committee for Lenin and USSR State Prizes in the Field of Science and Technology of the USSR Council of Ministers"]

[Text] The Committee for Lenin and USSR State Prizes in the Field of Science and Technology of the USSR Council of Ministers reports that the following works are to take part in the 1977 competition for USSR State Prizes:

1. Andrianov, A.N., "CYCLE OF WORKS ON THE THEORY OF ZETA FUNCTIONS OF MULTIDIMENSIONAL MODULAR FORMS."
Submitted by the Leningrad Branch of the Mathematics Institute imeni V.A. Steklov of the USSR Academy of Sciences.
2. Besov, O.V., Il'in, V.P., Nikol'skiy, S.M., "INTEGRAL REPRESENTATION OF THE FUNCTIONS AND THEOREM OF ENCLOSURE" (Monograph, Nauka, Moscow, 1975).
Submitted by the Mathematics Institute imeni V.A. Steklov of the USSR Academy of Sciences and the Siberian Branch of the USSR Academy of Sciences.
3. Glushkov, V.M., Derkach, V.P., Kapitonova, Yu.V., "THEORY OF DISCRETE TRANSDUCERS AND METHODS OF AUTOMATION IN DESIGN OF ELECTRONIC COMPUTERS USED IN EXISTING SYSTEMS." (Cycle of works).
Submitted by the Scientific-Research Center of Electronic Computing Technology and the Mathematics Institute imeni V.A. Steklov of the USSR Academy of Sciences.
4. Ditkin, V.A., Maslov, V.P., Prudnikov, A.P., "CYCLE OF WORKS ON OPERATOR COMPUTATION" (1973-1975).
Submitted by the Computing Center of the USSR Academy of Sciences.
5. Osipov, A.I., Platonenko, V.T., Stupochenko, Ye.V., Losev, S.A., Gordiyets, B.F., Konyukhov, V.K., Orayevskiy, A.N., Shelepin, L.A., Shcheglov, V.A., Vargin, A.N., Vasil'yev, G.K., Tal'roze, V.L., "DEVELOPMENT OF PROBLEMS OF THE KINETICS OF RELAXION PROCESSES IN ESSENTIALLY NONEQUILIBRIUM GASEOUS SYSTEMS AND ITS APPLICATION IN MOLECULAR LASERS."
Submitted by the Physics Faculty of Moscow State University imeni M.V. Lomonosov.

6. Mandel'shtam, S.L., Vasil'yev, B.N., Zhitnik, I.A., Tindo, I.P. Shurygin, A.I., "ROENTGEN EMISSION OF THE SUN" (Cycle of works).

Submitted by the Physics Institute imeni P.N. Lebedev of the USSR Academy of Sciences.

7. Pis'mennyy, V.D., Rakhimov, A.T., Andriyakhin, V.M., Belenov, E.M., Bogdankevich, O.V., Vavilov, V.S., Danilychev, V.A., Orlov, V.K., Popov, Yu.M., Suchkov, A.F., Cheburkin, N.V., "DEVELOPMENT OF PHYSICAL PRINCIPLES, CREATION AND INVESTIGATION OF LASERS ACTUATED THROUGH THE USE OF IONIZING IRRADIATION" (Cycle of works 1957-1975).

Submitted by the Institute of Atomic Energy imeni I.V. Kurchatov and the Physics Institute imeni P.N. Lebedev of the USSR Academy of Sciences.

8. Rumanova, I.M., Borisov, S.V., Ilyukhin, V.V., Kuz'min, E.A., Andrianov, V.I., Zhidkov, N.P., Reznikov, F.P., Simonov, V.I., Tarnopol'skiy, B.L., Tovbis, A.B., Kheyker, D.M., Shchedrin, B.M., "DEVELOPMENT AND INTRODUCTION OF DIRECT METHODS AND DIFFRACTOMETRIC APPARATUS FOR THE DETERMINATION OF CRYSTAL STRUCTURES."

Submitted by Gor'kiy State University imeni N.I. Lobachevskiy and the Institute of Crystallography imeni A.V. Shubnikov of the USSR Academy of Sciences.

9. Cherenkov, P.A., Gorbunov, A.N., Varfolomeyev, A.G., Taran, G.G., Fetisov, V.N., Vatset, P.I. Voloshchuk, V.I., Khokhlov, Yu.K., Gerasimov, S.B., Dzhibuti, R.I., Kopaleyshvili, T.I., "INVESTIGATION OF SPLITTING OF LIGHT NUCLEI WITH HIGH-ENERGY γ -RAYS WITH THE METHOD OF WILSON'S CHAMBER OPERATING IN POWERFUL BEAMS OF ELECTRONIC ACCELERATORS" (Cycle of works).

Submitted by the Physics Institute imeni P.N. Lebedev of the USSR Academy of Sciences.

10. Buchachenko, A.L., Likhtenshteyn, G.N., Rozantsev, E.G., "CREATION OF A NEW CLASS OF STABLE ORGANIC RADICALS AND THEIR USE IN CHEMISTRY AND MOLECULAR BIOLOGY."

Submitted by the Institute of Chemical Physics of the USSR Academy of Sciences.

11. Minachev, Kh.M., Garanin, V.I., Isakov, Ya.I., "SCIENTIFIC BASES FOR THE CREATION OF NEW ZEOLITE CATALYSTS" (Cycle of works).

Submitted by the Institute of Organic Chemistry imeni N.D. Zelinskiy of the USSR Academy of Sciences.

12. Rebinder, P.A., Shchukin, Ye.D., Goryunov, Yu.V. Pertsov, N.V. Likhtman, V.I., Bryukhanova, L.S., Danilova, F.B., Koshevoy, N.S., "CYCLE OF WORKS ON ADSORPTION REDUCTION OF DURABILITY OF HARD BODIES."

Submitted by the Chemistry Faculty of Moscow State University imeni M.V. Lomonosov.

13. Sadykov, A.S., Aslanov, Kh., Kuzhmuradov, Yu., "ALKALOIDS OF THE QUINOLYSIDINE SERIES" (Monograph, Nauka, Moscow, 1975).

Submitted by Tashkent State University imeni V.I. Lenin.

14. Sadykov, K.G., Khamidov, V.A., Rutskey, A.G., Aleshin, A.M., Rummyantsev, I.I., Borisov, V.M., Kipriyanov, Yu.I., Il'gisonis, I.V., Sadovskiy, G.B., Lykov, M.V., Bachkarev, G.S., "DEVELOPMENT AND BROAD INDUSTRIAL INTRODUCTION OF EQUIPMENT AND TECHNOLOGY OF REPROCESSING POOR PHOSPHATE ORES OF THE KARATAU BASIN INTO HIGHLY CONCENTRATED FERTILIZERS."

Submitted by the Almalyk Chemical Plant.

15. Marfunin, A.S., "CYCLE OF WORKS ON THE PHYSICS OF MINERALS" (1974-1975). Submitted by the Institute of Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry of the USSR Academy of Sciences.

16. Pusyrev, N.N., Babayan, G.D., Bochanov, A.I., Yegorov, G.V., Krylov, S.V., Kuznetsov, V.K., Mandel'baum, M.M., Mishen'kin, B.P., Monastirev, V.K., Rudnitskiy, A.L., Suvorov, V.D., Chichinin, I.S., "METHODS AND APPARATUS FOR REGIONAL SEISMIC RESEARCH IN DIFFICULT OF ACCESS LOCALITIES AND THEIR USE IN SIBERIA."

Submitted by the Institute of Geology and Geophysics of the Siberian Department of the USSR Academy of Sciences.

17. Sergeyev, Ye.M., Gerasimova, A.S., Yershova, S.B., Trofimov, V.T., Baulin, V.V., Zakharov, Yu.F., Mel'nikov, Ye.S., Sergeyev, A.I., "CYCLE OF MONOGRAPHIC WORKS AND ORIGINAL CHARTS ON ENGINEERING GEOLOGY, ENSURING EFFECTIVE NATIONAL-ECONOMIC DEVELOPMENT OF WESTERN SIBERIA" (1967-1976).

Submitted by the Geology Faculty of Moscow State University imeni M.V. Lomonosov.

18. Sinitsyn, V.M., "CYCLE OF WORKS ON ANCIENT CLIMATES OF THE EARTH" (1966-1976).

Submitted Leningrad State University imeni A.A. Zhdanov.

19. Kort, V.G., Bezrukov, P.L., Bogorov, V.G., Bruyevich, S.V., Burkov, V.A., Vinogradov, M.Ye., Dobrovol'skiy, A.D., Zenkevich, L.A., Lisitsyn, A.P., Parin, N.V., Rass, T.S., Samoylenko, V.S., "THE PACIFIC OCEAN" (Monograph in 10 volumes, Nauka, Moscow, 1966-1974).

Submitted by the Institute of Oceanology imeni P.P. Shirshov of the USSR Academy of Sciences.

20. Beker, M.Ye., Bukin, V.N., Viyestur, U.E., Liyepin' G.K., Kutseva, L.S., Val'dman, A.R., Beker, V.F., Riba, Ye.L., Sedvald, A.K., Latsars, A.A., Ruklish, M.P., "DEVELOPMENT OF THE SCIENTIFIC BASES FOR MICROBIOLOGICAL PRODUCTION OF FODDER LYSINE."

Submitted by the Latvian SSR Academy of Sciences.

21. Kudryashov, B.A., "BIOLOGICAL PROBLEMS OF REGULATION OF THE LIQUID STATE OF THE BLOOD AND ITS COAGULATION" (Monograph, Meditsina, Moscow, 1975).

Submitted by the Biology Faculty of Moscow State University imeni M.V. Lomonosov.

22. Knorozov, Yu.V., "STUDY OF THE MAYAN WRITTEN LANGUAGE (DECIPHERING, TRANSLATION)" (Cycle of works).

Submitted by the Institute of Ethnography imeni N.N. Miklukho-Maklay of the USSR Academy of Sciences.

23. Nechkina, M.V., "VASILIIY OSIPOVICH KLYUCHEVSKIY, STORY OF LIFE AND CREATIVE WORK" (Nauka, Moscow, 1974).

Submitted by the Institute of USSR History of the USSR Academy of Sciences.

24. Beloded, I.K., "PATTERNS IN THE DEVELOPMENT OF THE LANGUAGES OF THE SOCIALIST NATIONS OF THE USSR" (Cycle of works 1960-1974).

Submitted by the Institute of Linguistics imeni A.A. Potebni of the Ukrainian SSR Academy of Sciences.

25. Voronenko, M.S., Dobrik, V.F., Zhovchak, A.M., Kaminskaya, G.F., Kurovskiy, L.F., Marchenko, I.S., Petrovskiy, S.O., Pribylo, T.V., Trofimov, V.V., Udovichenko, Ye.T., Tsaryuk, N.M., "DEVELOPMENT OF SCIENTIFIC PRINCIPLES AND ADOPTION AT ENTERPRISES OF L'VOVSKAYA OBLAST OF A COMPREHENSIVE SYSTEM OF PRODUCTION QUALITY CONTROL ENSURING INCREASED EFFECTIVENESS OF PRODUCTION AND IMPROVEMENT OF PRODUCT QUALITY."

Submitted by the Western Scientific Center of the Ukrainian SSR Academy of Sciences.

26. Inozemtsev, N.N., Mileykovskiy, A.G., Martynov, V.A., Nikitin, S.M., Entov, R.M., Rymalov, V.V., Kudrov, V.M., Pevzner, Ya.Kh., Diligenskiy, G.G., "POLITICAL ECONOMY OF CONTEMPORARY MONOPOLIST CAPITALISM" (Monograph in 2 volumes, Mysl', Moscow, 1975).

Submitted by the Department of Economics of the USSR Academy of Sciences.

27. Alekseyev, S.S., "CYCLE OF WORKS ON PROBLEMS OF MARXIST-LENINIST THEORY OF LAW" (1966-1975).

Submitted by the Sverdlovsk Juridical Institute.

28. Lunev, A.Ye., Tikhomirov, Yu.A., Piskotin, M.I., Yampol'skaya, Ts.A., Lazarev, B.M., "PROBLEMS OF STATE ADMINISTRATION." (Cycle of works 1968-1973).

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29. Nechayeva, N.T., Atakurbanov, I.B., Borodin, A.F., Babayev, A.G., Mukhammedov, G., Prihod'ko, S.Ya., Petrov, M.P., Asamov, S., Shamsutdinov, Z., Chalbash, R., Saidov, D.K., Momotov, I.F., "DEVELOPMENT OF SCIENTIFIC BASES AND METHODS OF BASIC IMPROVEMENT OF THE DESERT PASTURAGES OF CENTRAL ASIA, THEIR ADOPTION IN PRODUCTION."

Submitted by the Institute of Deserts of the Turkmen SSR Academy of Sciences.

30. Tarasenko, T.Ye., Prokhozhay, I.D., Sukhanov, V.Ye., Il'chenko, V.A., Dolgobord, P.A., Kondrashov, S.A., Klinishev, A.D., Lenshina, T.I., Galushko, V.P., "GROWING AND INTRODUCTION INTO PRODUCTION OF STRAINS OF DONETSKIY 4 AND DONETSKIY 6 SPRING BARLEY."

Submitted by Donetskaya Oblast State Agricultural Experimental Station.

31. Yershov, V.S., Bessonov, A.S., Velichkin, P.A., Demidov, N.V., Kotelnikov, G.A., Kuznetsov, M.I., Orlov, I.V., Panasyuk, D.I., Petrochenko, V.I., Tsvetayeva, N.P., Zhumakovich, Ye.Ye., "BIOLOGICAL BASES FOR THE PREVENTION OF HELMINTHIASES OF AGRICULTURAL ANIMALS" (Cycle of works).

Submitted by the All-Union Institute of Helminthology imeni K.I. Skryabin.

32. Innos, E.A., Shknevskiy, E.N., Pustynskiy, F.I., Merkmaa, K.A., Karev, N.V., Belozerov, A.I., Kunevichus, I.-A. I., Terent'yev, A.M., "CREATION AND DEVELOPMENT OF SERIES PRODUCTION OF HIGH-EFFICIENCY EXCAVATORS-DRAIN PACKERS AND THEIR BROAD INTRODUCTION INTO LAND-IMPROVEMENT CONSTRUCTION ON DRAINED LANDS OF THE USSR."

Submitted by the USSR Ministry of Construction, Road and Municipal Machine Building and the Ministry of Land Reclamation and Water Resources.

33. Ogurtsov, N.A., Mysin, I.P., Aleshin, Ye.P., Polyakov, Yu.N., Kosharnitskiy, S.A., Gol'dner, R.M., Levin, P.A., Sarov, B.A., Prisyazhnyuk, V.T., Maystrenko, A.I., Kulish, A.D., "CREATION OF A LARGE WATER-MANAGEMENT COMPLEX ON THE KUBAN', INCREASING WATER PROVISION IN THE BASIN OF THE RIVER AND THE SHARP GROWTH OF RICE PRODUCTION IN KRASNODARSKIY KRAY."
Submitted by the USSR Ministry of Land Reclamation and Water Resources.

34. Abelev, G.I., Tatarinov, Yu.S., "DISCOVERY AND INVESTIGATION OF ALPHATHETOPROTEIN IN HEPATOCELLULAR CANCER AND EMBRYONIC TERATOBLASTOMAS AND CREATION OF AN IMMUNOLOGICAL METHOD OF DIAGNOSIS FOR THESE FORMS OF MALIGNANT TUMORS." (Cycle of works 1963-1975).
Submitted by the 2nd Moscow State Medical Institute imeni N.I. Pirogov.

35. Bunyatyan, A.A., Gal'perin, Yu.Sh., Gorlin, I.K., Darbinyan, T.M., Perel'mutr, A.S., Popova, L.M., Puzankov, V.M., Ryabov, G.A., Smirnov, I.P., Trofimov, P.I., Yurevich, V.M., "DEVELOPMENT, CREATION OF PRODUCTION AND INTRODUCTION INTO MEDICAL PRACTICE OF A COMPLEX OF TECHNICAL MEANS FOR NARCOSIS AND ARTIFICIAL RESPIRATION."
Submitted by the Ministry of Medical Industry.

36. Georgiyevskiy, P.K., Giorgobiani, T.N., Glukhov, S.A., Yermolayev, N.Ye., Yefuni, S.N., Ivanov, A.Ya., Klimov, L.Ya., Lopatin, V.V., Lukich, V.L., Utyamyshev, R.I., Shokhanov, N.A., Shulika, V.P., "CREATION OF A COMPLEX OF MEDICAL PRESSURE CHAMBERS FOR HYPERBARIC OXYGENATION."
Submitted by the State Union Planning Institute.

37. Dzugayeva, S.B., "CONDUCTING PATHWAYS OF THE HUMAN BRAIN IN ONTOGENESIS" (Monograph, Meditsina, Moscow, 1975).
Submitted by the Institute of the Brain of the USSR Academy of Medical Sciences.

38. Zatsepin, S.T., Imamaliyev, A.S., Kovalenko, P.P., Korzh, A.A., Trapeznikov, N.N., Chaklin, V.D., "EXPERIMENTAL BASIS, CLINICAL DEVELOPMENT AND INTRODUCTION INTO PRACTICE OF A METHOD OF TRANSPLANTATIONS OF LARGE BONE ALLOTRANSPLANTS TO A PERSON."
Submitted by the Central Scientific-Research Institute of Traumatology and Orthopedics imeni N.N. Priorov.

39. Chernykh, A.M., Kupriyanov, V.V., "CYCLE OF WORKS ON THE STUDY OF MICRO-CIRCULATION" (1961-1975).
Submitted by the Institute of General Pathology and Pathological Physiology of the USSR Academy of Medical Sciences and the 2nd Moscow State Medical Institute imeni N.I. Pirogov.

40. Belov, V.S., Buzunovskiy, Z.F., German, A.N., Glekov, S.F., Kebich, V.F., Kolodnyy, L.B., Kren'tikov, V.A., Novikov, D.L., Skizhenok, V.F., Ustimenko, V.A., Tsegel'nik, V.P., Svichar, N.Sh., "CREATION ON THE BASIS OF STANDARDIZATION OF WIDELY UNIFIED AGGREGATED GAMMA OF HIGHLY EFFICIENT HORIZONTAL AND VERTICAL BROACHING MACHINES AND ORGANIZATION OF ITS SERIES PRODUCTION."
Submitted by the Ministry of Machine Tool and Tool Building Industry.

41. Boltunov, V.I., Voytetskiy, G.P., Grishin, A.V., Grishin, P.I., Yerozhin, N.G., Igoshin, V.M., Kovylin, V.V., Markelov, N.N., Pospelov, D.R., Ruzin, N.A., Shaanov, A.I., Efros, V.V., "CREATION OF DESIGN OF A NUMBER OF AIR-COOLED MULTIPURPOSE DIESELS AND ORGANIZATION OF THEIR SPECIALIZED

FLOW-LINE MASS PRODUCTION."

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78. Bogataya, T.S., Yemel'yanova, Ye.P., Zakharova, A.F., Melikhova, G.I., Kushelevich, I.I., Padura, V.D., Pavlova, A.F., Polyakov, A.A., Sendyk, M.Yu., Solov'yeva, V.S., Chauskaya, S.I., "DEVELOPMENT AND ADOPTION OF A COMPLEX SYSTEM OF PRODUCT QUALITY CONTROL IN THE SEWING INDUSTRY ON THE BASIS OF IMPROVED TECHNOLOGY, SCIENTIFIC ORGANIZATION OF LABOR, PRODUCTION AND MANAGEMENT, AUTOMATION AND MECHANIZATION OF SEWING PROCESSES."

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Submitted by the Uzbek SSR Ministry of Food Industry.

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Submitted by the USSR Ministry of Education.

The titles of the works and the composition of the collectives of their authors (aside from items 7,8,15,33,75 and 76) are published as presented, without changes.

A total of 229 works and 16 textbooks were submitted for the 1977 competition of USSR State Prizes.

In publishing the list of 80 works and 6 textbooks included for participation in the competition, the Committee requests directors of scientific and scientific-technical societies, scientific institutions, enterprises and higher educational institutions to organize public discussions of the works and their authors.

We ask that all comments, materials and observations be sent to the Committee's secretariat before 1 September of this year, address: 125047, Moscow, 3-ya Tverskaya-Yamskaya Ulitsa, Dom 46.
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SOCIALIST-COMPETITION PACEMAKER CANDIDATES FOR LENIN, STATE PRIZES

Moscow IZVESTIYA in Russian 21 May 77 p 5

[Announcement: "From the Presidium of the Committee for Lenin and USSR State Prizes in the Field of Science and Technology of the USSR Council of Ministers and the All-Union Central Council of Trade Unions"]

[Text] The Presidium of the Committee for Lenin and USSR State Prizes in the Field of Science and Technology of the USSR Council of Ministers and the All-Union Central Council of Trade Unions reports that the following candidates and pacemakers of the All-Union Socialist Competition have been selected for participation in the competition for the 1977 USSR State Prizes because of outstanding achievements in labor:

1. Appatkin, M.S., Sviridonov, A.I., Feduro, O.N., Griva, V.I., Astashin, Ye.P., Akhtyamov, I.Kh., Belyy, P.G., Derepa, N.F., Zhuravlev, V.A., Kachalov, A.M., Koroten'kov, A.R., Papusha, I.P.--"FOR OUTSTANDING ACHIEVEMENTS IN LABOR, A SIGNIFICANT RISE IN THE EFFICIENCY OF METALLURGICAL PRODUCTION ON THE BASIS OF AHEAD-OF-SCHEDULE OPERATION OF PRODUCTION CAPACITIES, ADOPTION OF NEW EQUIPMENT AND ADVANCED TECHNOLOGY AND INITIATIVE IN THE DEVELOPMENT OF COMPETITION FOR FINDING AND FULLER USE OF RESERVES AT EVERY WORK PLACE." Sponsored by the CC of the Trade Union of Workers of the Metallurgical Industry, the USSR Ministry of Ferrous Metallurgy and the USSR Ministry of Nonferrous Metallurgy.

2. Metelkin, N.V., Amosov, I.G., Kuznetsov, N.P., Roslyakov, P.N., Smolyakov, V.I., Ivanov, P.V., Dubchak, A.A., Shamov, A.I., Grachev, V.M., Tarasenko, A.V., Fominykh, Yu.I., Kurakin, A.G.--"FOR OUTSTANDING ACHIEVEMENTS IN LABOR, A SIGNIFICANT INCREASE IN THE EFFICIENCY OF PRODUCTION IN POWER AND ELECTRICAL EQUIPMENT INDUSTRY AND INITIATIVE IN THE DEVELOPMENT OF SOCIALIST COMPETITION FOR IMPROVING QUALITY OF WORK AND MUTUAL ASSISTANCE IN LABOR." Sponsored by the CC of the Trade Union of Workers of Electric Power Stations and the Electrical Equipment Industry, the USSR Ministry of the Electrical Equipment Industry and the Ministry of Power and Electrification.

3. Kurylev, A.I., Litvinov, A.I., Zinov'yev, Yu.I., Khvostov, V.I., Yakovlev, I.M., Ledovskikh, V.N., Ryabokon', N.A., Mal'tsev, I.I., Kolomiyets, V.V., Knyazev, G.N., Shmelev, N.S., Maryushkin, V.D.--"FOR OUTSTANDING ACHIEVEMENTS IN LABOR BASED ON PERSONAL AND BRIGADE COUNTERPLANS FOR ACCELERATED GROWTH OF LABOR PRODUCTIVITY, MODERNIZATION OF EQUIPMENT, INCREASED EFFICIENCY IN USE OF EQUIPMENT AND OTHER RESERVES OF PRODUCTION."

Sponsored by the CC of the Trade Union of Workers of the Aviation Industry, the CC of the Trade Union of Workers of Machine Building and Instrument Making, the USSR Ministry of the Aviation Industry, the Ministry of Machine Building and the Ministry of the Machine Tool and Tool Building Industry.

4. Aver'yanov, K.V., Nikolayev, A.Ye., Kuprichev, Yu.Ye., Kiselev, Ye.I., Babich, V.P., Zhanaydarov, A., Leksin, N.S., Romanyuta, A.K., Sarapulov, S.P., Frantsuzenko, V.V., Avramets, M.D., Polyakov, A.A.--"FOR OUTSTANDING ACHIEVEMENTS IN LABOR, CREATIVE ACTIVITY AND INITIATIVE IN BUILDING UP FUEL-POWER RESOURCES AND A SIGNIFICANT RISE IN THE EFFICIENCY OF PRODUCTION BASED ON INTENSIFICATION OF PRODUCTION PROCESSES AND FULLER UTILIZATION OF MINING AND DRILLING EQUIPMENT."

Sponsored by the CC of the Trade Union of Workers of Geological Prospecting Work, the CC of the Trade Union of Workers of the Coal Industry, the USSR Ministry of Geology and the USSR Ministry of Coal Industry.

5. Brykina, S.N., Vakhnina, L.A., Bezrukova, A.I., Fefelov, N.A., Tereshchenko, N.P., Alekseyev, A.A., Dedov, N.S., Khudyakov, G.A., Kostyleva, Z.Ye., Yantso, V.M., Bolotov, N.I., Semenov, G.N.--"FOR OUTSTANDING ACHIEVEMENTS IN LABOR, SIGNIFICANT GROWTH OF LABOR PRODUCTIVITY BASED ON IMPROVEMENT OF TECHNOLOGY OF PRODUCTION AND ORGANIZATION OF LABOR, MODERNIZATION OF EQUIPMENT AND MORE EFFICIENT USE OF EQUIPMENT."

Sponsored by the CC of the Trade Union of Workers of Geological Prospecting Work, the CC of the Trade Union of Workers of the Timber, Paper and Woodworking Industry, the CC of the Trade Union of Workers of the Metallurgical Industry, the CC of the Trade Union of Workers of the Radio Electronics Industry, the CC of the Trade Union of Workers of the Petroleum, Chemical and Gas Industry, the Ministry of the Chemical Industry, the USSR Ministry of Electronic Industry, the Ministry of Wood and Woodworking Industry, the USSR Ministry of Nonferrous Metallurgy, the Main Administration of Geodesy and Cartography of the USSR Council of Ministers and the RSFSR Ministry of Forestry.

6. Valov, P.G., Molodchenko, N.R., Kolkov, V.I., Makarov, V.A., Ivashchenko, R.I., Osipova, R. Ya., Nigmatullina, F.G., Barysheva, A.F., Aleksandrov, I.D., Batishcheva, R.N., Puzanov, A.V., Kalmykov, I.S.--"FOR OUTSTANDING ACHIEVEMENTS IN LABOR BASED ON COMPREHENSIVE IMPROVEMENT OF LABOR PROCESSES, COMBINING TWO JOBS, INTRODUCING ADVANCED METHODS AND FORMS OF LABOR ORGANIZATION."

Sponsored by the CC of the Trade Union of Workers of the Motor-Vehicle, Tractor and Agricultural Machine Building, the CC of the Trade Union of Workers of Machine Building, the CC of the Trade Union of Workers of the Shipbuilding Industry, the Ministry of Machine Building, the USSR Ministry of Shipbuilding Industry and the Ministry of Tractor and Agricultural Machine Building.

7. Belova, A.A., Ageyeva, N.M., Zhitnik, Ye.G., Agafonov, Yu.V., Vasil'yev, N.S., Gridneva, V.S., Lokteva, V.Ye., Agafonova, Z.F., Lavskaya, N.S., Gavrilova, R.A., Zagrebel'nyy, V.G., Agafonova, T.V.--"FOR OUTSTANDING ACHIEVEMENTS IN LABOR AND INITIATIVE IN DEVELOPING COMPETITION FOR INCREASED PRODUCTION AND IMPROVED QUALITY OF CONSUMER GOODS BASED ON EXPANDED ZONES OF SERVICE AND ENSURING A REGIME OF ECONOMY."

Sponsored by the CC of the Trade Union of Workers of the Food Industry, the CC of the Trade Union of Workers of the Textile and Light Industry, the CC of Workers of the Chemical and Petrochemical Industry, the USSR Ministry of Light Industry, the USSR Ministry of Petroleum Refining and Petrochemical Industry, the USSR Ministry of Food Industry and the USSR Ministry of the Fish Industry.

8. Ostroverkhov, P.I., Shvetsov, V.K., Nikolayenko, V.V., Tenditnyy, G.P., Ushakov, G.M., Yaroshenko, I.T., Nosachev, V.N., Shkilev, V.F., Kuriy V.G., Karlinchuk, A.N., Filippenko, V.F., Bykova, A.I.--"FOR OUTSTANDING ACHIEVEMENTS IN LABOR AND INITIATIVE IN DEVELOPMENT OF SOCIALIST COMPETITION FOR INCREASING EFFICIENCY AND QUALITY OF WORK ON MOTOR-VEHICLE, WATER AND RAILROAD TRANSPORT."

Sponsored by the CC of the Trade Union of Workers of Motor Transport and Highways, the CC of the Trade Union of Workers of Railroad Transport, the CC of the Trade Union of Workers of the Maritime and River Fleet, the Ministry of the Maritime Fleet, the Ministry of Railways, the RSFSR Ministry of Motor Transport and the RSFSR Ministry of the River Fleet.

9. Tokminov, A.A., Niskovskikh, V.M., Khramtsov, A.I., Grin', M.P., Litovchenko, N.I., Ikhin, K.G., Basyrov, A.G., Vasil'yev, M.M., Belyayev, M.V., Berezin, Ye.I., Yatskov, N.A., Bushuyev, A.A.--"FOR OUTSTANDING ACHIEVEMENTS IN LABOR, INITIATIVE IN LAUNCHING A SOCIALIST COMPETITION FOR AHEAD-OF-SCHEDULE OPERATION AND MAXIMUM USE OF PRODUCTION CAPACITIES, INCREASED COOPERATION AND SPECIALISTS."

Sponsored by the CC of the Trade Union of Workers of Timber, Paper and Woodworking Industry, the CC of the Trade Union of Workers of the Petroleum, Chemical and Gas Industry, the CC of the Trade Union of Workers of Heavy Machine Building, the CC of the Trade Union of Workers of Electric Power Stations and the Electrical Equipment Industry, the Ministry of the Petroleum Industry, the Ministry of Heavy and Transport Machine Building, the Ministry of Pulp and Paper Industry and the USSR Ministry of Power and Electrification.

10. Aleksandrov, V.L., Basov, A.D., Bocharov, A.P., Bubyakin, M.A., Zhavoronkov, V.I., Zabolotnyy, V.M., Kalyuzhnaya, M.P., Kol'tsov, I.G., Savotikov, I.V., Satayev, D., Sinkevich, N.K., Surovtsev, A.M.--"FOR OUTSTANDING ACHIEVEMENTS IN LABOR, A SIGNIFICANT RISE IN THE EFFICIENCY AND QUALITY OF CONSTRUCTION WORK BASED ON COMPREHENSIVE MECHANIZATION, EFFICIENT UTILIZATION OF EQUIPMENT AND ADVANCED EXPERIENCE."

Sponsored by the CC of the Trade Union of Workers of Construction and Construction Materials Industry, the CC of the Trade Union of Workers of Railroad Transport, the USSR Ministry of Construction of Heavy Industry Enterprises, the USSR Ministry of Industrial Construction, the USSR Ministry of Construction, the USSR Ministry of Rural Construction, the USSR Ministry of Installation and Special Construction Work, the Ministry of Transport Construction, Glavmosstroy and Glavmospromstroy.

11. Brinyuk, L.M., Ventskus, S.V., Yershova, M.A., Zavdovyyev, V.G., Kolos, V.R., Konovalov, G.D., Kurilenko, N.Z., Lavrent'yev, Yu.N., Makarov, A.V., Mereshchenko, A.I., Selifonov, A.S., Shabalin, L.M.--"FOR OUTSTANDING ACHIEVEMENTS IN LABOR BASED ON INTENSIFICATION OF PRODUCTION, INTRODUCTION OF NEW EQUIPMENT AND ADVANCED EXPERIENCE AT ENTERPRISES OF THE CONSTRUCTION MATERIALS INDUSTRY AND THE CONSTRUCTION INDUSTRY."

Sponsored by the CC of the Trade Union of Workers of Construction and Construction Materials Industry, the USSR Ministry of Construction Materials Industry, the USSR Ministry of Industrial Construction, the USSR Ministry of Installation and Special Construction Work, Glavmospromstroyaterialy, Glavmosoblstroyaterialy and Glavlensstroyaterialy.

12. Trapeznikov, V.M., Liferov, N.A., Korolev, N.V., Pletnevskiy, Ye.G., Gorozhayeva, R.F., Sorokin, V.N., Ziglevskiy, A.P., Tyagno, I.I., Korchinskiy, A.V., Perevera, I.I., Alekseyenko, M.M., Tatenov, B.--"FOR OUTSTANDING ACHIEVEMENTS IN LABOR, WIDE-SCALE USE OF THE RESULTS OF SCIENTIFIC RESEARCH AND ADOPTION OF ADVANCED EXPERIENCE IN THE PRODUCTION OF RICE, CORN, BUCKWHEAT, SUGAR BEET, FLAX, ENSURING A SIGNIFICANT IMPROVEMENT IN THE STANDARD OF FARMING, EFFICIENT USE OF EQUIPMENT AND GROWTH ON THIS BASIS OF PRODUCTION OF AGRICULTURAL PRODUCE AND INITIATIVE IN THE DEVELOPMENT OF INSTRUCTION."

Sponsored by the CC of the Trade Union of Workers of Agriculture, the USSR Ministry of Agriculture, the USSR Ministry of Land Reclamation and Water Resources, and the All-Union Soyuzsel'khoztekhnika Association of the USSR Council of Ministers.

13. Gryaznov, V.L., Zhukov, V.P., Rozvezev, A.P., Kovalenko, L.K., Yudin, A.M., Pereverzeva, N.V., Dyunov, G.I., Avdyushin, S.V., Voronin, V.M., Steftsyuk, A.F., Kazakova, Ye.S., Samokishin, V.G.--"FOR OUTSTANDING ACHIEVEMENTS IN LABOR, WIDE-SCALE USE OF THE RESULTS OF SCIENTIFIC RESEARCH AND ADVANCED EXPERIENCE, A RISE IN THE STANDARD OF FARMING, EFFICIENT USE OF EQUIPMENT, ENSURING A SIGNIFICANT GROWTH OF GRAIN PRODUCTION AND INITIATIVE IN THE DEVELOPMENT OF THE INSTRUCTOR MOVEMENT."

Sponsored by the CC of the Trade Union of Workers of Agriculture, the USSR Ministry of Agriculture, the USSR Ministry of Procurement and the All-Union Soyuzsel'khoztekhnika Association of the USSR Council of Ministers.

14. Ligostayev, A.Ya., Alekseyeva, Ye.Ye., Rovtytyagin, V.I., Karpets, N.M., Chernakov, V.V., Stal'nova, A.S., Zasukha, M.Ya., Shadyul', A.V., Aytbayev, B., Glinskene, I.V., Salmin', A.T., Kir'yanen, R.I.--"FOR OUTSTANDING ACHIEVEMENTS IN LABOR, WIDE-SCALE USE OF THE RESULTS OF SCIENTIFIC RESEARCH AND ADVANCED EXPERIENCE, ENSURING A SIGNIFICANT RISE IN PRODUCTION EFFICIENCY AND QUALITY OF ANIMAL-HUSBANDRY PRODUCTS."

Sponsored by the CC of the Trade Union of Workers of Agriculture and the USSR Ministry of Agriculture.

15. Vishnev, L.L., Polovinka, M.I., Kravchenko, N.G., Kulikovskiy, V.I., Azimkhanov, A., Saparov, Kh., Kenkishvili, G.I., Efendiyev, Kh.G. Koltsa, I.A., Safarov, B., Ovnatanyan, P.M., Atabalov, B.--"FOR OUTSTANDING ACHIEVEMENTS IN LABOR, A SIGNIFICANT RISE IN EFFICIENCY AND QUALITY OF WORK AND

OBTAINING ON THIS BASIS LARGE HARVESTS OF VEGETABLES, POTATOES, GRAPES, COTTON, TOBACCO AND FODDER CROPS."

Sponsored by the CC of the Trade Union of Workers of Agriculture, the USSR Ministry of Agriculture and the USSR Ministry of Land Reclamation and Water Resources.

We ask that all comments, materials of public discussion and observations be sent to the committee's secretariat before 1 September of this year, address: 125047, Moscow, 3-ya Tverskaya-Yamskaya Ulitsa, Dom No 46; telephones: 250-38-08, 250-19-47.

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SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

WORK OF SIBERIAN DEPARTMENT OF ACADEMY OF SCIENCES DISCUSSED

Moscow TEKHNIKA I NAUKA in Russian No 5, 1977 pp 6-8

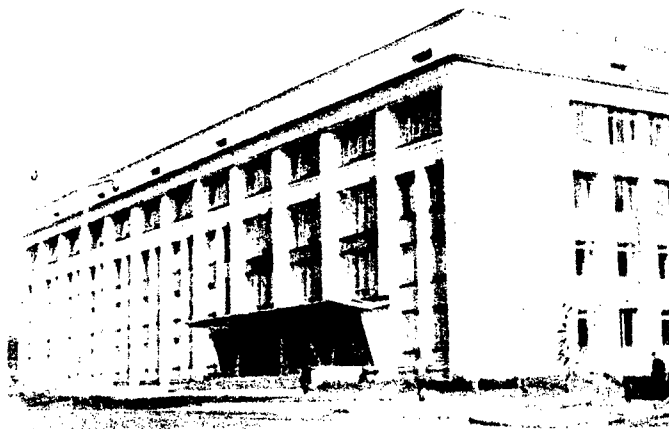
/Article by M. V. Lomonosov: "Siberian Academy: Alliance Between Science and Technology"/

/Text/ "Russian power will increase by Siberia"--M. V. Lomonosov.

The construction of Akademgorodok began 30 km south of Novosibirsk in May 1957. Thus began the implementation of the government decree on the establishment of a major scientific center in Siberia. A total of 48 scientific institutions operate here in 1977. Their contribution to the development of fundamental research and to the introduction of scientific achievements into practice over 20 years is widely known. In the last few years alone 700 major completed projects have been handed over to production workers. This is the distinctive gift of Siberian scientists on the 60th anniversary of the Great October.

The recently published decree of the CPSU Central Committee on the activity of the Siberian Department of the USSR Academy of Sciences contains a high evaluation of the labor of Siberian scientists and indicates the ways to further improve the quality and efficiency of scientific research. The decree states that the establishment of the Siberian Department of the USSR Academy of Sciences had a direct effect on the development of productive forces, education and culture of the country's eastern regions. In this issue of TEKHNIKA I NAUKA we are publishing a selection of materials (see pp 6-23), which show some aspects of the activity of the Siberian Department of the USSR Academy of Sciences and practical research results. The editorial board expresses its

thanks to the Presidium of the Siberian Department of the USSR Academy of Sciences and the personnel of the newspaper ZA NAUKU V SIBIRI for assistance in the preparation of this publication.



Presidium of the Siberian Department of the USSR Academy of Sciences

This year the Siberian Department of the USSR Academy of Sciences will be 20 years old. The decree of the USSR Council of Ministers on the organization of a scientific center in Siberia was issued on 18 May 1957. Our country's prominent scientists together with their collectives came to this harsh region and laid the foundation of Novosibirsk Akademgorodok. Scientists of the older generation--academician Mikhail Alekseyevich Lavrent'yev, first chairman of the Siberian Department, academicians S. L. Sobolev, S. A. Khristianovich, I. N. Vekua and others--made a significant contribution to the establishment and development of the Siberian Department. They deserve profound respect for their labor.

Today in Siberia there is a powerful research base with scientific centers not only in Novosibirsk, but in Irkutsk, Yakutsk, Ulan-Ude, Krasnoyarsk and Tomsk as well. The establishment of academic subdivisions in Tyumen', Kemerovo, Barnaul, Omsk and Chita has begun. At present the Siberian Department consists of 48 scientific research and experimental design organizations representing practically all the basic trends in natural and social sciences.

In brief, all the basic fundamental scientific trends not only were developed in Siberia, but made it possible to form large active collectives. About 35,000 people work productively in the institutes and institutions of the Siberian Department of the USSR Academy of Sciences, including about 70 academicians and corresponding members of the USSR Academy of Sciences, 400 doctors and 3,000 candidates of sciences. This is a vast creative force.



G. Marchuk, Academician, Vice-President of the USSR Academy of Sciences,
Chairman of the Siberian Department of the USSR Academy of Sciences,
Winner of the Lenin Prize, Hero of Socialist Labor

The decree of the CPSU Central Committee on the activity of the Siberian Department of the USSR Academy of Sciences notes that Siberian scientists obtained outstanding scientific results in the theoretical and applied sections of mathematics and mechanics, nuclear physics and semiconductor physics, quantum electronics, the theory and practice of catalysis, the study of combustion and explosion processes and biological research on the genetics and selection of plants and animals. Scientists actively participate in the development of theoretical principles of detection of mineral raw materials.

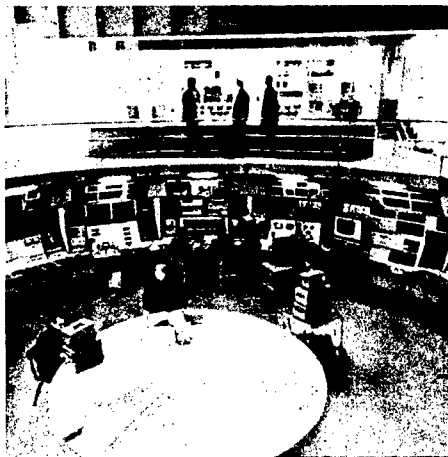
In accordance with the party decisions Siberia's national economy accelerates the rate of its growth during every five-year plan. With the limited labor resources in Siberia such a rate can be maintained mainly with the help of scientific ideas, new technology, the latest know-how and advanced methods of production organization. The results of fundamental and applied research are to play the role of accelerator here.

The 25th CPSU Congress especially stressed the importance of increasing the role of fundamental science in the life of our society. The development of algebra, logic, differential equations and analysis, applied and computer mathematics, mechanics of eddy processes and jet flows, rock mechanics, the theory of heat exchange and low-temperature power engineering can serve as an example of advances in this direction.

An original method of accelerating elementary particles on counterbeams was executed. The work in the field of laser physics laid the foundation of non-linear laser ultra-high resolution spectroscopy. A school of catalysis

developing the principles of forecasting catalytic reactions was established and received international recognition in the department. The methods of mathematical modeling by means of electronic computers made it possible to shorten the time of development of powerful reactors two or three times and to increase their efficiency. Major advances were made by Siberian schools of organic and inorganic chemistry. The investigations by the department's geologists became the theoretical basis for forecasting and searching for minerals. They play an important role in the study and exploitation of Siberia's mineral resources. The achievements in the field of molecular biology, genetics and biochemistry made it possible to solve a number of practical problems. New varieties of cultivated plants have been developed and methods of preventing diseases in plants, animals and man are being studied.

The overall economic and mathematical investigations and calculations of the rates and proportions of development of the economy and power engineering and of optimal variants of long-term national economic plans executed in the department are of great importance both for Siberia and for the country as a whole.



Unique Accelerating Installation on Counterelectron-Positron Beams. The Attained Energy--3.5 Billion Electron Volts

The development of fundamental research is especially important for the Academy of Sciences, because, in principle, profound theoretical ideas are not realized immediately, but it is they that have the most revolutionary effect on society at large, on the development of productive forces and on scientific and technical progress. Our homeland needs Siberia's intensive development. It is not accidental that the rates of its development during the Tenth Five-Year Plan were determined to be one and a half times higher than during the Ninth Five-Year Plan. Siberia is developing through the establishment of large territorial-industrial complexes, where power resources, mineral raw materials and processing plants are concentrated.

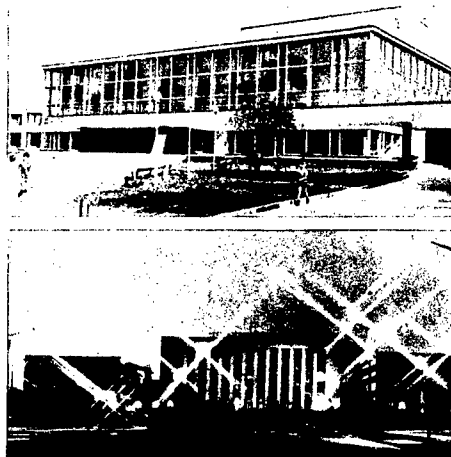


Fundamental Research On Explosion Energy Is Conducted in the Institute of Hydrodynamics by Means of Roentgen Pulse Equipment

We have already witnessed the rapid development of petroleum and gas extraction in West Siberia and the construction of the Bratsk-Ust'-Ilimsk Territorial-Industrial Complex and the Krasnoyarsk Complex, which is now being transformed into the Angaro-Yenisey Complex. Expanding the sphere of their action and effect on Siberia's development, the Sayano-Shushenskiy and Kansk-Achinskiy complexes are emerging. Now it is impossible to think of Siberia without visualizing the wide prospects that will be opened by the Baykal-Amur Trunk Line, giving access to the richest resources of coal, copper, polymetals and other minerals. The South Yakutsk Territorial-Industrial Complex will play an important role in Siberia's economy during this five-year plan. In brief, Siberia is beginning to uncover its storerooms. In order to utilize them effectively, there is a need for comprehensive programs, which will optimally take into consideration the various aspects of the national economic plan.

The growth of Siberia's productive forces on the basis of fundamental scientific trends and of the discovery of new ways in the techniques of exploiting and processing mineral raw materials and the creation of favorable conditions for people's life in this harsh region--this is the source of enthusiasm of the scientists of the Siberian Department. The Siberian Department of the USSR Academy of Sciences has specific experience in the introduction of scientific studies into the practice of the national economy, a brief discussion of which, apparently, will be of special interest to the readers of the journal *TEKHNIKA I NAUKA*.

The institutes and special design offices of the Siberian Department maintain scientific and technical cooperation with more than 320 enterprises in the country, primarily in Siberia.



Akademgorodok. The House of Scientists
The Building of the Institute of Nuclear Physics of the Siberian Department
of the USSR Academy of Sciences

In the last few years the institutes of the Siberian Department of the USSR Academy of Sciences have proposed hundreds of major completed scientific projects for introduction into the national economy. Many of these projects have already given significant economic benefits. These institutes annually fulfill large volumes of contract work for industry and agriculture. The scale of work is sufficient to generalize the available experience and to formulate a number of general methodological principles making it possible to increase the effect of science on production.

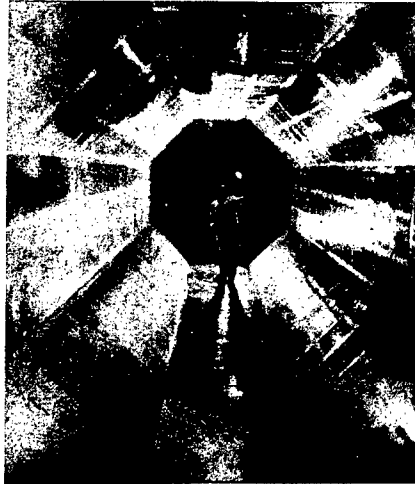
The sectorial level is reached and intersectorial cooperation is carried out mainly through the introduction of important scientific ideas into production, ideas which have an effect on the entire sector, not on individual isolated enterprises.

Intersectorial cooperation both in the sphere of science and in the sphere of production is an important condition for a successful introduction of modern, new techniques and new types of equipment. In other words, the creation of a new development requires joint efforts of scientists in different specialties and in different scientific sectors and its introduction requires the participation of a number of industrial sectors and overall many-sided intersectorial relationships.

Organizationally, the process of introduction can be conventionally divided into two stages.

At the first stage a scientific development is transferred to an enterprise and mastered through the efforts of scientists and production workers. A scientific institution sends its personnel to an enterprise and the latter

intensively improves the skills of its engineering and technical personnel. Scientists and production workers work together in a united collective which can be organizationally formulated in the form of an intersectorial scientific production laboratory or a design office.



A Low Turbulence Aerodynamic Pipe for the Study of Gas Dynamics Was Developed at the Institute of Theoretical and Applied Mechanics of the Siberian Department of the USSR Academy of Sciences

At the second stage, after the introduction is completed at one enterprise, it is necessary to separate the scientific idea from scientists in order to limit the participation of scientists in the further dissemination of the idea by scientific consultations; basically, it should be disseminated through the efforts of the sector itself. At this stage main administrations of ministries and other superior bodies should undertake the control and organization of the introduction.

In the Siberian Department of the USSR Academy of Sciences a special place in the improvement in the system of scientific research planning is assigned to coordinating plans connected with the solution of especially important scientific and technical problems. At present there are 20 coordinating plans which have been placed under the special control of the Presidium of the Siberian Department of the USSR Academy of Sciences. Coordinating plans unify the efforts of almost all the institutes of the Siberian Department aimed at solving a number of problems connected with microelectronics, optics, automation of scientific research, molecular biology, agriculture and so forth.

From the first steps of its activity the organization of the Siberian Department was based on efficient personnel policy. Today we have a balanced cycle of training of researchers calculated for many years, beginning from

all-Siberian olympiads of schoolchildren and ending with post graduate work. University and academic institutes are the main links of this cycle. The close creative relationships between researchers and a wide student audience make it possible to inform it of the latest scientific achievements and to discuss the trends and ways of research promising major results.



In the Laboratory of the Institute of Semiconductor Physics. Check on
Photosensitive Semiconducting Films

We saw to it that advanced engineers and technicians of industrial enterprises were trained for a realistic evaluation of the results of our research and were interested in their practical application. We wanted them to continue our work at plants. For this purpose a whole program of propaganda of scientific achievements in production collectives was developed and implemented and specific post graduate work for plant engineers was organized.

The originality of our work is determined by the conditions created in our scientific cities. The complex of institutes located together is more than their arithmetical sum. This makes it possible to unify the efforts of researchers in various fields of science. In our time major problems arise at the interfaces of science. Territorial proximity becomes creative proximity; mobility and efficient organization of research--this is the result of scientific integration. This makes it possible to realize the program-oriented approach to the organization and planning of research.

In our institutes there are many laboratories of sectorial scientific research institutes. Many design offices and experimental production facilities of various ministries have sprung up around Novosibirsk Akademgorodok. The contacts between a number of academic institutes with enterprises of various national economic sectors proved to be especially positive.



On the Coast of the Arctic Ocean the Workers of the Institute of Space Physics Research and Aeronomy of the Irkutsk Affiliate of the Siberian Department of the USSR Academy of Sciences Conduct Spectral Investigations of Aurora Polaris

The party has highly evaluated the role of Siberian science in an increase in the country's scientific potential and communist construction. However, shortcomings and unsolved problems in the activity of the Siberian Department of the Academy of Sciences should not be ignored. The decree of the CPSU Central Committee justly drew attention to them. Fulfilling its instructions, we will strive to increase the efficiency and quality of fundamental and applied research. We will concentrate our efforts on training highly skilled scientific personnel, improving research coordination, expanding and strengthening the contacts between science and production and accelerating the cycle from idea to introduction.

Facts and Figures

Soviet science welcomes the 60th anniversary of the Great October with vast achievements in many important branches of knowledge. About 1.3 million scientific workers work in the country--108 times more than in 1913. One-fourth of the world's scientists work in the Soviet Union. Of them 32,300 people have the academic degree of doctor of sciences and 326,800, candidate of sciences.

A substantial detachment of scientific workers work in the Siberian Department of the USSR Academy of Sciences. Among them there are 30 winners of the Lenin Prize, 24 winners of the State Prize and 9 winners of the Leninist Komsomol Prize.

During the Tenth Five-Year Plan industrial production in the country will increase by 35 to 39 percent and in Siberia it will rise approximately one and a half times.

From Siberia we will obtain practically the entire increase in petroleum extraction, the overwhelming proportion of gas and aluminum and a significant part of the output of chemical production and the cellulose and paper industry. The Siberian Department of the USSR Academy of Sciences cooperates with 300 enterprises and organizations of more than 70 ministries.

The largest territorial production complex for the extraction and transport of gas is being formed in the northern part of West Siberia. A total of 66 billion cubic meters of gas are to be obtained there this year. Thus, Siberian gas extractors will hold first place in the country.

The scientists of the Siberian Department of the USSR Academy of Sciences developed highly efficient techniques, automated control systems, machines and tools for the mining industry.

Their introduction at a number of the sector's enterprises reduced the production costs of operations by almost one-half and increased labor productivity 10 times.

The geneticists of the Siberian Department developed a nonlodging variety of spring wheat--Novosibirskaya-67--which has good baking qualities. It has already produced harvests 11 to 15 quintals above the average norm. By 1978 this variety is to be sown on more than 1 million hectares.

Preparing an appropriate welcome for the 60th anniversary of the Great October, in the anniversary year the personnel of the Siberian Department of the USSR Academy of Sciences undertook to concentrate their principal attention on increasing the efficiency of scientific research and introducing into practice new articles surpassing the best domestic and foreign models in their technical and economic indicators.

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PUBLICATIONS

CODING HANDBOOK FOR THE ASU (AUTOMATIC CONTROL SYSTEM) SAFETY

Moscow RUKOVODSTVO PO KODIROVANIYU INFORMATSII OB AVIATSIONNYKH PROISSHESTVIYAKH I PREDPOSYLKAKH K NIM (Coding Handbook for the ASU (Automatic Control System) in Russian 1977 signed to press 31 Dec 76 pp 5-6

[Table of Contents from book edited by L. M. Burdina, RIO GA, 500 copies, 245 pages]

[Text]	Contents	Page
	Instructions for Use of the Handbook and Data Coding	7
	Provisional Abbreviations	15
	Arrangement of Data in the AP/PAP Code	21
	Identifier	81
	General Data on Events	85
	Collision or Near Miss of Aircraft	91
	History of Flight	97
	Injuries, Material Losses	127
	Personnel Information	131
	Aircraft Commander and Copilot	135
	Crew Member	147
	Engineer Aviation Service (IAS) Personnel	155
	Ground Crew Personnel	163
	Flight Control Personnel	169
	Aircraft Information	177
	Ground Navigation Systems and Means	199
	Communications with the Aircraft	205
	Airport Information	209
	Weather Information	215
	Description of Location of Event and Position of Aircraft	223
	Fire Data	231
	Medical Information	237
	Conditions of Events during PANKh	247
	Human Safety Data	255
	Causes/Factors of Events	267
	Command Personnel	271
	Flight Control Service	275
	Aircraft Pilots	279

	Page
Onboard Engineer and Onboard Mechanic	291
Navigator	295
Radio Operator	299
Metereological Service	303
Engineer Aviation Service	307
Fuel and Lubricants Service	311
Airport Service	315
Radionavigation and Communications Service	319
Light Engineering Support	323
Design Office, Manufacturing Plant	327
Other People Participating in the Event	331
Aviation Repair Enterprises	335
Special Motor Vehicle Base	339
Shipping and Commercial Operation Service	343
Aircraft, Structural Design Systems	347
Airport, Air Lanes	369
Meteorological Conditions	373
Terrain	377
Other Factors and Refining Characteristics	381
Groups of Basic Causes of Flight Emergencies	393
Measures Taken from the Inspection Results	397
Remarks	399
Administrative Data	401
Appendix 1. Type of Aircraft and Aircraft Engines	405
Appendix 2. Administrative and Territorial Units of the USSR. Governments and Geographic Regions	413
Appendix 3. Organizations Making Reports on Emergencies with Aircraft Owned by Foreign Airlines	433
Appendix 4. Job Categories	437
Appendix 5. Nationalities	443

10,845

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