JPRS-UST-86-016

27 JUNE 1986

USSR Report

SCIENCE AND TECHNOLOGY POLICY

FBIS FOREIGN BROADCAST INFORMATION SERVICE

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ORGANIZATION, PLANNING AND COORDINATION

ECONOMIC STIMULATION OF TECHNICAL DEVELOPMENT OF PRODUCTION

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 2, Feb 86 pp 74-81

[Article by Doctor of Economic Sciences Professor V. Arkhangelskiy: "The Economic Stimulation of the Technical Development of Production"; capitalized passages published in boldface]

[Text] Under present conditions scientific and technical progress, the mobilization of the potentials of which depends to a great extent on the used forms and methods of management, is one of the decisive factors of the intensification of social production.

Under the conditions of the policy of retooling, which is being pursued intensively, more attention has to be devoted to the elaboration of the prospects of the updating of production and to its scientific substantiation. The effectiveness of such updating will depend to a decisive degree on the comprehensiveness of the measures and the level of the achievements of science and technology, which are used in them. Retooling should be regarded as a constantly and systematically pursued policy, which encompasses all aspects of the development of production and ensures in the shortest time its attainment of the leading levels and the maintenance of a high technical level. The accomplishment of this task is hardly possible in a single cycle of retooling. Consequently, in the sectors of the national economy and large associations it is advisable to establish a system of the forecasting and long-range planning of the retooling of production with the periodic implementation of major measures.

In development of the Procedural Instructions on the Drafting of Plans of the Retooling of Operating Production Associations (Combines) and Enterprises it is necessary to formulate long-term (for 10-15 years) plans which envisage profound qualitative changes in production on the basis of new advanced technology. Such plans should be aimed at the automation and robotization of production over its entire cycle, the use of advanced materials, the changeover to the output of new products, and the training and advanced training of personnel of the corresponding specialization.

The inadequate consideration of any component of the plan can lead to the decrease of the effectiveness of the measures, and at times also to their economic inefficiency. For example, the automation of a number of works,

which are based on the traditional technology of the cutting of metals, from an economic standpoint may be inadvisable and insufficiently effective as compared with plastic metal working and powder metallurgy. At the same time the use of new construction materials, which forms the technological stock of equipment, and so on has a fundamental influence on the development of technology.

In conformity with the mentioned procedural instructions the long-range plans of technical development will be implemented in stages through 5-year and annual plans.

Some experience in the formulation of comprehensive plans of the technical development of production exists. For a number of years they have been drafted in the Ministry of the Automotive Industry and have included assignments on the development and assimilation of new equipment.

When drafting the comprehensive plan of the technical development of an association it is necessary to direct attention to the need for the comprehensive introduction of the advanced technology, which is the base technology for the sector, as well as the corresponding equipment, in order to decrease the local reorganizations of production between the stages (cycles) of retooling. This will make to possible to lengthen the period of the stable operation of production, which is important for the efficient use of fixed capital.

The stages (cycles) of retooling should be substantiated by a rational period of the use of the equipment, which is connected with its moral value, the changeover to the output of new products, and other technical and technological changes with allowance made for the economically advisable service life of the means of labor.

On the basis of the establishment of this period the enterprises, which have completed the stage of retooling, will need to introduce a sectorial standard of the updating of the material and technical base as the ratio of the coefficients of the introduction and retirement of equipment. Whereas for industrial products such a process is stimulated by the system of the certification of quality, the updating of production equipment depends completely on the possibilities and desire of the managers of the enterprise. At present this has led to several discrepancies in the development of the material and technical base of production.

The data of the table cited below should a significantly longer time of the operation of industrial equipment as compared with the rational time.

The large-scale economic experiment envisages the financing of all operations on retooling by means of the assets of the enterprise. It seems that as needed it is advisable to allow an increase of the standards of the deductions for the production development fund by the decrease of the net surplus of the profit on the condition of the use of such assets for the financing of measures in conformity with the comprehensive plan of the technical development of the association (enterprise). In case of the insufficiency of these assets for the performance of the planned work the sectorial unified

fund for the development of science and technology, the assets of which should be allocated on the terms of long-term credit, can be an additional source of them.

Table

The Retirement of Industrial Fixed Capital as a Percent of Its Total Value at the Beginning of the Period by Sectors of Industry (by enterprises which are carried on an independent balance sheet)

	1971-1975	1976-1980	1981-1984
All industry	11	8	6
Electric power engineering	4	3	2
Machine building and metalworking	8	7	5
Light industry	14	11	8

All the measures of the comprehensive plan are accompanied at each stage by calculations of the economic impact and efficiency, which are coordinated with the basic indicators of the end results of production activity--THE PROFIT AND THE PROFITABILITY, and for the sectors of the national economy, which are conducting the large-scale economic experiment, THE PRODUCT COST, THE PROFIT, AND THE PLAN OF DELIVERIES. Here it is difficult to overestimate the influence of this practice on the economic stimulation fund.

As is envisaged by the decree of the CPSU Central Committee and the USSR Council of Ministers "On the Extensive Dissemination of New Methods of Management and the Increase of Their Influence on the Acceleration of Scientific and Technical Progress," starting in 1986 a set of markups and discounts on the wholesale price of products for production engineering purposes is being introduced. In this connection it is deemed necessary that certification would become the basis for the objective evaluation of the technical level and quality of the items being produced and the stimulation of their increase.

The problem of the further improvement of the economic mechanism of the management of scientific and technical progress consists in the accomplishment of one of the most difficult tasks--the creation of a stable economic interest of associations and enterprises in the increase of the technical level and quality of products and in the development of the material and technical base of production.

It is well known that during the period of the assimilation of new equipment the profit and profitability decrease, which is a substantial economic hindrance of the technical development of production and the output of new products. Here the amounts of the deductions for the economic stimulation funds, which are formed according to the corresponding sectorial standards, decrease. At the same time the assets for the formation of incentive funds at enterprises, as a rule, are available; in conformity with the established system of the distribution of the profits they are turned over to the budget in the form of the net surplus. Consequently, it is necessary to orient the economic mechanism so that the implementation of the plan of technical

development (the introduction of new equipment) or its stages would not cause a decrease of the economic stimulation funds, while its nonfulfillment would not lead to a decrease of the economic indicators.

As one of the versions of the solution of this problem it is possible to suggest the following mechanism of the formation of economic stimulation funds for the fulfillment of the plan on the increase of the profit with allowance made for the implementation of the plan of technical development. When determining the amounts of the deductions due to this indicator it is advisable to regard the economic impact of the set of measures on technical development (new equipment), which were completed during the year in question, as the increase of the profit during the standard period of their assimilation and introduction. For the establishment of the estimated profit it is possible to use the formula:

$$П_р = П + \sum_{i=1}^{n} (\pm Э_i),$$

where П is the balance sheet profit of the enterprise;

$Э_i$ is the cost accounting economic impact of measure i of the plan of retooling (new equipment);

n is the number of measures in the plan of retooling (new equipment).

As production capacities (new equipment) are assimilated, the economic impact will be reflected more and more in the indicator of the balance sheet profit.

If a measure is implemented in conformity with the plan, the economic impact is involved in the sum with a plus sign. Regardless of the actually obtained economic impact this makes it possible to neutralize the decrease of the profit in case of the introduction of new equipment or the assimilation of a product, which would occur in case of its calculation by the traditional method. In case of the nonfulfillment of the plan on this measure the impact is taken into account in the calculations with a minus sign. Thus, the value of the component, which "compensates" for the decrease of the profitability, and, consequently, the formation of economic stimulation funds depend entirely on the plan of technical development. As new equipment is assimilated and introduced, the economic impact finds expression to a greater and greater degree in the increase of the profit (the decrease of the product cost).

The implementation of this approach will also have a positive influence on the increase of the intensity of the plans of technical development (new equipment), since in case of the more intense pursuit of the technical policy the "compensating" component of the profit will be larger.

The existence of a long-range plan of the technical development of production with a breakdown by 5-year periods and for the next five-year plan by years ensures the uniformity and goal-orientation of the measures being implemented and the systematic increase of the level of production and product quality.

The economic participation of associations and enterprises in the development for them of new equipment (products) in conformity with the plan of technical

development should be broadened, that is, the function of a client should be assigned to them. At present the research and development, which pursue these goals, are performed by scientific production associations, scientific research institutes, and designed bureaus of the sector by means of sectorial funds or budget assets. The involvement of the enterprise in the formation of the directions of its technical updating for the future is minimal. The assets of the production development fund, as a rule, are not used for these purposes.

It seems advisable to finance all the measures of the comprehensive plan of the technical development of the association (enterprise), including scientific research, the development, production, and introduction of new equipment, only through this association (enterprise) by means of the assets of the production development fund and sectorial funds, for example, the unified fund for the development of science and technology.

The above-examined coordination of the indicators of the plan of technical updating and the evaluation of the results of the activity of the production collective satisfies the requirement of the decree of the CPSU Central Committee and the USSR Council of Ministers on the improvement of the economic mechanism to plan the economic impact from scientific and technical progress. This provision for the present has not been realized owing to the great differences between the anticipated and actual impact. The used method of calculating the economic efficiency of new equipment and the suggestions of scientists are not yielding reliable results.

The shortcomings of the existing methods of determining the economic efficiency of research and development are leading to the low accuracy of the calculations of the impact by stages of the "research--production" cycle. The analysis of the activity of Moscow scientific research institutes shows that the ratio of the anticipated and actual economic impact of research and development comes to 3:1. As a result the national economy is bearing significant material losses.

The dependability of the calculations of the efficiency of individual studies and developments is connected not so much with the improvement of the methods themselves as with the reliability of the data being used. The specification of the initial information will help to shift from the evaluation of the potential economic efficiency of scientific and technical measures to sound calculations which make it possible BRING the anticipated levels of the indicators CLOSER to the actual levels, as well as to determine the influence on science on economic growth. This would contribute to the accomplishment of the task on the planning of the impact from scientific and technical progress. Then it will be possible to coordinate quantitatively the economic impact of research and development with the rate of economic growth of associations and enterprises and to establish the level of effectiveness of the expenditures on the development of science, which ensures their rapid recovery.

The Method of Determining the Economic Efficiency of the Use in the National Economy of New Equipment, Inventions, and Efficiency Proposals (1977) made a substantial contribution to the establishment of a uniform approach to such an evaluation. At the same time it does not take completely into account the

specific nature of the calculation of the economic impact and efficiency of research and development, which are at the initial stages. (Footnote 1) (The draft of the Procedural Instructions on the Comprehensive Evaluation of the Efficiency of Measures Which Are Aimed at the Acceleration of Scientific and Technical Progress, which is presently being discussed, is also not void of the noted shortcomings) Consequently, it is necessary to make several refinements.

The production facilities, which serve as the basis for the determination of the economic efficiency of research and development, are not indicated in the Method. This requirement, which is automatically satisfied in case of calculations of the anticipated cost accounting impact at the stages of the assimilation and introduction of new equipment or the actual impact, at the stage of research causes certain difficulties. Scientific organizations, as a rule, consider the possibility of the most extensive dissemination of the anticipated results in the national economy or at least in the sector, that is, calculate the potential impact. Thus, in the Method the maximum economic impact and the upper limit of efficiency, the achievement of which is possible under ideal conditions of the dissemination of scientific and technical achievements, are specified. And, finally, it is risky to include the obtained value of the impact of research and development in the long-range plans of the development of production.

The establishment at the early stages of research and development of the actual user of the innovations and the real extent of introduction, which make it possible to determine the minimum economic impact, which is guaranteed by the developer, and the impact, which the national economy will obtained at the facilities of the priority implementation of an innovation, is necessary for the increase of the reliability of the evaluations of the results of research and development. Such an approach will bring the value of the impact, which was calculated at the early stages of research and development, closer to the actual impact and will ensure the possibility of its planning with allowance made for the dates of the completion of research and the standards of introduction. The increase of the scale of the use of innovations will make it possible to change the estimated amount of the impact only upward.

When determining the economic impact and efficiency at the early stages in practice the total expenditures on the conducting of research and development and on the assimilation and introduction of the obtained results are not always taken into account, although this is envisaged by the procedural instructions. At the stage of development the production expenditures are not taken completely into account, at the stage of introduction the preproduction expenditures (the estimated cost of research and development) are not taken completely into account. As a result the total amount of the economic impact is overstated as compared with the real amount.

The consideration of both the preproduction and production expenditures of the future period, which are connected with the assimilation and introduction of the anticipated results in the national economy, is necessary for the increase of the reliability of the economic evaluations of the themes of research and development at the initial stage of research and development. The suggestion made by us on calculating the economic impact with respect to specific

industrial objects, which have been planned for priority introduction, facilitates this task. In this case the reliability of the evaluations depends mainly on the choice of the period of the determination of the impact and expenditures, as well as on the method of their making.

It seems that at the initial stage of research and development the use of the average annual values of the economic impact and expenditures during the period of the greatest moral value of the scientific results will ensure the greatest reliability of the evaluation of the efficiency. The calculations according to the average annual indicators are least liable to fluctuations due to changes of the annual amounts of the impact in connection with the nonuniformity of the performance of work and the high initial production cost of a new product.

For the comparative evaluation and selection of scientific and technical problems in case of inclusion in the plan one should use more extensively the indicator of the efficiency in the form of the economic impact per ruble of expenditures together with the indicator of the total value of the anticipated impact, which is being used quite extensively at present.

In conformity with the prevailing statute only the direct economic impact, which finds reflection in the decrease of the product cost, is calculated, which, in our opinion, decreases the total value of the impact and efficiency. The objectivity of the evaluation of measures requires the social consequences of the pursued policy of technical development to be taken into account.

For the selection of economically efficient themes when formulating the plans of research and development of any level it is important to specify a scientifically sound LOWER LEVEL--THE STANDARD OF EFFICIENCY, which makes it possible to demonstrate the advisability of the planned expenditures. Here it is necessary to take into account a number of things:

--a portion of the themes of research and development do not pursue the goals of obtaining a directly economic impact. Among them are fundamental and basic development, as well as research in the area of the social sciences. Consequently, the expenditures connected with them should be recovered by means of the impact which has been provided by the implementation of other applied research;

--some operations, which are aimed at the solution of applied problems, might not yield the anticipated economic impact or might culminate in a negative result;

--the results of individual, successfully completed studies might not find adequate application in the national economy, as a result of which the expenditures will not be recovered.

The aggregate economic impact, which is provided by a portion of the themes of research and development, which are planned for implementation at specific production facilities, should offset the total expenditures on the development of science and the introduction of the obtained results in social production. Here what is meant is the achievement of an economic impact, which is

sufficient for expanded reproduction with a coefficient of efficiency which is not less than the standard coefficient.

Our calculations show that the lower level of efficiency of the applied themes of research and development for the national economy should come to 7.5 rubles per ruble of expenditures. Obviously, the value of the lower level can be established in a differentiated manner by ministries on the basis of the approach described by us. It will serve as a guideline when selecting themes for inclusion in the plan of research and development. Such a selection will provide the national economy with an impact which is sufficient for the offsetting of the total expenditures on science and technology, which are made by society.

The practical use of the proposed procedural approach will make it possible, in our opinion, to reduce to a minimum the differences between the potential and planned impact, (Footnote 2) (By the planned (guaranteed) impact there is meant the minimum economic impact, the obtaining of which is guaranteed by the developer at facilities of priority introduction in conformity with the comprehensive plan of technical development) while the economic efficiency of research and development will ensure a quicker rate of recovery of expenditures as compared with the rate of recovery which is established by the standard for capital investments.

A procedure of the mandatory calculation of the guaranteed economic impact and the lower level of efficiency when drafting each annual plan at all the stages of the "research--production" cycle should be introduced. Annual calculations will make it possible in good time to identify and exclude from the plans the themes of research and development, the efficiency of which for various reasons, which were detected in the process of research, prove to be less than the standard efficiency. However, when settling the question of halting the elaboration of themes it is also necessary to take into account the other types of impacts, which are created by them.

With respect to the economic content the planned impact is the minimum value of the actual economic impact and it, consequently, eliminates almost entirely the risk of an industrial enterprise when introducing new equipment. This occurs because in conformity with the prevailing methodology a different technical level of production is taken as the base. Thus, in case of the calculation of the planned impact there serve as the base for comparison in conformity with the Method of 1977:

--at the stage of the formulation of the plans of research and development and the making of decisions on the delivery of new equipment to the works--the indicators of the best domestic analogues (or foreign equipment, which can be purchased in the necessary quantity and can be developed in the USSR on the basis of the purchase of licenses);

--at the stage of the formulation of the plans on the assimilation of the first industrial series and the introduction of new equipment and advanced technology and of new methods of the organization of production and labor--the indicators of the equipment being replaced.

Thus, the estimated value of the actual impact will exceed its anticipated value owing to the difference in the technical level of production, which is ensured by the new equipment. An additional impact will also be obtained as a result of the more extensive use of the results of research as compared to the use which was planned in case of the economic substantiation, for example, in case of the spread of the innovation to a larger group of industrial enterprises of one or several sectors than was proposed earlier.

The improvement of the method of determining the impact of scientific research affords possibilities of the consideration of the anticipated economic results in the plans of production and the inclusion of scientific and technical progress in the system of planning and economic stimulation, which is in effect at associations. The reliability of the estimates of the impact also depends on the procedure of the use of the results of its calculation in the planning of production. Therefore, the approach examined above to the planning and stimulation of the technical development of production should be coordinated with the existing system of reporting on the fulfillment of research and development.

The certificate of introduction, as is known, is the summary document of the completion of a theme for "production" purposes. When drawing it up the economic impact at times is not specified, but the changes of individual technical parameters of machines and equipment are estimated. The very value of the impact, which is indicated in the certification, does not always correspond to the real increase of production efficiency or the decrease of the product cost, which was noted in the reporting documents.

The economic impact from the introduction of research and development often does not have an influence on the indicators of production and is used only when tallying the results of scientific activity and determining the deductions for the stimulation funds of the scientific organization. The value of the economic impact, which is indicated in the certificate of introduction, should automatically be coordinated with the economic indicators of production (the decrease of the product cost and the profit) and be planned during the next planning period.

For the increase of the interest of scientific organizations in the quality and efficiency of research and development it is advisable to make the following changes in the system of economic stimulation for the development and introduction of new equipment. It is necessary to make the deductions for the economic stimulation funds of the scientific research institute in two stages. Directly after the completion of research and development and their delivery to the client the material incentive fund should be formed according to the established standard from the economic economic impact which is indicated in the certificate of introduction. After the introduction of the achievements, which are envisaged by the certificate of the economic parameters, it is possible to make final settlement with the scientific research institute and to create the funds for sociocultural measures and housing construction and the development of the organization. This will ensure an economic interest in the high quality and efficient of scientific and technical results of both the specific performers and the collectives.

The coordination of the corresponding forms of the statistical reporting of scientific organizations and production associations (enterprises) is of great importance for the calculation of the economic impact of research and development. At present the statistical reporting does not make it possible to trace the change of the value of the economic impact in the process of development and introduction and to determine the actual impact which has been obtained in production. Form 2-nt (NPK) envisages its calculation with respect to each study or development. Form 10-nt, which is filled out by the industrial enterprise, is drawn up according to the directions of scientific and technical progress and does not make it possible to establish the actual impact from the introduction of specific measures. There is no direct connection between these reporting forms, which complicates the actual evaluation of specific measures of scientific and technical progress and their influence on the increase of the efficiency of social production.

It is advisable to establish an interconnection in the statistical forms which reflect the efficiency of scientific and technical measures in production and at the scientific research institute. For this in form 10-nt the data on the effectiveness of the most important measures in the basic directions should be supplemented by information on the specific achievements of scientific and technical progress, which have been implemented at the enterprise, and their efficiency, while having retained their common coding in forms 2-nt (NPK), 2-nt, and 10-nt. As a result the calculation of the economic results of scientific and technical progress in production with respect to specific scientific and technical achievements will be facilitated.

It is well known that a report on introduction, which is signed by the developer and the client and in which the economic impact from the practical use of the innovation is calculated, is drawn up upon the completion of research and development. The latter serves as the basis for the payment of a bonus to the developer, but, as a rule, is of a conditional nature and is not reflected in any planning documents of the client. This decreases the demandingness of the client on the measures elaborated for it in conformity with the plan of retooling (the introduction of new equipment) and does not create the economic prerequisites for the speeding up of their introduction in production. Consequently, any scientific and technical measure, which has been fulfilled in conformity with the order of an association or enterprise, should be included in the plan of technical development (the introduction of new equipment) for the year which follows its completion. The economic impact, which is indicated in the certificate of introduction during this year, is included in the estimated section (if the process of introduction caused a decrease of the economic indicators of production) or is taken into account as the increase of the balance sheet profit (if the measure has been introduced); with assimilation it is fully reflected in the increase of the profit.

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CSO: 1814/157

COMPETITION, DEVELOPMENT OF MASS CREATIVE WORK

Moscow SOTSIALISTICHESKIY TRUD in Russian No 1, Jan 86 pp 67-73

[Article by Doctor of Technical Sciences Professor V. Shorin, Honored Figure of Science and Technology of the RSFSR and USSR State Prize winner (deceased), and Candidate of Economic Sciences A. Vladimirov, senior instructor of the Higher School of the Trade Union Movement of the All-Union Central Council of Trade Unions: "The Competition of Ideas and the Development of Mass Creative Scientific and Technical Work"]

[Text] In any sphere of activity, and especially in science, the best result can be identified only on the basis of the comparison of several developments, designs, and ideas. This is an axiom. At the same time the situation is such that in a large number of cases there is simply nothing to choose from. Many scientific research, planning and design, and technological organizations have a kind of monopoly to the elaboration of some designs and technical and economic solutions or others. Therefore, the client is frequently forced to be content only with what they offer him.

The question is legitimate: Are there really in modern science (both basic and applied) no different scientific schools and research organizations, at which they perform operations which are identical from the standpoint of their end results? In other words, do alternate versions of the solution of scientific problems exist? Of course, they exist. What is more, in the country there are more than 80 scientific information centers alone, the themes of which basically coincide, but differ only with respect to departmental affiliation. Approximately 200 design institutes are conducting similar development, true, for different sectors of industry. These circumstances already presume the need for the extensive use of a competitive system in the development of new items and new types of equipment and technology and for competition in creative scientific and technical work.

Some experience in the competitive selection of the best approaches has been gained, for example, in architecture. Special review commissions, which also select the best designs, work here. Leading architectural specialists, who evaluate several designs which have been submitted for competition, belong to such commissions.

Competitive forms are very widespread in the area of art--for the evaluation of the creative activity of ballet dancers, singers, and musicians.

It is obvious that competitions will receive a new stimulus for development in construction, since it is envisaged by the decree of the USSR Council of Ministers "On the Further Improvement of Planning Estimate Work and the Increase of the Role of Expert Appraisal and Author's Supervision in Construction," which was adopted in 1985, to establish new prices for design operations with allowance made for the expenditures connected with the elaboration of different versions of the construction of future enterprises.

However, as a whole the development of scientific and technical innovations by means of this form of competition is still rarely encountered in practice. But competition in case of the choice of solutions would be effective not only in the case of the evaluation of designs, but also in case of the determination of the most effective means of the management of one process or object or another: the works, the subdivision, and so forth. For example, the question of which is better--to consolidate the scientific subdivisions of institutes and to change the overall organizational structures or to establish temporary subdivisions made up of representatives of several departments for the period of the development and introduction of innovations--is being settled. Frequently the following alternative also arises: is one to establish at a scientific institution its own computer center or is it more advisable to be connected to a collective-use computer center.

Problems of this sort are not a rarity in the practice of the work of institutions of science, and for the most part they are solved by a purely administrative means, that is, as an act of one-man management, without collective discussion, moreover, not in all instances are the solutions optimal. At the same time the powers of the labor collective in the management of scientific institutions can be implemented precisely by the analysis of different versions and the choice of the best of them, that is, on a competitive basis and with collective discussion. Of course, no one intends to take away from the administration the right to make the final decision, but it is hardly necessary to ignore the folk wisdom which is well known to everyone--two heads are better than one.

The broadening of the rights of labor collectives in the formulation of alternate proposals, as well as in their evaluation is an objective requirement of the present. Precisely the competition of different collective and individual proposals of workers will make it possible to contrast and compare them from the standpoint of social utility and economic soundness and will also help to create the corresponding moral and psychological mood.

Moreover, the proposals of workers, which have as a goal the improvement of the organization of labor, its stimulation, evaluation, and so forth, are no less important and, in a number of cases, are more important than technical or technological innovations. However, at present there is in practice no scientifically sound system of their elaboration and selection, which decreases significantly the possibility of the more complete use of the creative potential of various categories of workers. It seems that precisely under present conditions, when enterprises and institutions in conformity with

the USSR Law on Labor Collectives are being afforded greater opportunities to solve their internal problems of social and economic life independently, without petty surveillance and rigid regulation on the part of superior organs, the need for the development of such a system has become urgent.

It is quite obvious that competitive forms could substantially enrich and diversify the methods of long-range thematic planning at scientific institutions, especially those which are conducting basic research. For this it is advisable to introduce in the process of the formulation of the future directions of basic research methods of scientific research like what is called "brainstorming," which are well known, but are rarely used in practice. In its essence "brainstorming" is also the competition of ideas, and the very fact of the inclusion of the problems posed by scientists in the long-range plan of work is already a significant moral stimulus for them.

A competition of ideas has been held several years in a row at the Institute of Atomic Energy imeni I.V. Kurchatov. The only thing that is required of its participants (and young specialists are them) is an original scientific idea which has been set forth on one or two hand-written pages. The ideas can be most improbable, and no one risks looking silly in case of failure: the proposals are signed with a motto, the key to which is in a sealed envelope. It is revealed only if the idea has been commended. In this way priority is preserved, and here the competition participants do not experience moral embarrassments. The winners are granted the right to implement their ideas at institute laboratories. Such competitions make it possible to develop among scientists creative activeness and readiness for rivalry. Moreover, as practical experience shows, such competitive emulation is also more effective as compared with "spontaneous" emulation.

After all, it is no secret that the lack of competitive selection with respect to the entire set of scientific, technical, and economic positions frequently leads to the inefficient use of material resources and financial assets. This finds expression in the fact that the developers of new equipment receive large bonuses for the development and introduction of equipment, which is called new, but proves to be inefficient economically. The estimated efficiency often remains precisely the estimated efficiency and is very far from the actual efficiency. Workers receive bonuses on the basis of the planned efficiency, not to mention the significant one-time material rewards. But this is only a part of the expenditures. The stage of the introduction of innovations accounts for the basic costs. But what if these innovations do not yield a substantial socioeconomic impact? Competitive selections can erect barriers in the way of the introduction of inefficient equipment and technology. Moreover, the competitive mechanism should be oriented toward not only the technical and economic, but also the social consequences of the introduction of new equipment, its ability to improve working conditions, to decrease unproductive manual labor, and so forth.

Competitions as a form of emulation do not require complex systems of the evaluation of the results of creative work, a quite complicated body of mathematics, and weighting coefficients of importance, which are used for the comparability of the indicators of creative labor, in the direction of which the terms of emulation err at times. The selection of the best solutions can

be carried out by means of a small number of indicators which reflect the novelty and utility of each of the proposed solutions.

The effectiveness of competitions also consists in the fact that their object is the end results of the creative activity of scientists and specialists, and not the intermediate results. Precisely this demand is being made today on the emulation which is contributing to the changeover of science to the path of intensive development.

Why has competitive selection all the same not yet received extensive recognition and dissemination in practice?

The uneconomical nature of the conducting of parallel scientific research, designing, and engineering is advanced as the basic argument against the competitive procedure. But in science, as was already noted above, there were, are, and will be individual workers and entire collectives, which are working on identical or nearly identical problems. As to planning and design operations, the expenditures on them under present conditions are not so significant as compared with the costs of the very object of designing. Moreover, in the majority of cases it is sufficient to submit for competition not a final solution, but only the basic layout and technological designs.

There are also factors which are connected with the inertness of the thinking of some economic managers, who do not have a sense of what is new and are not capable of agreeing to take risks. At times the activeness of trade union organs in the matter of the extensive dissemination of competitions is also low. An efficiently developed system of their organization and holding and the stimulation of the participants is also lacking.

Such objections as, they say, people's "peaks" of creative activity are different, are also arising. Some people have a number of ideas and proposals and, as they say, "generate" them in short intervals of time, and sometimes several simultaneously. Others require long intervals for the "ripening" of an idea. These psychological peculiarities of creative work can also be taken into account when holding competitions. It is not at all obligatory to set a specific short time. After all, the competition can be organized as permanent emulation, since its main task is to ensure the unending search for and choice of the best versions of the solution of the most different problems.

It is important to note that in some instances additional expenditures on the development of innovations will not be required. It happens that they have already been developed, but, unfortunately, have not found material embodiment, and are being kept in the form of reports and technical specifications on the dusty shelves of the archives of institutions, the workers of which were not able to introduce them due to the negative attitude toward "other's" proposals of several organizations which are zealously protecting their monopoly in the same field of scientific research.

The organization of competitions among young scientists, specialists, and innovators merits special attention. Young people have always been distinguished by great mobility and susceptibility to the competitive elements in creative work. They, as a rule, react positively to what is new and easily

support undertakings and initiatives. The advertisement of competitions is hardly necessary among young workers. But it is important for the organizers of emulation to understand that the increased interest in self-affirmation among young specialists is also accompanied by an increase of the criticalness, categoricalness, and maximalism in evaluations. In this connection it is necessary to select especially attentively and to substantiate carefully the criteria of the evaluation of the results of competitions. First place in the competition should not turn into an end in itself. Here the promotion of what the results of the emulation gave the collective and what their social utility is, is of particular importance. As sociologists claim, it is inadvisable to set simultaneously for young scientists several goals and to enlist them in the elaboration of several themes of research.

It seems that competitive elements could also be used during the preparation of dissertation works by graduate students, but on the condition of the mandatory assurance of constant and high-quality monitoring on the part of scientific supervisors. Why not charge two graduate students with the elaboration of one theme of a dissertation with the subsequent awarding in conformity with the existing criteria of academic degrees to each of them? Such research work would be performed simultaneously, but periodically, for example, after the writing of each chapter it is possible to organize the discussion of the results in order to dwell on the best solution of the scientific problem. The effect of rivalry, undoubtedly, will stimulate the origination of original, new ideas, which is also required of the seekers of academic degrees. In case of such an approach the responsibility and the quality of the work of scientific supervisors increase, which is also of no small importance.

The organizers of science might as well also think about new elements in the holding of competition for the filling of positions in much the same way as Central Television previously conducted a talent search (the program "Hello, We Are Searching for Talents"). Unfortunately, the system of competitions for the filling of vacant positions, just as the very certification of staffs of instructors, scientists, and engineering and technical personnel, for the present in most instances is operating poorly. Apparently, the main reasons lie once again in the lack of real competitors and the decrease of the objectivity of the evaluation of the competition commissions. It seems that the trend toward the use of the Shchekino method (the performance of amounts of work with a smaller number of personnel), which has at scientific institutions its own modification (namely the Karpov system), on the condition of its mass introduction will make it possible to improve the state of affairs in the area of the search for talented people. Obviously, when evaluating the personnel of science one should use more actively the principle which has been made the basis for the admission of students to music schools and the conservatory: the mandatory existence of an ear for music. After all, without the aptitude for creative scientific research it is hardly worth expecting that new ideas will be "found."

The development of competitive elements and the orientation of socialist competition toward the elaboration of new ideas and approaches are important reserves of creative technical work and the increase of the return from the

movement of innovators. Meanwhile under many conditions of the competition the indicators of invention and efficiency promotion are only among those being taken into account, that is, are taken into consideration when tallying the results and determining the winners only on the condition of the equality of the other, so-called basic indicators.

The organizers of creative technical work may object that a special form of the organization of the rivalry of innovators--the All-Union Socialist Competition of Inventors and Efficiency Experts--exists. However, as practical experience shows, this form is being developed in the majority of instances as "a thing in itself," in isolation of others. But under present conditions the quality of the organization of competition, apparently, cannot be evaluated only according to the number of frequently formally existing forms of labor rivalry. Obviously, the organization of competition, to use sports terminology, should be patterned after the Olympic system, and the effectiveness of innovation, the novelty of the technical idea, and its economic and social effectiveness should become the most important criteria for the attainment of the highest levels of labor rivalry.

The unity of competition and creative work should be not simply proclaimed, but embodied in the socialist obligations and counterplans, in the entire organization of rivalry, in the indicators of the tallying of its results, and in the systems of stimulation.

Sociological studies show: the need for competition, although inherent in the nature of man, is not always embodied in active labor rivalry. It increases depending on the success in it and is developed more successfully in case of a real comparison of the results of one's own labor with the achievements of rivals, which is absolutely necessary for self-evaluation. Initiative and the sweeping away of established approaches and mean norms, of course, conclude with the attainment of the highest level. But at the same time the need for social recognition and the mass dissemination and introduction of the innovative initiative arises, which serves as the reference base for new initiatives. It is an incomparable joy to see how your will, your example, and your experience, which people need, change the matter for the better, how the brigade, from which they did not expect anything good, before your eyes becomes better, how talent awakes in people, how skill comes, and how creative work inspires the soul. V. Gaganova repeatedly emphasized this idea in her statements.

The complex dynamics of the need for competition presumes the need for the development and use of a set of stimuli. Information, which is comprehensible to all and ensures the comparison of some technical ideas or others of innovators, acts as one of them. Meanwhile precisely in the sphere of invention and efficiency promotion the system of information and publicity is obviously operating unsatisfactorily. According to the data of sociologists, for example, at the Dnepropetrovsk Metallurgical Plant imeni Comintern among the surveyed innovators 7 percent were not acquainted with the terms of incentives, 11 percent--with the progress of reviews and competitions, 24 percent--with the rules of the drawing up of proposals, and 40 percent--with the list of bottlenecks of production. Of course, this is hindering the development of the need for creative rivalry.

The guaranteed support of innovative initiatives is also an important stimulating factor. It seems that under any conditions of competition such support should rank with other stimuli. It is especially important to disseminate the innovative initiative in the collective, of which its author is a member.

It seems necessary to improve the procedure of enlisting workers in public creative organizations, using for this the competitive system of the joining of the All-Union Society of Inventors and Efficiency Experts and the periodic certification of innovators. The results of scientific, inventing, and efficiency activity, which have already been achieved by workers and are socially recognized, can become the basic criterion of evaluation in such competitions. The introduction of a system of candidate probation is also possible. Measures of this sort should contribute to the increase of the social status of the participants in the movement of innovators with the simultaneous increase of their responsibility for the effectiveness of creative work.

The tendency to elaborate measures on the increase of the social status of innovators already exists in the organization of creative technical work in a number of labor collectives of the country. In Irkutsk Oblast, for example, the Ratsionalizator-25 Club, of which efficiency experts who have not less than 25 introduced efficiency proposals can be members, has been established for the workers of the timber industry. The club of "millionaire" inventors has been organized at the State Scientific Research and Design Institute of Basic Chemistry (NIOKhIM). The club has been operating for several years now under the trade union committee of the institute. Representatives of the board of directors and public organizations belong to its acceptance commission. The club consists of full members and candidates. The obtaining within a 5-year period of a national economic impact from the use of their inventions in the amount of not less than 1 million rubles is a necessary condition for full members, and not less than 500,000 rubles--for candidates. About half of the staff members of the institute are encompassed by this movement.

The competitive forms of the emulation of inventors and efficiency experts, which are aimed at the acceleration of scientific and technical progress, need more extensive dissemination. Some experience of their organization already exists. Thus, at the Novokramatorskiy Machine Building Plant imeni V.I. Lenin an interesting form of the stimulation of the activity of inventors and efficiency experts, their enlistment in the solution of urgent technical problems, and the elimination of bottlenecks at the works arose recently--this is auctions of technical solutions. What is their essence? The themes and problems, which require solution, are brought to the notice of the entire collective via plant radio and the plant newspaper ZA TEKHNICHESKIY PROGRESS. An organizing committee, of which representatives of the administration, the trade union and Komsomol committees, and the council of scientific and technical societies and the All-Union Society of Inventors and Efficiency Experts of the enterprise and leading specialists and innovators are members, is appointed by order for the plant. The place and time of the holding of the auction are established, assets are allocated for the stimulation of the authors, whose proposals are recognized as the best.

On the day of the auction everyone, who wishes to take part in it, is invited to the Palace of Culture and Technology of the plant. The auction participants report on their versions of the solution of the suggested problems and show the drawings, models, and devices, which were developed by them during the time free from work. Anyone present in the hall can participate in the discussion. In the conclusion the organizing committee summarizes the competition and awards the prizes to the authors of the best proposals.

It is noteworthy that proposals, which have not yet been used in practice, are stimulated at the auction. Such an approach is very promising. Obviously, it is necessary to disseminate on a broader scale this experience of the stimulation of the development of the creative work of workers, since it is important to encourage not only the fact of the introduction of a technical innovation in production and the obtaining of an economic impact, on the size of which the amount of the bonus depends, but also the very process of creative work. Unfortunately, the stimuli of innovation operate only at the concluding stage of this process and the examples cited above are still rarely encountered in practice.

In our country there are more than 25 million people in scientific and technical societies and the All-Union Society of Inventors and Efficiency Experts, and in the future this figure will increase. The effectiveness of creative scientific and technical work in this case can be increased significantly, if quite simple truths are realized and are used extensively in the practice of stimulation: the creative process requires a stimulating approach to the proposals of innovators. Even in a doubtful idea it is possible to find positive elements and thereby to stimulate the continuation of creative research.

At the Kislorodmash Scientific Production Association, where all the workers are efficiency experts and inventors, a one-time reward is paid to the author just for an idea, if it is at least of some production interest. In 1984, 400,000 rubles were spent on the stimulation of the "generators" of ideas, while an impact of 2.2 million rubles was obtained from the introduction of proposals.

Given a positive approach to innovative ideas it is also ensured that many proposals, especially of young innovators, which have not been completely thought out and "have not made it" to the status of efficiency proposals, are not automatically rejected. It is important in principle to complete them. The organizers of creative technical work at the Frunze Instrument Making Plant imeni 50-letiya Kirgizskoy SSR, in particular, are acting this way.

The development of competitions presumes the need for the approval of a detailed legal basis of their holding and stimulation at the different levels of the management of scientific and technical progress: from the structural subdivisions of enterprises and scientific institutions to intersectorial comprehensive programs. The decisive role here should belong to the USSR State Committee for Science and Technology, the USSR Academy of Sciences, the USSR State Committee for Inventions and Discoveries, the All-Union Central Council of Trade Unions, ministries, and departments, which in a special

statute on competitive selection could indicate for what designs and scientific and technical solutions competitions are mandatory, what the procedure of their holding and stimulation are, and how they are interconnected with other forms of socialist competition.

The competitions do not abolish the other forms of the organization of competition, but are called upon to supplement them, in order to develop more extensively the competitive elements in creative scientific and technical work, to stimulate the human factor, and to unite in practice the two most important revolutions of the present--the scientific and technical revolution and the social revolution.

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CSO: 1814/155

ORGANIZATION, PLANNING AND COORDINATION

PROBLEMS WITH FASTER INTRODUCTION OF COMPLETED RESEARCH

Moscow SOTSIALISTICHESKIY TRUD in Russian No 1, Jan 86 pp 74-76

[Article by Corresponding Member of the USSR Academy of Sciences Professor P. Kirpichnikov: "How to Expedite the Introduction of Completed Scientific Research"]

[Text] At present an abnormal situation has come about, where the enormous, ever increasing scientific and technical potential concentrated at institutes of the USSR Academy of Sciences and higher educational institutions, is not finding an outlet to practice. For decades new technologies have not been assimilated, newly developed and modified materials, which have unique properties, have not been produced, and, hence, enormous economic harm has been done to the national economy of the country.

Many people believe that the establishment of a pilot industrial base in the system of the USSR Academy of Sciences and the USSR Ministry of Higher and Secondary Specialized Education, from which finished developments will be transferred to their sectorial ministries and departments following the example of the institute which Academician B.Ye. Paton heads, can aid the matter. The RSFSR Ministry of Higher and Secondary Specialized Education has gone even further: it has established a cost accounting scientific association, assuming that this will make it possible to concentrate scientific forces and material resources on the most important scientific directions. But here they did not take into account the entire breadth of tasks and possibilities, as well as the decisive role of the author, who is the creator of a new thing and who in the system of the Ministry of Higher and Secondary Specialized Education is inseparably connected with the educational process.

By such a very expensive means, in our opinion, it is possible to solve only several important problems and tasks, to organize the output of prototypes, and to create apparent well-being, but it is necessary to achieve a decisive upswing in all sectors of industry and agricultural production and to speed up drastically the implementation of the achievements of science and technology and their advance.

Practical experience shows that an outlet of academic institutes and higher educational institutions to numerous sectorial scientific research institutes

does not ensure the shortening of the time of development and introduction. Moreover, even the tendency to hinder the advance of ideas, which have come "from outside," is frequently observed. At times the creator of a new thing, the author, in general as if disappears with all the negative consequences ensuing from this. Sectorial institutes after the transfer of developments further--to enterprises--evade, as a rule, assimilation, since they do not bear direct responsibility for the state of affairs in the sector.

"Small-scale" chemistry, which is close to me and is called upon to produce the most different reagents, for example, found itself in a most difficult position in the sense of introduction. It is a question of stabilizers, inhibitors, and modifiers, which in case of introduction in very small amounts (not more than 1 percent) make it possible to preserve large-tonnage materials and to give them new, often unique properties. Unfortunately, the breakdown of the management of the chemical industry into several ministries has greatly complicated the production of new efficient reagents and materials. Thus, 12 years ago Professor B.D. Chernokalskiy developed the simple substance khlofin, which prevents the biological fouling of deep-sea vessels, but its production so far has not been organized. The settlement of the question of the output of the very effective medicinal compound, which was developed by Professor A.I. Razumov, has dragged on for 10 years.

The experience of the work of scientists of Kazan higher educational institutions and institutes of the USSR Academy of Sciences enables us to conclude that the direct contacts of creative scientific collectives headed by the author of an invention or discovery with an industrial enterprise, at which his proposal will be introduced, are fruitful. Such contacts actually lead to the drastic shortening of the time of introduction and increase the effectiveness of the entire "research--production" cycle. As it seems to us, it is advisable to allocate to enterprises assets and resources in a special-purpose manner. Then the leading enterprises will be able to assume responsibility for the implementation of the achievements of science and technology in practice and to achieve success, of course, on the condition of the granting to them of the right to settle all questions connected with introduction, beginning with the determination of which organizations and which specialists of the highest skill should be enlisted for this from institutions of the USSR Academy of Sciences, higher educational institutions, sectorial scientific research institutes, and design organizations.

In our conviction, only in such a way is it possible to sweep away the formed conservativism in the introduction of the new and latest achievements of science and technology.

This conclusion is based on our own experience. For example, when the industrial production of synthetic isoprene rubber was assimilated for the first time in the world, great difficulties, which were connected with the clogging of the units of the purification and extractive distillation of isoprene with a thermopolymer, arose. Its elimination required great expenditures of time and labor. The recommendations issued by sectorial scientific research institutes did not help. At that time a group of Kazan scientists and production workers under the supervision of Professor A.G. Liakumovich developed on the basis of amino phenols a new inhibiting system

which completely eliminated the processes of the thermopolymerization of isoprene. It was possible on the same equipment to increase by 25 percent the output of products and to eliminate the losses, which provided an economic impact estimated in the tens of millions of rubles. The inhibiting system also proved to be effective for other monomers, became universal, and made it possible to abandon imported inhibitors.

The creative collective also successfully solved the problem of how to eliminate the decrease of the activity of the catalysts of dehydration as a result of carbon build-up. This solution also yielded a large economic impact.

Immense work on the use of the latest achievements of science and technology in production practice is being performed on a broad front at the plants of the Nizhnekamskneftekhim Production Association with the enlistment of a wide range of engineering and technical personnel of the enterprise and tens of academic and sectorial scientific research institutes, higher educational institutions, and design organizations. This is joint activity on catalysts and oxidation, on the development of new brands of synthetic rubber with improved properties, on the dimerization and trimerization of ethylene, on the obtaining of synthetic drying oil from production waste, and others.

When enterprises are interested in the developments of scientists, then, as a rule, by the joint efforts of collectives it is possible to quickly bring them up to introduction, while the interested sectorial ministries support this process by opening sectorial laboratories. It is important that engineering and technical personnel of industrial enterprises, who have a sense of what is new, are able to master modern technology well, and know how to quickly introduce advanced developments in production, also develop in such joint work. However, for the present, unfortunately, in this most important matter, as was already noted above, there are still many shortcomings, on the elimination of which it is necessary to concentrate our efforts.

It is possible to cite the following example. The extensive use in technological processes of vortex-action equipment, which increases by an order of 10 the productivity of processes with the same decrease of the metal content of equipment, should make a large contribution to scientific and technical progress. This equipment, which was designed at the Kazan Institute of Chemical Technology, has already demonstrated great productivity in the quantitative removal of dust and chemical reagents from waste gases in two versions--with filters and flare reflux. After its display at the Exhibition of USSR National Economic Achievements we received numerous orders and sent about 100 working drawings for the production of such equipment at individual enterprises. But, apparently, it is economically more advisable to organize their industrial production at specialized enterprises of the Ministry of Chemical and Petroleum Machine Building.

Even greater prospects in the national economy, biology, and medicine are connected with the recently discovered phenomenon of electrochemical activation, which makes it possible to change radically many technological processes, to improve product quality, and to decrease the consumption of raw materials and energy, and in the system of industrial agricultural complexes

to increase the yield of agricultural crops and, what is especially important, to preserve food products and fodders.

It is impossible to tolerate the cases, when the introduction of new technologies and new technical solutions is hindered due to the sluggishness of the system of management. After all, for the obtaining of the maximum economic impact everything advanced and fundamentally new should be introduced as quickly as possible on an extensive scale. The direct contacts of scientific institutions and the authors of innovations with the industrial enterprises, which are interested in introduction, should be strengthened in every possible way.

A large role in this is being assigned to the USSR State Committee for Science and Technology (GKNT), which jointly with the management of sectorial ministries and departments should clearly specify and include the problem themes in the plan of new equipment of enterprises and should shape organizationally the creative collective and select reliable performers from among the leading industrial enterprises. Then it is a question of systematic checking, the comprehensive objective evaluation of the results, and the extension of new developments to the sector as a whole. Prompt measures are needed in order to do away with the "paper supply," which has increased incredibly.

In our opinion, it would be advisable also to simplify the system of the establishment of prices for newly developed products. To supply prototypes free of charge and to seek intensively for them areas of application, and then with their assimilation on an industrial scale to decrease the prices gradually during the assimilation of the technology. Here it is useful to grant the managers of enterprises and organizations the right to spend a more significant portion of the profit, which is derived by the enterprise, on the development of new equipment (while supporting this with the necessary material resources), the financing of plans of social development, and the payment of bonuses to the workers who have distinguished themselves most.

If an enterprise is in charge of the introduction of something new, the budget of scientific research and design institutes will mainly depend on their efficiency, mobility, and the concentration of the creative potential on the most important developments and the introduction of the results in practice.

All-union and sectorial competitions, which played a large role in the past when developing new technologies and making important technical decisions, can give significant assistance in the solution of the fundamental problems of scientific and technical progress. It stands to reason that it is necessary to reward the winners of the competitions, without limiting the payment of bonuses for the implementation of the plans of new equipment to all the developers and especially the management personnel, staff members of the highest skill, and engineering and technical personnel, regardless of departmental affiliation.

It is impossible to tolerate further the underestimation of the role of central plant laboratories and the active participants in new developments and

their introduction. Apparently, the time has also come to consider the urgent questions of the remuneration of their labor.

As for the directors of plants and chief engineers, it is also necessary to connect their salaries and pay more closely with the results of the scientific and technical development of enterprises, having made them dependent on the introduction of new equipment and the carrying out of renovation.

It seems that without decisive and quick steps in this area it is impossible to achieve the complete use of the enormous creative potential of science and its quick effect on the acceleration of scientific and technical progress.

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CSO: 1814/155

ORGANIZATION, PLANNING AND COORDINATION

FORMS OF INTEGRATION OF SCIENCE, PRODUCTION ANALYZED

Moscow SOTSIALISTICHESKIY TRUD in Russian No 1, Jan 86 pp 57-62

[Article by Candidate of Economic Sciences F. Novikova under the rubric "Science for Production": "The Forms of the Integration of Science and Production"]

[Text] The great effectiveness of science in our times depends on the coordinated solution of an entire set of problems in the area of planning, management, and the stimulation of workers at all the stages of the "science--technology--production" cycle. These problems are difficult, especially as they, as a rule, are of an intersectorial nature, while the interrelations of all the participants for the present have not been properly adjusted. Thus, many sectorial institutes have in their "portfolios" a large number of completed jobs which were frequently performed on the direct instructions of a ministry. However, their pilot checking and introduction were never organized. In nearly every sector of the national economy there have been instances, when the period of the introduction of important scientific developments, which are of fundamental importance, has been dragged out so much that innovations have become obsolete, having never ended up by being assimilated.

Why does the problem of the introduction of innovations, which promise the national economy an advantage, continue to remain difficult to solve?

First of all the fact of the lack of interest of the consumer in these innovations is conspicuous. The existing practice of planning and system of the evaluation of the economic operations of enterprises orient them to direct all their efforts at the fulfillment of the current plan assignments, and not at the improvement of production technology or the output of products of a new assortment and better quality. It even happens that enterprises and ministries change pilot plants over to the output of planned products.

The problems of the introduction of what is new become even more complicated, if the question not of the traditional "improvement" of obsolete equipment and technology, but of the large-scale use of fundamentally new achievements of science and technology arises. Not only the organizational and economic conditions, but also the existing legal norms hinder this. Thus, in the Method of Determining the Economic Efficiency of the Use in the National

Economy of New Equipment, Inventions, and Efficiency Proposals it is indicated that "the indicators of the equipment being replaced" should be used as the basis for comparison when determining the actual impact from the introduction of new technical solutions. Such a norm assumes in advance the existence of analogues--equipment which is already being used. In the same instances, when there are no analogues (and fundamentally new equipment might not have them), it is impossible to find the value of the impact and, consequently, to count on deductions for the material incentive funds.

In connection with the adoption of the decree of the CPSU Central Committee and the USSR Council of Ministers of 12 July 1985, "On the Extensive Dissemination of New Methods of Management and the Increase of Their Influence on the Acceleration of Scientific and Technical Progress" a large number of specific measures on the improvement of the system of prices and markups for technically advanced products of the highest quality category have to be elaborated, the importance of plan indicators on new equipment and the role of standards have to be increased, a new procedure of the formation and expenditure of production development funds has to be ensured, and their material and technical supply have to be improved.

For the increase of the efficiency of the integration of science and production it is also important to use more actively the organizational reserves at the different levels of the management of the process of the interaction of scientific and production collectives.

The traditional organizational forms of the combination of science and production are represented by the "institutes of the Academy of Sciences--sectorial scientific research institutes--production" system. However, as the practice of recent decades has shown, sectorial science most often remains passive in the use of the latest results of basic research. One of the causes of this is the orientation, which was inherited from the times of the extensive development of the economy, not toward fundamentally new scientific and technical solutions, but toward the partial gradual improvement of already known equipment and technology. In order to use the latest scientific and technical innovations, thematic and organizational reform is frequently needed, but the present structure of scientific research institutes is not suited for it. Moreover, frequently sectorial institutes simply do not have enough material resources either to perform by themselves the necessary basic and applied research or to enlist academic institutes in this work. The point is that in sectorial science at present the expenditures on research work come to about 10 percent of the total expenditures, meanwhile in the late 1960's they were about 25 percent. (Footnote 1) (VESTNIK AKADEMII NAUK SSSR, No 8, 1984, p 40)

Some main institutes of sectorial departments are pursuing a rigid narrow departmental technical policy, which far from always conforms to statewide interests. The 12-year struggle over the decombustion chamber pilot-flame method of ignition in internal combustion engines, the use of which provides a large saving of gasoline and makes it possible to pollute the air less, comes to mind. At that time the president of the USSR Academy of Sciences and the chairmen of the USSR Committee for Science and Technology and the USSR State

Committee for Inventions and Discoveries came out on one side, the two main institutes came out on the other. (Footnote 2) (PRAVDA, 12 July 1982)

Many directors of institutes believe that the existing procedure of introducing the achievements of academic science needs serious improvement. (Footnote 3) (The author made surveys of 56 academic institutes) They, in particular, unanimously note that basic scientific and technical results do not have today a "standard force," their use is absolutely not mandatory for potential users. Under these conditions the institutes of the academic type are trying to establish direct relations with industrial enterprises, to set up creative collectives, which include workers of both science and production, to form scientific and technical complexes, which consist of scientific and production collectives, and so forth.

A number of new forms of the cooperation of science and production have demonstrated their effectiveness in practice. One of them is interdepartmental scientific production complexes. Academic and sectorial institutes, technological and start-up and adjustment organizations, pilot works, as well as enterprises and associations belong to them. Such complexes are operating actively at the Western Scientific Center of the Ukrainian SSR Academy of Sciences, while interdepartmental regional scientific production complexes have been established on the initiative of the Ministry of the Chemical Industry and the USSR Academy of Sciences. As experience shows, here departmental isolation is being overcome, the use of the results of basic research in applied operations is being accelerated, and the scientific research potential of the cooperating organizations is being combined for the solution of scientific and technical problems of an intersectorial nature. The management of the complexes is based on contracts and statutes on creative cooperation.

Considerable experience of scientific and production interaction in accordance with comprehensive contracts on scientific and technical cooperation has been gained. Joint problem scientific research and sectorial laboratories are being established. Such laboratories, especially the ones operating directly at large production enterprises, help to turn the results of basic research over promptly to production.

For the purpose of developing a mechanism of the more rapid introduction in the national economy of the results of scientific research work an experiment on the establishment of temporary scientific and technical laboratories, which perform assignments directly of the sector, was conducted at the USSR Academy of Sciences. The experience of the work of such temporary collectives attests to the promise of this organizational form. Thus, the temporary scientific and technical laboratory at the Institute of Metal Physics of the Ural Scientific Center of the USSR Academy of Sciences was able along with the fulfillment of the planned scientific assignments to increase by more than twofold the amount of work connected with introduction. Neither additional equipment nor the expansion of the work areas was required here. The basic impact was achieved owing to organizational reform.

It seems to us that temporary scientific collectives have a great future. They spare the necessity of establishing new academic and sectorial

subdivisions of institutes and design bureaus and of building new pilot experimental and industrial enterprises. They facilitate the accomplishment of major goal program tasks of an intersectorial nature. However, in our opinion, it would be advisable to strengthen the relations between the individual subdivisions of such temporary collectives, having regulated their joint activity with respect to not only the organizational, but also the economic parameters. This means that for the time of the accomplishment of the task posed for the collective greater rights should be turned over to the basic leading unit--the main organization, namely: all the limits on labor and financial assets for the scientific and technical programs initially should be released only to it, while the other organizations and enterprises can temporarily transfer to its balance sheet.

As practical experience shows, at times it is easier to achieve such a kind of the integration and establishment of "working forms" on a regional scale. The experience of the Siberian Department of the USSR Academy of Sciences, as well as individual experiments in the union republics attest to this.

A "zone of introduction"--a set of sectorial scientific research institutes and design bureaus, which are called upon to speed up the transfer of scientific developments to the national economy--began to be established 18 years ago on the initiative of the Novosibirsk Oblast Party Committee and the Siberian Department of the USSR Academy of Sciences around the Novosibirsk Scientific Center. This idea as a whole has withstood the test of time. The possibility of enlisting skilled specialists and of using the scientific developments of the institutes of the department is enabling ministries in the shortest possible time to assimilate technical and technological innovations and to perform work at a most advanced level. Good and significant practical results were obtained at those organizations of "zone of introduction," at which they directed attention to the achievements of the institutes of the department in leading basic and applied research.

For example, the Siberian Soyuzgeofizika Special Design Bureau of the USSR Ministry of Geology, by relying on the achievements of the Institute of Automation and Electrometry and the Institute of Geology and Geophysics of the Siberian Department of the USSR Academy of Sciences and other scientific institutions, has securely taken leading positions in the area of the development of the latest geophysical equipment for mineral prospecting. As a result of the joint work of the Institute of Thermal Physics of the Siberian Department of the USSR Academy of Sciences and the Energokhimmash Special Design Bureau of the USSR Ministry of the Petroleum Refining and Petrochemical Industry it was possible in a short time to develop models of highly efficient plasma generators, on the basis of which new plasma chemistry technologies for the production of polymers, light alloys, and products for powder metallurgy were developed. The total economic impact from the developments, which were introduced by all the sectorial special design bureaus of the "zone of introduction," came to more than 250 million rubles.

Great potentials of the further increase of the efficiency of such a form of the introduction of scientific developments in practice exist. For the realization of these potentials the Council for the Coordination of the Activity of Sectorial Scientific Research Institutes and Design Bureaus and

Academic Institutions of the Siberian Department, to which the development of a stable mechanism of the interaction of sectorial organizations with the institutes of the Novosibirsk Scientific Center was simultaneously assigned, was established under the Presidium of the Siberian Department of the USSR Academy of Sciences.

The Council for the Promotion of the Scientific, Technical, and Socioeconomic Development of the Oblast, which was established under the Novosibirsk Oblast Committee of the CPSU, is playing a large role in the establishment of interdepartmental interaction and the territorial cooperation of scientific and production organizations. The work of the council is clear confirmation of the effectiveness of party support of the efforts on the acceleration of technical progress. At present the department has bilateral long-term agreements with 22 ministries and departments of union and republic subordination. The work in accordance with coordinated programs is leading to the constant extension of the relations of science and production and is ensuring their fundamental inclusion in the national economic plans.

I would especially like to note that the statute on the formation and use of economic stimulation funds, which is being used at the Siberian Department of the USSR Academy of Sciences, has been brought substantially closer to the one which is in effect in industrial ministries. Not the impact from the introduction of new equipment, but the guaranteed economic impact, which is recorded and included in the estimated cost of economic contractual operations, is regarded as the fund-forming impact. These amounts serve for academic institutes not as an additional, but as the basic source of stimulation. Regardless of whether or not they have introduced a development, in conformity with the amount of the guaranteed impact the assets are received by the academic institute. This was an additional economic lever for the intensification of the integration of science and production.

One of the main conditions, which afford republic academies of sciences the possibility of implementing in practice their scientific research work, is the existence at them of a pilot production base. The management of the academies is devoting much attention to its development and strengthening. Thus, whereas in 1965 at the Ukrainian SSR Academy of Sciences there were 16 cost accounting pilot production subdivisions with a total production volume of about 12 million rubles a year, in 1983 their number had increased to 72, while the total amount of work exceeded 200 million rubles. (Footnote 4) (VESTNIK AKADEMII NAUK SSSR, No 9, 1984, p 42)

The establishment at the leading academic institutes (the Institute of Electric Welding imeni Ye.O. Paton, the Institute of Cybernetics imeni V.M. Glushkov, and others) of cost accounting planning and design and production subdivisions led to the origination of a qualitatively new form of the combination of basic research, planning and design work, and production. Powerful scientific and technical complexes, which consist of an institute, a design bureau, and an experimental works or pilot plant, were established on the basis of such institutes. In such complexes the conditions are created for the rapid implementation of the entire cycle of the introduction of scientific and technical innovations.

Another channel of the introduction of completed scientific and technical work is through the sectorial laboratories of the Academy of Sciences. An example of this is the laboratories of the Ukrainian SSR Academy of Sciences. Academic institutes carry out their scientific methods supervision, while the ministries, which are interested in their developments, finance them.

The contracts on scientific and technical cooperation between the Ukrainian SSR Academy of Sciences and enterprises of different oblasts of the republic, which are aimed at the comprehensive solution of regional problems, and particularly at the increase of the efficiency of the cooperation of territorial and sectorial management, have become an effective form of the cooperation of science with production. Academic institutes, on the one hand, and enterprises of the oblast, on the other, are the partners of these contracts. The scientific centers of the academy and the oblast party committees perform coordinating and control functions.

In recent times engineering centers have begun to be established at the most important academic institutes in order to turn over more rapidly to enterprises models of the latest equipment and materials and technical specifications and to give assistance in the training and advanced training of engineers. The search for effective forms of the combination of science and production is already yielding appreciable results. In 1982 the return per ruble of expenditures for the Physical and Technical Problems of Materials Science Department of the Ukrainian SSR Academy of Sciences came to 6 rubles 30 kopecks, including 7 rubles 20 kopecks for the Institute of Electric Welding imeni Ye.O. Paton and 7 rubles for the Institute of Problems of Material Science. (Footnote 5) (VOPROSY EKONOMIKI, No 9, 1984, p 7) In 1983 alone more then 1,350 works, which were completed by scientists of the Ukrainian SSR, were introduced in the national economy of the country; the total economic impact exceeded 1 billion rubles. (Footnote 6) ("Sotsialisticheskoye sorevnovaniye v sfere naucho-tekhnicheskoy deyatelnosti" [Socialist Competition in the Sphere of Scientific and Technical Activity], Moscow, 1984, p 61)

There are many examples of the successful introduction of scientific developments at the Belorussian SSR Academy of Sciences. The form of economic contracts, for which the academy receives more then half of all the financial assets (this is the highest indicator in the country), is being actively used here. (Footnote 7) (VESTNIK AKADEMII NAUK SSSR, No 9, 1984, p 42)

The practice of the work of a number of scientific organizations of the academy demonstrated the advisability of the uniting of an academic institute and a special design bureau with a pilot works into a unified academic scientific and technical complex, in which the entire cycle of the development of new equipment, starting with basic research and ending with prototypes, is implemented. Moreover, the institute, while concluding an economic contract with an enterprise for the fulfillment and introduction of one technical development or another, at the same time concludes an internal economic contract with its design bureau. These results could have been, in our opinion, even more significant, if such a complex had a sufficiently powerful pilot works which is capable of bringing developments up to the stage of the production of an experimental model or prototype.

Effective forms of the cooperation of academic institutes with production are being used in the Lithuanian SSR. These are joint laboratories of institutes and enterprises of the sector and, in case of the conducting of intersectorial research, intersectorial laboratories, which use the well-equipped working facilities of enterprises and pilot plant personnel. Another channel of the introduction of completed scientific and technical work is through the base shops of large enterprises. An effective form of the cooperation of academic institutes of the republic with production organizations is scientific production associations, which are organized on a voluntary basis.

Much is being done for the increase of the scientific potential and the increase of the efficiency of the introduction of scientific and technical achievements in other regions of the country as well. For example, a center of the automation of research and metrology has been established and is operating successfully at the Moldavian SSR Academy of Sciences. More than 40 percent of the total stock of instruments of academic institutes is concentrated in it, which made it possible to enlarge the group of users and to increase the quality of service. The utilization ratio of equipment increased by threefold, the cost of calculating and analytical operations decreased to one-half to two-thirds. The technical equipment of the academic institutes of the Moldavian SSR in the past 5 years has increased by 1.7-fold, which, of course, affected the efficiency of scientific research. At the Institute of Applied Physics, for example, the economic impact from the introduction of the results of development increased by fourfold, the amount of economic contractual research increased by more than twofold, while the number of works, which were completed at the level of inventions, increased by fourfold. (Footnote 8) (PRAVDA, 22 June 1982)

The appearance of new, effective forms of the integration of science and production is helping to speed up the introduction of scientific and technical achievements in practice. But serious efforts, organizational and economic reforms, and the improvement of the legal regulation of the processes of the introduction of new equipment are still needed for the cardinal improvement of this matter. Information supply also needs improvement; in particular, the establishment of a unified information center, to which all information from the institutes would flow and at which it would be possible to determine in advance the users of basic scientific and technical achievements, would be of great benefit.

For institutes with a poorly developed production base (and the majority at the Academy of Sciences are such) it is possible to recommend the establishment of a network of specialized general contracting scientific and technical organizations, which would engage first of all in the introduction of scientific and technical results. Here it is important on the basis of multilateral economic contracts to increase the influence of the sectors, which are the users of the products, on the technical policy of the producer sectors.

The corresponding changes have become imminent in the organization and management of scientific and production collectives, in particular, the approval of the "start-to-finish" principle in planning at all the stages of the "research--production" process with the distribution of the available

resources and the establishment of specific dates of the completion of each stage. Today the introduction of start-to-finish planning at scientific and technical complexes is coming up against certain difficulties. The legal and economic independence of scientific research and experimental design subdivisions is erecting organizational barriers between them. In our opinion, a unified planning document, which reflects all the stages and the ultimate goal of joint operations and the procedure of the interaction of the planning services of the complex, is necessary for the effective implementation of the system of start-to-finish planning.

The system of the planning of the most important discoveries and inventions needs serious improvement. The present procedure of including the achievements of such a level in state and sectorial plans not only does not guarantee the most important discoveries and inventions any advantages, but even places them in fact in a much worse situation than ordinary improvements of traditional equipment and technology.

In our opinion, for the rapid and large-scale use in the national economy of the most important and valuable discoveries and inventions it is necessary to establish a special priority organizational and legal procedure of their selection, official recognition, and introduction in production. A State Register of Especially Important Achievements of Science and Technology is needed.

It would be advisable to assign the duty to keep it to a special commission made up of representatives of the USSR Academy of Sciences and the State Committee for Science and Technology.

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CSO: 1814/155

FACILITIES AND MANPOWER

ACTIVITY OF INSTITUTE OF BIOCHEMISTRY OF LITHUANIAN ACADEMY

Vilnius TRUDY AKADEMII NAUK LITOVSKOY SSR. SERIYA V--BIOLOGICHESKIYE NAUKI in Russian No 3, 1985 pp 133-138

[Article by Y. Samaytis and V. Petrauskas: "The Activity of the Institute of Biochemistry in 1978-1982"]

[Text] On 5 December 1984 the results of the scientific and scientific organizational activity of the Institute of Biochemistry (IBkh) in 1978-1982 were discussed at an expanded plenary meeting of the Presidium of the Academy of Sciences (AN).

The Bureau of the Chemical, Technological, and Biological Sciences Department (OKhTBN) and a special commission of the Presidium of the Academy of Sciences: Corresponding Member of the Academy of Sciences A. Prokopchik, deputy academician secretary of the Bureau of the Chemical, Technological, and Biological Sciences Department (chairman); Professor P. Prashkyavichyus, rector of the Kaunas Medical Institute (deputy chairman); Candidate of Biological Sciences A. Palenene, scientific secretary of the Chemical, Technological, and Biological Sciences Department; Doctor of Biological Sciences Professor B. Yuodka, chief of the Chair of Biochemistry and Biophysics of Vilnius State University imeni Vintsas Kapsukas; Doctor of Biological Sciences Professor A. Glyamzha, deputy general director for scientific work of the Ferment Scientific Production Association; Corresponding Member of the USSR Academy of Sciences and Academician of the Lithuanian SSR Academy of Sciences V. Kontrimavichyus, academician secretary of the Chemical, Technological, and Biological Sciences Department; Academician A. Merkis, director of the Botany Institute of the Academy of Sciences; Candidate of Biological Sciences A. Sruoga, deputy director for scientific work of the Institute of Zoology and Parasitology; Doctor of Biological Sciences Z. Vagonis, director of the Lithuanian Scientific Research Institute of Animal Husbandry, and responsible officials of the staff of the Presidium of the Academy of Sciences, prepared the question for discussion.

Corresponding Member of the Academy of Sciences A. Prokopchik, chairman of the commission, familiarized the Presidium with the results and conclusions of the commission.

At the end of 1982 in the Institute of Biochemistry (founded in 1967, the director is Corresponding Member of the Academy of Sciences L. Rasteykene, the deputy director for scientific work is Corresponding Member of the Academy of Sciences P. Sadauskas) there were 10 laboratories:

--the Laboratory of the Regulation of the Activity of Genes (founded in 1975, the director is Corresponding Member A. Yasaytis); the Laboratory of the Biochemistry of Microorganisms (1967, Corresponding Member S. Kanopkayte); the Laboratory of Enzyme Chemistry (1974, Doctor of Chemical Sciences Yu. Kulis); the Laboratory of Immunology and Immunochemistry (1974, Candidate of Biological Sciences V. Tamoshyunas); the Laboratory of Enzymology (1967, Candidate of Biological Sciences T. Chyurlis); the Laboratory of Cytology and Cytochemistry (1967, Corresponding Member P. Sadauskas); the Laboratory for the Study of Biologically Active Substances (1967, Doctor of Biological Sciences A. Malakhovskis); the Laboratory of the Chemistry of Amino Acids and Peptides (1967, Candidate of Chemical Sciences K. Karpavichyus); the Laboratory of Organic Synthesis (1967, Candidate of Chemical Sciences A. Yuodvirshis); the Interinstitute Laboratory of Molecular Biology (1978, Candidate of Physical Mathematical Sciences P. Mikulskis); and the Experimental Production Section (1981, Candidate of Biological Sciences V. Laurinavichyus).

A specialized scientific council, which accepts for defense dissertations for the academic degree of candidate of biological sciences in the specialties "Biochemistry" and "Cytology," has been working under the Institute of Biochemistry since 1979.

A scientific society--the Lithuanian Biochemistry Society--the Lithuanian Department of the All-Union Biochemistry Society--has been working under the Institute of Biochemistry since 1960.

At the end of 1982, 253 people worked at the Institute of Biochemistry, of them 119 are scientists, including 7 doctors of sciences (2 corresponding members of the Academy of Sciences) and 75 candidates of sciences.

The basic direction of the scientific research work of the Institute of Biochemistry is "The Biochemical and Genetic Principles of the Functioning of the Cell (the Study of Immunogenesis, Malignancy, the Mechanisms of Enzymatic Catalysis, the Modification of Macromolecules, the Conversion of Energy in Biological Membranes) and the Directed Synthesis of Cytoactive Compounds" (which was approved by the Presidium of the USSR Academy of Sciences and was confirmed by Decree No 87 of the Presidium of the Lithuanian SSR Academy of Sciences of 28 March 1977).

All the themes being elaborated by the Institute of Biochemistry are included in five all-union programs. The issues of the problem "The Physical Chemical Principles of the Organization of Biological Systems" were elaborated.

In 1978-1982 the Institute of Biochemistry studied 86 themes and completed the study of 32. The Institute of Biochemistry annually elaborated three or four themes in accordance with economic contracts. The total value of this work came in 1978-1982 to 562,000 rubles. Scientific and technical themes made up

42 percent of all the themes being elaborated. More than 90 percent of the themes, which are being elaborated in accordance with economic contracts, correspond to the basic scientific direction of the institute.

In fulfilling the annual plans of scientific research work and implementing Decree No 323 of the Presidium of the Lithuanian SSR Academy of Sciences of 25 October 1978, "On the Scientific and Scientific Organizational Activity of the Institute of Biochemistry in 1973-1977," in the most important fields of research the Institute of Biochemistry achieved the following most significant scientific results (the basic indicators of the scientific and scientific organizational activity of the Institute of Biochemistry in 1978-1982 are presented in the table.

Table. The Basic Indicators of the Activity of the Institute of Biochemistry of the Academy of Sciences in 1978-1982

Indicator	Year 1978	1979	1980	1981	1982
Comprehensive programs fulfilled (total).....	6	6	6	5	5
all-union programs.....	5	5	5	5	5
republic programs.....	1	1	1	-	-
Themes fulfilled (total).....	14	15	15	21	21
basic.....	6	7	8	11	13
scientific and technical (total).....	8	8	7	10	8
budget-carried.....	4	4	15	5	4
economic contractual.....	4	4	-	5	4
Study of themes completed (total).....	5	3	11	6	7
basic.....	2	-	6	1	4
scientific and technical (total).....	3	3	5	5	3
budget-carried.....	2	2	3	1	-
economic contractual.....	1	1	2	4	3
Total (accumulated after 5 years of introduction) economic impact from the introduction of the results of research (thousands of rubles).....	-	-	378	378	378
Contracts on creative cooperation fulfilled.....	10	12	12	14	15
Publications issued (number of titles).....	3	3	2	2	4
Their volume (publisher's signatures).....	14	33	10	33	29
Applications submitted for recognition of inventions.....	9	11	14	12	17
Positive decisions received.....	4	19	11	15	12
Scientific conferences organized (total).....	1	1	1	-	2
all-union.....	1	1	1	-	2
Public lectures given.....	150	158	179	134	146
Popular scientific articles published.....	11	35	26	40	28
Days of Science organized.....	3	2	2	2	2
Foreign specialists came.....	2	1	3	4	1
Number of foreign business trips.....	6	7	7	3	8
Number of laboratories, departments (on 31 December).....	9	9	10	10	10

[Table continued on following page]

Indicators	Year 1978	1979	1980	1981	1982
Total number of workers (on 31 December).....	239	241	239	265	260
scientists (total).....	118	124	126	124	129
doctors of sciences.....	4	4	4	5	5
candidates of sciences.....	62	68	73	75	76
Number of graduate students (total, on 31 December).....	15	16	14	15	16
resident.....	9	10	9	10	12
in special-purpose graduate studies at scientific centers of the country.....	-	-	-	-	1
Graduate students admitted (total).....	4	4	5	4	6
resident.....	5	3	4	3	5
Graduate studies completed (total).....	4	3	7	3	5
resident.....	3	2	5	2	3
Doctoral dissertations defended.....	-	-	1	-	2
Candidate dissertations defended.....	4	8	3	5	4
Capital investments (total, thousands of rubles)	409	916	51	-	25
construction and installation work (thousands of rubles).....	144	903	51	-	25
Expenditures (total, thousands of rubles).....	904	938	1018	1030	1085
wages (item 1) (thousands of rubles).....	400	436	478	501	487
scientific research work (item 5) (thousands of rubles).....	246	227	235	250	281
purchase of equipment, apparatus, and implements (item 12) (thousands of rubles)...	192	199	209	200	125
Revenues from economic contracts (without special assets, thousands of rubles).....	118	126	111	111	96
Expenditures on economic contracts (thousands of rubles).....	118	126	111	60	84

The Chemistry of Amino Acids and Peptides. Means of the synthesis and physical chemical methods of the configurational and conformational analysis of these compounds, which have in their structure natural or synthetic amino acids of a specific optical and geometric configuration, were developed; the conformational energy of various cytotoxic groups and the conformational equilibrium in compounds of aminocyclohexylalkanoic acids were established. This basic research made it possible to establish the dependence of the biological activity of the studied compounds on various structural factors and revealed promising directions of the development of compounds with specific physiological properties.

Immunology and Immunochemistry. During the study of immunological mechanisms in the process of the development of the leukemic process methods of the detection and identification of immunoglobulins were developed; monospecific antisera against individual classes and structures of immunoglobulins were obtained. Antigens and antigenic determinants, which are characteristic of the embryonic period of the development and the period of the early differentiation of cells, were detected on the surface of leukemic cells. Methods of the identification of preparative extraction and the study of the functional properties of lymphocytes were developed.

Cytology and Cytochemistry. The micronuclei and the cells, which synthesize DNA, in lymphocytes which have surface receptors were established; the reactions in animals, which are ill with chronic leukemia, were studied; the regularities of the development of macrophages and fibroblasts were established.

The Biochemistry of Microorganisms. The level of individual forms of cobalamin in the blood and organs of healthy cattle and cattle with chronic leukemia was studied. It was established that a change of the total amount of cobalamins and the disturbance of the metabolism of their individual forms are a consequence of this disease. A relative increase of the level of methyl cobalamin in the blood of animals already at the early stages of the disease was noted for the first time. The possibility of the biochemical formation of several cobalamins was shown.

Enzyme Chemistry. New methods of the absorption and covalent immobilization of subparticulate enzymes were developed. The dissociative mechanism of the kinetic thermal inactivation of enzymes was substantiated theoretically for the first time. Methods of the stabilization of subparticulate enzymes were developed and more stable immobilized biocatalysts were obtained. The phenomenon of the direct (mediatorless) transport of electrons between the active centers of enzymes and conducting materials was detected.

Enzymology. From the cells of Bac. subtillis 168 three peptide hydrolases were separated and identified, their basic physical chemical properties were established; the natural mutability of Bac. subtillis R-623--the commercial producer of alpha-amylase--was studied; the biosynthesis of elastases of 80 cultures of pure microorganisms was studied; four base enzymatic compounds were obtained.

Organic Synthesis. Original methods of the synthesis of alk-thiochlorcarboxylic acids were developed. Valuable data on the isomerization, dehydration, and oxidation of the indicated compounds, which were used for the directed synthesis of antitumor compounds of original structure, were obtained. An original method of obtaining the antitumor compound Troksozon was proposed.

Biologically Active Substances. The antileukemic and antitumor activity and toxicity of 200 newly synthesized compounds of various classes were studied. The peculiarities of the metabolism of corticoid hormones and the role of cyclic nucleotides in carcinogenesis were studied.

The Regulation of the Activity of Genes. It was demonstrated that the difference of the electrochemical potentials, which is generated metabolically on the membrane of cells, in the processes of the genetic transformation and infection of bacteriophages is the motive force of the transport of DNA to the cells of bacteria. It was demonstrated experimentally that a system of the intermembrane transfer for electrons functions in the mitochondria of the kidney.

Corresponding Member of the Academy of Sciences L. Tasteykene, director of the Institute of Biochemistry, Academician Yu. Matulis, Academician V. Kontrimavichyus, and Professor B. Yuodka spoke during the discussion.

Generalizing the results of the discussion, President of the Academy of Sciences Academician Yu. Pozhela noted that the research being conducted by the collective of the Institute of Biochemistry has a high theoretical and experimental level. An exceptional scientific institution can boast that all its planned themes are included in all-union scientific and technical programs. The introduction of the results of research is being improved. The method of research has a high level, this is also responsible for the achievements. However, there are not very many new ideas, repetition is being noted, although it is also at a high level. It is also necessary to update the themes of research. Close cooperation with other sciences and with other scientific institutions will promote the accomplishment of this. Mathematicians, theoretical physicists, specialists in semiconductor physics, and others are interested in the problems being worked on by the institute, and the Institute of Biochemistry should take the initiative for the strengthening of cooperation with them. The institute should also strengthen the contacts with central organizations of the country and display initiative, since without procedural assistance and a good material and technical base it is possible to turn quickly into a secondary scientific institution. Closer contacts should be maintained with biologists of the Latvian SSR, it should worry more itself about the improvement of the base.

The Presidium of the Academy of Sciences adopted Decree No 386 "On the Scientific and Scientific Organizational Activity of the Institute of Biochemistry in 1978-1982," in which it noted that along with significant achievements in the activity of the institute there are unsolved problems and shortcomings. The newly organized subdivisions are inadequately specialized, biotechnological research is being inadequately coordinated, the Interinstitute Laboratory of Molecular Biology is being inadequately supplied with equipment, the inventions of the institute are being introduced to an inadequate degree in the national economy and are being poorly advertised and exhibited.

The Presidium considers expedient the further development at the Institute of Biochemistry of research in the areas of the study of the biochemical and genetic principles of the functioning of the cell and the synthesis of cytoactive compounds.

The Presidium obliged the Institute of Biochemistry when working on the problems of the combating of leukoses and malignant tumors in man, as well as in agricultural animals and poultry to study the immunological questions of the leukemic process, to develop methods of early immunodiagnosis, to expand the research in the area of immunotechnology, and to study the products of the immune systems and their basic molecular elements; for the purpose of the development of effective antileukotic and antitumor compounds to expand the search in various classes of organic substances for cytoactive and other biologically active substances.

The Presidium obliged the Institute of Biochemistry when working on the problems of molecular biology, physical chemical biology, and biotechnology to intensify the studies of the transfer of electrons in protein systems, to develop new bioelectrocatalytic systems, which are intended for the synthesis of organic compounds and the analysis of biologically active compounds; to study the process of the methylation of biopolymers, the exchange of energy in procaryotic and eucaryotic organisms, and the regulation of the energetics of genetic processes and the activity of genes, to use the methods of genetic engineering for the development of microbic hyperproducing systems.

The Presidium obliged the Institute of Biochemistry:

--to concentrate scientific forces on the study of all-union problems, to define more accurately the specializations of the scientific work of new subdivisions, to improve the coordination of biotechnological research, to improve the supply of the Interinstitute Laboratory of Molecular Biology with equipment by the cooperation of assets of other institutes, to broaden the scientific and technical cooperation with institutions and organizations of the republic, to strengthen the cooperation with production organizations, and to introduce more extensively the results of the research completed by the institute and the completed inventions by means of economic contracts.

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CSO: 1814/151

INCREASING WORK EFFICIENCY OF UKRAINIAN RESEARCH GROUPS

Moscow SOTSIALISTICHESKIY TRUD in Russian No 1, Jan 86 pp 63-67

[Article by Doctor of Economic Sciences G. Dobrov and Candidate of Economic Sciences A. Savelyev, Research Center on the Scientific and Technical Potential of SOPS UkSSR AN UkSSR [Ukrainian Academy of Sciences' Council for the Study of Productive Forces in the Ukrainian SSR]: "On Means of Increasing the Efficiency of the Functioning of Scientific Collectives"]

[Text] The intensification of scientific activity is the most important problem of the present stage of the scientific and technical revolution. A reliable means of its solution is the comprehensive study and improvement of the mechanism of the functioning of scientific collectives, the formation of new approaches to the management of scientific research work, the optimization of the use of the material resources of science, and the stimulation of the human factor. In addition to the general socioeconomic conditions, which facilitate or complicate the use of all the components of the scientific and technical potential, the effective organization of the activity of scientific collectives and the systems use in the practice of management of all the factors, which influence the increase of the effectiveness and output of scientists, up to those which are directly manifested in the primary research collectives--the thematic groups, which constitute the basis of the organizational structure of all science--are required.

In 1981-1984 a large-scale sociological study of the organizational, economic, information, and sociopsychological conditions and factors of the efficiency of the activity of research groups (IG's) was conducted at several scientific institutions of the Ukrainian SSR (about 500 primary units). It is characterized by a new approach to the study of scientific labor within the framework of an international project of UNESCO. (Footnote 1) (In all 14 UNESCO member countries from 4 continents took part in this project. Several thousand primary collectives were surveyed)

The previous approaches to the study of the efficiency of scientific labor at the level of the individual specialist or entire institute contained very significant shortcomings. In the former case the activity of the researcher was examined to a significant degree in isolation of the real organizational conditions under which it occurs, while in the latter a structurally very nonhomogeneous collective was the object of study.

The recognition of research groups as the basic component of the organizational and production structure of scientific research institutes in our times is finding greater and greater support. The management of many academic institutes in its everyday practice is devoting increasing attention to the analysis of their scientific potential, problem organization, and output. Such a situation has been created, for example, at the institutes of electric welding, superhard materials, strength problems, electrodynamics, and others. And here, as a rule, they are obtaining the best results of scientific research and are using more intensively the intellectual and material resources which are involved in the scientific process.

At the same time the lack of any standard materials, which specify the conditions of the activity of research groups and particularly the rights of scientific supervisors for themes and the collectives of performers, is adversely affecting the efficiency of their work. In the opinion of a number of institutes of the Ukrainian SSR Academy of Sciences (the institutes of applied mathematics and mechanics, problems of material science, the Kharkov Department of the Institute of Economics, and others), in the Charter of the Scientific Research Institute of the Ukrainian SSR Academy of Sciences the need has arisen to specify the status of the research group, namely: the principles and forms of the participation of the research group in the organization of the production and social activity of scientific institutions and its management, the rights and duties of the manager and members of the research group in the settlement of questions of the organization of scientific labor. This would make it possible to create more favorable organizational conditions for the increase of the efficiency of their scientific labor. And the reserves here are significant.

According to the data of our studies and other participants in the international project, a significant dependence of the effectiveness and output in the studied scientific groups on the "level of involvement" of the manager of the collective directly in the process of research was identified. (Footnote 2) (The "level of involvement" was estimated according to the share of the working time of the manager, which is spent directly on planned research within the framework of the division of scientific labor, which has been adopted in the given collective) If the real values of the level of involvement were less than one-third of the budget of working time for managers of research groups in the natural sciences and one-half of the budget of working time for managers of research groups in the technical sciences, the results worsened drastically. The maximum individual effectiveness of labor for all members of the collective was observed in those instances, when the expenditures of time of the manager on scientific research within the research group came to 60-75 percent of his workday.

But the studies also showed that the greater the scientific skill of the manager is, the fewer opportunities he has to engage during the workday directly in research activity. This is explained by the fact that with the increase of skills he is more often diverted for the performance of jobs which are not connected with the research process of the research group managed by him, and in general the structure of the basic expenditures of working time of the manager changes. He has to engage more and more in scientific

organizational work, thereby reducing his own reserve of time, which is spent on the conducting of research.

Our analysis attests as a whole to the decrease at the Ukrainian SSR Academy of Sciences in 15 years of the proportion of scientists with extremely large values of unproductive expenditures of working time. The proportion of those having losses of this sort of 2 to 3.5 hours a day decreased from 70 percent to 60-42 percent (depending on the categories of staff members). At the same time the very influence of losses of this sort on the decrease of the scientific and technical potential is now stronger, since in connection with the doubling in this time of the scientific and technical potential of research groups two- to threefold greater indirect losses from the decrease of the effectiveness of the labor of the collectives managed by them are being added to the direct losses in the effectiveness of the managers themselves.

According to our estimates, the direct losses and inefficient use of different kinds of working time overall can be estimated on the average at the level of 3 hours a day (35-37 percent of the working time). The decrease by just one-half of the losses of working time of scientists and leading specialists can provide a substantial increase (up to one-third of the actual increase) of the potential of the research collectives managed by them. How is this to be achieved? In our opinion, the practice of the drafting and approval at scientific research institutes of standard plans of the organization of the work of the managers of research groups, which guarantee them a specific structure of the working time and untouchable hours for direct participation in the research process, could help here. And, of course, the work on the tightening up of labor discipline should be continued.

The evaluation of the activity of the groups at institutions of the Ukrainian SSR and the data of UNESCO attest that the inefficient expenditures of working time of the manager of the research group are essentially connected with the size of the group, moreover, the nature of the dependence is determined by the formula "few--poorly and many--poorly." The data of the UNESCO project, which were confirmed by the experience of actually operating research groups of academic institutes, give reason to believe that for the conditions of theoretical and humanities research the values of the optimum size of the group come to 3-5 people, and for applied research--8-12 people. In case of the lack of conformity of the size of the research group to the optimum values the inefficient expenditures of time of the manager increase rapidly.

Of course, this dependence is not "ironclad." By comparing domestic and foreign estimates, it is possible to say that the great effectiveness of the scientific collective and the individual output of its manager retain great stability even in case of the increase of the size of the scientific collective, if a manager, who has significant experience in scientific organizational work, is in charge of it. For inexperienced managers the increase of the size of the scientific collective inevitably and quickly leads to a decrease of the effectiveness.

It should be noted that the manager in modern science is the most prevalent occupation (this is the function of one scientist in five), moreover, it is the only one which they master too often without any professional scientific

organizational training. Here the managers of research groups are the most massive category of scientific managers. They are in fact a reserve for the formation of all the ranks of managers in science. And, unfortunately, at present all of them are acquiring scientific organizational experience by individual efforts, by the "trial and error" method. Their successes and errors have not yet become the subject of scientific analysis and generalizations; the experience of other generations of managers is being poorly used. The scientists who perform the functions of managers, without having scientific organizational experience and special knowledge, sustain unjustifiably large losses of time in routine operations and perform other scientific organizational functions at an inadequate level of efficiency. The decrease of the losses of working time of managers and the increase thereby of the "level of involvement" directly in research by 20-25 percent are entirely feasible, but on the condition of the increase of the skills of managers in the scientific organizational area.

Therefore, it would be advisable for the acquaintance of managers with the fundamentals of the theory and the experience of the management of scientific collectives and with modern methods of forecasting, planning, and the evaluation of the effectiveness of the results of work to envisage within the framework of the prevailing system of the increase of the organizational and management skills of the management staff of the Ukrainian SSR Academy of Sciences the advanced training of managers of research groups.

The indicators of the effectiveness of research groups in many ways are also determined by their technical equipment and the conformity of the supply of the group with scientific instruments to the problem orientation and used technology of research.

The average estimate by the managers of research groups of the shortage of scientific equipment for the entire surveyed group was on the order of 37 percent. This is greater than in past years, moreover, the indicators for academic research groups are better than for scientific collectives of higher educational institutions with a similar specialization. However, the following fact merits attention: in academic research groups, in which the basic hardware is concentrated, the highest indicators of dissatisfaction with the supply with scientific equipment are also noted. Thus, in groups of the natural science type, which have a wide range of hardware, the shortage of equipment of minimum and maximum value came respectively to 49 and 78 percent, and in groups of the physics type--43 and 50 percent. The lowest values of the estimates of the shortage (respectively 4 and 6 percent) were noted in academic research groups of the social science type, in which there is little scientific equipment.

The point is that both the scientists, who have much hardware, and those, who have little of it, brought the methods and organization of the research process in line with the level of the technology of research, which is characteristic of them. The former cannot advance without expensive equipment, which becomes obsolete three- to fourfold more rapidly than it wears out. The latter frequently rely only on a fountain pen and already traditional equipment. In conformity with the existing technology of research

notions of the acceptable levels of the effectiveness of scientific work have also formed here.

The data of our study show that the research groups, in which a relatively high level of technical equipment was noted, differed from research groups, which are similar in scientific type, with a relatively lower level of technical equipment by higher indicators of effectiveness: in basic research--1.5-fold, in applied research--approximately twofold, and in development--three- to fourfold.

Domestic and foreign practice confirms the lack of promise of the attempts to increase substantially the overall level of the technical equipment of research by making up a complete stock of instruments and equipment in each individual collective (group, laboratory, department). The efforts, which are being undertaken on the concentration of the equipment of an institute in laboratories for joint use, for the present have not led to the radical increase of the technical equipment of research and development. The organization of collective-use laboratory centers, especially in large cities with a branched network of scientific institutions (Kiev, Kharkov, Dnepropetrovsk, Donetsk, Lvov, and so on), seems to us to be the most promising solution. The organization in the republic of a territorial system of Tsentrnauchsnab (in much the same way as the one in operation in Leningrad for the Northwest Region of the country) would contribute to the increase of the level of the supply of scientific collectives with scarce equipment.

As the experience of efficiently operating groups showed, the possibility of intensifying the research process on the basis of the mastering by scientists of modern mathematical methods and the use of means of the automation of the experiment is being confirmed. The analysis of the supply with computer hardware showed that although 80 percent of the surveyed collectives have access to computers, for the present only approximately half of the research groups are directly using computer technology. In one scientific collective in three, which needs data processing, there are no staff members who are capable of working independently at a computer. But meanwhile in the research groups, in which 80 percent and more of their members use computers, the indicators of publication effectiveness are 2.7-fold greater as compared with the research groups, in which only up to 25 percent of their members know how to use computer hardware. The other indicators are also noticeably better. For the use of automation equipment in all the observed cases also made it possible to increase the reliability and quality of the experimental data.

At many scientific research institutes of various countries of the world the workplaces of the manager of the subdivision and his professionally trained secretary are equipped with modern office mechanization equipment, which includes processors for the editing and reprinting of texts. This makes it possible to free during the year nearly a month's budget of working time of the basic unit of managers and to increase substantially the overall organizational level of the activity of the collective. The expenditures on office mechanization equipment and the retraining of technical personnel are recovered, as a rule, in 1-2 years. In this connection it is advisable, in our opinion, to organize courses on the improvement of occupational skills for scientists and technical personnel, including the mastering of the practical

skills of the use of computer hardware. In the future it is very important to elaborate and approve standards of the supply of the workplaces of staff members of scientific institutions with office mechanization equipment with allowance made for the specific nature of the functions being performed.

The improvement of the technology of research is an important reserve of the increase of the efficiency of research groups. The traditional approach to the technology of research only as the improvement of the equipment of the experiment and the development of the experimental production base today is certainly becoming obsolete.

In the present understanding the technology of research (TI) is a set of means of the solution of scientific problems, which includes functionally interconnected: scientific methods, equipment, and organizational instructions. The use, for example, of the methods of mathematical planning makes it possible to decrease significantly the amount of experimental work, and in several instances also to avoid altogether the conducting of lengthy and expensive experiments. The comprehensive approach to the development and updating of the technology of research presumes the systems improvement of all its components.

The effectively working groups in our country and in the other countries participating in the UNESCO project are using knowledge and methods from two or three scientific fields. The tendency for the "distance" between the base fields of scientific knowledge and the fields being enlisted (the multidisciplinary nature and "transdisciplinary nature") to increase was also identified. The groups of a multidisciplinary orientation surpass in effectiveness by three- to fourfold the research groups with relatively lower average values of the corresponding characteristics.

The generalization of the domestic and world experience of the activity of research groups, as well as the data of the analysis of the forecasts of the development of scientific problems, which was made at the USSR Academy of Sciences, make obvious the need and possibility already in the next few decades to increase sharply (by a minimum of twofold) the effectiveness of the labor of the personnel engaged in science. For this it is important to carry out the timely programmed updating of the technologies of research, to develop systematically the material and technical base of science, and to improve the organizational forms of its use.

The data of the analysis of the real personnel composition of research groups attest that, on the one hand, many collectives are poorly provided with auxiliary personnel and, on the other hand, the auxiliary personnel frequently do not have the necessary vocational training for the performance of experimental work and acquire it in the process of research. In the surveyed groups the ratio of the number of basic and auxiliary workers in only 30 percent of the cases approached the value of 1:1, while in 50 percent of the cases either there were no auxiliary staff members at all in the groups (13 percent) or this ratio did not exceed the value of 1:0.3. At the same time the highest indicators of effectiveness, which were calculated for the past 3 years per member of the research group, were observed in the groups

which have within them up to 40 percent auxiliary personnel who are engaged directly in the support of scientific research.

In many cases a shortage of specialists, who know how to perform nonrepetitive work operations of great complexity, was noted. Here the need for vocationally trained workers of the highest skills, laboratory assistants, and technicians is especially acute.

The obtained dependences of the results of the labor of scientists on individual factors and conditions, under which the research process takes place, give a clear idea of the directions in which it is necessary to improve the mechanism of the organization of the activity of scientific collectives, in order to use their internal reserves more rapidly and to increase the efficiency of work, while increasing with fewer social expenditures the contribution of science to the acceleration of the technical and social progress of the country.

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CSO: 1814/155

BOOK ON CALCULATING ECONOMIC EFFICIENCY OF DATA PROCESSING

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR in Russian No 12, Dec 85 pp 122-123

[Review by A. Sprogis and O. Demchuk of book "Metody rascheta ekonomicheskoy effektivnosti mashinnoy obrabotki dannykh" [Methods of Calculating the Economic Efficiency of Computer Data Processing] by I.Ya. Vanags, Finansy i statistika, Moscow, 1984, 216 pages, under the rubric "Criticism and Bibliography": "A Significant Contribution to the Development of Methods to Determine the Economic Efficiency of Computer Data Processing"]

[Text] The present is characterized by the mass introduction of electronic computer technology (EVT) in various areas of social production and spheres of activity of people. The calculations of the economic efficiency of computer data processing, which make it possible to substantiate the advisability of the establishment of computer centers (VTs's), automated data processing systems (ASOD's), and automated control systems, to select an economically profitable version of data processing, to substantiate the advisability of the use by enterprises of the services of computer centers, and to identify the sequence of the changeover of problems (sets of problems) to computer-aided solution, are of great importance for the efficient allocation of assets and the more complete use of the possibilities of electronic computer technology.

The questions of the economic evaluation of the automation of management labor and computing and data processing operations, in spite of the existence of a large number of publications in domestic literature, have been examined inadequately, and a large number of urgent problems, which await their solution, remain. In this connection the publication of the book "Metody rascheta ekonomicheskoy effektivnosti mashinnoy obrabotki dannykh" [Methods of Calculating the Economic Efficiency of Computer Data Processing], (Footnote 1) (I.Ya. Vanags, ""Metody rascheta ekonomicheskoy effektivnosti mashinnoy obrabotki dannykh," Moscow, Finansy i statistika, 1984, 216 pages) the practical examples and conclusions of which are based on the analysis of the results of the introduction of computers and the establishment of computer centers in the Latvian SSR, is very timely. The experience of the work of the computer system of the Latvian SSR Central Statistical Administration was used to the greatest extent.

The book consists of four chapters and contains specific recommendations of the author on the solution of a number of theoretical and practical problems of evaluating the economic efficiency of computer data processing. In the first chapter of the book "The General Principles of Determining the Economic Efficiency of Computer Data Processing" the peculiarities of determining the efficiency are set forth, the process of the formation of the economic impact as a result of the mechanization and automation of management labor is characterized, the need for the singling out in the calculations of the efficiency of the direct saving (the saving in the sphere of data processing) and the indirect saving (the saving in the sphere of production) is substantiated, and the procedure of selecting the base for comparison and the conditions of the comparability of the versions of data processing are cited. The clear classification of the versions of the calculations of economic efficiency subject to their ultimate goals and the forms of the manifestation of the impact is the service of the author.

As is known, the automation of management labor is characterized by the fact that it requires large preproduction expenditures (on the development of plans and programs of the computer solution of problems and their introduction), which in case of the development of automated data processing systems and automated control systems frequently exceed the cost of the set of hardware. In this connection the fact that a special section in the book is assigned to the method of calculating the preproduction expenditures, should be rated positively.

The need for the consideration of the preproduction expenditures in the capital investments and the attribution of their corresponding portion (in the form of amortization deductions) to the current expenditures on data processing is substantiated in the work. Methods of including the preproduction expenditures in the cost of data processing are cited. At present these suggestions of the author are acquiring particular urgency in connection with the grouping of computer programs, as well as automated data processing systems and automated control systems, with products for production engineering purposes.

In the second chapter "The Determination of the Economic Efficiency in the National Economy of Computer Data Processing" the method of determining the national economic efficiency both in case of the establishment and functioning of computer centers and in case of the solution of individual problems (sets of them) is examined. The basic indicators of economic efficiency and the methods of calculating the capital investments, the current expenditures, and the expenditures of labor in case of computer data processing, as well as the saving in the sphere of production are cited. The initial data, which are necessary for more accurate and consolidated calculations of efficiency, are described in detail. At the same time it would have been advisable to examine subsequently in greater detail the process of the formation and identification of the national economic impact with allowance made for the positive changes in the production operations of the facilities which use the results of computer data processing.

The substantiation and detailed presentation by the author of this book of the method of determining the standard of expenditures for the calculation of the

economic efficiency of computer data processing, to which the third chapter is devoted, make a definite contribution to the practice of the calculations of efficiency. It is a plus that along with the method of developing standards of the cost of 1 standard hour (computer-hour, man-hour) of work, which is performed on computer hardware of different types or on designing, programming, the preparation, output, and processing of data, the methods of calculating the specific capital investments and expenditures of labor, which are attributed to the costing unit, are examined for the first time. The breakdown of data processing and computing operations into four groups (those performed on punchcard and keyboard computers, as well as devices for data preparation; those performed on computers; those performed on devices for the acquisition of primary data, data transmission, and terminals; operations, the amount of which is expressed in man-hours or man-days) makes it possible to take more completely and accurately into account the peculiarities of each type of operations separately.

When determining the standards of expenditures as objects of cost accounting it is recommended quite validly to use significantly more detailed types of operations than the ones which were used and are being used at present in the practice of planning and calculating the expenditures at computer centers, and as the costing units along with the traditional units to use the display-hour and channel-hour. For the characterization of the reliability of the results of the calculations of the standards of expenditures according to the method cited in the book several components of the capital investments, items of expenditures, and initial data, which are proposed by the author, are given below: the cost of the auxiliary equipment, special furniture, and office mechanization equipment, which are necessary when performing a job of the corresponding type; the coefficient which determines the value of the unused (standby) equipment of the corresponding type; the coefficient which determines the ratio of the value of the premises for general operating purposes and the value of the premises, which have a direct production purpose at the given computer center; the coefficient of the ratio of the established output norms of operators to the common output norms for the given type of operations; the expenditures on the centralized maintenance of computer hardware; the coefficient which determines the ratio of the basic wage of engineering and technical personnel of mechanized development and operators of the given computer center; the coefficient which characterizes the decrease of the wage fund in connection with the receipt of benefits during illnesses from the assets of social insurance.

The method, which is presented in the fourth chapter "The Determination of the Cost Accounting Economic Efficiency of Computer Data Processing From the Standpoint of the Users of Computer Centers," is of great importance under the conditions of the extensive development of collective-use computer centers and multiple-user computer centers. Much useful work was done on the systematization of the indicators of the cost accounting efficiency and on the elaboration of methods of determining the costs of the user enterprise both under the conditions of the availability of uniform cost sheets or estimated schedules of expenses and under the conditions of their absence.

It is especially important, in our opinion, to emphasize that the results of the research of the author are not limited to the methods of calculating the

economic efficiency of the use of electronic computer technology, but have been reduced to standard forms of the calculation of the economic efficiency of computer data processing and the determination of the standards of expenditures, which are provided with detailed instructions and directions on the making of the calculations. Their use ensures the decrease of the expenditures of labor of developers and the increase of the reliability and accuracy of calculations.

The viability of the methods and standard forms, which are presented in the book, was verified on the basis of the practice of the work of computer centers, user enterprises, and design and scientific research institutes of the Latvian SSR. The work contains examples of the calculation of the efficiency and the standards of expenditures, which are made with the enlistment of much statistical material on the activity of the sector of data processing and computing service in the republic, which facilitate the practical making of calculations of the economic efficiency of the automation of management labor.

As a whole the book under review is a serious study of the theoretical and practical problems of the economic efficiency of computer data processing and a definite step ahead in the development of methods of its calculation, is of interest for a wide range of scientists, instructors, and workers of computer centers and user enterprises, and should give substantial assistance to specialists.

It should be hoped that the use of the methods proposed in the work will actually increase the efficiency of computer data processing. In this connection it is desirable for the author to continue the publications on the examined theme, especially with allowance made for the subsequent experience of the changeover of computer production to work under the new conditions of planning and economic stimulation and the changeover of the national economy of the country to the intensive means of development.

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CSO: 1814/149

BOOK ON CONFLICT SITUATIONS IN INFORMATION SYSTEMS

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR in Russian No 12, Dec 85 p 127

[Review by I. Mizin of book "Konfliktnyye situatsii v informatsionnykh sistemakh" [Conflict Situations in Information Systems] by E.V. Zinovyev and A.A. Strekalev, Zinatne, Riga, 1985, 166 pages, under the rubric "Criticism and Bibliography": "A Valuable Contribution to the Study of Information Systems"]

[Text] The intensive computerization of various aspects of human activity, while affording more and more opportunities in the solution of the most diverse problems, at the same time is posing for the developers of hardware and software new and difficult problems. This especially concerns a broad class of promising data processing systems for various sectors of the national economy--information systems which are based on advanced means of computer technology and information science.

At present we are at that stage of scientific and technical progress, when information needs are appearing on the same level as other vitally important resources of our society (such as energy, food, and other resources), and the importance of information resources among other resources is constantly increasing. Moreover, not so much the amount of available information (which is increasing in a continuous and avalanche-like manner) as the possibility of the quick retrieval and processing of the necessary information under the conditions of its collective use and territorial dispersal is important.

In this connection the need for a qualitative leap in the development of existing information systems (database management systems, information retrieval systems) has arisen, and such a leap is possible owing to the development of effective forms and means of parallel data processing in distributed information systems--computer networks.

The monograph of E.V. Zinovyev and A.A. Strekalev, (Footnote 1) (E.V. Zinovyev and A.A. Strekalev, "Konfliktnyye situatsii v informatsionnykh sistemakh" [Conflict Situations in Information Systems], Riga, Zinatne, 1985, 166 pages) which is being discussed, is also devoted to this direction of research. For the first time the authors have analyzed comprehensively the problems which arise in case of the establishment of systems of distributed databases (RBD's). Particular attention is devoted to the problems which are connected

with the resolution of conflict situations in case of the parallel access of processes (transactions) to common information resources (databases) in local and distributed information systems.

The basic goal of the management of the parallel fulfillment of processes is formulated in the book. It is shown that the elaboration of methods of the management of the parallel functioning of processes can be based on an adequate condition of consistency, which consists in the assurance of the quasisequential fulfillment of parallel processes. The problem of the consistency of information resources (databases) is studied. Specific methods and algorithms of the assurance of the internal and external consistency of distributed databases are discussed.

The problem of deadlock situations, which arise in case of the interaction of parallel processes with information resources, is analyzed in the work. The methods of combating deadlock situations and the peculiarities of the detection of deadlock situations in distributed systems are examined.

The method of eliminating deadlock situations under the conditions of incomplete a priori information on the needs of the processes for resources is of particular interest. In the work a set of simulation models for the analysis of various methods of combating deadlock situations is cited and the problem of the optimum way out of a deadlock is examined.

Information on the existing designs of systems of distributed databases, which owing to the importance of the questions at hand and their inadequate coverage in the literature should also have been included in the book under review, is cited in earlier publications of the authors (see E.V. Zinovyev and A.A. Strekalev, "Banki dannykh v vychislitelnykh setyakh" [Data Banks in Computer Networks], Riga, IEVT, 1979, 69 pages, as well as E.V. Zinovyev and A.A. Strekalev, "Upravleniye informatsionnymi protsessami i resursami v vychislitelnykh sistemakh i setyakh s uchetom tupikovykh situatsiy" [The Management of Information Processes and Resources in Computer Systems and Networks With Allowance Made for Deadlock Situations], Riga, IEVT, 1983, 48 pages).

The methods of ensuring the consistency of distributed databases and of resolving deadlock situations, which were developed by the authors, are distinguished by completeness, are presented concisely, and are of interest both for specialists, who are developers of specific information systems, and for readers, who are becoming acquainted with this problem for the first time.

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CSO: 1814/149

BOOK ON ANALOG-TO-DIGITAL CONVERSION FOR INSTRUMENTS

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR in Russian No 12, Dec 85 p 128

[Review by G. Muchnik of book "Stokhasticheskoye funktsionalnoye preobrazovaniye: modeli, prilozheniya" [Stochastic Functional Conversion: Models, Applications] by A.Zh. Viksna and M.A. Elsts, Zinatne, Riga, 1984, 173 pages, under the rubric "Criticism and Bibliography": "A New Contribution to the Development of Instrumentation"]

[Text] The problem of optimizing the algorithms of measurements is one of the most urgent in modern technology. Analog-to-digital conversion is the key stage of measurement. This appears most vividly when evaluating the parameters of rapidly changing signals.

The upper frequency limit of the signal being converted, which is determined by the accuracy of the conversion of the parameter of the signal of the given frequency, directly depends on the dynamic characteristics of the used analog-to-digital converter (ATsP). Here the level of the dynamic error of the analog-to-digital converter tends to increase with an increase of the number of quantization thresholds.

However, the decrease of the number of quantization thresholds is responsible for the increase of the systematic quantization error, which appears in the form of the bias of the evaluation of the required characteristic of the signal. Thus, the task of increasing the upper frequency limit of digital measuring instruments consists in the solution of the problem of developing a method of the low-threshold unbiased analog-to-digital conversion of the readings of the signal being studied.

The high speed of digital instruments for statistical measurements is governed by the length of the cycle of the formation of individual estimates, the shortening of which is responsible for the large hardware expenditures on the development of specialized computing, mainly multiplying, devices.

It is possible to assert that the high level of the error of the traditional method of the analog-to-digital conversion of the instantaneous values of a rapidly changing signal, as well as the large volume of results of multiple-threshold quantization and the difficulty of their mathematical processing are the basic factors, which gave rise to the need for the development of a new

method of the low-threshold analog-to-digital conversion of the instantaneous values of a rapidly changing signal, which has been combined with the integral exponential conversion of these values.

A promising class of algorithms of the functional analog-to-digital conversion and estimation of the stochastic processes of stationary random processes, which make it possible to surmount these difficulties, is examined in the monograph under review of A.Zh. Viksna and M.A. Elsts, "Stokhasticheskoye funktsionalnoye preobrazovaniye: modeli, prilozheniya" [Stochastic Functional Conversion: Models, Applications]. (Footnote 1) (A.Zh. Viksna and M.A. Elsts, "Stokhasticheskoye funktsionalnoye preobrazovaniye: modeli, prilozheniya," Riga, Zinatne, 1984, 173 pages) The authors show that the building of efficient analyzing and measuring equipment of high-frequency signals, which has an extensive set of functional possibilities, is possible on the basis of the general theory of stochastic functional conversion. In light of what has been said the overall theme of the monograph is topical.

The basic principles of the synthesis of the algorithms of stochastic conversion with the given properties of the variance of single-unit conversion are formulated in the monograph. The authors propose a new base model of single-threshold stochastic functional conversion, which is the basis of the synthesis of specific algorithms of invariant or medium effective conversion.

The method of organizing the pseudostochastic mode of conversion, which was recommended by the authors and is characterized by the use as the source of the reference random signal of a low-order pseudorandom number generator, is of great practical importance. The organization of such a mode of conversion makes it possible to simplify significantly the hardware implementation of the algorithms of stochastic conversion.

The algorithm of multiple-threshold nonuniform stochastic quantization, which guarantees the invariance of the deviation of the estimate of single-unit exponential conversion, is of the greatest interest for instrumentation.

The fourth chapter is useful for the developers of equipment of the statistical analysis and conversion of random signals, since the results of the authors in the area of the formation of original structures of electrical measuring instruments are presented in it.

The monograph, in our opinion, reflects quite thoroughly the many years of scientific and practical experience of the authors, who are well-known representatives of the Riga school of the stochastic processing of signals, which is headed by its founder I.Ya. Bilinskiy. The work, which is rich in new results, ideas, and practical recommendations, is of great interest for a wide range of scientists and developmental engineers, who are engaged in the study and analysis of random signals and the development of the corresponding measuring equipment.

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CSO: 1814/149

SOVIET-BULGARIAN COOPERATION IN AGRICULTURAL SCIENCE

Krasnodar SELSKIYE ZORI in Russian No 12, Dec 85 pp 53-54

[Article by Doctor of Historical Sciences Professor D. Peschanyy and Candidate of Historical Sciences E. Vartanyan, the Kuban State University: "Sworn Friends in Science. The Cooperation of Soviet and Bulgarian Agricultural Scientists"]

[Text] With each year the cooperation of two countries--the USSR and Bulgaria--in the field of agricultural science is being enriched by new forms and is becoming more and more systematic and intensive.

The bilateral relations, which began with trips of scientists, practical studies, and the exchange of samples of seeds, planting stock, and pedigreed animals, already in the late 1950's and early 1960's were supplemented with cooperation on a multilateral basis within the framework of CEMA permanent commissions and international organizations of the socialist community.

Contacts of the most important institutes, particularly the Krasnodar Scientific Research Institute of Agriculture, the All-Union Scientific Research Institute of Oil Bearing Crops, and the Dobrudzhan Scientific Research Institute of Wheat and Sunflowers, the All-Union Scientific Research Institute of Tobacco and Makhorka and the Plovdiv Institute of Tobacco, the Northern Caucasus Zonal Scientific Research Institute of Horticulture, Viticulture, and Wine Making and the Bulgarian Scientific Research Institute of Viticulture and Wine Making, the All-Union Scientific Research Institute of Sheep and Goat Breeding and the Bulgarian Scientific Research Institute of Animal Husbandry, and others were characteristic of the first scientific relations between Soviet and Bulgarian scientific research institutes of the agricultural type, which arose in the middle of the 1950's. Agreements with the scientific centers of the RSFSR, the Ukraine, and Moldavia, the All-Union Scientific Research Institute of Plant Growing, and the Institute of Plant Growing of the Bulgarian Academy of Sciences and later between the All-Union Academy of Agricultural Sciences imeni V.I. Lenin and the Bulgarian Academy of Agricultural Sciences played an enormous role in the emergence and strengthening of the cooperation of sectorial scientific research institutes.

In all in the late 1950's and 1960's, 19 Bulgarian and 22 Soviet scientific research institutes entered into direct relations. They jointly elaborated 7 problems with 30 themes. The most important of them were "The Application of Radioactive Radiation and Chemical Mutagens in Obtaining Artificial Mutations of Plants," "The Use of Isotopes and Radiations in Research on Agriculture," "The Introduction of Scientifically Sound Systems of the Management of Agriculture," and "The Introduction of New Technologies of the Harvesting of Grain Crops, Corn, and Sunflowers."

The best Soviet strains of cereal crops aroused great interest in Bulgaria. In just 6 years scientific institutions of the fraternal country received from the USSR about 2,000 strains of elite seeds of spring and winter wheat and 28 valuable strains of corn. Whereas in the early 1960's Bezostaya-1, which was developed by Academician P.P. Lukyanenko, occupied more than one-third of the sowings, in 1974 Bezostaya-1, Avrora, Kavkaz, and Rannyaya-12 already accounted for 758,000 hectares, or 89 percent of the total sowings of wheat in Bulgaria. On the basis of the strains, which were developed by P.P. Lukyanenko, Bulgarian scientists developed new highly productive strains of wheat. With the dissemination of Bezostaya-1 alone the average yield of wheat was firmly established at the level of 25-30 quintals per hectare, that is, it increased by more than twofold.

During those years Soviet strains and hybrids of corn--VIR-42, VIR-25, Krasnodarskaya-5, and others, of which well-known Kuban scientists Academicians M.I. Khadzhinov and G.S. Galeyev were the authors--received extensive dissemination. Of the strains and hybrids of this crop, which were imported from various countries of the world to Bulgaria, more than 80 percent were Soviet. On test plots they yielded under local conditions 125-165 quintals of corn cobs per hectare. In turn 18 samples of seeds of corn, which are grown in Bulgaria and were used at the nurseries of the All-Union Scientific Research Institute of Corn, the Krasnodar Scientific Research Institute of Agriculture, and other institutes for strain testing and selection, were placed at our disposal.

The Krasnodar sunflower strain Peredovik in 1975 occupied in Bulgaria 96.3 percent of the areas of planting of this crop. The average oil content of the seeds in a decade increased from 31 to 43.5 percent. Due to this the annual additional yield of oil in the late 1960's came to nearly 40,000 tons a year.

The Maykop testing station of the All-Union Scientific Research Institute of Plant Growing and the Institute of Genetics and Selection of Plants (Sofia) are working successfully on the development of new strains and hybrids of tomatoes, which are suitable for mechanized harvesting and industrial processing. In the 1970's they obtained about 1,000 strains and hybrids of this crop, from which the 8 best sterile lines were singled out for further selection work.

In those years the abundant traditions and the experience, which had been gained by horticulturists and grape growers of our country, found embodiment on the Bulgarian land. More than 100 strains and hybrids of the best Soviet strains (Rkatsiteli, Saperavi, Kaberne, Sovinyan, and others), which are being

successfully cultivated alongside local strains (Bolgar, Pamid, Yubiley, Frakiyskiy misket), were delivered to Bulgaria. By way of exchange Moldavian, Ukrainian, and Kuban grape growers received millions of cuttings of dessert strains from Bulgaria.

For more than a decade viticultural scientists of the All-Russian Scientific Research Institute of Viticulture and Wine Making have been cooperating with the related scientific research institute of Pleven. These institutes in the 1970's successfully elaborated the joint urgent theme "The Development of New Strains of Grapes (Winter-Resistant and Winter-Hardy, Table, Early and Late Ripening for Long-Term Storage, Disease-Resistant) and the Production of Virus-Free Material."

The All-Union Scientific Research Institute of Tobacco and Makhorka and the Plovdiv Institute of Tobacco are successfully developing an advanced technology of the cultivation and processing of tobacco (new strains, protection against diseases, drying, primary processing).

Soviet experience was used extensively during the establishment and in the development of public animal husbandry in Bulgaria. This appeared most vividly in the organization of breeding and in the extensive use of the achievements of Soviet scientists in the intensification of sheep breeding. By the crossing of the coarse wool herd of low productivity, mainly with pedigreed Stavropol and Caucasian breeds (during the 1950's through the 1970's about 20,000 pedigreed rams and ewes were imported from the USSR) in a few decades Bulgarian sheep breeding turned into highly productive fine-wooled and semifine-wooled sheep breeding with the preservation of the lactescence of the ewes. It took third place in world in saturation per 100 hectares of pastures (163.7 sheep). The All-Union Scientific Research Institute of Sheep and Goat Breeding, which jointly with Bulgarian colleagues is elaborating the theme "Breeding Work on the Improvement of Breeds of Sheep for Industrial Production," is making an important contribution to such cooperation.

The versatile cooperation of scientists of the USSR and Bulgaria on the improvement of breeds of agricultural animals and the introduction of scientifically sound developments on their feeding and keeping made it possible to increase in Bulgaria the level of management of the sector and as compared with the prewar level to increase the total production of livestock products by twofold and of milk by nearly fivefold.

Personal contacts of scientists of the USSR and Bulgaria, the exchange of literature on agriculture, periodicals, and scientific and technical documents, and the assistance of our country in the training of scientists and highly skilled personnel for agriculture of Bulgaria serve as an important form of Soviet-Bulgarian cooperation. The first agreement between the governments of the two countries on the training of Bulgarian citizens at Soviet higher educational institutions was signed back in 1947 on the initiative of G. Dimitrov. In the 1950's the overwhelming majority of Bulgarians, who studied in the USSR, received a higher education, starting in the 1960's graduate students and special students began to constitute the bulk of them. Graduate studies and long-term and short-term specialization in such specialties of socialist agriculture as biology, chemicalization,

mechanization, and irrigation acquired an especially broad scope--personnel in these fields at one time were not trained at all in Bulgaria. Hundreds of Bulgarian scientists and special students increased their scientific level at the All-Union Scientific Research Institute of Oil Bearing Crops, the Krasnodar Scientific Research Institute of Agriculture, the All-Union Scientific Research Institute of Tobacco and Makhorka, and the All-Union Scientific Research Institute of Sheep and Goat Breeding and in graduate studies of the Krasnodar, Stavropol, and other agricultural institutes.

The division of labor of scientists and the establishment of coordinating centers for the most important problems of science were the next stage of the cooperation of academies, scientific research institutes, and higher educational institutions. One such center coordinated selection and seed growing, new methods of the developing of high-yielding and high-quality strains and hybrids of cereal crops. At first it united the work of only 14 scientific institutions of the fraternal countries, including Bulgaria, while in the 1980's their number came to 78. In other words, all the scientific collectives, which are working in the area of the development of new strains and hybrids of cereal crops, including the Krasnodar Scientific Research Institute of Agriculture, were included here.

Many urgent problems are being solved by joint collectives of Soviet and Bulgarian scientists. The elaboration of the problem "The Programming of the Yields of the Most Important Agricultural Crops" was the result of the joint work. Seven Bulgarian institutes were enlisted for the comprehensive elaboration of scientific and practical questions. Academician of the All-Union Academy of Agricultural Sciences imeni V.I. Lenin S. Shatilov headed the joint collective of scientists, which was formed in Bulgaria. The immense organizing activity of 200 Bulgarian scientists and an entire army of agronomists contributed to the introduction of an intensive technology. On the programmed fields the yield of corn, for example, in 1976-1979 increased in Bulgaria by more than twofold.

The experience of the activity of the first joint collectives and the value of direct contacts of scientists are acquiring particular importance in our times in light of the decisions of the Economic Summit Conference of the CEMA Member Countries in Moscow (1984), which emphasized the importance of the pursuit of a unified scientific and technical policy of the fraternal countries, the establishment of direct contacts of collectives and institutions, and the setting up of joint scientific collectives. The Comprehensive Long-Term Program of the Development of the Economy and Scientific and Technical Cooperation Between the USSR and Bulgaria for the Period to 2000, which was signed on 7 June 1985 in Moscow, serves as a scientifically sound basis for the development of a coordinated and, in several areas, a unified scientific and technical policy of our countries.

In the draft of the new version of the CPSU Program it is emphasized that integration is called upon to an increasing extent to promote the progress of social production in the countries of the socialist community. The CPSU will actively participate in the joint work of the fraternal Communist Parties on the improvement of the mechanism of economic cooperation, the search for new forms of it, the intensification of the specialization and cooperation of

production, the coordination of plans, and the establishment of direct contacts between associations and enterprises. The experience gained in recent decades of the efficient use of scientific and technical cooperation, and particularly of scientific research institutes of the agricultural type of the USSR and Bulgaria, has a direct bearing on the imposing tasks which have been posed for science in the drafts of the new party documents.

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CSO: 1814/154

PROBLEMS, TRENDS OF DEVELOPMENT OF BELORUSSIAN SCIENCE

Moscow SOTSIALISTICHESKIY TRUD in Russian No 1, Jan 86 pp 77-81

[Article by G. Nesvetaylov and V. Osipov, the Institute of Economics of the Belorussian SSR Academy of Sciences: "Problems of the Development of Science in the Union Republic"]

[Text] The comprehensive socioeconomic forecasting of the development of science and technology is an important tool when solving the problems of the acceleration of scientific and technical progress under the conditions of the union republic. In Belorussia the first attempt of this sort was made in 1972. At that time a forecasting report on the most important socioeconomic, scientific, and technical problems of the development of the Belorussian SSR national economy for 1976-1990 was prepared. However, this first work was carried out without the proper procedural support and preliminary scientific research, which decreased its practical utility.

Later the development in this area proceeded in the direction of the changeover from individual forecasts, which were compiled by the organization of temporary commissions and conferences, to constant systematic forecasting and analytical activity, which was based on the use of a special system of methods. The Scientific Council for Problems of Scientific, Technical, and Socioeconomic Forecasting of the Belorussian SSR Academy of Sciences and the Belorussian SSR State Planning Committee was established in the republic. Special subdivisions, which have been formed at the Academy of Sciences, in the State Planning Committee, the Ministry of Higher and Secondary Specialized Education, the Belorussian SSR State Committee for Construction Affairs, the Belorussian SSR Ministry of Health, and at scientific production associations, are elaborating the problems of the economics, organization, and long-term planning of research.

The republic Comprehensive Program of Scientific and Technical Progress to 2005 was formulated under the scientific methods supervision of the Institute of Economics of the Belorussian SSR Academy of Sciences. When drawing it up, in particular, it was envisaged to create favorable organizational and economic conditions for the development of science and the optimization of its interaction with production.

As is known, the scientific and technical potential of the Belorussian SSR in recent decades has developed very dynamically. Although the share of the republic in the USSR population has decreased, the proportion of Belorussian scientists in the total number of scientific personnel and candidates and doctors of sciences of the country has increased noticeably. Authoritative scientific schools in various fields of knowledge have been formed here.

The scientific institutions and organizations of the republic are confidently changing over to the intensive means of development; the productivity of research and development is increasing more rapidly than the expenditures on their conducting. Thus, during the past five-year plan the average annual growth rate of the economic impact from the use of the results of the work of the Belorussian SSR Academy of Sciences came to about 30 percent, while the volume of the assignments performed in accordance with economic contracts increased by 11 percent, yet the number of workers in the system of the academy increased by only 3.3 percent a year. Now such a lead of the increase of the results as compared with the expenditures is also characteristic of many other scientific organizations of the republic.

As practical experience shows, the surmounting of departmental barriers and the more complete consideration than before of regional conditions and peculiarities are one of the promising directions of the intensification of science. Nevertheless there are still many unsolved problems here. How the matter is suffering from this is evident from the example of the development of applied science, which in practice is completely subordinate administratively to the management of production sectors and associations and is divided by departmental barriers. For example, the scientific institutions located on the territory of the Belorussian SSR are subordinate to more than 50 union and republic ministries and departments.

At one time such subordination of scientific organizations to departmental interests had definite advantages, ensuring the development of the direct contacts of scientists with production personnel and the speeding up of the practical implementation of the results of research and development. However, with the development of the national economy the departmental subordination of scientific institutions is coming more and more into conflict with the intersectorial nature of the problems being solved by them. Problems of an economic and social nature, the solution of which is not within the capability of a single ministry or department, but is possible only by the joint efforts of organizations which belong to different ministries and departments, are arising more and more often. For example, in 1986-1990 many scientific institutions of the republic will participate in the fulfillment of the assignments of the Food and Energy Programs and will work on the problems of the economic and social development of the countryside and the intensive development of the natural resources of the Polesye Lowland in combination with a rational ecological policy. For work of this scale it is necessary to learn to combine more fundamentally the sectorial and regional approach to scientific and technical progress. It is important to ensure, as is noted in the draft of the Basic Directions of USSR Economic and Social Development for 1986-1990 and the Period to 2000, the unity of sectorial, territorial, and program planning.

Unfortunately, for the present many scientific organizations are giving inadequate assistance to the enterprises of their region. The survey conducted in 1984 showed that with respect to republic programs, for example, 20 percent of the total amount of research and development is being performed at the BelrybNIIproyekt, up to 10 percent at the Dormash Scientific Production Association, and only 2-4 percent at the Scientific Research, Design, and Technological Institute of Founding of the Automotive Industry and the Minsk Affiliate of the All-Union Scientific Research Institute of the Bearing Industry.

The efficient coordination of the efforts of research institutions, enterprises, and organizations, which belong to different ministries and departments, is necessary not only in the process of solving important comprehensive problems, but also for the successful introduction in practice of the results of scientific work. However, such coordination at times is lacking.

At present a persistent search for new interdepartmental and regional forms of the management of science is being made. Much has already been done. Suffice it to mention the extensive use of the goal program method of planning and the formulation of a set of statewide, republic, and regional scientific and technical programs, which have as a goal to unite research and design organizations and enterprises regardless of their departmental affiliation for the solution of complex scientific, technical, economic, and social problems. Thus, during the 11th Five-Year Plan 130 sectorial scientific research institutes, 50 design bureaus, 24 institutes of the Belorussian SSR Academy of Sciences, 20 higher educational institutions, and 200 industrial enterprises, which are subordinate to nearly 100 ministries and departments, are taking part in the fulfillment of republic scientific and technical programs.

The policy of the consolidation of programs and the more careful selection of the priority directions of research of a national economic and intersectorial scale has been adopted. The formulation and implementation during the 12th Five-Year Plan of the Intensification National Economic Program will be an important step in the direction of the improvement of the planning of scientific and technical progress and the surmounting of interdepartmental barriers. It includes five subprograms, which are devoted to the automation of production, the saving of manpower expenditures, materials, and energy, and the increase of product quality. The active participation in it of large enterprises of union subordination, which are located on the territory of the republic, will be a distinctive feature of the programs.

Among the other forms of the organization of scientific and technical activity, which are making it possible to surmount departmental barriers, it is possible to note the organization of sectorial scientific production and educational scientific production associations, laboratories of dual subordination, and temporary scientific collectives and the conclusion of long-term contracts on cooperation at the level of ministries and departments. The effectiveness of these forms will be even greater, if the economic mechanism of the interaction of science and production is adjusted. Many enforceable enactments, which regulate the processes of the formation and use of the scientific and technical potential, require revision and specification.

Thus, when locating large enterprises on the territory of the republic the sector of industry does not always allocate assets for the corresponding development of the scientific potential. This complicates the formation of integrated regional scientific production complexes and causes a number of structural disproportions. In particular, the obvious lag of science behind the development of chemical production is being observed in the republic, but departmental limitedness is preventing the successful surmounting of the formed discrepancy.

The inadequate attention on the part of a number of union ministries to the increase of the scientific and technical potential in regions is having the result that the scientific service of enterprises of the given sectors is being shifted onto the shoulders of republic science, mainly academic science and science of higher educational institutions. But such a shift does not pass without leaving a trace. The scientific service of current production by the forces of these sectors of science, especially if it is dragged out for a long time, can decrease the amount and the scientific and technical level of their basic research. Moreover, the organizational legal and economic conditions of the functioning of academic science and science of higher educational institutions are worse suited for direct cooperation with enterprises as compared with sectorial science.

In recent times the economic contract has become the most powerful economic lever which links academic science and science of higher educational institutions with practice. Whereas, for example, in 1961-1970 in case of a comparatively small amount of economic contractual work its average national increase at the Belorussian SSR Academy of Sciences did not exceed 800,000 rubles, during the next decade the average absolute increase came already to 2.6 million rubles a year. The proportion of the assets from the fulfillment of economic contractual work in the current expenditures of the Belorussian SSR Academy of Sciences in recent years has exceeded 50 percent. This indicator is even higher at higher educational institutions of the republic. The increase of the amounts of work, which are being performed in accordance with economic contracts, is strengthening the relations of science with production and is speeding up the processes of the introduction of innovations; the technical equipment of research here is increasing.

However, one must not, of course, allow the unlimited increase of economic contractual research, which can lead to the retarded development of basic research. Therefore, it is so important to substantiate carefully and comprehensively the choice of themes and to reject casual work, which does not correspond to the scientific specialization of institutes or does not logically follow from previously conducted research. It is also necessary to consolidate operations resolutely and to change over to long-term scientific production relations.

Such trends have become firmly established at the Belorussian SSR Academy of Sciences. Whereas in 1960 the average annual estimated cost per economic contractual theme came to 3,000 rubles, by 1970 it had reached 25,000 rubles, while in recent years has exceeded 40,000 rubles. The economic impact on the

average per introduced economic contractual job also increased by many fold. However, the consolidation of economic contracts also bears a new problem: such cooperation is becoming beyond the means of medium-sized and small enterprises of the republic. This to some extent explains the causes of the decrease of the proportion of republic enterprises among the clients of scientific institutions, which are located on the territory of the republic.

Regional cooperation on research themes, in our opinion, is a way out of the situation. Republic ministries and departments, apparently, should act as centralized clients which are capable of financing major scientific operations. Such cooperation will help to eliminate the duplication of the themes of the research, which organizations of academic science, science of higher educational institutions, and sectorial science are conducting.

In the future it is advisable, in our opinion, to use economic contractual sources of financing for the development of basic research. For example, in case of the conclusion of major long-term contracts it is advisable to include in them a special paragraph on the allocation of a portion of the assets, which are received by the academic institute, for basic research which corresponds to its scientific specialization. This would contribute to the expansion of research of a new type--research which is basic in nature and at the same time is aimed at the solution of specific national economic problems.

The cooperation of ministries and departments in the area of scientific service and first of all in the material and technical supply of research should become an important direction of the intensification of science in the republic. In the future the equipment of the experiment will determine more and more both the organization of research itself and its effectiveness. The functioning of complex systems of equipment instead of individual instruments, the substantial increase of the level of standardization of research equipment, and the automation of the conducting of experiments and the integration of their results are the most important traits of modern research. The scientific, technical, and economic need for the combining of instruments, research equipment, and computer technology into common integrated multifunctional systems is increasing. Under these conditions the prerequisites are created for the formation of a regional and unionwide network of collective-use specialized research centers.

Some positive experience of the cooperation of scientific service has already been gained at the Belorussian SSR Academy of Sciences, at which the centralized supply of instruments and other equipment is being successfully developed.

Five centers for the collective use of scientific equipment are in operation. The Center of Automated Spectroscopic Measurements (TsASI), which was established at the Institute of Physics in 1973, has acquired all-union fame.

The process of the territorial and interdepartmental centralization and development of collective forms of scientific service is objective and inevitable. It makes it possible to achieve a high level of the material, technical, information, and manpower supply of research with a substantial saving of assets and time. In Minsk, where an overwhelming portion of the

scientific and technical potential of numerous ministries and departments is located, cooperation will make it possible to save millions of rubles by the rejection of the development of the research infrastructure after the pattern of "a natural economy." In cities with a small concentration of the scientific potential such cooperation will help to acquire expensive equipment for the conducting of research at a modern level.

In our opinion, it would be advisable already in the immediate future to establish interdepartmental regional centers of scientific service, which have been given extensive duties and rights and have complete information on the needs, availability, and actual utilization of research equipment in the given city. Their goal is to increase the level of the supply of research by means of local resources and to achieve the intensive use of the available technical base. It is natural that cooperation is necessary not only during the use, but also already at the stage of the purchase and assimilation of scientific equipment. The organizational and economic forms of the use of research equipment, which have given a good account of themselves in other union republics and abroad, are also of interest.

Some experience in this respect has already been gained at the Ukrainian SSR Academy of Sciences, here a unique interinstitute plan of the joint use of research equipment is drafted and is approved by an order of the presidium of the academy. In it both the institutions, which make their instruments available for temporary use, and the user institutions are precisely indicated, the time of the operation of the equipment is specified, and so forth. The practice of creating mobile sets of modern scientific equipment for aiding outlying scientific institutions and higher educational institutions is interesting.

The Ukrainian SSR Ministry of Higher and Secondary Specialized Education publishes a list of the unique scientific equipment and instruments, which some higher educational institutions or others of the republic have. This equipment can be used by staff members of other higher educational institutions. For this they need to turn to the higher educational institution which is the owner of the equipment, to the base higher educational institution of the region, or to the working group which operates permanently under the ministry.

Useful experience in the collective use of scientific research equipment has been gained at the Novosibirsk Scientific Center. The Pribor Information Retrieval System, which makes it possible to establish promptly the location and the basic technical characteristics of many thousands of instruments, is in operation here. This makes it possible to facilitate greatly the making of management decisions and makes it possible to form and use more efficiently the technical base of research. Positive experience in the collective use of instruments and equipment also exists at the Academies of Sciences of Moldavia, Uzbekistan, Georgia, and Lithuania, and in the system of the State Committee for Standards, the RSFSR Ministry of Higher and Secondary Specialized Education, the Ministry of the Chemical Industry, and the USSR Academy of Medical Sciences.

Experience in the collective use of scientific research equipment on a state scale has been gained by a number of European socialist countries. For example, in the Hungarian People's Republic the service for the instrument supply of the Hungarian Academy of Sciences, which operates as an independent organization which is intended for the leasing of instruments and equipment for temporary use for a fee within the country, has existed since 1957. The Science Policy Committee attached to the Hungarian Council of Ministers, having studied and generalized the experience of the activity of this service, adopted a 10-year program of its development.

In the CSSR a national information retrieval system, which concentrates information over the entire territory of the republic on instruments and equipment worth more than 50,000 korunas per unit, as well as on similar equipment of the leading world instrument making firms, is operating successfully. The retrieval system can in a most prompt manner help scientific institutions to purchase or hire in the republic, as well as abroad the necessary instrument, tool, material, and spare part.

When elaborating measures on the rapid development and optimization of the use of the material and technical base of science it is also useful to take into account the experience of capitalist countries. In particular, a program of the establishment of regional scientific centers, at which complex and expensive equipment is concentrated, has been implemented since 1978 for higher educational institutions of the United States under the aegis of the National Science Foundation. Moreover, smaller, so-called instrument centers (3-10 scientific associates) are being set up at individual chairs of higher educational institutions.

We must not linger with the practical embodiment of the ideas of the collective use of research equipment and scientific service, although, of course, there are a lot of difficulties here. In our opinion, it is advisable to include the study of this problem and practical measures in the republic comprehensive programs of scientific and technical progress.

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CSO: 1814/155

MOSCOW RAYON PARTY COMMITTEES AID S&T PROGRESS

Moscow SOTSIALISTICHESKIY TRUD in Russian No 1, Jan 86 pp 82-92

[Article by F. Kozyrev-Dal, first secretary of the Krasnopresnenskiy Rayon Committee, CPSU; M. Chekin, chief of the Industry and Transport Department of the Voroshilovskiy Rayon Committee, CPSU; B. Muravlev, chief of the Science and Education Institutes Department of the Oktyabrskiy Rayon Committee, CPSU; under the rubric "Capital City Rayon Committee Representatives Speak Out": "On the Forms of Party Support for Scientific and Technical Progress"]

[Text] The study and discussion of the precongress materials, which have been published in the press and submitted for national advice, are making it possible to evaluate more completely and thoroughly the importance and urgency of the problems of the acceleration of scientific and technical progress. They, as is indicated in the draft of the Basic Directions of USSR Economic and Social Development for 1986-1990 and the Period to 2000, are, in particular, "to strengthen the ties of science and production, to develop such organizational forms of the integration of science, technology, and production, which make it possible to ensure the efficient and rapid passage of scientific ideas from conception to extensive use in practice."

Even within such a relatively small territorial production complex as the city rayon practically all the most diverse stages of this cycle occur, and each labor collective in it plays "its own fiddle," be it an academic institute or sectorial scientific research institute, production association, plant, factory or laboratory, design bureau or scientific library. And at each stage of the cycle, especially at the "meeting points" between them, there are still significant reserves and possibilities, which can and should be put to use. We have experience in this matter.

Back at the beginning of the 11th Five-Year Plan the rayon committee of the CPSU posed for scientific organizations and institutions of the rayon the task to give industrial enterprises of the rayon assistance in increasing production efficiency without an increase of expenditures, mainly by the efficient use of the available potential. Direct contacts of industrial enterprises with scientific research institutes and design bureaus, which not only proposed a number of interesting scientific and technical solutions, but are also directly ensuring their introduction, were ensured under the direct supervision of the rayon party committee.

For example, the Moscow NIOPIK Scientific Production Association is taking part in the development and introduction of new technologies of the dyeing of fabrics at the Trekhgornaya manufaktura Combine; the Central Order of Lenin Institute of Advanced Training of Physicians is dealing with such an important problem as the decrease of occupational morbidity. We expect a significant impact from the use of automated control systems for accounting and the marketing of products, which specialists of two institutes are developing for the combine.

Three basic directions have formed in the practice of party work on the implementation of the policy of the acceleration of scientific and technical progress.

The first is the increase of the role and responsibility of the party organization of each scientific collective in the improvement of the style and methods of work and the concentration of their efforts on the solution of the priority problems of the acceleration of scientific and technical progress.

The second direction of work is the assurance of the interaction of scientific organizations and industrial enterprises for the purpose of the active use of the accumulated scientific potential and the increase of the efficiency of social production.

And, finally, the third is the cultivation of the adherence to principle and the persistence of each communist and of his responsibility for the performance of scientific research and for the implementation of the set of measures on the improvement of the organization of labor and the creation of a creative atmosphere in the collective.

The questions of the acceleration of scientific and technical progress, the strengthening of the contacts of science with production, and the quickest introduction of the achievements of science and technology in practice have been repeatedly discussed at plenums of the rayon committee of the CPSU and are regularly examined in the buro of the rayon party committee and in the primary and shop party organizations. The workers of the rayon party committee are directing their efforts at bringing the experience of the work of the leading scientific research institutes to all party organizations and at seeing to it that the methods of work of these party committees and communists would become generally accessible and would be used extensively by all other scientific and production collectives in the rayon.

The Institute of Radio Engineering and Electronics of the USSR Academy of Sciences, the All-Union State Scientific Testing Institute of Veterinary Preparations, the Institute of Earth Physics imeni O.Yu. Shmidt of the USSR Academy of Sciences, and the All-Union Scientific Research Institute for the Comprehensive Designing of the Technology of the Erection of Enterprises of Light and Food Industry and Glass Tubing, the collectives of which are constantly performing work on the increase of the scientific and technical level of basic research and applied development, have gained great scientific prestige.

The advanced forms of the cooperation of science and production enjoy party support. The rayon party committee and the party organizations are constantly keeping these questions under control. It is natural that the primary party organizations of scientific research institutes, planning institutes, and design bureaus at their meetings discuss the urgency of the themes and the efficiency of scientific research and design work, as well as the progress of their fulfillment. Particular attention here is being devoted to comprehensive goal programs and programs on the solution of the most important scientific and technical problems, in which 24 collectives of the rayon are participating under the general supervision of the State Committee for Science and Technology.

In the solution of the problems of the development of the economy of the rayon and the improvement of the use of the scientific and industrial potential the rayon committee of the CPSU is also using the resources of such public formations as the Technical and Economic Council, the University of Quality, and the Club of Business Meetings. With their assistance the rayon committee is seeking stable business contacts between scientific organizations and industrial enterprises and is organizing extensive mutual information and the sharing of gained experience and ideas.

Under the general supervision of the party organization the initiative on the shortening of the time of the fulfillment of scientific research is being developed in the collective of the Institute of Radio Engineering and Electronics of the USSR Academy of Sciences. A number of additional studies have been conducted here by means of the saving of labor and material expenditures on the performance of scientific research work. In 1983-1984 alone the time of the completion of 40 scientific research jobs was shortened owing to the better organization of work and the automation of the experiment. Specialists are using the freed time for the performance of new fundamental and basic operations.

This year the buro of the rayon committee of the CPSU endorsed the collective initiative of scientific research, planning, and design institutes of Krasnopresnenskiy Rayon on the increase of the contribution of scientists to the accomplishment of the tasks of the 11th Five-Year Plan and the more distant future on the basis of the early completion of research and development and the introduction of the achievements of science and technology in production. The motto of this initiative is "Efficient Science for an Intensive Economy, Practical Use for the Achievements of Science."

In development of this initiative the collectives of scientific research institutes and design bureaus adopted increased socialist obligations, by which it is envisaged to increase by 8 percent the yield per ruble of expenditures on research work as compared with the previously outlined level. This made it possible in 1985 to additionally obtain a saving in the amount of more than 30 million rubles and to save 185,000 tons of standard fuel and 200,000 tons of metal. They also undertook to give assistance to industrial enterprises, including in Moscow and in Krasnopresnenskiy Rayon, and to kolkhozes and sovkhozes of Moscow Oblast in the practical introduction of the results of scientific research and planning and design developments. Thus, specialists of the scientific production association of the All-Union

Scientific Research Institute of Foundry Machine Building and Foundry Technology undertook to place into operation ahead of time at the Moscow Stankolit Plant the first automatic program-controlled molding line in the country, which provides a 25-percent increase of labor productivity and frees workers from difficult monotonous labor.

Sectorial and academic institutes are extensively developing creative cooperation with industrial enterprises, moreover, their relations with industrial enterprises are, as a rule, of a long-term, goal-oriented nature.

Attaching great importance to the strengthening of the relations of science with production, the rayon party committee constantly monitors the progress of the fulfillment of contracts on cooperation. Since 1978 an intrarayon plan of the creative cooperation of institutes and design bureaus with industrial enterprises has been formulated and annually updated. Bilateral and multilateral contacts of representatives of scientific research institutes and the corresponding enterprises are being established for providing assistance in the area of the improvement of production and its organization. In particular, the scientific associates of the All-Union Scientific Research Institute of Standardization and the VNII standartelektro are giving much assistance to enterprises of the rayon in the development, introduction, and improvement of the integrated product quality control system (KS UKP).

Scientists of these institutes are helping production workers to analyze the work of enterprises, in order to identify the reserves of the increase of the output and the improvement of the quality of products. As a result technological discipline is being tightened up, the output of products with the State Emblem of Quality increased, the losses from defective output decreased, other indicators also improved. Thus, since the moment of the introduction of the integrated product quality control system the output of furniture with the State Emblem of Quality at the Interyer Production Association has increased by twofold and at present has reached 92.1 percent. The economic impact from the introduction of the integrated product quality control system at this enterprise for 1984 alone came to 101,000 rubles. The Rostokinskiy Plant of Reinforced Concrete Components of House Building Combine No 1 prior to the introduction of the integrated product quality control system did not produce at all products of the highest quality category, while now the share of such items comes to 90.4 percent in the total volume of certified output.

Now all the industrial enterprises of the rayon have developed and introduced integrated product quality control systems. Active work is being performed on the development of the rayon product quality control system (the Presnya RS UKP). The Technical and Economic Council (TES) of the rayon committee of the CPSU is in charge of it. The All-Union Scientific Research Institute of Standardization has become the scientific methods center of this work. The University of Quality, of which Doctor of Economic Sciences Professor A.V. Glichev, director of the All-Union Scientific Research Institute of Standardization and an honored figure of science and technology of the RSFSR, is the rector, operates under the Technical and Economic Council.

In 1983 a workers' faculty of quality was established at the base of the Moscow Proletarskiy trud Hardware Plant. Such a form of instruction is making it possible to give workers, brigade leaders, and foremen good theoretical and practical training and to use advanced know-how as applied to the specific nature of their enterprise. Specialist-scientists carry out the instruction of workers in accordance with the approved thematic plan.

The promotion of advanced know-how, which the Scientific Methods Center organizes, is important for the efficient functioning of the Presnya Rayon Product Quality Control System. A permanent exposition, which reveals the know-how of the leading enterprises of the rayon, which are achieving a high level of the development and functioning of integrated product quality control systems, the output of products with the Emblem of Quality, and so on, has been formed here.

The work being performed in the rayon is contributing to the increase of the technical level and the quality of the output being produced. During the current five-year plan the output of products with the State Emblem of Quality has increased by twofold, the export of products has increased by one-fourth, the losses from claims and intraplant rejects has decreased to one-half.

The policy of the systematic long-term cooperation of representatives of science and production by no means implies the rejection of the establishment of temporary collectives, but, on the contrary, presumes that for the performance of the most important scientific research and the concentration of the efforts of collectives on this work it is important to establish temporary multiple-skill subdivisions and brigades. They can unite representatives of various institutes, laboratories, scientific production associations, and enterprises. For example, at the Moscow NIOPIK Scientific Production Association specialized multiple-skill brigades made up of representatives of the scientific production association and industrial enterprises are established for the quickest assimilation of objects of new equipment and their successful output. Developers of new products, specialists in means of mechanization, analytical control, and so forth belong to the brigades. Thus, in July 1984 a multiple-skill brigade made up of staff members of the scientific production association and the Novomoskovsk Orgsintez Production Association was organized for the start of the large-scale production of maleic anhydride. When they discussed the joint plan of work at the production conferences of the brigades of the shop of maleic anhydride, the workers supplemented it with specific proposals. Now the two units are operating in a continuous mode, while prior to this for 2 years they did not succeed in working even a week. "In passing" the specialists of the Moscow Scientific Production Association developed and jointly with specialists of the plant started up a dehydration unit, which increased by 25 percent the yield of finished products and practically eliminated waste water.

The establishment of joint laboratories of a scientific research institute and the corresponding ministries, which are interested in introduction, is also being used in practice for speeding up the introduction of scientific achievements, in particular, seven such laboratories have been organized at the Institute of Radio Engineering and Electronics of the USSR Academy of Sciences.

When evaluating during the precongress days the achieved results, it is important to focus attention on the still unsolved problems, to take more completely into account the present conditions when formulating thematic plans and selecting the main, most promising directions of research, and to see to it that the leading scientific forces and material resources would be concentrated on them. To develop the initiative of all workers and to increase their responsibility for the assigned job and for work quality. The problems of the establishment and strengthening of the pilot experimental base of the sectorial and academic institutes, which are located in the rayon, require immediate solution.

From the standpoint of the immediate importance of scientific and technical progress one should in practice also approach in a new way the evaluation of the results of the production activity of industrial enterprises. Thus far the fulfillment of the plan on sales has been regarded as a necessary and adequate condition for the high rating of their work, although the plan on the introduction of new equipment might not have been fulfilled. Now the time has come to increase substantially the importance of the scientific and technical novelty of products when evaluating the results of production activity, and to include the assignment on the introduction of new equipment among the basic indicators.

Our rayon has a significant scientific and technical potential. The introduction in production of the latest achievements of modern science and technology should be raised from the level of ordinary "measures" to the level of a permanent system which ensures the extensive influx of new ideas and technical solutions into production. It is important that the measures on moral and material stimulation both in science and in production would ensure their common interest in high end results and in the rapid introduction in practice of all the useful scientific and technical achievements, to which the creative dedicated labor of scientists and production workers has given rise.

[Comments by M. Chekin, chief of the Industry and Transport Department of the Voroshilovskiy Rayon Committee of the CPSU]

Voroshilovskiy Rayon of the capital developed historically as a rayon of large-scale science. Both scientific research institutes and planning and design organizations exist here. The acceleration of scientific and technical progress in the area of atomic energy research and in instrument making, machine building, and medicine depends in many ways on their activity.

The party organization of the rayon is performing much organizing work, which is aimed at the increase of the efficiency of the labor of scientists, the development of basic research, and the speeding up of the use of the results of this research in applied development, and is seeing to the shortening of the time of the introduction in the national economy of new technological processes and models of new equipment.

During the years of the current five-year plan the scientists and engineers of our rayon have completed more than 5,000 scientific research and experimental design developments and projects.

The fact that certificates for discoveries were obtained for 4 of the completed jobs and certificates of authorship for inventions were issued for more than 2,500, attests to their high scientific and technical level. During the five-year plan 37 patents and 32 licenses have been sold; 7 works were awarded the Lenin Prize, 46 were awarded the USSR State Prize.

Nevertheless the tasks, which were posed at the conference in the CPSU Central Committee on scientific and technical progress and in the precongress documents, are aiming us at the further increase of the efficiency of scientific research, the development of fundamentally new types of equipment and technology, and the speeding up of their introduction in production. Here we are relying on the already gained experience of those scientific organizations of the rayon, at which there is something to learn.

Thus, the main directions of the work of the most important scientific center--the Order of Lenin and Order of the October Revolution Institute of Atomic Energy imeni I.V. Kurchatov--are constantly in the field of view of the party committee of the institute and the rayon committee of the CPSU. This concerns, in particular, the participation of the institute in the fulfillment of the Energy Program of the country. It is a question of the concentration of forces and assets on the solution of such problems as the optimization of the use of nuclear fuel and the increase of the level and efficiency of the scientific supervision of operations, the goal of which is the hastening of the time of the start-up and the bringing up to the design capacities of new nuclear electric power plants and the increase of their reliability and economy.

The party committee of the institute is supporting in every possible way research in new, nontraditional directions, which can lead to a significant increase of labor productivity and the saving of resources by the introduction of new technology. Thus, a group of scientists headed by communist P.A. Cheremnykh proposed a method of the magnetic separation of low-quality iron ores. It is possible to use successfully in the blast furnace process the iron concentrate which was obtained in this manner.

The orientation toward the search for new forms and methods of the increase of the efficiency of the labor of scientists is characteristic of the party organization of the institute. Here they are not afraid of experiments. Useful experience was gained, in particular, when establishing temporary labor collectives. With allowance made for the nature of the problems being solved groups of creative specialists are formed regardless of administrative affiliation. This can be "a group for the solution of an urgent problem" or "a multiple-skill creative youth collective." As a rule, they work under the supervision of leading scientists. Precisely such a collective was able to solve the problem of the radiation resistance of the reactor vessel of the Novovoronezhskaya Nuclear Electric Power Plant, to lengthen its life, and, hence, to save 5 million rubles a year at each block of the plant. The idea of establishing temporary creative collectives has been supported in the rayon; they are working especially successfully at the Institute of Virology imeni D.I. Ivanovskiy and the Institute of Molecular Genetics of the USSR Academy of Sciences.

The rayon committee of the CPSU is also seeing to the dissemination of the useful experience of the intensification of scientific research, which has been gained at the Scientific Research Institute of Instrument Making, at which an integrated system of goal program planning was developed and introduced. Since its introduction the basic indicators of the activity of the institute have constantly improved. The number of types of instruments, which have been turned over to series production, increased by approximately twofold. The number of developments, which were awarded the State Emblem of Quality, increased from 3 to 118; the total economic impact from the introduction of inventions increased by threefold.

In practice the technical and economic council, which was established under the rayon committee of the CPSU, organizes the dissemination of the best know-how. Management personnel and specialists of scientific organizations, industrial and transportation enterprises, and construction and installation administrations are members of it. They are united in various sections: for the contact of science with production, for the efficient use of computer technology, and others.

The first section, in particular, deals with organizational and procedural assistance in the promotion of the achievements of science and technology and the identification of completed scientific research developments, which are of practical interest for industrial enterprises of the rayon; it sees to their quickest introduction and organizes assistance to enterprises, which are in need of cooperation with scientific research institutes and design bureaus.

Incidentally, the benefit from this is mutual. In this respect the experience of the cooperation of the collective of Motor Vehicle Combine No 1 with scientific institutions is instructive. A testing laboratory was established at the combine with the participation of the Scientific Research Institute of Automobiles and Automobile Engines, the Moscow Highway Institute, and the BelavtoMAZ, Avtodizel, and ZIL Production Associations. While studying the practice of the use of trucks, specialists of the motor vehicle combine took part in the elaboration and implementation of a set of measures on the increase of the quality and durability of MAZ and ZIL trucks and YaMZ engines. It was possible to increase the total kilometers logged of trucks without an overhaul to 300,000 kilometers.

The rayon committee of the CPSU is concerned about party support and is encouraging the participation of manufacturing plants in developments already at the stage of designing and of the developers of items in the process of their assimilation at industrial enterprises. The establishment at the Plant of Reinforced Concrete Items No 17 of an industrial complex for the production of items of prefabricated road surfaces made of fine concrete, for example, was a result of such cooperation. Such a complex was established for the first time in the Soviet Union. The total economic impact from introduction came to about 1 million rubles.

Experience in the use of new organizational and economic forms of the integration of science, technology, and production, in particular, scientific production complexes, has also been gained in the rayon.

Under the supervision of the rayon party committee a plan of the development of the creative cooperation of scientific research, experimental design, and planning organizations both within the rayon and with other enterprises and organizations of Moscow and the country was drafted for the 11th Five-Year Plan. On the basis of the development of the creative cooperation of scientific research institutes and design bureaus work on the retooling of production is being performed persistently and systematically under the supervision of party organizations at industrial enterprises of the rayon. Thus, in 5 years of the five-year plan the level of the equipment of industrial production has increased significantly. In all 15 shops and sections have been completely mechanized and automated, 19 mechanized flow and automatic lines have been introduced, and 271 units of new highly productive equipment have been installed. The proportion of products with the State Emblem of Quality in the volume of output liable to certification increased from 49.3 percent in 1980 to 58.0 percent in 1985.

In addition to the increase of the growth of technical equipment, the introduction at industrial enterprises of the rayon of an integrated product quality control system also contributed to this. The party organization of the All-Union Scientific Research Institute of Normalization of Machine Building came forth with the initiative to develop and introduce this system. It is important that today this system with constant party support is being improved and developed in conformity with the new tasks.

Taking into account that the use of microelectronics and computer technology in scientific research helps to conduct it at a high technical level, to shorten its time, and to increase quality, the party organizations of many institutes of our rayon treated with great attention the work in this direction of the Institute of Atomic Energy imeni I.V. Kurchatov. In particular, the first section of the system of the integrated automation of the designing, development, and production of items at the pilot works of scientific research institutes and design bureaus (KAPRI) has been completed here. It ensures the complete automated cycle of the engineering, the designing of the technology, and the production of items. According to preliminary estimates, the development and introduction of the KAPRI system will make it possible to increase labor productivity during engineering by 1.5- to 3-fold, during the period of the technological preparation of production by 2- to 4-fold, and in production by 1.3- to 3-fold.

For the development of modern economic thinking the rayon party committee is using the seminar of economic managers on urgent problems of the development of the socialist economy. For the sharing of experience in the introduction of the most interesting forms of work we are conducting seminars of secretaries of the party organizations. The permanent specialized commissions for the monitoring of the implementation of scientific and technical goal programs, which have been set up in the party organizations of scientific research institutes and design bureaus, have given a good account of themselves. The commissions help the management of the institutes to ensure the completion of scientific developments at a modern level and on the planned date. They regularly analyze the plans and reports of the subdivisions and inform the party committees and party buros about the real efficiency of the

work being performed. It also happens that the commissions correct the managers of those departments and laboratories, which are attempting to live in the old way, by accumulating "volumes" by means of minor themes.

In our opinion, such forms of work as the hearing of the reports of scientific and economic managers at meetings and sessions of the party buros and party committees and interviews with them in the rayon party committee are being used successfully in the practical work of the party organizations of the rayon. Unfortunately, much formalism is also being allowed here. During the discussion of reports it is a matter at times exclusively of the results of the activity of the collective as a whole, while the specific contribution of the manager and individual performers and the style of their work are not analyzed. The rayon party committee corrects such party organizations and aims them at holding the first managers and their deputies more strictly accountable. As to the role of party organizations in the improvement of the personnel composition of scientific and technical personnel, in the future the possibilities of periodically conducted certifications have to be used more completely for this purpose and conditions for the increase of labor productivity and the scientific return of all workers have to be created in everyday work in the collectives.

[Comments by B. Muravlev, chief of the Science and Education Institutions Department of the Oktyabrskiy Rayon Committee of the CPSU]

In Oktyabrskiy Rayon of Moscow there are 37 academic and 47 sectorial institutes and 4 large higher educational institutions. In 1984 alone 6 scientific discoveries and more than 1,300 inventions were registered at them. Many developments of scientists are being used in the national economy.

The high concentration of scientists in the rayon to a significant degree determined the style and methods of work of the rayon party committee on the stimulation of the creative forces and potentials of scientific collectives. Many interesting forms of the stimulation of the creative work of scientists and specialists arose during competition and the development of the movement for a communist attitude toward labor. Such a form as the work of engineers, technicians, and scientists in accordance with personal creative plans underwent extensive dissemination. Such a form is especially useful in connection with the consolidation of research themes and in case of the changeover to comprehensive and goal program planning. It is being used effectively, for example, at the Institute of Organic Chemistry imeni N.D. Zelinskiy of the USSR Academy of Sciences, where the trade union committee, the party buro, the board of directors, the council of young scientists, and the Mendeleyev Society annually organize review-competitions under the motto "For Each Scientific Associate and Engineering and Technical Worker a Personal Creative Plan."

On the initiative of the rayon committee of the CPSU a system of public organizations, the efforts of which are concentrated on the solution of the problems of the acceleration of scientific and technical progress, is operating in the rayon. For example, the council for science and higher educational institutions, which is represented by prominent scientists, is performing much analytical work and is collectively elaborating new ideas: it

is promoting new effective forms of the cooperation of science and production. Public commissions and groups for the promotion of scientific and technical progress are working fruitfully at the majority of scientific institutions. They not only check how things are going, but also help to establish contacts with workers of related fields and to draft contracts on creative cooperation and schedules of joint actions.

In general the most diverse competitions of scientific works and ideas, works on introduction, and scientific works of young people and scientific groups and the special competition on the theme "The Automation of the Experiment" are being organized in the rayon. They enjoy great popularity. At the Institute of Chemical Physics of the USSR Academy of Sciences, for example, one associate in two participates in the competitions, at the Geology Institute of the USSR Academy of Sciences one in four does.

The party organizations are devoting special attention to the development of the creative abilities of beginning engineering and technical personnel and future specialists. Here the party organizations of higher educational institutions are laying the "first stone." It is a question of the purposeful formation among student youth of both deep professional interests and an active position in life. For in itself knowledge without the internal aspiration of the specialist to realize it in practice can remain "dead capital."

In this connection a comprehensive program, which is aimed at the formation and development among students of the aptitude for creative work and the ability to surmount the inevitable difficulties here, has been formulated and is being implemented at the higher educational institutions of the rayon. The organization of seminars on the principles of management and organizing activity, the establishment of student educational scientific production complexes, the formation of professional specialized detachments for doing practical work, the enlistment of students in the work of the chairs and scientific research subdivisions of their higher educational institution, their participation in the operations on economic contractual themes, and so on are included in the program.

Experience shows that all these forms help to combine better the educational process and scientific research and to conduct it on the basis of well-equipped laboratories, scientific research institutes, and design bureaus and make it possible to eliminate the inevitable gap between syllabuses and the present level of the development of science and technology, to acquaint the graduates of a higher educational institution with the innovations in the sector, in which they have to work, and to cultivate the skills of independent creative work. For example, such a form as the joint work of a group of students on collective graduation projects in accordance with the real assignments of enterprises has shown itself to advantage. Thus, at the Moscow Institute of the Petrochemical and Gas Industry imeni I.M. Gubkin more than 50 collective graduation projects, in which more than 250 students working for a degree participate, are completed annually.

The party committees of the rayon are seeing to the strengthening of the cooperation of scientific institutions and higher educational institutions

with enterprises of industry and agriculture. The rayon committee of the CPSU recommended, in particular, to scientific research institutes and higher educational institutions to conclude long-term contracts on creative cooperation with enterprises. It coordinated the work on the drawing up of a rayon plan of the cooperation of scientific institutions and industrial enterprises, during which more than 4,100 contracts on socialist cooperation among them were concluded. Multiple-skill brigades of scientists and production workers and interdepartmental laboratories, which are concerned with the solution of specific problems in the area of the technical improvement of production, began to be established on their basis.

The analytical work being performed in the rayon has made it possible to establish that the greatest national economic impact from the introduction of scientific and technical achievements is achieved when "emergence into the sector" takes place through large enterprises, that is, when a scientific idea is realized first at one enterprise, and then spreads to similar enterprises of the sector and other related enterprises, which belong to different ministries. Thus, in 1984 an agreement between the executives of the USSR Ministry of Higher and Secondary Specialized Education, the USSR Ministry of Ferrous Metallurgy, and the USSR Ministry of Nonferrous Metallurgy on the introduction within 2 years at 11 large enterprises of the country of 23 promising developments of the Moscow Institute of Steel and Alloys was concluded and legalized in documentary form.

The communists of the Institute of Metallurgy imeni Baykov of the USSR Academy of Sciences were the initiators of the formulation of a most important national economic program of the increase of the efficiency of the use of metal on the basis of the extensive application of powder metallurgy. Much organizational work preceded this: the themes were significantly consolidated, the structure of the institute was changed. This initiative received a high rating and was endorsed by the Buro of the Moscow City Committee of the CPSU.

The collectives of the academic institutes of the rayon, by using long-term goal program planning, are increasing their contribution to practice. The following figures attest to this: in 1984 the academic scientific institutions of the rayon introduced 535 scientific research developments with an economic impact of 78 million rubles.

The special "commissions for introduction," which have been established at the Institute of Physics imeni Lebedev and the Institute of Organic Chemistry imeni N.D. Zelinskiy, are working well. The work of the production commissions for cooperation with sectorial scientific research institutes and industrial enterprises at the Institute of Elementoorganic Compounds and the Institute of Chemical Physics is effective. Intersector collectives, creative groups and brigades, and Komsomol youth collectives are working successfully at a number of academic institutes.

The rayon committee of the CPSU is directing the attention of scientific collectives to the increase of the competitive ability of their experimental design developments and instruments, in order to reduce imports and to increase the export potentials of the country. As a result of the efforts of

specialists in recent times a number of operations, which made it possible to develop domestic equipment which replaces previously imported equipment, have been completed and 31 new instruments have been developed at the level of the best world models.

The collectives of the academy's Institute of Chemical Physics and Institute of Molecular Biology, the Institute of Soil Science imeni V.V. Dokuchayev of the All-Union Academy of Agricultural Sciences imeni V.I. Lenin, and the Institute of Fertilizers and Insectofungicides are making a substantial contribution to the solution of the problems of the scientific and technical support of the USSR Food Program. The sponsored Ozerskiy Rayon of Moscow Oblast, which is distinguished by stable and high production economics indicators, is serving as a kind of "testing ground" for the introduction of the latest scientific and technical achievements.

All this attests to the ability and willingness of academic scientific collectives to deal with specific problems of production. At the same time we believe that the representatives of basic science should not be turned into a "first aid" brigade which at any call rushes to the plant entrance gate. When planning the economic contracts of scientific research institutions, especially of the academic type, it is important to see to it in time that minor themes, which solve special problems of an individual enterprise and are not of interest for the sectors of the national economy as a whole, would be eliminated.

As to the activity of sectorial institutes, the rayon party organization sees its task in helping to draw up collectively proposals on a wide range of scientific and technical problems with which they are occupied. The questions of increasing the efficiency of the activity of sectorial institutes were discussed at a plenum of the rayon party committee; they have repeatedly been the subject of detailed examination in the buro of the rayon committee. Specialized sections, at which the activity of these institutes is analyzed and suggestions on its improvement and the improvement of the coordination of scientific research are drawn up, meet regularly. In 1984 the sectorial institutes introduced 2,030 developments and obtained a proportionate economic impact which exceeds 420 million rubles.

With allowance made for the fact that patent and license activity is one of the most important indicators in the work of the sectorial institute, let us note that in 1984 scientists and specialists received 756 certificates of authorship. Of them 549 were introduced in production and an economic impact of more than 70 million rubles was obtained.

The party organization of the rayon regularly holds competitions in the area of patent and license work, organizes socialist competition for the awarding to research and development of the rating "excellent quality," and promotes the most effective forms of the interaction of science and production. On the basis of bilateral and multilateral cooperation in 1984 sectorial institutes performed work on 1,591 contracts, including 523 contracts with enterprises of industry, construction, and transportation. But here a significant portion of the institutes have comprehensive contracts, in which, in addition to the institute and enterprises of the sector, other organizations and enterprises

of related sectors are given a part. Special-purpose scientific production collectives, which unite workers of all the interested organizations for the solution of a specific scientific and technical problem, are being established on the initiative of the party organizations at several institutes (the Institute of Power Engineering imeni G.M. Krzhizhanovskiy, the PromtransNIIproyekt of the USSR State Committee for Construction Affairs, and others).

Creative brigades of scientists and production workers have been established and are working productively at a number of institutes. Joint labor at all stages of development ensures a high technological feasibility of the solutions. Moreover, concurrent work is facilitated and the gap in time between the completion of a scientific and technical development and the beginning of its production assimilation is reduced. At the same time the strengthening of relations with academic institutions, particularly the organization of special scientific collectives, according to our observations, is also useful for sectorial institutes.

The higher educational institutions of the rayon also have a substantial scientific and technical potential. During the 11th Five-Year Plan they are taking part in the fulfillment of 18 all-union comprehensive goal programs. The proportionate economic impact, which was obtained from the implementation of the results of the scientific research conducted at higher educational institutions, came to 59 million rubles (about 2.2 rubles per ruble of expenditures). The contracts between higher educational institutions and enterprises encompass a wide range of problems which are being solved jointly in the interests of both parties: the study and introduction in production of various kinds of scientific and technical developments, the training and the improvement of the skills of personnel for enterprises and, in turn, the participation of specialists from production in the giving of special courses and the conducting of seminars, the participation of instructors in political educational work in production collectives.

Sectorial laboratories, which are financed by ministries, are a promising form of the uniting of the interests of science of the higher educational institution and production. For example, at the Moscow Institute of the Petrochemical and Gas Industry imeni I.M. Gubkin the sectorial laboratories, which in 1984 provided an economic impact of 14 million rubles, account for more than 50 percent of all the economic contractual themes.

The interest in such sectorial laboratories is understandable, since this form guarantees to a greater degree large-scale introduction.

For the time being, unfortunately, "emergence in the sector" remains a problem which is hard to solve. But, at the Moscow Textile Institute the majority of developments (about 90 percent), which were completed in accordance with economic contracts, are introduced at only one or two enterprises, although they can be used at many.

The rayon party committee is supporting in every possible way the cooperation of scientific institutions and higher educational institutions with production, is directing the attention of scientific organizations to the

solution of urgent national economic problems, and is giving incentives to production workers who actively cooperate with science and introduce its achievements. And all the same many problems still exist in the convergence of science with production. The units, which are connected with the practical implementation of scientific achievements, are weak: the economic mechanism of the introduction of advanced innovations is imperfect, the departmental barriers, which hinder the mass use of advanced solutions, are high.

The organizational unity of the research, which is being conducted at sectorial institutes and at enterprises of the same department, in practice, often proves to be formal. The enterprises in the absence of reserve capacities, a long-term plan as the basic form of planning, and a real material interest accept from institutes and bring up to technological use only relatively minor innovations, which are capable of making individual, not too substantial changes in the production process. They are not interested in conducting more thorough research, since this comes into conflict with the operational production tasks, the system of planning, reporting, and stimulation, as well as the size of the enterprises themselves and the amounts of resources, which the enterprises can allocate for their technological retooling.

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CSO: 1814/155

PROBLEMS OF PLANNING, MANAGEMENT OF AGROINDUSTRIAL COMPLEX

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 2, Feb 86 pp 121-122

[Article by Candidate of Economic Sciences O. Yermolova and N. Kireyeva (Saratov) under the rubric "Scientific Life": "Problems of the Planning and Management of the Agroindustrial Complex"]

[Text] In May 1985 the All-Union Scientific Conference on the theme "Problems of the Improvement of Planning and the Strengthening of the Influence of the Economic Mechanism on the End National Economic Results of the Development of the Agroindustrial Complex," which was organized by the USSR State Planning Committee jointly with the Economics Department of the USSR Academy of Sciences, the Scientific Council for Socioeconomic and Legal Problems of the Agroindustrial Complex of the USSR Academy of Sciences, and the Institute of Socioeconomic Problems of the Development of the Agroindustrial Complex of the USSR Academy of Sciences (ISEP APK AN SSSR), took place in Saratov. Responsible officials of planning and economic organs and leading agricultural scientists of the country took part in its work.

The most important directions of the development of the agroindustrial complex and the key questions of the improvement of its planning were specified in the report of First Deputy Chairman of the USSR State Planning Committee P.A. Paskar, who opened the conference. After dwelling on the unsolved problems, the speaker especially singled out the need for the increase of the responsibility of enterprises and organizations for the end results of production.

Chairman of the USSR State Committee for Prices N.T. Glushkov covered the means of the further development of the system of prices as an important component of the economic mechanism of the agroindustrial complex. He dwelt on the positive trends in the economic interrelations between industry and the agrarian sector, which have already begun to appear.

Much attention at the conference was devoted to the question of the qualitative reorganization of the prevailing system of indicators of the plan of development of the agroindustrial complex for the changeover to its intersectorial planning. In particular, the need for the decrease of the number of approved indicators in the plans of the economic and social development of the agroindustrial complex was noted.

The procedural principles of the calculation of the indicator of the final product of the agroindustrial complex were presented in the report of V.A. Bulkhov, deputy chief of the Consolidated Department of the Agroindustrial Complex of the RSFSR State Planning Committee. Individual aspects of this problem were touched upon in the statements of Candidate of Economic Sciences N.S. Mymrikov, T.N. Tikhinyan, and others.

Means of implementing an intersectorial approach to the planning of the agroindustrial complex were proposed in the report of Doctor of Economic Sciences A.A. Anfinogetova (the Institute of Socioeconomic Problems of the Development of the Agroindustrial Complex of the USSR Academy of Sciences). Such an approach, which is based on the introduction in the system of planning of the agroindustrial complex of indicators of the final product with respect to the physical and material composition and the use of standards of the total expenditures of resources, makes it possible to decrease significantly the number of plan indicators. In the reports of A.S. Popko, chief of a subdepartment of the Consolidated Department of the Agroindustrial Complex of the USSR State Planning Committee, and several other conference participants the suggestion on the transition from the planning of state purchases of agricultural products to the planning of their delivery to the all-union fund was substantiated on the basis of the analysis of the results of the experiments being conducted in a number of republics of the country.

The problems of planning the product subcomplexes in the system of the agroindustrial complex held an important place in the work of the conference. They found reflection in the reports of: RSFSR Deputy Minister of the Fruit and Vegetable Industry N.V. Averyanov; A.P. Dolotov (the USSR State Planning Committee); K.V. Yartsev (the RSFSR Ministry of the Fruit and Vegetable Industry); and A.N. Lifanchikov (the Central Scientific Research Institute of Economics attached to the RSFSR State Planning Committee). The discussion revealed different points of view on the composition of the subcomplexes and the principles of their distinction in the system of the agroindustrial complex. A number of participants supported the proposal to draft the plan of the economic and social development of the agroindustrial complex with a breakdown by the basic product and supply subcomplexes.

Yu.G. Krivov, deputy chief of the Department of the Intersectorial Balance of the RSFSR Central Statistical Administration; Candidate of Economic Sciences R.I. Yaushev (the Institute of Economics of the Uzbek SSR Academy of Sciences); and V.M. Masakov, chief of a sector of the Institute of Economics and Organization of Industrial Production of the Siberian Department of the USSR Academy of Sciences, devoted their statements to questions of the development of the procedural base of planning, the assurance of the reliable balance of plans, the formation of an efficient intersectorial structure of the agroindustrial complex, and the need for the regular drawing up of reporting and planning intersectorial balances of the agroindustrial complex of the country, union republics, and regions (at the level of the oblast).

The experience of the Kazakh SSR in the development and use of a three-level system of models of the development of the agroindustrial complex of the republic, as well as of the Latvian SSR in the development of a balance

optimization model, which is intended for the coordination and optimization of the plan indicators of the development of the agroindustrial complex of the republic, was endorsed at the conference.

In the statements of many conference participants attention was directed to the need to intensify the work on the development of sets of norms and standards of the agroindustrial complex, their interconnection, and the factors which determine their level and dynamics. The advisability of the changeover to the standardized planning of the agroindustrial complex and the development of long-term standards of the use of material and technical resources and the specific capital investments in the increase of the deliveries of the products of the agroindustrial complex to the all-union fund was substantiated in the reports of L.G. Aleksandrov (the USSR State Planning Committee), Candidate of Economic Sciences T.A. Datsevich (the Scientific Research Institute of Economics attached to the USSR State Planning Committee), and F.F. Katinas (the Scientific Research Institute of Economics and the Planning of the National Economy of the Lithuanian SSR State Planning Committee).

The reports of E.Ya. Nagla (the Latvian SSR State Planning Committee), Corresponding Member of the Estonian SSR Academy of Sciences M.L. Bronshteyn, Corresponding Member of the Latvian SSR Academy of Sciences A.A. Kalnynsh, Doctor of Economic Sciences R.A. Otsanon, and others were devoted to questions of the improvement of the economic mechanism of the agroindustrial complex.

As the conference participants noted, an urgent problem of the improvement of the economic mechanism is the granting to enterprises of the system of the agroindustrial complex of greater independence in the making of decisions in the area of economic activity. Given the centralized approval of the economic standards, which determine the wage fund, the economic stimulation fund, and so forth, this will contribute to the increase of the level of development of economic initiative. The importance of the sharp increase of the efficiency of the use of the entire production potential and the increase of the output of products per unit of production resources was emphasized in the report of Corresponding Member of the Ukrainian SSR Academy of Sciences A.M. Omishchenko.

The social aspects of agroindustrial integration and the means of improving the social planning of the agroindustrial complex were also discussed at the conference. New large-scale problems of the planning of social development under the conditions of agroindustrial integration were specified in the reports of V.V. Biryukov, chief of the Consolidated Department of the Agroindustrial Complex of the USSR State Planning Committee, and V.B. Ostrovskiy, director of the Institute of Socioeconomic Problems of the Development of the Agroindustrial Complex of the USSR Academy of Sciences. It was noted that the elaboration of regional comprehensive goal programs, in which the plans of the distribution of production, rural settlement, and the development of the nonproduction infrastructure should be interconnected, has become a vital need of practice. The questions of the improvement of the organization of the elaboration of diagrams and plans of regional layouts, the attachment of the rural population and the stabilization of labor collectives, and the drawing up of a balance of the manpower resources of the

agroindustrial complex and a balance of workplaces with allowance made for scientific and technical progress were touched upon.

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CSO: 1814/157

PROMINENT SCIENTISTS ON GAINS, GOALS IN SCIENCE, TECHNOLOGY

Moscow ZNANIYE-SILA in Russian No 1, Jan 86, No 2, Feb 86

[Article: "Scientific and Technical Progress: Means of Acceleration"]

[No 1, Jan 86, pp 1-5]

[Text] 1. What, in your opinion, are the most significant achievements in your field in the past several years?

2. What is the possible contribution of your field to the solution of the urgent problems of the acceleration of scientific and technical progress?

3. What research directions, developments, ideas, and designs seem most promising to you?

[Comments by Academician A.P. Yershov, department chief at the Computer Center of the USSR Academy of Sciences' Siberian Division: "The Formation of the Information Industry...."]

1. In the area of computer technology and its applications the most important achievement is the appearance of microprocessors, the start of their extensive use, and the realization of their role in all spheres of the production relations of people. In essence, in recent years the scientific and technical prerequisites of what is called the formation of the information industry and the complete "informatization" of society have been established.

I am deliberately not regarding as of paramount importance any of the specific scientific achievements or technical innovations. A portion of them existed independently, many were formed previously, in the early 1970's. I regard as the main achievement the development of the prerequisites for such an integral, total impact which microprocessors and microprocessor computer hardware are now yielding in the overall development of society.

2. Our society is now faced with two most urgent problems--the sharp increase of labor productivity in industry and the significant increase of the efficiency of management at all its levels. In order to solve both, the most extensive use of microprocessor equipment and its software is necessary.

3. Your third question enables me to detail my responses to the two preceding ones.

I will name three events in computer technology, which played, in my opinion, the greatest role. There is, first, the invention of small disk memories. They belong to peripheral computer equipment, but it is possible to argue over which is more important -- to develop a computer based on one silicon chip, or to supply it with a compact, reliable memory. Precisely the achievements in the area of peripherals gave a real nature to the ideas of the computerization of human society. The new devices of the storage, input, and output of information became the necessary intermediaries between microprocessors and man and made possible the development of the personal computer, which I regard as the main motive force of progress in the mass application of computer technology. The small magnetic memory in essence contributed to an even greater degree to the appearance of computer technology at our worktable than even microprocessors, because previously there were already sufficiently compact calculators, for example, onboard systems of various types, while peripherals have acquired desk-top size only know, with the development of flexible, so-called floppy disks and Winchester disks, which I consider a fine construction, which is just as successful as the ferrite memory, which for 15 years served us reliably in all computers, was in its time.

The second major achievement in the area of computer peripherals is the laser printer, which made practicable the development of the electronic typesetting of texts and the automatic preparation of documentation with the aid of a computer. It is possible owing to it to accomplish the "closure" of paperless information science, in case of which all the information can actually circulate within a network of computers, but at the necessary place, at the necessary time, and, what is the main thing, with the necessary speed can be reproduced in a form customary to man.

So far I have been speaking about the purely technical inventions which seem most important to me in my field in recent years. If I speak about the fate of a more theoretical discipline--programming, here I would like to mention a new procedural tool which originated comparatively recently. This is so-called object-oriented interaction with the computer. A very interesting change of notions in the ideology of dialog systems took place. During the 1950's and 1960's they were based mainly on the exchange of textual messages. Reactions of every kind to the messages being sent by the operator came from the computer, while the actions of man consisted, thus, simply in the typing of all kinds of commands intended for execution by the computer. That is, this was conventional programming, which, however, has been dragged out in time--step-by-step programming, as it is sometimes called. A new approach to interaction with the computer, one that I called object-oriented contact with it, has begun to form in recent years. Its essence consists in the fact that the work of a person with the computer appears as a direct action on some information object which is located in the computer, and, what is significantly more important, such interaction is accomplished by way of developed means of presentation, which are inherent in modern computers--the object, with which a person is working, appears on the display, and is not only being processed somewhere there in the depths of the electronic circuits. Here the information is given in either graphic or structural textual form,

that is, not simply some text, but a text, which has been organized in a certain manner, is in front of the operator. A kind of model of the world, which has visual expression, is created in this way, and the person senses himself to be a part of this world.

If, for example, the operator is working with a text, he sees certain lines and finds in them the place which it is necessary to erase. He moves to this place something similar to a pen or eraser and erases. Strictly speaking, such was also always the case in the past, but the main thing when working on a computer consists in the fact that the erased place on the screen is immediately contracted, the corrected text immediately acquires final form, a page, in which there are neither superfluous phrases or blanks, which remained after their removal, immediately appears before the operator. And the matter, if it is necessary to insert something in the text, takes place in exactly the same way. These simple editing operations just a few years ago were performed in a quite complicated manner: it was necessary to write an entire series of commands for the computer, so that it would clear the necessary place in the memory, increase the volume taken up by the given text, and so on.

True, here perceptive experts are also finding an inconsistency in the application of the new method. For example, in office systems, which are realized on the basis of computers, a document, which it is necessary to destroy, having removed it from the file (its image in this case appears on the screen, the file is closed, the pages filed in it are gone through, until the operator sees the one he needs at the given moment), is moved across the screen to the corner, where the picture of a box for papers appears. Thus, in this operation they see not a direct method, but the use of the same command language, only instead of the code of the operation the character of the box is used. I, however, believe that these fine points are not of great importance for us, since all the same the person has the complete sensation that he is directly affecting the text, but is not controlling the computer which is performing the necessary operations. This method of contact with the computer is also one of the major achievements of recent years.

The new method is not some hardware innovation or specific system of programming, but rather a volte-face in work on computers, a new philosophy or ideology of our relations with the world of computers. It contains a large number of technical procedures, which have been found and been put into scientific circulation in various places of the world and in different collectives, which use computers in their work. This, perhaps, is the most serious change in programming, which, while preserving the formal rigidity inherent in this type of work (what is called "programming by contract"), is acquiring the additional character of direct and creative activity ("programming for oneself").

[Comments by President of the Ukrainian SSR Academy of Sciences Academician B.Ye. Paton, director of the Institute of Electric Welding imeni Ye.O. Paton: "...A Significant National Economic Impact"]

1. The leading role of domestic welding science and technology is recognized throughout the world. Welding in our country uses all the welding processes

known in the world, a large portion of which are based on the results of the research, development, and inventions of Soviet scientists.

Today more than 560 structural subdivisions of scientific research institutes and design bureaus, higher educational institutions and enterprises are working in the area of welding and related technologies. Technological processes of the welding of practically all existing metals, alloys, and plastics have been developed by their coordinated efforts. Along with the welding of traditional and new construction materials made of ferrous metals the welding of aluminum and its alloys is becoming widespread. A portion of the welded components are being made from copper, bronze, and other alloys with copper. In chemical machine building, aviation technology, and several other fields welded components made of titanium and alloys based on it are being used with a great impact. They have begun the production of welded components made of molybdenum, niobium, zirconium, beryllium, and other rare metals. The welding of polymer materials is being developed intensively. In addition to arc, electroslag, and resistance welding new highly productive types of welding are in use: electron-beam, plasma, high-frequency, explosion, friction, solid-state, and laser welding.

It is important to note the comprehensiveness of research, when for the solution of one production problem or another the technology, the necessary equipment, and materials are developed practically at the same time. This is speeding up significantly the use of innovations in production. At the same time development, as a rule, is oriented to the achievement of a significant national economic impact. Here are just a few examples.

On the electrified railroads of the country they used the new process of the explosion welding of the current-carrying wires into an ideally smooth line which does not hinder the sliding of the pantograph. More than 20 million rubles a year are being saved.

The production cost of the crankcases of power diesel engines was reduced to one-eighteenth and about 300 welders were released as a result of the introduction at just 1 plant of the continuous flash resistance welding of parts with a large cross-section. The many hours of annealing of items after welding became unnecessary.

A unique 72-electrode electroslag welder was introduced at the Volgodansk Atommash Plant in the production of large parts of atomic reactors with a weight of up to 400 tons. These "parts" can be walls 4 meters thick! Two synchronous electric drives move the welder over rails. Thus, it is possible to make welds of practically any length.

The complexity and great labor intensiveness of casting and forging operations in the production of machines of large unit power (superpresses, turbogenerator units of 1 million kilowatts and more) are well known. Here traditional production is already going beyond economic advisability or the technical possibilities. The situation, at first glance, is a "dead end" one. But a way out was found--the replacement of inefficient cast and forged components with welded components. This not only simplifies production

significantly, but also gives a substantial saving of all types of resources. The production of many types of cast and forged components is now being converted to making by welding. In 1984 alone 340,000 tons of them were replaced by welded components. As a result 300,000 tons of metal and more than 250 million rubles of capital investments were saved. Nearly 3,000 workers were released.

Such a phenomenon as the avalanche failure of pipes, when the metal does not withstand cold and the high pressure of the gas, worries the builders of gas pipelines. But meanwhile in the near future gas pipelines will begin to operate under an even higher pressure. In an emergency the rapidly developing crack suddenly literally splits the main line in two, putting it out of commission for a long time, since a gap several kilometers long is formed. They are attempting to solve the problem by using pipes made of steel, which has been alloyed with additions of niobium, nickel, and molybdenum. Expensive in itself, this steel also requires special methods of rolling, which sharply decrease the capacity of the rolling mills. As a result the cost of gas pipelines increases.

The use of large-diameter multilayer pipes, the design of which was developed at the Institute of Electric Welding, is one of the effective means of increasing the reliability of main pipelines. They are made from rolls of 5-millimeter steel strip. Such pipes are no more expensive than ordinary ones, it is possible to make their walls thinner, they resist explosion better than pipes made of solid thick metal. Multilayer pipes are already being produced, and we hope that in the near future they will begin to build all northern pipelines with the use of precisely such pipes, which are explosion-proof.

The fundamentally new Sever pipe welding complex, which was developed by the Institute of Electric Welding, has received a high rating among the builders of gas pipelines. The welding unit moves within the pipe and as if strings the individual sections onto itself. The welding proceeds completely automatically, reliably ensuring the high quality of the weld. They obtain a joint in 2-3 minutes. Another 5-10 minutes are needed for moving to the next joint. New generations of such machines for the welding of pipes of the most different diameter are now being developed.

A significant impact, not merely economic but also social, can be obtained in case of the construction of welding pipelines made of plastic pipes. It is possible to use them for the transportation of various products (including natural gas) at low pressures and temperature. True, for this it is necessary to solve the far from simple problems of the organization of the domestic production in sufficient quantity of plastic pipes of the gas assortment, the development of special pipe welding equipment and means of checking the quality of welding, and the training of the corresponding personnel.

It can be said with gratification that today the welders have for the most part solved their part of the problem and have tested the found solutions in practice. The gas pipeline made of plastic pipes, which was built in Nikolayev Oblast, is the first large-scale experiment in the country, which was conducted on the initiative of the Nikolayev Oblast Committee and

Novoodesskiy Rayon Committee of the Communist Party of the Ukraine and the Institute of Electric Welding. The length of the 4 sections of the operating experimental gas pipeline is 30 kilometers. It supplied the Leninskaya iskra Kolkhoz and the Bugskiy and Druzhba Sovkhozes with gas.

It is possible to build polyethylene gas pipelines threefold more rapidly than metal gas pipelines, moreover, without the use of heavy-duty pipe layers--polyethylene pipes are very light. They operate them much longer, 50-70 years instead of 15. The use of steel pipes for repair needs is eliminated, while this on the scale of the country is about 9 million tons a year. Moreover, the development of gas pipelines made of plastic pipes in rural areas can save nearly 8 million tons of liquified bottled propane-butane gas, which is used extensively here and is a valuable chemical raw material.

The construction of rural gas pipelines is of great social importance. Gas is heat in homes and at farms and the improvement of working and living conditions. Not without reason after the construction of the first section of the gas pipeline did nearly 500 families come to Novoodesskiy Rayon for permanent residence.

2. If we speak about the future, say, to 2000, it is possible to be confident that welding will remain the basic method of the development of one-piece components in machine building, in industrial construction, and in other metal-consuming sectors of production. But an enormous qualitative leap will occur during these years in the methods of welding. There are grounds to foresee the rapid development of new welding technologies. The arsenal of welding processes, which ensure a saving of material, manpower, energy, and other resources, should be expanded.

The use on a large scale of new original and promising types of welding is beginning already today.

Explosion welding and cutting are revealing their masterly possibilities. By what other method is it possible to cut in a wink a pipe 1.5 meters in diameter? If the pipe is filled with petroleum, it is possible to feel at easy--the petroleum will not catch fire. Or it is possible, without halting the pumping of fluids, to cut into a pipeline a branch pipe from the basic main. Such methods provide an economic impact estimated in the millions of rubles.

The use of electron-beam welding will be expanded significantly in the production of heavy equipment, for example, in chemical and power machine building. It will also find application in space. Electron-beam technology will enable the cosmonaut to perform under the conditions of a natural vacuum the operations of heating, soldering, welding, cutting, and deposition.

It is safe to say that the next decade will be marked by the introduction in welding of continuous-radiation laser technology. It is not ruled out that the laser beam will also replace the arc in several traditional areas of use.

Plasma, flame, detonation, and electric arc spraying and other diverse methods of applying strengthening and protective coatings--processes with great

potential and far from used possibilities--will undergo vigorous development in the next few years.

The assimilation of the series production and the large-scale introduction in welding of robots and robotized complexes lie ahead. The problems of the integrated automation of the production of welding components are inevitably leading us to the need for the development of flexible welding systems, in which robots will not only perform the basic welding operations, but will also assemble the components, transport them, as well as check the quality of work and change tools and accessories.

The problems of the optimum organization of the production process for the purpose of the drastic reduction of the number of personnel should be solved already today, in order to achieve a sharp increase of labor productivity.

Extensive prospects in the practical accomplishment of the imposing tasks, which were posed by the draft of the Basic Directions of USSR Economic and Social Development for 1986-1990 and the Period to 2000, are opening up before Soviet welding science and technology and domestic welding.

[Comments by Corresponding Member of the USSR Academy of Sciences A.S. Monin, director of the Institute of Oceanology imeni P.P. Shirshov of the USSR Academy of Sciences: "Create the Opportunity for Discovery...."]

1. Oceanology is an integrated science, it includes the physics and chemistry of the ocean, marine geology and biology, and equipment for underwater research. Quite important achievements exist in all these directions.

In the area of the physics or, more precisely, the hydrodynamics of the ocean, recent years have been marked by a discovery which has radically changed our notions about the dynamics of the ocean. Large eddies, which are similar to cyclones and anticyclones in the atmosphere, were discovered in ocean currents. The size of these eddies, which create the synoptic variability of currents, is, as a rule, from 100 to 200 kilometers. But in 1985 an expedition of the Institute of Oceanology of the USSR Academy of Sciences in the tropical Atlantic recorded smaller formations, about 5-10 kilometers in size, about which we previously did not know. The task of immediate research is to understand what their properties are and what role such eddies may play in the dynamics of the ocean. The same expedition obtained new results which concern the structure of ocean waters. It was possible to record in this region a pronounced lens of water (about 500 meters thick and several tens of kilometers across), which differs in its properties from the surrounding waters: the temperature in it is 5 degrees warmer than that of the surrounding body of water. We had previously not had occasion to observe such distinct lenses in the ocean. This phenomenon is forcing us to look in a new way at the structure of ocean waters. Perhaps, in places the ocean is divided into horizontal water layers, which can be created by various inhomogeneities or collisions of cold and warm fronts.

In the area of marine geology there are new things all the time. The latest is the discovery of sulfide ores in the rift zones of mid-ocean ridges. As ocean ores they have obvious advantages over iron-manganese nodules, because

they occur at lower depths than the nodules and it is easier in principle to reach them. Moreover, the concentration of metals--cobalt, zinc, nickel--in these ores is much greater, sulfide ores, which contain more than 50 percent zinc, are being encountered. The main task now is to understand whether there is a lot of such ores in the ocean and whether they will be able to be of commercial value. I would also group with the important achievements of marine geology the fact that newer and newer underwater deposits of petroleum and gas are being found. Their world reserves are now estimated to be more than several years ago.

After the introduction of the Convention on Maritime Law, which established the priority of littoral states to a 200-mile zone along their coasts, many countries, including our country, had to orient maritime fishing toward regions of the open ocean. Here marine biology came to the aid. Previously it was believed that large schools of fish were tied without fail to the shelf, where the depths are no greater than 200 meters. Now it has turned out that in the open ocean there are quite large commercial reserves of fish. And now fishing is being successfully conducted in the open ocean.

Marine technology has taken a large step forward. Here, first of all, it is necessary to speak about the extensive use of divers for underwater operations at a depth of up to 400 meters. These are difficult depths, the pressure there reaches 20 atmospheres, and a diver in a rigid diving suit can do hardly anything. Now these depths have been mastered. Special devices--high-pressure chambers with diving bells--are being used at all underwater oil fields. And daily in the world hundreds of divers without any detriment to their health are working at a depth of 300-400 meters, for so far no automatic machine can properly replace human hands either in underwater welding or in the screwing of pipes together. We are pondering over the further possibilities of man in the mastering of the depths of the sea. Today's world record is 68.5 atmospheres (at depth of more than 600 meters), but this, most likely, is not the limit.

2. I believe that much will be done in all the listed directions of oceanology. Marine biologists are now faced with the task to learn to develop cultivated farms on the oceans; to replace the catching of fish, which is still being carried out in many ways according to the principle of hunting, with fish breeding and mariculture, and not only in the littoral zone, but, perhaps, also in the open ocean. This task is difficult, for it is necessary to study the commercial species of fish, their economy, and their life cycle and to establish norms and methods of catching. As to mariculture, a special laboratory, which has already launched work at the Black and White Seas, has been established at our institute. We have transported fish for transplanting from the Far East to the White and Barents Seas. Gray mullet was transplanted from the Black Sea to the Caspian Sea, and it has survived there well--it has become stronger. The Caspian proved to be for it a favorable ecological niche. The experiment with gray mullet, true, is not new, but such experiments with different species of fish are being conducted every year. So that marine biology has significant prospects, it, undoubtedly, will help to make a significant contribution to the fulfillment of the Food Program.

At the new stage of the acceleration of scientific and technical progress we expect important results from marine geology. These are iron-manganese nodules, sulfide ores, about which I have already spoken, and iron-manganese crusts, which were recently discovered on the slopes of underwater mountains and are rich in cobalt. Now we are developing methods of the recovery of valuable metals from these geological formations.

The assurance of the safety of seafaring was and always will be one of the main tasks of the marine sciences. The forecasts of favorable routes for ships under specific weather conditions can yield a large saving, and such forecasts are now to some extent already being made. We are also beginning to ponder over underwater transport, for example, over underwater tankers. It is possible to take them to great depths, where there are no storm waves, but here, true, other difficulties can arise--internal ocean waves. It is necessary to study them, this is the task of specialists in the physics of the ocean for the immediate future.

Two, I would say, opposing problems have to be solved in the area of the chemistry of the ocean. The first is the extraction of valuable substances from sea water, the second is the combating of the pollution of the world ocean. True, I would put in first place the combating of pollution, which from year to year is increasing and in places is reaching dangerous amounts. But as to the second direction, we are now learning: in our country experiments are being conducted on the extraction of valuable metals from sea water by means of ion-exchange resins. Such work is also under way at our institute. Here a definite prospect exists, although the success of the matter depends not only on the fundamental possibilities--precisely they do exist--but, as always, also on the economic aspect.

3. All our forecasts--and, of course, it is necessary to make them--are an extrapolation of today's knowledge to the future, as far as this is possible. But in the future what we have also not thought about frequently appears. And I would say that this very "what" will appear without fail and can turn completely upside down all our present views in one field or another of science. Take such discoveries as lasers, high-speed computers, and semiconductor electronics. All this appeared between 1940 and 1960, but in 1940 no one predicted the rapid development of these fields of science. So that, in making forecasts, it is necessary to learn to choose the path, on which new discoveries are possible, to guess the field, and thereby to create the opportunity for discovery. It seems that now it is possible to regard geology, especially marine geology, as such a promising field. New global tectonics, which was confirmed in geology, proved to be an extremely fruitful theory. If we speak about the practical aspect, by means of it in recent years quite a number of deposits of minerals have been discovered in the world.

The practical aspects of oceanology are very diverse. I have already spoken about the discoveries in the physics of the ocean, biology, and geology and about the great progress in the technical equipment of oceanology. All of them are now giving much to practice. Let us take, for example, such an important sector of the national economy as petroleum production. Marine geologists have made an invaluable contribution to the development of this

sector. Owing to their work in recent years promising petroleum structures have been discovered in the Barents Sea. There are forecasts and some actual data that in Western Siberia the petroleum-bearing regions stretch from Tyumen to the north and emerge in Arctic waters. It has also been established that from Sakhalin such regions spread under the water to the north and northeast. Petroleum-bearing structures have also been discovered in the Bering Sea.

In general the petroleum reserves in the world, if you take into account underwater petroleum, as I have already said, have proven to be greater than was thought several years ago. Today already 30 percent of this most valuable natural raw material is being recovered from under water, while by 2000, according to the forecast of economists, its underwater recovery will come to 40 percent. And this is in spite of the fact that it is much more difficult than recovery on land.

[Comments by Corresponding Member of the USSR Academy of Sciences M.V. Ivanov, director of the Institute of Microbiology of the USSR Academy of Sciences: "Seek the Most Unexpected Directions...."]

1, 2. If we speak about the achievements of microbiology, they are connected mainly with the more detailed study of already known microorganisms, both microbiological and genetic study.

I would call the second direction "more microbiological": this is the description of various new groups of microorganisms. This world has been described, I am now saying studied, significantly worse and less than such two large kingdoms as the animal and plant kingdoms.

For example, it seemed to us that we know what the microorganisms that produce biogases--methane, hydrogen, and so on--are. But these microorganisms use, as a rule, only low molecular compounds--alcohols, acids, gaseous components. But in order to convert the substances of the sewage of cities or livestock complexes into a substrate for methane-forming bacteria, an entire chain of other microorganisms should come into action. It is possible, it would seem, even not to know the fine points of how this chain works, but then it will not be possible to obtain biogases on a scientific basis and this process will not lend itself to regulation. For it is one thing when the obtaining of biogas was only a secondary process. Clean water was the basic product. And it is a completely different matter if we see in biogases one of the alternate sources of energy. That is precisely what the question is. By means of biogases it is possible to obtain an 8-10 percent saving of energy resources.

And without knowing all the interactions of this complex process, in which at the input there is an organic substance, while at the output there are clean water, biogas and, in addition to this, also a rather good organic fertilizer, it is difficult to expect success. The cooperation of microbiology and medicine is well known to the public at large. This fine story, when microbes fight microbes, is most popular. But the popularity is also based precisely on the continuing cooperation with medicine.

I want to speak about those sections, in which microbiology is imperiously invading technological processes--little known and not very traditional processes. For example, the obtaining of fodder protein.

The problem of industrial microbic protein still requires close attention. It is a question of the search for other substrates, besides liquid paraffins, for its production.

The search is proceeding in several directions--the use of low molecular alcohols, and natural methane is regarded as a very promising raw material. Therefore, very much attention is now being devoted to the study of methane-oxidizing microorganisms.

A few words about the raw material resources of the day after tomorrow--hydrogen and several other gases. Their price for microbic synthesis for the present is still high. Nevertheless microbiologists know specific groups of bacteria which oxidize both hydrogen and carbon monoxide. In particular, at our institute, in the laboratory of Corresponding Member Georgiy Aleksandrovich Zavarzin, work is being conducted intensively with these microorganisms.

In accordance with my professional interests the set of questions, which are connected with the use of microorganisms for the extraction of minerals, is closest to me. Previously we called this geological microbiology, now we are forming this into a separate branch--biotechnology. Microbiological methods of extracting nonferrous metals are no longer a laboratory system, in the world they are now extracting hundreds of thousands of tons by this method.

Thus nature ordered: all sulfides are poorly soluble, while the majority of sulfates of metals dissolve very well. The flow chart of the use of microorganisms was also based on this. If there is a deposit, say, with copper sulfides, it is possible to oxidize them, by using so-called thionic microorganisms, to sulfates, and both halves of the molecule--the sulfate and the copper--will pass into solution. It remains only to extract the copper from the solution. There is no need for the processing of enormous amounts of rock body, in general the need for stripping and the building of shafts are disappearing or will disappear with time.

If gold is associated with the sulfides, this method is also suitable here.

The same thing concerns petroleum. From many deposits it is now possible on the average to extract somewhere on the order of about half of the reserves. But there are also such deposits, at which it is possible to recover only a tenth. Microorganisms produce a number of compounds which can affect the increase of recovery, by decreasing the viscosity of the petroleum. I will not say that we have completely mastered this technology, but we can regulate a large number of microbiological processes even in an oil pool, that is, at a depth of about 2 kilometers.

Finally, the coal industry. The deeper miners go, the more methane the coal seam gives off. The work has to be halted. The result is a paradox: the

more productive the machines being introduced in the coal industry are, the less time they operate.

They exhaust the methane through holes, and at times this helps. They try to inject polymers into the seam. The results are also rather good, but it is a difficult, expensive, and rather dangerous job. The miners themselves also suggested to us to use methane-oxidizing microorganisms. Two technologies were developed--the injection of biomass through a system of holes and the treatment of the already worked spaces. The effect is the neutralization of 50-60 percent of the gas. One thing, I dare say, is checking the work--the shortage of biomass itself. It is, after all, the same, fodder biomass.

3. In the immediate future, I believe, the obtaining, in addition to fodder substances, of food substances as well will be developed. Already for man. This problem has many opponents. They base themselves obviously or not obviously on one thing: microorganisms are all the same a nontraditional component of food. Incidentally, in a number of countries they are already using biomass--there is there a less strict toxicological, as well as biomedical evaluation. I will not conceal the fact that I share the alertness of the opponents. But is it possible to hide from the problem? I believe, rather, that this will be the obtaining of individual metabolites. For example, several amino acids.

Now about the activity of microorganisms in the environment. Here it is worth seeking directions which, perhaps, are most unexpected. The same thermophilic microorganisms.... Recently the work of Baros on the segregation of cultures superthermophiles, which develop at a temperature of 260 degrees, went all round the scientific press. The reliability of this research is open to great doubt. But let us imagine for a moment that they all the same do exist. But if this is so, their enzyme systems, which are stable and efficient at such high temperatures, also exist. Hence, a means to the intensification of all present technological processes, which are based on the vital activity of microorganisms or their enzymes and occur today at 25-40 degrees, appears. That is why this work also had such repercussions. Why they also rushed to check it!

But let there even not be the same superthermophiles. The existence of microorganisms at 105-106 degrees and their development under laboratory conditions are already a proven fact. It is also not bad if we think about the remote consequences.

The second direction is again connected with the vital activity of microorganisms in nature. I manage the work of an international center for the global sulfur cycle. Two figures. Annually in volcanic processes on the average 28 million tons of sulfur are released. But mankind in case of all types of mining work extracts in a year at the surface of the earth 170 million tons. Is this a lot or a little? And where is the limit, beyond which there is danger? After these questions an interest in the natural cycles of substances in nature and in their quantitative evaluation also arose. The limits of activity will inevitably have to be realized, for example, according to the scheme: no harm, limited harm, a catastrophe.

Therefore, in recent years microbiologist-ecologists have been working actively on the obtaining of methods of the quantitative evaluation of the vital activity of microorganisms under natural conditions. Some results already exist. And they confirm the intuitive concept, from which microbiologists proceeded long ago--the geological scale of microbiological processes. Thus, microorganisms in the bottom sediments of the world ocean are responsible for the conversion of 500 (!) million tons of sulfur annually. As you see, the scale is colossal. But the main thing is the figure. It is possible to reflect on it, comparing it with others.

Unfortunately, we microbiologists for the present in far from all cases can yet give the quantitative characteristics of those processes which are due to "our" microorganisms. Such a job seems to me to be one of the most important and necessary ones.

At our institute Academician Yevgeniy Nikolayevich Mishustin generalized the data on nitrogen fixing in the soils of the Soviet Union and found that the contribution of the bacteria of nitrogen fixers to the supply of soils with nitrogen is comparable to the contribution which our entire chemical industry provides. This means that along with the development of fertilizer production it would not be bad to develop methods on the stimulation of the activity of natural nitrogen fixers. Prior to this there was no figure. It was only known that our industry in a year provides, well, for example, 12 million tons of nitrogen. But is this a lot or a little? With what is it to be compared? Now a figure has appeared, and it is possible to ponder: Is it necessary to invest billions in the construction of chemical plants with all the negative consequences for the environment or from these billions to invest something in the work on the study of natural microbiological nitrogen fixing? Prior to this it was also impossible to decide.

So here they are, the two important directions, which will enable us after some time to imagine the full picture of the participation of microorganisms in the formation and degradation of soils, in the obtaining and preservation of the crop, in the formation, disaggregation, and use of minerals, and in the elaboration of a set of scientific principles of the protection and preservation of the environment.

[Comments by Academician P.G. Kostyuk, academician secretary of the Physiology Department of the USSR Academy of Sciences, director of the Institute of Physiology of imeni A.A. Bogomolets of the Ukrainian SSR Academy of Sciences: "Penetrate the Molecular Foundations...."]

1. In my opinion, the most significant achievement of recent years is the fact that we were able finally to penetrate the molecular foundations of the main processes, which occur in the nervous system, and to ascertain precisely what specific molecules make the nerve cell special. And the extensive introduction in the practice of biological experiments of the latest achievements of physical chemistry, electronics, and computer technology, which afforded us incredibly broad opportunities, ensured this triumph of scientists.

Now we can measure absolutely exactly the activity of nerve cells and those macromolecules, which cause it, and to calculate, for example, how densely distributed these specific molecules are in the membrane of the nerve cell and how their quantity changes when the cell is developing or, on the contrary, is aging. Moreover, we can separate such molecules from the cell, regardless of the fact that there are very few, literally an infinitesimal number of them. This made it possible to approach a determination of how they are arranged and what combinations of atoms are the basis for such a specific construction. It seems to me that this is extremely interesting! True, at times they ask: But is this physiology? Of course, it is physiology! For it is a question of processes which occur in a living organism. Although, on the other hand, what prevents one from calling this molecular biology or biochemistry? When the conversation turns to research at the molecular level, which is accompanied by a large set of most different approaches, the boundaries between sciences as if dissolve and their division into physiology, biochemistry, and biophysics loses all meaning.

So what is behind the specific molecules which give the nerve cell unique properties? First of all, these are very large structures, the most complex protein formations. They are incorporated in the cellular surface membrane--the most important micro-unit of the nervous system, which plays a decisive role in the origination of the nerve pulse. It should be added that these proteins are very vulnerable. The slightest attempt to exert any influence on them by conventional means has a lamentable end: they lose their properties and no longer can perform the corresponding functions. It was necessary to do much work in order to find a method of their segregation in unspoiled, if it can be expressed that way, form. Fortunately, this problem for the most part has been solved. Moreover, it is possible to force them to work already in a different, synthetic membrane, which was reconstructed by means of equipment after the image and likeness of the natural membrane. And there they preserve their basic properties, creating something like a nerve pulse.

All this is bringing us closer to the time, when we will be able to understand the structure of the most important molecular formations of the new cell. And, hence, to make a directed search for all possible factors, which are capable of affecting it in the necessary direction. To seek not randomly, by trying everything in succession, but to predict exactly what, for example, chemical substances would be capable, by interacting with these molecules, of controlling some functions or others of them. Such research is very important for medicine and pharmacology.

I would also note another important achievement. It concerns no longer the individual cell or molecule, but how in the nervous system, in a system of many billions of cells, information is transmitted, processed, and stored.

2. Since the specific molecules of the nerve cell continue to work in the synthetic membrane, why not use this property when developing, for example, integrated circuits or computer complexes, which operate on the principle of the action of the nerve cell? Of course, modern computers are in some way far superior to the brain. In the number of operations per second, for instance. But in reliability and plasticity technology for the present has not developed anything of the sort. And, most likely, will not create it soon. Therefore,

the use of the principles of the action of the nerve cell for technical progress is exceptionally interesting.

And another thing. We speak at times about scientific and technical progress, while somehow forgetting for what this progress is needed. At times it becomes a sort of end in itself. But it is needed for man, and not in itself. And the only one, to whom it is given to achieve this progress, is also man. While physiology is the science which studies precisely man. That is why the studies of man in general and physiological studies in particular are playing a primary role in scientific and technical progress.

Automation and computer technology are always like that. But man has to work with all this! And the more complicated the equipment and the conditions, under which it is necessary to work, are, the more difficult the tasks which face the body. If one does not take this into account, but thinks only about technology, nothing good will come of it. I want to recall that one of the applied tasks of modern physiology is the determination of the optimum conditions of the work of the body in case of interrelations with machines and modern means of conveyance, which are becoming more and more rapid and more and more dangerous. And what about the new spheres, in which man has to work--space, high mountains, the depths of the oceans?... No, one cannot do here without physiology.

3. Perhaps, the most promising directions have been determined by the discoveries of recent years. I already spoke about them at the beginning--the determination of the specific molecular structures, on which all nervous activity is based, and the search for the substances, which are specifically linked with these structures. One recent example. They detected in the brain molecular complexes which are specifically connected with morphine. It was thereby possible to explain the amazing property of morphine, which has been known for centuries, to relieve pain and to cause hallucinations. But subsequently this had the result that in the central nervous system itself they identified its own analgesic substances--endomorphines, for which, in essence, nature also created receptors. The studies of the molecular structures of nerve cells led unexpectedly to a practical result: we began to look quite differently at the nature of pain and at the methods of controlling it. By the way, it also became clear, on what principle acupuncture is based.

Finally, the direction which is connected with our notions about how information is coded, how it is transmitted, and how it is stored. What is least clear for the present is the mechanisms of memory. Scientists of the entire world are racking their brains over them. Memory is a most complex phenomenon, which includes not only molecular changes, but also changes of the connections between cells. I believe that this direction is very promising, although, unfortunately, still inadequately prepared. Perhaps, this work is for future decades.

Incidentally, I would not want to deny the promise of other developments which might appear in the very near future. It seems to me that it is more important to emphasize another thing. In our field the directions, which are at the meeting point of physiology with other sciences, especially modern technology, are most promising. Without this it is now impossible to solve

successfully the problems facing us. Assume that work is proceeding on the molecular level. How can one do here without modern, most precise biochemical methods of distinguishing some substances or others, without chromatography which makes it possible to separate them, without research which involves the use of nuclear or paramagnetic resonance! In order to understand what role one specific molecule or another plays in the body, the close combination of studies of the functions of the body with the latest methods of molecular analysis is necessary.

If it is a question of the systems activity of the brain, the transmission or storage of information, here the basis of success lies in the most extensive introduction of computer technology, in close contact with cybernetics, in the creation of models of the system, which interests the research, on a computer....

Of course, the nervous system is the headquarters of the general cellular army of the body. But it is not worth forgetting that everything living is in a profound interrelationship. Here, for example, such macromolecular structures in the surface of the nerve cell as ion channels are kinds of gates which are capable of letting pass or inhibiting the flow of ions within the cell. Such structures have been detected in the muscular cell, in the heart cell, and in the cells which form the walls of a vessel. Therefore, the gains, which have been made by us in neurophysiology, can also be used in other fields of physiology. It is not surprising that we are cooperating very closely with the specialists who work in oncology, cardiology, and neurology. In short, the breakthrough in the field of the study of the excitability of nerve cells is affording new prospects for various fields of both physiology and medicine.

[No 2, Feb 86, pp 2-7; first four paragraphs are ZNANIYE-SILA introduction]

[Text] We are continuing the series begun in the preceding issue of publications in which prominent Soviet scientists, in responding to the questions of the editorial office, tell about the achievements of individual fields of science and the plans for the future, which are closely connected with the task of accelerating scientific and technical progress.

1. What, in your opinion, are the most significant achievements in your field in the past few years?

2. What is the possible contribution of your field to the solution of the urgent problems of the acceleration of scientific and technical progress?

3. What research directions, developments, ideas, and designs seem most promising to you?

[Comments by Academician I.A. Glebov, chairman of the Presidium of the Leningrad Scientific Center, director of the All-Union Scientific Research Institute of Electrical Machine Building of the USSR Academy of Sciences: "Fundamentally New Technical Solutions...."]

I will answer simultaneously the three questions of the editorial office. The future of electrical machine building, as my colleagues and I believe, lies in the development of fundamentally new power machines, which use the effect of superconductivity, and cryogenic turbogenerators. The commercial testing of the first prototype of such a turbogenerator in the world has already taken place. It should be connected to the electric power network of Leningrad for the decrease of the losses of electric power and the improvement of its quality.

The sound forecasts of the development of power engineering to the end of our century testify that a substantial increase of the ratings of turbogenerators will be required. For the present the maximum ratings of two-pole machines come to not more than 2,500 megawatts. The inadequate mechanical strength of steel rotors, the problems of eliminating the vibration of machines, and the limited potentials of rail transportation are checking further progress. Therefore, it was necessary to find fundamentally new technical solutions. The idea of using the effect of superconductivity suggested itself. The point is that the rating of superconducting turbogenerators can be two- to threefold greater than that of conventional turbogenerators, given the same parameters of the machines. Such a rapid increase of capacity is very rarely encountered in technology.

A large number of obstacles arose in the way of the real, practical application of superconductivity. Alloys of niobium with titanium and of niobium with tin, the peculiarity of which lies in the fact that, by acquiring in liquid helium ideal conduction, they did not lose it in the powerful magnetic field which originates in an operating generator, were obtained only in the 1960's.

A large group of Leningrad scientists conducted basic research in the field of thermodynamics, thermal physics, mechanics, physical metallurgy, and other sciences. Without it success would have been impossible. They also approached in a new way, of course, the designing of the machine itself. The rotor with the thinnest filaments made of an ultrapure alloy of niobium and titanium was immersed in liquid helium with a temperature of 4.5 degrees Kelvin (-269 degrees Celsius), which is very close to absolute zero. The rate of rotation of the rotor is 3,000 rpm. And there are no losses by heating in the winding of the rotor.

Externally the turbogenerator differs little from its colleagues. It is merely of significantly smaller size, and next to the slip rings the frost-covered device for the feeding of liquid helium is scarcely noticeable. The helium itself is contained in silver tanks which are lined up in a file. A powerful compressor under pressure liquifies the helium, turning it into an ideal coolant.

The efficiency of the machine increased. Here the weight was reduced to approximately two-fifths. The rotor became one-fifth as heavy. Such a paradox in technology is a unique phenomenon.

It is necessary to add to this that the consumption of helium comes to only 3 grams a second. The losses of this very expensive gas are negligible, since it circulates in a closed space.

The cryogenic generator has another merit: the new design of the winding of the stator will make it possible to obtain up to 110 kilovolts and more, that is, a four- to sixfold greater voltage than modern thermal and nuclear electric power plants usually generate. Hence, step-up transformers are becoming unnecessary. This yields a large saving of valuable nonferrous metal.

For the first production prototype the power is limited to 20,000 kilovolts. But the production of a significantly more powerful generator--300,000 kilovolts--has already begun. It has been decided to assemble and test it by the 27th CPSU Congress.

At the All-Union Scientific Research Institute of Electrical Machine Building work has been started on the designing of a 1,200-megawatt turbogenerator with a superconducting excitation winding.

It is safe to say that the prospects of the extensive use of superconducting machines are inseparably connected with the progress of cryogenic engineering. The desirability of the use of superconducting generators in the power systems of the country is governed, on the one hand, by their unmistakable advantages, about which we have already spoken, and, on the other, by the high operating reliability of power-generating units with such generators.

I believe that superconducting turbogenerators with a rating of 3 million, 5 million, and more kilowatts will become a reality at the beginning of the 21st century. And for these giants, perhaps, helium will not be needed: superconductivity will be achieved at significantly higher temperatures.

The introduction of superconducting turbogenerators of large unit power is impossible without the continuation of basic research. First of all we should develop superconductors with higher critical parameters and study more thoroughly the properties of basic construction and insulating materials at low temperatures. The problems of the heat transfer and hydrodynamics of new machines have to solved. In short, serious research in various fields of science and practice lies ahead.

It should be said that the use of superconductivity in power engineering is not limited to turbogenerators. Designs of superconducting inductive energy accumulators for the development of reserve capacities on the scale of state power systems already exist.

The development of DC and AC cryogenic electric power transmission lines lies ahead. Their advantage is the practically complete absence of losses of

energy in cables made of ultrapure niobium, which have been cooled to helium temperatures.

It is anticipated that motors with superconducting excitation windings will find extensive use in the systems of electric motors of ships and in the drives of rolling mills. The first domestic motors with a rating of 100 and 200 kilowatts were developed at the Physical Technical Institute of Low Temperatures of the USSR Academy of Sciences. Cryogenic magnetic systems may find use in the development of high-speed magnetic-suspension transport and in many other fields of technology and science.

[Comments by Corresponding Member of the USSR Academy of Sciences Ch.V. Kopetskiy, director of the Institute of Problems of Technology of Microelectronics and Ultrafine Materials of the USSR Academy of Sciences: "The Changeover of Microelectronics to Nanoelectronics"]

1. The integrated circuit, the IC, is the basis for today's rapid development of all kinds of means of automation. The areas of the application of computers, up to the mass production of household electronic equipment--clocks, toys, and even sports shoes (with built-in microprocessors)--have been drastically broadened owing just to the miniature size and relative inexpensiveness of this amazing development of physicists, chemists, crystallographers, and mathematicians.

We are now on the eve of new possibilities in the technology of microelectronics. Fundamental changes and a qualitative leap will occur.

2. The changeover of microelectronics to "nanoelectronics," in which the size of the individual element of an integrated circuit is measured no longer in micrometers, but in nanometers, is next. Let us remember: a micrometer, or micron, is a millionth of a meter, a nanometer is a billionth of a meter. This changeover is not far off. It is anticipated that already in 1990-1995 industry will assimilate an IC with minimum dimensions of the individual parts of 0.2-0.5 microns (200-500 nanometers). The number of them in a microcircuit--a silicon wafer with an area of several tens of square millimeters--will come to tens of millions, that is, will increase by at least a thousandfold. The possibilities in this case will increase not by a thousandfold, but much more--for the law here is not linear.

At present the majority of IC's are metal-insulation (or oxide)-semiconductor "structures." Thin dielectric and metallic films, which insulate the semiconductor micro-instruments from each other and achieve the necessary electrical contacts between them, are applied in sequence to a semiconductor substrate.

Nanometric dimensions will require of technology the even greater purity of the substances and materials being used, the perfection of chips, and the uniformity of films. Today such technology is being developed in laboratories.

What specifically will the appearance of nanoelectronics yield? What new technological processes will be required for its development?

The basic material of integrated circuits is silicon. Its role in microelectronics is similar to the role of steel in machine building: not less than 98 percent of all integrated circuits are made on its basis. And, like steel, in spite of the existence of strong and serious competitors, silicon will also retain its preeminence at least at the beginning of the next century.

The increasing demands on microelectronics and the changeover to nanoelectronics are also forcing us to turn to chips made of other compounds--gallium arsenide and indium phosphide. But for the present there are even more problems which it is necessary to solve here, and they are more difficult than for silicon. The main one now is to ensure the purity of the source chemical elements--arsenic and phosphorus, since the level of purity of gallium and indium now is already quite high. The purity of arsenic and phosphorus should be increased by ten- to a hundredfold.

With the advent of nanoelectronics the architecture of semiconductor instruments will also change.

All the processes, which govern the operation of IC's and in general of semiconductor instruments, as a rule, rage in the thin layers near the surface. The thickness of the layers here is minimal, up to several atomic layers. This is, so to speak, unidimensional architecture. Nanoelectronics will also deal with three-dimensional--multilayer--integrated circuits. The technology of obtaining such multilayer circuits already exists--this is a new direction in the development of microelectronics.

The level achieved today of the purity of the metals, which are used in the creation in IC's of electric connections--"interconnections"--in the form of thin films, is quite sufficient for the changeover to nanometric electronics. However, the decrease of the size of the parts of IC's will lead to the further increase of the current density in the connections, which will achieve 1 million amps per square centimeter. Aluminum and its alloys, which are now used extensively for interconnection, will no longer be able to withstand such currents: they will simply be "blown away" by the electron wind from the IC. Refractory metals--ultrafine tungsten, molybdenum, and their compounds with silicon (silicides), which have metallic conduction--should come to the aid.

These materials are also very promising for multilayer metallization and for the creation of the spatial framework of the three-dimensional building of nanoelectronics. Now it is already impossible to design an integrated circuit without the use of computer hardware. With the changeover to three-dimensional circuits only a powerful computer is capable of determining how to interconnect in the optimum manner millions of devices, while optimizing in so doing both the circuit and the technology of its production. The role of computer-aided design systems is becoming decisive.

The changeover to nanoelectronics can be accomplished only as a result of the replacement of the existing methods of photolithography by new methods of lithography, which use focused electron and ion beams and X-rays. These methods in recent times have been called more and more often "nanolithography." Whereas photolithography, including photolithography which

uses ultraviolet radiation, ensures a minimum size of the elements of an IC of 0.5-1 microns, modern ion-beam lithographic units ensure the obtaining of minimum sizes of the parts of the pattern of an IC at the level of 10-100 nanometers. Ion-beam lithography, which combines all the necessary means which ensure the production of an IC in the nanometric range of sizes in a single technological cycle, is the most promising method of nanolithography. The additional use of the laser machining of the surface of the IC will make it possible to complete this cycle. The time when, having loaded into the reaction chamber a semiconductor wafer with a specially prepared surface, by exposing it only to ion and laser beams, and by regulating the atmosphere in the necessary manner, we will obtain a finished integrated circuit with nanometric dimensions of the lines, is not far off. All the operations here will be carried out completely automatically and will be controlled by computer hardware.

New directions of the electronics which is called functional electronics are emerging on the basis of nanoelectronics.

First of all this is optoelectronics. The minimum size of the structures of optoelectronic circuits will come to fractions of the length of a light wave, which is close to 1 micron. The size of such optoelectronic structures will reach 100 nanometers, the size of the individual parts may come to up to 20 nanometers. Such demands, in particular, are being made in case of the production of semiconductor lasers, waveguides, modulators, filters, and so on. The successes of the development of submicron technology are bringing us significantly closer to the time when optoelectronics will take its place in the element base of computer technology. The computer, which is based on optical elements, will provide a new qualitative leap of computer hardware in speed, reliability, and other characteristics. The technology of submicron dimensions is also ensuring the progress of devices based on surface acoustic waves, which will supplement the element base of computers of the future, while simplifying them and broadening their functions.

The communications equipment industry is, apparently, the next field after computer technology, which has to go through the technical revolution which was brought about by submicron technology.

Submicron structures are playing an important role in the development of new methods of X-ray optics, spectroscopy, and light and electron microscopy.

Finally, new directions in the development of science have been opened up with the successes of submicron technology. Here is just one example.

The electron in a solid, like any elementary particle, has wave properties, but in the majority of cases these properties are not manifested, and the behavior of electrons is similar to the behavior of classical charged particles. If the size of an electronic device is sufficiently small and is comparable to the wavelength of an electron, these properties of it become significant and can be the cause of many unusual effects.

One of the phenomena of this kind--the quantum oscillations of the electrical conduction of metallic rings of submicron size--was recently detected in the

joint work of the Institute of Problems of Technology of Microelectronics and Ultrafine Materials of the USSR Academy of Sciences and Kalmar Technological University (Sweden).

In case of further studies of electron wave phenomena--and such experiments are possible only with the enlistment of nanoelectronics--one should expect many new similar effects, on the basis of which, perhaps, fundamentally new electronic devices will be developed.

The appearance of nanoelectronics is affording abundant opportunities in the broadening of our knowledge of the surrounding world and its laws.

[Comments by Academician of the Ukrainian SSR Academy of Sciences A.A. Sozinov, director of the Institute of General Genetics of the USSR Academy of Sciences: "Modern Genetics Is a Complex Science...."]

1. Qualitatively new modern genetics emerged owing to the synthesis of genetics and physical chemical biology, which began about 30 years ago (it is possible to take as a reference point the discovery of the double helix of DNA). Its main distinctive feature is the thorough understanding of the mechanisms of genetic processes and the explanation of the cause-effect relations between the events, which occur at the molecular level, with the mutation of the traits and properties of organisms, as well as the laws of the evolution of species and the biosphere.

Among the most important discoveries in modern genetics are the establishment of the minute structure of the gene of eucaryotes, the development of ideas about the laws of the functioning of the eucaryotic genome, the discovery of mobile genetic elements and their influence on the mutation of traits, and the study of the laws of the formation of nonrandom associations or blocks of allelic variants of genes, which are responsible for the adaptation of organisms to new living conditions and determine the intensity of the manifestation of quantitative traits, including economically valuable traits (productivity, resistance to diseases, pests, low temperatures, drought, and others). The development of methods of the cloning of genes and fragments of DNA, the designing of vectors for genetic transformation, and the development of an entire set of means of genetic engineering, hybridoma technology, as well as a number of other techniques, which make it possible to study effectively the structural-functional peculiarities of the genome and to control the hereditary mutation of organisms, had an enormous influence on the development of modern genetics.

2. The constant change of priorities has occurred in the history of scientific and technical progress. In the second half of the 18th century and until the middle of the 20th century the main events were connected with the development of all kinds of machines, mechanisms, and means of communications, which increase first of all the physical possibilities of man (muscular strength, hearing, vision). It is possible to group with them the invention of the steam engine and diesel motor, aircraft, all kinds of devices for the transportation of passengers and cargo, various machine tools, radio, and television. Then the search for alternate energy sources and first of all the use of atomic energy became most active. Today, along with the continuing

development of the mentioned directions, the palm in scientific and technical progress unquestionably belongs to cybernetics and microelectronics, which are ensuring a significant increase of the efficiency of the functioning of the human brain both in the control of technological processes and in the solution of all kinds of difficult problems.

What awaits us in the immediate future?

The analysis of the events, which are occurring in science and the world surrounding us, makes it possible to assert quite validly that in the immediate decades genetics--the science of heredity and mutation, which affords unlimited possibilities for the adaptation of the biosphere to the needs of the flourishing of mankind--will advance to the spearhead of scientific and technical progress. It is a question of one of the main factors of the transformation of our planet into a noosphere (sphere of reason) which was predicted by V.I. Vernadskiy. This is possible only on the basis of the mastering of the methods of the goal-oriented control of the mechanisms of genetic processes at the molecular, cellular, organism, and population levels. In the immediate future owing to the use of recombinant molecules of DNA a large number of new types of microorganisms for all kinds of biotechnological processes, which ensure the obtaining of a wide range of medicinal compounds and biologically active substances, will be developed and the problems of the intensification of biological nitrogen fixing and the increase of the efficiency of many industrial technologies will be solved. New forms of plants and animals, which have been developed by man, will make it possible to increase significantly the production of foodstuffs with a moderate increase of the expenditures of energy and the minimum contamination of the environment. Finally, means of protecting the genetic health of man by the elimination of hereditary diseases will be found.

It should be noted that the problem of the improvement of the nature of man, which eugenics posed and which frequently figures in science fiction novels, is similar. We all belong to the same species and should be concerned about the well-being of precisely our species, and not of some new forms of hominids. Evolution endowed us with exceptional genetic heterogeneity and a truly inexhaustible variety of character traits, which are formed in the interaction of the genotype and social factors. It is difficult even to imagine how dreary society would look, if we all were identical and reacted unequivocally to education. Therefore, the task of genetics is not the improvement of the genetic nature of man, but the preservation of healthy mankind.

In speaking about the fact that genetics will determine the main directions of scientific and technical progress, it should be emphasized that it is called upon to use the enormous potential which the diversity of the biological processes, systems, and forms of living beings contains. Stable agrocenoses and biocenoses, which not only will provide mankind with a sufficient amount of diverse food, but will also bring people a clean environment, the joy of contact with nature, and constant concern for comrades of smaller and vegetative communities, which modern man, who lives under the conditions of constant stresses, especially needs, will be developed with the aid of genetics.

3. The most important discoveries in genetics will probably be connected with the determination of the mechanism which programs the inheritance of the spatial form of an organism. Today we know almost nothing about this. At the same time the mastering of these mechanisms will make it possible to begin the purposeful development of new forms of the highest organisms and to prevent various defects in the development of man. Among the ideas, which may bear fruits in the next few years, one should note the new approach, which increases drastically the effectiveness of genetic analysis and is based on the use of a new type of genetic markers. By means of this approach it is proposed to ascertain the laws of the formation of the genome of plants and animals in the process of purposeful artificial selection. A new strategy of the development in a short time of the forms of plants and animals, which man needs, will be formulated on this basis. In general the use of the methods of cellular engineering may lead to the significant speeding up of the selection process. The extensive use of genetic transformation, that is, the purposeful transfer for the needed genes from one organism to another, is next. This will make it possible first of all to solve the extremely important problem of the significant increase of the resistance of cultivated plants to pathogens, pesticides, arid conditions, and acidic and alkaline soils and as a result will make it possible to increase the productivity and stability of farming, to decrease the expenditures of energy on the obtaining of food and agricultural raw materials, and to decrease the danger of the contamination of the environment.

The intensification of the research, which is connected with the determination of the genetic mechanisms of evolution and the development of the genetics of populations, will reveal means of the protection and improvement of the living world which surrounds us. The development of effective methods of the prenatal (prior to the birth of a child) diagnosis of hereditary diseases and the study of the genetic processes, which occur in the population, will be of the greatest importance for the genetic health of the population.

In conclusion I would like to note that modern genetics is a complex science and its successful development is possible only if there are highly skilled specialists, who are able to use the methods of molecular biology and mathematical analysis and at the same time know well the biology of plants, animals, and microorganisms. Moreover, the appropriate material and technical base is also necessary for the development of genetics. Unfortunately, for a number of reasons the pace of development of domestic genetics obviously lags behind the requirements of scientific and technical progress.

[Comments by Corresponding Member of the USSR Academy of Sciences V.S. Surkov, director of the Siberian Scientific Research Institute of Geology, Geophysics, and Mineral Raw Materials of the USSR Ministry of Geology: "In Geology the Union of Theory and Practice Is Indissoluble...."]

1. First I will recall a well-known fact: the minerals located near the earth's surface are becoming less and less, the reserve of such deposits is practically depleted. The prospectors of mineral resources have been forced to conduct exploration in new regions that are hard to reach, to make an "inspection" of deeper horizons of the earth's crust, and there to find and prospect petroleum and gas pools and deposits of ores of ferrous and

nonferrous metals. It is especially important to work efficiently in the regions of operating petroleum, gas, and mining enterprises, it is necessary to supply them with mineral reserves for decades of continuous work.

The development of the mineral resources of a complex geological structure, at a great distance from the earth's surface, is greatly complicating the performance of prospecting and exploratory operations. For example, the Siberian Platform--one of the basic objects of research of our institute--is a geographically most difficult region. In addition to rigorous natural conditions, the extensive prevalence of igneous rock, salt-bearing series, and permafrost hinders the effective use there of traditional prospecting methods. In Western Siberia petroleum and gas are now being extracted from ancient marine deposits from a depth of about 3 kilometers. But in order to find new deposits, it is necessary to survey deeper strata of continental rocks and to identify in them nonstandard petroleum and gas traps.

Practice is posing for petroleum prospectors new problems, and it is very difficult, at times impossible, to solve them by traditional methods. Fundamentally new approaches in getting to know the interior of the earth are necessary. They will make it possible to survey strata in greater detail, to gather much more information on their structure and material composition, to conduct precise studies of promising sections, and, in the end, to get a clear idea of a specific stratum of the earth's crust: whether or not there are present there accumulations of minerals, which it is economically justified to continue to explore, say, with wells. This applies not only to petroleum and gas pools, but also to many types of solid minerals.

The scientific achievements of recent years in the area of applied geophysics also concern precisely these main questions of modern prospecting operations. Equipment and methods for the conducting of volumetric seismic surveying, which will make it possible to obtain a three-dimensional "photograph" of the section being studied, are being developed. Multiwave seismic surveying, which records the speeds of the propagation of waves of various types: longitudinal, transverse, exchange..., is being developed. Scientists propose to increase sharply the number of channels of observation--to many hundreds instead of tens! Seismic surveying should become multiwave and multichannel, while this, in turn, leads to the obtaining of such a large amount of information that it is impossible to process it by conventional methods. Only by means of modern high-speed computers is it possible "to grasp the boundless"--to process and analyze the increased flow of information on the structure of the subterranean expanse. The same trends also exist in electrical prospecting.

We see that at the same time as the complication of the geological conditions of prospecting operations the "all-embracing nature" of applied geophysics is also being developed, it is striving to take into account the largest possible number of factors, which signal the presence of deep accumulations of minerals, and to record and interpret the processes occurring in the interior of the earth in the vicinity of deposits.

2. Are the prospectors of mineral resources ready to implement in practice the suggestions of scientists and thereby to make their contribution to the

solution of the listed problems of modern applied geophysics? In geology the union of theory and practice are indissoluble, the prospecting and exploration of deposits are a unified scientific and production process. The necessary instruments and devices for the most advanced seismic surveying have been developed at Siberian institutes.

The Vibrolokator source of the excitation of longitudinal and transverse waves has been developed. From the name of this instrument it follows that it will, like a locator, "illuminate" the interior of the earth with waves of two types, moreover, their characteristics will be given precisely. A multichannel seismic station has been designed for receiving the signals which have been reflected from the boundaries of different strata. It is already undergoing field tests. And, finally, about the last unit of the new complex--the processing unit, it is also ready for checking in practice--this is the computer center for the automated field processing of the obtained data.

At the end of the 12th Five-Year Plan the entire seismic surveying complex will be completely formed and developed. The control of the sources of the excitation of oscillations--explosive or vibration sources--will be carried out via radio, hundreds of geophones will register the signals, which come from the interior of the earth and in automated mode will be able to be processed on computer. This will make it possible there, in the field, to evaluate tentatively the underground situation. In the 1990's multichannel multiwave seismic surveying stations will begin production activity.

Of course, seismic studies for a long time to come will remain the leaders in petroleum and gas prospecting operations. However, in many cases their efficiency increases significantly, if other types of prospecting geophysics are also used together with them. For example, in the Siberian Platform all the petroleum and gas pools occur in water-encroached horizons--brines of high concentration. In a liter they contain 300-400 grams of matter. These are ideal electric conductors. And, hence, electrical surveying should detect and distinguish these horizons in the geological section. Having discovered a horizon of brines, geophysicists also establish the location of the petroleum- and gas-bearing stratum--it is higher! An additional prospecting criterion....

Tsikl electrical surveying stations of several types, which make it possible at depths to 3 kilometers to identify strata with brines, were developed at our institution jointly with the design bureau of the Neftegeofizika Scientific Production Association. This equipment also belongs to the new generation of geophysical instruments: it is more sensitive, takes measurements of three components of the electromagnetic field, and can be used successfully during the prospecting and exploration of ore deposits. As in seismic surveying, the task of developing multichannel three-component electrical surveying has been posed. The Kriom-1 magnetometer, which is capable of measuring with great accuracy the magnetic components of an electric field, was developed for these purposes. Its great accuracy is based on the use of the phenomenon of superconductivity.

Both types of geophysical surveying, which embodied the most advanced modern ideas in a new generation of equipment, will soon be used successfully in the prospecting for many minerals, first of all petroleum and gas, the ores of ferrous and nonferrous metals.

Let us imagine the immediate future: new seismic surveying and electrical surveying instruments are combined--a unified complex, which is equipped with a field computer center, operates in little studied regions of Siberia and the Far East and beyond the Arctic Circle. The comprehensive study of the interior of the earth makes extensive and reliable information available to geologists. Electrical surveying will reveal what the seismic surveying equipment "overlooks," and in joint operation they will help to establish more completely the geological structure of individual regions and to identify within them the sections which should be subjected to more detailed study. This complex will be sufficiently compact owing to the use of microprocessor equipment and will be easy to transport on trucks and all-terrain vehicles under the most difficult natural conditions.

Modern applied geophysics is using on a larger and larger scale the latest achievements of various fields of physics, chemistry, mathematics, and cybernetics and advanced technical ideas; its arsenal is being continuously updated. Just this means of enlisting all the possible achievements of scientific and technical progress is contributing to the greatest extent to the more complete geological knowledge of our territory. And this means the strengthening of the mineral raw material base of the Soviet Union.

[Comments by Academician G.A. Razuvayev, director of the Institute of Chemistry of the USSR Academy of Sciences: "A Previously Unknown Physical Phenomenon Was Discovered...."]

1. Among the most interesting achievements of recent years I would name the study of processes on the basis of complexes of metals with free radicals.

This new field of research could not but have appeared because the chemistry of free radicals, which gave rise to it, and the chemistry of metalloorganic compounds (MOS), each developing independently in its own direction, had at the same time many points of contact. That is, the interest of chemists in the symbiosis of metals--a radical in explicit or implicit form--had already existed for quite a long time. It was possible to make great gains in this field with the development of the method of electron paramagnetic resonance (EPR), the informative nature of which with respect to paramagnetic chemical particles (free radicals, ions of transition metals) is unique. Figuratively speaking, by means of this method in the "haystack" of ordinary chemical compounds it is possible to find the "needle" and, moreover, to examine the parts of this "needle"--chemical molecules with an unpaired electron. The new combination of metals--the free radical--also gave new properties. Thus, it turned out that many of the obtained compounds are capable of being repeatedly oxidized and reduced back and forth, being, thus, a kind of reservoir for electrons.

As often happens in science, one discovery led to new ones. The unique photomechanical effect was discovered owing to radical complexes. What is its

essence? If crystals of free radical complexes are exposed to visible light or infrared radiation, they begin to bend. The spectacle is quite amazing in itself. But, of course, the main thing is that a previously unknown physical phenomenon was discovered. The deciphering of its mechanism is extremely important in the theoretical sense. I believe that the practical applications of the discovered effect will also be no less interesting.

Another achievement of recent years is the recently discovered phenomenon of redox-isomerism. Various manifestations of isomerism are quite well known: molecules, which are of identical chemical composition, but differ in the arrangement of the atoms, can display different properties.

Redox-isomerism is the existence of a paramagnetic complex of a transition metal in the form of two isomers: one with a free radical ligand and a diamagnetic ion of the metal, the other with a diamagnetic ligand and a paramagnetic ion of the metal. These two processes are in equilibrium. The described phenomenon involves the migration of the electron within the molecule, while the migration itself depends on the temperature, the nature of the solvent, and the free radical ligands. By changing each of the three parameters, it is possible to control finely the equilibrium position, shifting it in one direction or another.

Now about the chemistry of polynuclear metalloorganic compounds. This is a new field of metalloorganic chemistry. It is a question of molecules of a very unusual structure. Whereas previously chemists dealt with compounds in which the atom of metal is bound with atoms of carbon, in this case substances, which contain chains (or hulls) made of atoms of metals, were obtained. And what is entirely unusual, the metals in the chain are different: palladium, germanium, mercury, and so forth. That is, given the decomposition of such molecules it is possible to obtain a film, which consists of successively alternating layers of the different metals and has very interesting properties.

2. Scientific and technical progress encompasses all aspects of our life, and the achievements of metalloorganic chemistry can find application in all these areas.

In party documents particular attention has been devoted to microelectronics, computer technology, and instrument making. But these sectors of industry cannot do without our metalloorganic compounds.

What, would it seem, is the connection? A most direct one: in speaking about equipment, we inevitably touch upon its reliability. While reliability depends, in particular, on the quality of the metal coating on working parts. Previously such coatings were obtained by the deposition of metal. Such technology had many shortcomings, the main ones of which are the variability of the thickness values and, hence, of the parameters and manual labor. And that is why both the quality and the quantity suffered. Metalloorganic compounds made it possible to solve this problem very ingeniously. The temperature, pressure, and time are given. The preheated parts pass through vapors of the metalloorganic compound (the height of the passage is

regulated). A chemical reaction occurs, the compound decomposes. While a coating of a strictly set thickness is obtained on the surface of the part.

In this way all the problems were solved. The spread of the parameters is minimal, since the thickness of the coating is uniform. While the process of depositing the metals has been automated. Here another circumstance is important: the properties of such coatings do not vary over a wide range of temperatures--from -100 to +100 degrees. And what is the main thing, the electric conductivity does not vary.

But, of course, such coating can also be used in other sectors--these are protective films for pipes and for chemical equipment, wear-resistant coatings for parts of motor vehicles, and so on.

The use of metalloorganic compounds in organic synthesis is no less interesting. Metalloorganic chemistry has carried out here a genuine revolution: compounds, which it was not possible to obtain by other means--for example, several new medicinal compounds--are being synthesized by means of it.

Perhaps, it is worth speaking separately about the use of metalloorganic compounds in stereospecific synthesis. Without dwelling on the special details, I will merely say that such synthesis makes it possible to develop analogues of natural substances. Here it is important that it is possible to obtain compounds which are at times of great vital importance--if it is a question, let us assume, of medicine. But the main thing is that such synthesis allows researchers to some extent to come closer to an understanding of the very complex processes which occur in living nature. And this is already an outlet to a new level of science and, hence, to new practical applications.

[Comments by Corresponding Member of the USSR Academy of Sciences V.A. Kovda: "The Soil Has Many Tasks in the Biosphere...."]

1. Modern science believes that without the ozone layer life would perish. It is generally acknowledged that its protective role contributed to the preservation and development of life on the planet.

I have come to the conclusion that the soil cover on dry land and in shallow waters plays much like the ozone layer so important a protective role. If the destruction of the ozone layer can wipe out life, the destruction of the soil cover and its degradation will lead to serious consequences in the biosphere.

For the soil has many tasks in the biosphere. Hardly anyone knows that it is an ecological niche, that is, a haven of living organisms. In neither the atmosphere nor the hydrosphere is there not such a high concentration of living matter as in the soil cover.

The soil cover together with vegetation fixes cosmic energy and retains this energy in the form of humus. All the reserves of fossil fuels went through the ancient soil-forming process. Coal, petroleum, bitumen, and peat are

products of the conversion of organic matter. The reserves of energy, which have been accumulated in the soils of the planet, come to 10^{20} kilocalories.

The prebiosphere planet is the solidified magma, lava, and ash of volcanoes. In short, a lifeless monolith. The soil cover with the vegetative cover has performed in the time of the existence of life the role of the conversion of magmatic rocks into land. It "created" fine earth, which was carried away and formed sedimentary rocks. For this reason organic matter is also present in the strata of the lithosphere. It is the result of the ancient conversion of magmatic rocks into land, which began on dry land approximately 500 million years ago. The role of the soil as one of the biosphere shells lies in this.

The soil cover ensures the circulation of water, carbon, oxygen, and sulfur. Nitrogen is fixed in soils, while protein is formed in plants and animals. And this is possible only because nitrogen is fixed in soils by microorganisms.

Agriculture relies on soil as the most important means of production. Our food interests and fuel resources are also connected with the soil.

There are no less than 300 main types of soil covers. While each of the large countries has tens of thousands of smaller varieties of soils. At every kolkhoz and sovkhoz with an area of up to several thousand hectares tens of unique soils exist. And the rejection of a stereotyped pattern is needed in their use; the rejection of a technocratic attitude toward the land should be the basis for regional and local systems of farming, in which agrobiocenoses replace natural ecosystems. It is a difficult task, which requires a thoroughly scientific approach and accuracy, to develop and design productive agrocenoses, that is, anthropogenic biological systems with incredibly complex relations and characteristics. The spearhead, so to speak, of present-day scientific and technical progress in the field of soil science. And the outstanding Soviet scientist Academician M.S. Gilyarov was the pioneer in this.

This spearhead is aimed at the biologization of science and technology, which are connected with the soil. This process began long ago, which can be seen very well if only from the example of mineral fertilizers. D.N. Pryanishnikov, the founder of the Soviet school of agrochemistry, wrote: "It is incorrect to think that with the development of the chemical industry and the extensive dissemination of mineral fertilizers the importance of manure should be relegated to the background, on the contrary, with the increase of the use of mineral fertilizers the amount of manure will also increase."

Some shift of domestic soil science and agrochemistry in the direction, so to speak, of the biologization of agricultural operations is already visible here. It emerged back when researchers could only guess, and then far from always, the actual importance of mineral fertilizers for plants and the mechanisms of the effect of these fertilizers on the soil.

The most important task of the immediate future is the universal introduction in practice of scientific principles of the conducting of farming.

The yields of cereals and corn, beets and cotton on the fields of scientific institutions are, as a rule, two- to threefold greater than the average yields for the country. However, in practically even oblast there are individual sovkhozes and kolkhozes, on the fields of which the yields are so great and stable. High yields and their stability during unfavorable periods (droughts, early cold weather, excess rains) are achieved when the farms take well into account in the details the peculiarities of the soils, the relief of the farm lands, and local weather conditions, where the proper ratio of forest, orchard, and field plantings has been ensured. The natural ecosystem preserves the created biomass of the crop and uses it within its territory. But in agricultural ecosystems man alienates the crop and causes by this a decrease of the reserves of natural fertility. Therefore, in agricultural ecosystems for the obtaining of harvests man should not only restore in the soil the used elements, but also ensure their expanded reproduction. This especially concerns the reserves in soils of moisture, humus, compounds of nitrogen, phosphorus, potassium, and calcium, and trace elements. Soil scientists have to provide all agricultural farms with detailed soil maps for the scientific management of agriculture.

Aerospace methods of cartography and the evaluation of soils should become a part of the practical work of the soil service.

Soil erosion and dust storms should be reduced to a minimum, and then stopped. Water erosion and dust storms are destroying the best soils of the Soviet Union--black soils and chestnut soils, on which the famous Russian wheat of unsurpassed quality is grown. The soils of mountain pastures and the cut slopes of forests of the Carpathians, the Crimea, the Caucausus, and Central Asia are being damaged by erosion. Large-scale and directed scientific surveying, designing, and construction operations will be required. Without waiting for the development of a general program on the combating of erosion, it is already now necessary to stabilize ravines everywhere, to halt their growth, and to introduce on slopes lateral cultivation, the contour strip (horizontal) organization of the territory, and the alternation of the fields of the crop rotation. Openwork (penetrable) forest strips in fields and perennial tree belts along roads and at farmsteads are necessary.

Our country is a country of thermal agricultural technology and thermal reclamation. A large part of the territory of the USSR is located north of 45-50 degrees latitude. Seasonal frozen ground and permafrost, a short vegetation period, and a shortage of heat limit the possibilities of conventional farming. But the scientific management of agriculture will make it possible to obtain high yields.

Undoubtedly, farming, animal husbandry, and forestry of the 21st and 22nd centuries will differ greatly from the present ones. The role of basic science in the management of these sectors of biotechnology will probably increase. I did not make a mistake, having applied this term, which is used in cellular and molecular biology. But agriculture and forestry are the highest and most complex form of biotechnology at the level of the landscape, the soil cover, and populations of organisms. In this version of biotechnology plants and soils are the main and only producers of biomass and the energy connected with it. The task of producing valuable biomass and

biological compounds under the artificial conditions of a laboratory and plant as the basic task falls on biotechnology of the cellular and molecular level. Biotechnology of the macrolevel is solving more difficult and diverse problems.

Agriculture and forestry need to produce various types of valuable biological products in extremely large quantities and under not artificial, but complex natural conditions. In contrast to biotechnology of the cellular-molecular level in agriculture it is necessary to use complex and diverse types of microorganisms and populations, which have a specific heredity and ecological demands on the habitat.

The highly productive agricultural and forest ecosystems in the biosphere of the planet, which are managed by man, should perform the functions, which were performed in the past by primeval virgin land ecosystems and have now disappeared, have been greatly disturbed or weakened. Moreover, agriculture and forestry on the basis of comprehensive reclamation are called upon to expand the boundaries and reserves of the biosphere, drawing the now barren deserts (hot and cold) into biological production processes. Unfortunately, empiricism, ignorance of soils, guesswork, and reliance on potential success and an easy profit still reign in agriculture and forestry. Precisely these areas of classical biotechnology, that is, agriculture, are still being underestimated by "large-scale science," modern mathematics, fine experimental physics, electronics, chemistry, biochemistry, automation.... But I believe that soon these fields of knowledge will make their contribution to classical biotechnology.

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