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USSR

TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY

BIOMEDICAL AND BEHAVIORAL SCIENCES

(FOUO 19/79)

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Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 3-4

[Appeal adopted at the session of the General Meeting of the USSR Academy of Sciences "Science For Agriculture," 7 December 1978]

[Text] The General Meeting of the USSR Academy of Sciences, having discussed at its session the tasks of Soviet science in implementing the integrated program of further development of the country's agriculture as drawn up at the July 1978 CC CPSU Plenum, appeals to all workers of the scientific institutions of the USSR Academy of Sciences, the academies of sciences of the union republics, and VUZ's, and scientists and designers of the institutes and project-planning organizations of the ministries and departments, to multiply their specific contribution to this nationwide matter, to concentrate their efforts on working out current problems of intensification of agricultural production, enhancing its effectiveness, and bringing closer together the material and cultural conditions of life in the city and the countryside.

Comprehensive, dynamic development and substantial enhancement of the effectiveness of kolkhoz and sovkhoz production and a reliable supply of food and agricultural raw materials for the country in order to further improve the material standard of living of the people constitute a main, a key task of that economic sector. An enormous role in this is played by science. Soviet scientists are doing a great deal to speed up scientific-technical and social progress in agriculture. But new, critical tasks facing agriculture require even more vigorous participation by scientists of various specialties, a greater contribution to the successful resolution of a great variety of tasks in village development.

It is the duty of workers in science and technology to constantly enrich practice with new discoveries and accomplishments, to promote in every way through their research increased production of grain, meat, and other goods, to impart greater stability and dynamicity to the development of all sectors of agricultural production. Scientists of all specialties must constantly study and find ways to move scientific-technical advances out of their domains and into agriculture. The resolution of large-scale scientific and technical agrarian problems requires a stronger integrated approach to their formulation, broader use of joint intersector goal-directed programs of research to promote the proportional development of all sectors of the country's agroindustrial complex.

Substantial tasks face fundamental science, the advances of which have always been the basis, the foundation for effective development of agricultural research.

Scientists will have to focus much more attention on molecular-cytogenetic, physiological, biochemical, and other types of research in order to develop newer methods of developing higher-yield varieties, breeds, and hybrids of plants and animals which are well-adapted to conditions of industrial technologies and possess high resistance to particular unfavorable factors. It is essential to focus more attention on working out biological methods of enhancing soil fertility, theoretical and applied problems of rational utilization of land and water resources, and environmental protection.

Major tasks face scientists in the field of chemicalization of agriculture. It is important to direct their efforts to develop new, effective, and economical fertilizers and other chemicals, improved processes of producing them, the development of new chemical and biological methods of fixing atmospheric nitrogen, directed synthesis of pesticides that do not harm the environment, especially herbicides with specific bioactive properties, pheromones, hormones (in particular prostaglandins), juvenile hormones and other hormonal compounds, effective feed preservatives and stabilizers, and new methods of storing farm goods.

Further research must be made in molecular biology and genetic engineering, the development of new biological methods of producing physiologically active compounds for various processes of farm production. It is very important to develop new processes and intensify production in the microbiology industry, to find new types of raw materials for the industrial production of lysine, beta-carotene, and other highly-effective means of raising animal productivity. It is also necessary to focus attention on finding effective methods of producing microbiological means of protecting plants against diseases.

Another important task is to further develop the theoretical principles of the prevention and control of animal diseases, improving the quality of livestock products.

Scientists in the field of machine building must cooperate closely with biologists and selective breeders to expand the scale of research in the development of new systems of farm machinery, new methods of equipment design to substantially boost the reliability and service life and reduce the level of vibrations and noise of tractors, combines, and other machinery, and the adoption of the latest processes of surface alloying, laser, plasma, and other methods of toughening and protecting the surfaces of parts and components to control wear and corrosion.

It is essential to implement faster adoption of aerospace methods of monitoring the condition of farm crops.

Large and crucial tasks face the social scientists called upon to work out current economic and social problems of the village, specialization and concentration of farm production on the basis of interfarm and agroindustrial cooperation, the development of socialist competition.

The General Meeting of the USSR Academy of Sciences called on all scientists to focus their efforts and knowledge on resolving the tasks before them, to make a worthy contribution to implementing the CPSU's program of further development of agriculture designed to steadily enhance the wellbeing of the Soviet people.

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CSO: 1870

SESSION OF THE GENERAL MEETING OF THE USSR ACADEMY OF SCIENCES

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 p 5

[Text] In mapping out the ways of development of agriculture in our country and the specific measures designed to boost agriculture, the decisions of the July 1978 CC CPSU Plenum view increased effectiveness of scientific research as one of the key factors in accelerating scientific-technical progress in farm production.

At the plenum, CC CPSU General Secretary and USSR Supreme Soviet Presidium Chairman Comrade L. I. Brezhnev remarked: "It is vital that the working out of the numerous problems of accelerating scientific-technical progress in agriculture continue to involve the active participation not only of workers in agricultural science but also the USSR Academy of Sciences, the academies of sciences of the union republics, and scientists in all sectors of knowledge. As we have repeatedly remarked, the upsurge of agriculture is our common national cause, our common concern."

Enhancement of the role of science in resolving the tasks facing agriculture was the focus of the session of the General Meeting of the USSR Academy of Sciences held in Moscow on 6 and 7 December 1978. The session was participated in by CC CPSU Secretary M. S. Gorbachev, CC CPSU division managers V. A. Karlov and S. P. Trapeznikov, and ministry and department officials.

The session opened with an introductory speech by USSR Academy of Sciences President Academician A. P. Aleksandrov. Reports were also given by USSR Agriculture Minister V. K. Mesyats, USSR Academy of Sciences Vice President Academician Yu. A. Ovchinnikov, VASKhNIL [All-Union Academy of Agricultural Sciences] President Academician P. P. Vavilov.

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OPENING SPEECH BY USSR ACADEMY OF SCIENCES PRESIDENT ACADEMICIAN A. P. ALEKSANDROV

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 5-9

[Text] Comrades! The July 1978 CC CPSU Plenum focused the attention of all our people on problems of further development and improvement of agriculture. About three years ago we drew up a joint program of the Academy of Sciences, the Ministry of Agriculture, VASKhNIL [All-Union Academy of Agricultural Sciences], and the Ministry of Chemical Industry dealing with problems of project development for agriculture. These projects are being carried out more or less satisfactorily, and we will refer to them again. But now a new situation is developing. The fact is that in the next few years we will have to carry out a great deal of work to reduce the labor-intensiveness of agriculture.

In recent years, the CC CPSU and all organs of Soviet power have expended much effort to boost agriculture. As a result of the nation's heroic efforts in developing the Virgin Lands, new land has been put into production. A large-scale chemical fertilizer industry has been organized. Now we are producing more fertilizer than any other country in the world. We have accomplished colossal work in developing agricultural machine building. As a result, the productivity of our agriculture has been rising year by year; it has become less dependent on weather conditions--witness the year 1978, for example, when a record crop of 239 million tons was harvested despite the fact that the weather in many regions of the country was unfavorable.

Now it is a matter of putting to work possibilities for further substantial improvement of our farm production. This applies to grain, vegetables, and livestock. In order to further boost farm output, as has been mentioned, we will have to exert serious effort to reduce labor-intensiveness in agriculture.

It must be pointed out that in recent years only some of the projects of the Academy of Sciences have touched upon farm production. This has been due to historical factors. The situation must be corrected, and the possibilities for this exist.

The November 1978 CC Plenum focused attention on the fact that we must adopt scientific advances in agriculture more quickly. CC CPSU General Secretary Comrade L. I. Brezhnev was completely justified in saying that the efforts of the scientific institution in this regard are inadequate. After the July Plenum we made a very careful study of what is being done in the Academy of Sciences and what can be useful for agriculture. I will dwell on just a few of these questions in order to show how sometimes completely new fields of application, often quite unexpectedly, can prove useful for agriculture.

In the field of nuclear physics and radiation technology, for example, we have for a long time been studying the effect of radiation on matter and on living beings. About three years ago the late Academician G. I. Budker (Siberian Department) proposed the use of electronic accelerators to sterilize grain in order to reduce losses in storage. Experience showed that it is a very effective method of safeguarding a substantial portion of the crop that would be destroyed by farm pests. Large-scale experiements are now underway, and in the near future, to all appearances, we will be producing at least a dozen such accelerators per year and in the long run provide all major grain storage facilities with this equipment.

Another example. V. A. Kotel'nikov's institute (the USSR Academy of Sciences Institute of Radio Engineering and Electronics) has traditionally dealt with the development of methods of radar and radiation research. Two years ago it was shown that it is possible to develop equipment which permits high-speed monitoring of soil moisture from the air. This makes it possible to control watering conditions, use just the right amount of moisture, and monitor leakage from irrigation canals. For example, the enormous Karakum Canal can be checked in two hours. One variant of this method makes it possible to determine the onset of soil salination, making it possible to protect large areas of useful land against salination.

Our space technology today is fully capable of monitoring land conditions and use from satellites, monitoring crop conditions, warning about plant diseases, forest fires, and so on.

This work is now in its initial stage, we are lagging somewhat. Such work is already being carried out in the United States, and it is proving itself economically useful. Obviously, the same thing can happen here, and we must hasten to adopt the results of research in production. This will require enormous joint efforts by the USSR Academy of Sciences and the Ministry of Agriculture in collaboration with the developers of space equipment for agricultural use.

In recent years, substantial changes have taken place in many scientific disciplines. Molecular biology, biology and genetics in general, have begun to develop more rapidly. It is now possible to direct the inherited properties of organisms.

It must be pointed out that despite individual large successes in the field of selection, we are not making adequate use of modern methods in this field: chemical and radiation mutagenesis, remote hybridization, the development of heterotic forms, the incubation of high-bred embryos in low-bred animals to accelerate improvement of the herd, and so on. Sometimes, selection is carried out without considering changes in sensitivity to weather conditions or diseases, and so on. The scientific level of efforts in this area must be raised, requiring joint efforts by the USSR Academy of Sciences and VASKhNIL.

Now, science has the possibility of including in DNA, which determines heredity, any particular gene responsible either for fixing nitrogen or some other biochemical process in the organism. This opens up the practical and interesting possibility of artificially introducing into the plant's genetic apparatus genes of nitrogen fixation which make it possible for the plants to fix nitrogen directly from the air.

The problem of transgenosis is now being worked on in the institutes of the Academy of Sciences. There is no doubt that in a short while the findings of this research will find practical application in the field of plant husbandry and in livestock farming. The same kind of approach to problems of agriculture is developing now in the USSR Academy of Sciences.

Unfortunately, our approach along these lines is not yet sufficiently systematic. The situation must be decisively corrected, because here as nowhere else we must take account of all aspects of a complicated agricultural process. At one point, for example, we undertook to develop a mineral fertilizer industry; now we have substantial experience in this and are successfully developing it further. But we have not at the same time adequately developed an industry of herbicides and other chemicals, also biological means of plant protection. This has brought it about that land cultivation is becoming extremely labor-intensive, requiring repeated weeding. In addition, substantial amounts of fertilizer do not wind up boosting crop yields but are used by the weeds, which eagerly gobble them up. We are now purchasing large amount of herbicides, and we are producing many ourselves. But the scale of Soviet production, especially with regard to the assortment of means produced, is not yet up to agriculture's needs.

At present, up to 200 types of means of plant protection are being used in foreign countries (different ones in different countries); in our country, although we have developed the technology for producing about 60 types of herbicides, only a few of them are being manufactured in adequate quantities. This is because the chemical industry has not adequately developed low-tonnage chemistry, the direct contribution of which in the sector's balance of the chemical industry is too low.

This shortcoming in the structure of the chemical industry must be corrected; it affects not only agriculture but a number of other sectors--electronics, medicine, and so on.

It is also necessary to focus attention on the fact that in the production of chemical means of plant protection we cannot get by once and for all with a particular selected compound. As in medicine, bacteria adapt to a particular substance and in the long run become insensitive to it; in agriculture, similarly, it is necessary to change the herbicides from time to time in order to avoid processes of adaptation. For these purposes, therefore, it is more effective to set up small-scale production with technologies that can be changed easily.

If we orient ourselves toward purchases of chemicals abroad we will always be in a difficult situation.

It is essential to speed up efforts along these lines in the chemical and the technology institutes; it is especially necessary to develop a chemical technology which can without special outlays convert from the production of certain types of protective substances to other types. This is very difficult to do in extremely large-scale operations, but with a production scale of about 5,000 to 10,000 tons per year for each type, it is quite possible to have flexible types of production.

Some success has been made along these lines, of course. The Armenian Academy of Sciences Institute of Precision Organic Chemistry, for example, has set up an excellent block facility for the production of a number of medical substances. They are now producing 23 types of substances and can freely convert from one production operation to another by simply changing the technological layout and sequence of operations involved in the production of a particular substance. The facility includes filtration, distillation, and other blocks; by changing the sequence in which these substances pass through the standard blocks it is possible to vary the array of substances being turned out in a broad range.

Obviously, this is the way to organize production in low-tonnage chemistry, which must be developed in order to produce plant protective substances.

There is much for us to do along these lines, comrades. The fact is that just as in the case of medicines, here also we must synthesize enormous numbers of substances and then sort them out through testing. This work is extremely labor-intensive. In these efforts, about one out of every 10,000 synthesized substances proves useful.

This clearly shows the enormous scale which these synthetic and testing efforts must attain. We must necessarily move far enough ahead so that we are not dependent on foreign suppliers and can exchange our goods on an equal basis, utilizing rational international division of labor and at the same time having the possibility of developing our agriculture independently.

Consider another field--machine building. In recent times, the academy's presidium has done a great deal to substantially improve our machine products. In the field of agriculture, our situation is especially complicated. Because of the mass nature of machine products going into agriculture it is not possible to set aside for it high-alloy steel or very scarce materials. In the case of most products, therefore, we must be content with ordinary grades of steel. On the other hand, the lack of proper utilization and storage of farm machinery has led to a situation in which they wear out much too fast. The actual service life of many of our farm machines is about two years, and considering that they work for only about one or two months per year it must be acknowledged that the machines frequently go out of commission after working about four months.

This untimely writing-off of machinery constitutes the waste of considerable invested labor. It causes enormous damage to the national economy and leads to a situation in which our machine building industry is not up to the task of providing enough machines to meet agriculture's needs.

At present the USSR Academy of Sciences and a number of related ministries, in particular the Ministry of Ferrous Metallurgy, are vigorously working to develop powder metallurgy, which makes it possible to use surface alloying instead of volume alloying in many cases; this protects the steel against corrosion and wear in friction components, an especially vital factor in agriculture. Work being done along these lines has shown that proper development of this method can boost the machinery's service life by several times; in effectiveness this is equivalent to a corresponding growth in agricultural machine building. This is the most effective way to resolve difficulties in this area.

Modern technology--plasma spraying, laser treatment of the surface--makes it possible to obtain the necessary surface quality, boost wear-resistance, make corrosion breakdowns less frequent, and reduce the results of machine erosion. In this regard the Academy of Sciences can provide considerable help to agriculture.

Applications in the field of agricultural machine building must be linked to applications in the field of developing essential plant forms which in terms of their morphological characteristics, synchronicity of fruit maturation, and other qualities can make the use of machinery and equipment most effective.

In this regard, our efforts are extremely inadequate; what is needed is complex work simultaneously on machinery and on plants so as to reduce the labor-intensiveness of production in our agriculture. An excellent example of beginning work along these lines is the development of tomato harvesting machinery and plant forms suitable for this. But this is not a completely separate application. Excellent results have been achieved by our specialists in the field of cotton harvesting machines.

It is very important to draw the attention of the academy's economists to problems of agriculture. Up to now, the very principles of economic incentive, principles of determining the proper proportions in agriculture, have not yet been substantiated on an adequately scientific economic basis. In this regard we must step up our efforts considerably.

Our task, comrades, is to see to it that economic problems become the focus of attention of our academy, VASKhNIL, and the Ministry of Higher Education, which has an enormous number of scientific forces and capabilities to do work along these lines.

Also very important is a systematic approach to resolving problems in the area of agriculture. This is an area which can and must be developed by the Academy of Sciences and its computer centers, and the results that can be achieved are very great.

Comrades! We have been thinking about concluding this session with the creation of a new program of project development in the Academy of Sciences, the Ministry of Higher Education, the Academy of Agricultural Sciences, and in many departmental institutes--an integrated program of project development to meet agriculture's needs. I believe that the creation of such a program can play a vital role. We will set up this program under maximally favorable conditions in the sense of supplying and allocating the necessary resources, and at the same time we will check in detail to determine what is being done.

I do not believe that we can at this time examine the program in its final form, but we can study it in its rough form; it will require lengthy organizational and stylistic refinement. It will probably take us one month to draw up this program in its final form.

The USSR Academy of Sciences will carry out its duty to the country and make a substantial contribution toward further improvement of agriculture, that enormous sphere of application of the efforts of all our people.

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UDC 630

CURRENT TASKS OF DEVELOPMENT OF THE COUNTRY'S AGRICULTURE

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 10-23

[Report by USSR Minister of Agriculture V. K. Mesyats]

[Text] In recent years, our country has implemented large-scale measures designed to boost agriculture. Guided invariably by Leninist doctrine concerning the agrarian question and the ideas and principles of the Leninist cooperative plan, our party has worked out and is steadily implementing a broad, integrated, long-term program of comprehensive intensification of farm production. Its main goal is to raise agriculture to a level which makes it possible to reliably supply the country's rising need for food and agricultural raw materials, to transform agriculture into a highly-developed sector of the socialist economy, bringing the material and cultural conditions of life in the city and the countryside closer together.

The main results of implementation of the present agrarian policy and the forthcoming tasks of further development of the USSR's agriculture were tallied and mapped out at the July 1978 CC CPSU Plenum.

CC CPSU General Secretary Comrade L. I. Brezhnev's report and the plenum's decisions set forth the key directions in the party's agrarian strategy under conditions of developed socialism to implement industrialization of farm production, assure economic and scientific-technical progress in agriculture, and improve social-economic relations in the villages.

The experience of preceding years and the results that have been attained convincingly demonstrate the scientific substantiation and vital strength of today's agrarian policies. In consideration of this, the July Plenum set forth a precise directive: to continue to keep closely to the course of action worked out by the March 1965 CC CPSU Plenum and subsequent plenums and party congresses.

The documents of the July Plenum set forth the positive shifts that have taken place in the Soviet economy's agrarian sector in a relatively short period. The average annual gross farm output in 1971-1977, compared with the seven-year period preceding the March Plenum, increased by almost 35 billion rubles--40 percent. Average annual grain production rose by 61.5 million tons, sugar beets--25, cotton--more than three, and vegetables--6.8 million tons. Average annual meat production rose from 9.2 to 14 million tons, milk by almost 25 million tons, and eggs by 1.9 times. Almost all of the output increase came from increased labor productivity, through intensification of land cultivation and livestock farming.

The rise in farm output made it possible to substantially improve supplies of farm products to workers in cities and villages. The country's population increased by more than 28 million persons, while per capita meat consumption rose from 41 kilograms in 1965 to 57 kilograms in 1977; respective figures on milk are 251 and 322 kilograms, eggs--124 and 224. Vegetable and fruit consumption rose substantially. Also recording increases were the output and sale of cotton and linen fabrics and other goods made from farm products.

Of course, these advances did not come by themselves. They resulted from the selfless labor of kolkhoz members and sovkhoz workers, the day-to-day organizational and political efforts of party and soviet organizations and farm organs, the result of efforts by the party and the whole people to boost and develop agriculture and the whole country's agroindustrial complex.

We now have 27,000 kolkhozes and over 20,000 sovkhozes. These are large, highly-mechanized, big-producing farms. Each kolkhoz has an average of 6,600 hectares of farm land, including 3,800 hectares of plowed land. The average sovkhoz size is about 18,000 hectares, including 6,200 hectares of plowed land. The kolkhozes and sovkhozes now produce 90 percent of all commercial plant and livestock products.

We are obliged to conduct our farm production under complicated, one might say severe, natural-climatic conditions. Almost two thirds of the farm lands in the country are located north of the 48th parallel. The spring and summer period--that is, the plants' growing season--is relatively short: 130 to 140 days, and even fewer in the northern zones. About half of the arable land in the country is located in areas where the average annual precipitation does not exceed 300 to 400 millimeters. For this reason, our main task is to secure a steady rise in farm output, to surmount the age-old dependence of agriculture on weather conditions. In this regard, we have made considerable progress in recent years.

In the interests of a stable upsurge of farm production and to strengthen its material-technical base, the party and the state undertook a definite redistribution of resources in the national economy in order to sharply boost capital investments to meet farm needs. The total capital investments channelled into the development of agriculture between the March 1965 Plenum and the year 1978 exceeded 320 billion rubles--3.4 times more than was invested in all the preceeding years of Soviet rule.

At the same time, there was a substantial increase in capital investments in those sectors of industry which comprise the industrial complex providing for farm production. Accelerated development characterized tractor and farm machine building and the production of mineral fertilizers. A number of specialized major sectors were in effect reorganized: water management and reclamation, machine building for livestock farming and feeds production, rural construction, combination feeds, and the microbiology industry.

As a result of all these measures, substantial quantitative and qualitative changes took place in the material-technical supplying of farm enterprises. The machinery and tractor fleet grew and was in effect completely renovated. At present, farm workers are armed with 2.6 million tractors totalling more than 170 million horsepower, more than 700,000 grain harvesting combines, more than 1.5 million trucks, and a large variety of farm machinery. Agriculture's total energy potential stands at 525 million horsepower--more than two times greater than in 1965; the power-to-worker ratio on the kolkhozes and sovkhozes rose by 2.5 times. Electricity consumption on the farm more than quadrupled. In 1978 the kolkhozes and sovkhozes were given more than 80 million tons of mineral fertilizers, whereas in 1965 deliveries totalled 27 million. In those 13 years, irrigated and drained lands more than doubled in area, now totalling 28 million hectares. Reclaimed land now produces about 30 percent of the total gross output of land cultivation.

In close harmony with the strengthening of the production base, problems are also being resolved with respect to restructuring the villages, improving the farm workers' working and living conditions. The construction of well-built housing and cultural-service facilities is underway on a broad scale. The material wellbeing of kolkhoz members and sovkhoz workers is steadily rising. Wages and payments from the social consumption fund are rising. The very nature of farm labor is changing in character; it is becoming more and more like a variety of industrial labor.

Agriculture employs more than 1.6 million specialists. Practically all kolkhoz chairmen and sovkhoz directors have a higher or a secondary specialized education and much work experience. On the average, every farm has 29 certified specialists. At present, one out of every five farm workers is a machinery operator, and the total number of machinery operators exceeds 4.3 million.

The rising technical and economic potential of farm production, the availability of highly-qualified cadres, and the whole people's and the party's concern for agriculture's upsurge--all of these open up new possibilities for more rapidly boosting the production of all types of farm goods, improving quality, and successfully resolving social problems of the countryside.

The July 1978 Plenum mapped out the goals which must be achieved in the 11th Five-Year Plan. The average annual gross grain production in 1981-85 is to be raised to 238-243 million tons, and by 1990 the figure is to reach one ton per capita. Meat production by the end of the forthcoming five-year plan is to be raised to 19.5 million tons. The production of milk, eggs, vegetables, fruit, and other farm products must be increased at a rapid rate.

These are difficult and intensive targets. But they are unquestionably feasible. A reliable base is being built to accomplish them; everything possible is being done to intensify kolkhoz and sovkhoz production in every way.

The cornerstone of everything is the task of completing the integrated mechanization of the cultivation of all farm crops in the forthcoming five-year plan and substantially raising the level of mechanization in all livestock sectors. In recent years, as has been mentioned, the technical supplying of the kolkhozes and sovkhozes has risen sharply. Nevertheless, a large number of urgent problems still remain to be resolved in farm mechanization. In terms of the capital-labor and energy-labor ratios, agriculture lags substantially behind industry.

The shortage of complexes of essential machinery is hampering the adoption of progressive production technologies developed by science. Yet the assimilation of these technologies yields a very high effect. Let me cite just one example: this year, Chadyr-Lungskiy Rayon in Muldavia was given a full set of essential machinery and herbicides to cultivate corn on 20,000 hectares. That rayon produced an average of 61 quintals of high-quality seed grain per hectare under dryfarm conditions. All of the work was carried out during the optimal agrotechnical periods, with practically no manual labor.

Decrees adopted by the CC CPSU and the USSR Council of Ministers approved an elaborated program for boosting the production and improving the quality of farm machinery. Implementation of the program will make it possible to eliminate bottlenecks in the mechanization of land cultivation and livestock farming; it will substantially boost the energy-labor ratio in agriculture. During the 11th Five-Year Plan our agriculture will receive new highpowered tractors, more powerful grain harvesting combines, and other farm equipment.

In the forthcoming five-year plan, deliveries of mineral fertilizers will be increased to 135-140 million tons and, an especially vital factor, the increase will comprise high-quality phosphate, highly-concentrated and complex fertilizers. It will become possible to allocate full norms of fertilizer for all industrial crops and on the whole area of reclaimed lands, also to substantially increase their application to grain and feed crop plantings and to improved meadows and pastures.

As in the past, special attention is being focused on land reclamation in the broadest sense. The scale of reclamation work will continue to expand.

Basic reliance will be placed on sharply improving the use of reclaimed areas, on eliminating delays in their economic development. The state is investing huge sums in reclamation; this five-year plan alone it has appropriated 40 billion rubles, and it is justified in demanding a proper return from the reclamation and farm workers in the form of increased output and an effectively high level of land cultivation on irrigated and drained lands.

It is clear that the practical implementation of all these measures with regard to the intensification and steady growth of farm production will require considerable financial and material resources. The July Plenum emphasized that both in the 11th Five-Year Plan and in the longer-term future the proportion of capital investments in agriculture must not decline in the overall volume of funds allocated to develop the nation's economy. In other words, the party will continue to hold fast to the principled course of action to increase investments in farm production, also in sectors comprising the country's agroindustrial complex.

Capital investments and material-technical resources are being concentrated primarily in the key directions--the implementation of integrated, nationwide programs providing for the greatest rise in effectiveness and highest possible intensification of farm production.

One such major program is that designed to boost agriculture in the Nonchernozem zone of the RSFSR. This zone includes 29 oblasts and autonomous republics in the center of Russia, with almost 50 million hectares of farm land and a population of about 60 million. In recent years, substantial changes have taken place in this vast area and have begun to have a positive effect on production output and on the farmers' working and living conditions. As was emphasized at the July Plenum, however, efforts to boost the Nonchernozem zone have not yet reached the scale and efficiency necessary to resolve the tasks successfully. Possibilities for increasing the productivity of land cultivation and livestock farming on the kolkhozes and sovkhozes of the Nonchernozem zone are great. In effect, this area is our second Virgin Lands, where in the near future we can ensure a rise of two to 2.5 times in the volume of farm output.

Large funds and substantial resources are also being allocated to develop the agriculture of Siberia and the Far East, to create a food base in the zone of construction of the BAM [Baykal-Amur Railroad]. Everything necessary must be done there to meet the population's need for products such as meat, milk, eggs, vegetables, and potatoes--from local production, as far as possible.

Overall, all zones of the country, all republics and oblasts have considerable reserves for boosting farm production. Farm workers see their duty, their primary obligation, as that of making the most rational and productive use of everything generously provided by the party and the state to boost kolkhoz and sovkhoz production.

The present stage of development of agriculture is characterized by substantial qualitative changes in the organization of production and in the sphere of social life on the farm. They involve the growth of productive forces and accelerated scientific-technical progress, increased specialization and concentration of production, the transition from a certain amount of farm separateness toward broader cooperation.

Our party, relying on the abundant experience of socialist construction in the countryside, is taking account of the objective laws governing these profound processes and predetermining their proper directionality. Clear proof of this is seen in the CC CPSU decree "Further Development of Specialization and Concentration of Agricultural Production on the Basis of Interfarm Cooperation and Agroindustrial Integration." Guided by this decree, all of the republics, oblasts, and rayons have worked out and are implementing long-range plans of specialization and systematic conversion of farm production to an industrial basis.

At present, the country has more than 8,000 different interfarm enterprises and organizations. Practically all of the kolkhozes and a substantial number of the sovkhozes are participants in interfarm cooperation.

Along with the introduction of farm enterprise cooperation, agroindustrial integration has recently begun to develop more vigorously, especially in such sectors as horticulture, vegetable farming, and viticulture. In agroindustrial enterprises and associations, of which we now have a great number, the production and processing of goods are organically linked in a unified technological process. This yields a high economic effect and ensures better utilization of material-technical, financial, and labor resources.

Naturally, interfarm cooperation and agroindustrial integration are complex processes which require scientific and planned administration. From the organizational, scientific-technical, and economic standpoint such work is much more complex than the consolidation of small kolkhozes that we carried out some time ago.

The practical development of interfarm cooperation has not been without certain distortions and oversights. Sometimes under the banner of specialization and concentration people have curtailed certain sectors of production on kolkhozes and sovkhozes; this, of course, cannot be permitted.

I should also state that some of our economists sometimes rather naively, without a proper scientific analysis, take up and begin to propagandize particular organizational forms of interfarm cooperation and agroindustrial integration which subsequently do not prove to be feasible over the long run.

The CC CPSU has decisively condemned the shortcomings occurring in the development of interfarm cooperation and demanded that this work be conducted more vigorously, in a more businesslike and well-thought-out manner, in conjunction with all other measures designed to intensify farm production.

The decisions of the July 1978 Plenum were received with great enthusiasm and unanimous approval by farm workers and all the Soviet people; they are perceived as a militant program of urgent practical actions.

What is the focus today of the main efforts of farm workers, what are the main resources and means?

The central link, the key has been and remains that of boosting grain production. The year 1978 produced the biggest gross grain crop in the country's history--235 million tons. It was a truly great labor victory, one based on the efforts of the party and all the Soviet people.

Let me cite data concerning the growth of grain production: for the Seventh Five-Year Plan the average annual production was 130.3 million tons; in the Eighth--167.6; in the Ninth--181.6; in 1976-77--209.7; in 1978--235 million tons. The increases, as you can see, are substantial.

These grain farming successes must not only be consolidated but also further developed in order to boost gross harvests, especially of groats, legumes, and feed grains. Grain yields must be raised in the next few years to a national average of 20 quintals per hectare (the 1978 figure was 18.5); in the North Caucasus, the Ukraine, Moldavia, Belorussia, and the Baltic republics yields should be raised to 35-40 quintals or more.

What realistic reserves and possibilities do we have for this?

Above all, the introduction of new high-yield varieties which can be moved into the fields quickly, and improved organization of seed breeding.

Specialists estimate that through extensive variety renovation and improved seed quality it is fully possible to boost grain crop yields by at least 20 percent.

A vital factor is that of increasing the application and improving the utilization of fertilizer. In 1978, the kolkhozes and sovkhozes allocated about 30 million tons of mineral fertilizers for grain crops. In 1980 it will be possible to increase the figure to 48 million, and in 1985 to 63 million tons. Fertilizers pay off: a ton of fertilizer yields a ton of additional grain at the minimum. In addition, the application of organic fertilizers is increasing--manure, peat, and compost.

One major reserve is further improvement of the crop structure. And although a great deal has been done, problems of expanding the grain area at the expense of less productive annual grasses and other crops, especially in the Nonchernozem zone, Belorussia, and the Baltic area, remain urgent ones requiring more thorough scientific work and practical solutions.

The grain area will be expanded every year on reclaimed lands. We now have many farms harvesting 60 to 70 or more quintals of wheat per hectare, 70 to 80 quintals of rice, and 80 to 100 or more quintals of corn grain on irrigated lands. The task is to use this accumulated experience and improve the utilization of reclaimed areas in order to assure the production of high, guaranteed, programmed crop yields everywhere.

In assuring a steady rise in grain production, it is of great importance to adopt moldboardless, soil-protective cultivation of the soil. Measures adopted to increase the output of antierosion equipment will make it possible during this five-year plan to expand the scale of moldboardless cultivation from 27 to 44 million hectares. Practice has shown that as a rule, the assimilation of the soil-protective system of land cultivation results in a grain crop yield gain of two to three or more quintals per hectare in any year.

And, of course, supplying the kolkhozes and sovkhozes with powerful tractors and highly-productive harvesting and other farm machinery, improving their utilization, and enhancing the professional skills of the grain farmers constitute a reliable basis for shortening the time it takes to complete field operations, for reducing crop losses, and for increasing gross harvests of grain and other products.

These are the basic directions of agricultural strategy in grain production. Similar integrated programs have been worked out and are being implemented to further develop beet raising and cotton farming, to intensify vegetable farming and horticulture, viticulture, and all other sectors of land cultivation.

Especially vital tasks must be resolved in livestock farming. These tasks are at the forefront today. Quite naturally, the people's rising prosperity has brought about increased demand for livestock products, especially meat. And despite substantial increases in meat and milk production in recent years, the present level of livestock development is not keeping up with the country's rising needs.

What are the sources, what are the ways being counted on to increase meat production?

In most areas of the country, this primarily involves increasing the production of beef. We have vast meadow and pasture lands, substantial possibilities for boosting the production of coarse and succulent feeds, for making fuller utilization of byproducts of food industry enterprises, for organizing excellent feed-lot and pasture fattening of cattle.

A main reserve here is to raise the weight specifications on livestock slaughtered for meat and to shorten fattening periods.

In 1977 the average weight of cattle sold by the kolkhozes and sovkhozes to the state was 355 kilograms; in 1978 it was 367. In 1965 it was 253. Many kolkhozes, sovkhozes, and interfarm enterprises are now delivering livestock weighing 400 to 450 or more kilograms. Achieving such indicators on all farms will make it possible to increase the production of high-quality beef by at least 1.5 million tons from the same number of feed-lot cattle. This is completely feasible.

A major source for expanding meat resources is to accelerate the development of specialized meat livestock farming. At present the country has about four million head of meat livestock. The task now is to increase the herd to 9-10 million.

There are also substantial reserves for boosting the production of pork more rapidly. In recent years the country has built more than 1,000 large-scale hog complexes utilizing industrial technologies for raising and fattening the animals. These enterprises are now supplying almost one quarter of all the pork purchased. Their work indicators are good. Industrial hog complexes are being built and will continue to be built in accordance with capabilities. But we must, of course, continue to focus attention on the production of pork in ordinary farm sections, where conditions also favor increasing meat production.

One of our priority tasks today is to develop meat poultry farming. Until recently, priority in this sector was given to increasing the production of eggs. It can be stated that the problem of supplying the population with eggs has been largely solved. Now the focus of attention is meat poultry production. In May of 1977, the CC CPSU and the USSR Council of Ministers adopted a special decree "Measures to Increase the Production of Poultry Meat." In the current five-year period, plans call for building and rebuilding 199 state meat poultry plants and creating a network of pedigree and reproduction farms. Meat poultry farming will be further developed on the kolkhozes and sovkhozes, also on the basis of cooperation with state poultry plants. Implementation of the approved program--and everything necessary is being allocated for this--will make it possible in the next few years to increase the production of broilers by several times, to substantially boost the production of other domestic fowl, and to expand the assortment of high-quality poultry meat.

Plans also call for implementing major measures to develop sheep raising, horse breeding, reindeer breeding, and rabbit farming to more fully meet the population's demands for these types of meat products.

At the same time, farm workers will have to do considerable work in the matter of improving the productivity of dairy livestock and in boosting the production of eggs, wool, karakul, and all other livestock products.

In addition to intensifying kolkhoz and sovkhoz livestock farming it is also essential to make fuller use of the possibilities of producing meat and other products in the subsidiary operations of industrial enterprises and various organizations and on private plots, providing them with all kinds of help and support. At the November 1978 CC CPSU Plenum, Comrade L. I. Brezhnev emphasized: "It is also essential to create a definite social climate in which kolkhoz members and sovkhoz workers feel that in raising livestock and poultry at home they are doing something useful for the state."

And, of course, the fundamental basis of livestock development is feed. There are many unresolved problems in feed production. On a large number of farms, feed production is quite primitive. The introduction of progressive technologies and scientific-technical advances here is weaker than in other sectors. There are not enough storage facilities. Losses are high and quality is impaired in the procurement and storage of hay, haylage, and silage. The combination feeds industry is not adequately developed.

The CC CPSU and the government have approved a system of measures to find fundamental, integrated solutions to problems of intensifying feed production, creating a specialized industry for feed production. The necessary funds are being allocated. The practical realization of such a program is the foundation for successful completion of targets to boost production of all types of livestock products.

And there is another vital, urgent task--that of eliminating product losses. Losses of grain, potatoes, vegetables, fruit, and cotton, as was correctly pointed out at the November 1978 Plenum, constitute not only an economic but also a major political problem. The CC CPSU has called for all-out efforts against mismanagement and negligence leading to losses of the nation's wealth; responsibility for product safekeeping and quality must be increased. Targets have been set forth for seeking out additional resources to develop the capacities of enterprises processing farm goods and raw materials, to build elevators, vegetable and potato storage facilities, and warehouses, and to adopt the latest technologies of processing and storing goods. The task has been set forth precisely and clearly: every kilogram of hard-won product must be stored properly and delivered to the consumer in good quality.

The ever-increasing scale and complexity of tasks in agriculture cannot be resolved without the vigorous and all-encompassing participation of science. Its role as a direct productive force is constantly rising.

Our science has been making enormous contributions toward implementing the party's agrarian policies. We are all justly proud of the achievements of Soviet scientists in developing new, high-yield varieties of farm crops and breeds of animals, new means of mechanization and chemicalization, progressive production technologies, and effective methods and techniques of reclamation to enhance land fertility.

The kolkhozes and sovkhozes are making extensive use of farming operation systems worked out by science for various zones of the country and recommendations on improving the forms of organization of labor and administration, specialization and concentration of production, and improved economic effectiveness. In the long run, all this materializes as additional millions of tons of grain, meat, milk, and other essential farm products.

The specific work being done by the scientific-research institutions, the results that have been achieved, and the long-range tasks are discussed in detail in the reports of Yu. A. Ovchinnikov and P. P. Vavilov. For this reason, I will dwell on just a few urgent problems of accelerating scientific-technical progress in agriculture.

To intensify land cultivation, it is extremely important to strengthen selective breeding work. The successes of the Soviet selective breeders are well known and acknowledged. But production's need for new, intensive varieties is growing constantly.

On the basis of this need, selective breeding work in grain crops needs to continue to concentrate efforts on developing during the current five-year plan short-stalk varieties of wheat with potential yields of 80 to 90 quintals per hectare, winter-hardy varieties of winter crops for Siberia and North Kazakhstan, high-yield varieties of spring wheat and feed grains with high protein content, and early-ripening and medium-ripening corn hybrids yielding 80 to 90 quintals (120 to 130 quintals on irrigated land).

In the selection of sunflowers, the urgent problem today is to develop varieties and hybrids which in addition to a high oil content have all-round resistence to fungous and bacterial diseases.

In the selection of sugar beets, the main thing is to raise the sugar content of the roots and the germination capacity of the seeds. At the same time, it is necessary to strengthen efforts against bolting, which in some years causes considerable losses to commercial sugar beets.

In cotton selection, it is extremely important to develop fine-fiber varieties and varieties not susceptible to wilt.

In potato selection, it is especially important to focus attention on improving the food and technological qualities of new varieties, on increasing their resistence to phytophthora, nematodes, viruses, and other diseases. It is also necessary to resolve the problem of converting potato seed breeding to a virus-free basis.

In the selection of vegetable crops, special importance both for open and closed ground attaches to the development of new varieties and hybrids with better taste qualities suitable for mechanized harvesting, with uniformly-maturing homogeneous product capable of lengthy storage.

As you can see, the selective breeders have a great deal to do, and all of their tasks are vital and urgent. We are now acquiring more and more possibilities for resolving them successfully. Some 44 large-scale selective breeding centers have been set up and are in operation in the country. A long-range program has been worked out for each of them. They are being outfitted with the necessary equipment, means of mechanization, and laboratory apparatus. Our best scientific forces are being concentrated here.

And the main thing, of course, is to move new, promising varieties and hybrids into production as quickly as possible. The USSR Ministry of Agriculture and the republic agricultural organs have drawn up and are implementing measures to restructure the State Varieties Testing system, to expand the network of elite seed breeding farms and strengthen their production base. The USSR Sortsemprom has been organized. All of this will undoubtedly make it possible to conduct variety renovation and variety replacement and radically improve seed breeding operations.

Pedigree selection work must also be fundamentally improved in livestock farming. As is well known, a course of action has been undertaken to convert all livestock sectors to an industrial basis and to industrial technologies.

With regard to zonal specialization, large-scale poultry plants have been created and are being built to accomodate 300,000 to 500,000 or more laying hens and produce five, seven, and 10 million broilers per year; hog complexes are being built to accomodate 12,000, 24,000, 54,000, and 108,000 animals; complexes and feed-lots are being built to accomodate 5,000, 10,000, and even 20,000 head of cattle; sheep farming complexes are being built to fatten 10,000, 20,000, and 30,000 head; dairy complexes are being built to accomodate 400, 800, and 1,200 cows.

Irrigated feed lands are being developed in conjunction with these complexes, also modern feed processing shops and enterprises. Training has been organized for specialist cadres and workers in the mass trades skilled in industrial production technologies.

An urgent problem today is to stock large specialized enterprises with highly-productive livestock. Naturally, this requires a new approach to resolving scientific and practical problems of improving herd reproduction and pedigree, zootechnical, and veterinary work. For it is one thing to conduct such work on farm sections with 100 to 200 head of livestock, and quite another under conditions of high concentration.

The livestock scientific-research institutions and pedigree farms must now orient themselves to expand efforts on perfecting existing and developing new specialized, highly-productive breeds, breed groups, and lines of livestock and poultry adapted to conditions of industrial technology. It is essential to develop systems of livestock maintenance and feeding which assure milk yields of 5,000 to 7,000 kilograms per cow, average daily weight gains of 1,100 to 1,300 grams in cattle fattening and 700 to 750 grams in hog fattening, also high indicators in poultry and sheep operations.

On the organizational plane, problems of perfecting pe .gree work have been resolved. The CC CPSU and the USSR Council of Ministers have adopted the decree "Measures to Further Improve Pedigree Work in Livestock Farming." Funds have been allocated to strengthen existing pedigree farms and organize new ones, especially in areas of Siberia, Kazakhstan, and the Far East. An All-Union Scientific-Production Association for pedigree work and artificial insemination is being created, also corresponding republic, kray, and oblast associations and large-scale pedigree selection centers. On the basis of the latest advances in genetics, physiology, and biochemistry, such associations and centers can deal much more effectively with pedigree selection work, research into the development of scientifically substantiated systems of herd reproduction, directed raising of young pedigree stock, and hybridization and inter-breed industrial crossbreeding of livestock. The end goal is to "design" breeds of highly-productive livestock and develop large homogeneous herds which are fully adaptable to conditions of industrialized technology.

In the concentration of livestock farming, new and higher demands are being imposed on veterinary science. What is needed is an effective system of preventive veterinary and sanitation measures to ensure on each complex and farm section stable veterinary health conditions and a reliable barrier against potential stock diseases as well as protection of the environment against pollution. For these purposes it is essential to conduct more vigorous scientific research and adopt the latest methods promptly in production.

Life itself confronts science with multiple, vast problems with regard to all aspects of scientifc-technical progress in agriculture.

In the field of mechanization and electrification, it is necessary to concentrate scientific forces on the development of radically new energy and technical means, on the development of combination units capable of carrying out a complex of operations at once, on improved electrified and automated systems, central control and diagnostic equipment, and on the formulation of recommendations to substantially improve the effectiveness of utilization of the machinery and tractor fleet.

In the field of chemicalization, it is very important to strengthen research efforts into the scientific principles of plant nutrition and problems of radically improving the nutrient balance in the soil, to develop new fertilizers, to improve their assimilability, and to draw up scientifically substantiated proposals on the most rational use of liquid, compound, and highly-concentrated fertilizers, also manure, peat, and compost, also improvement of the agrochemical service.

Now in the forefront of hydraulic engineering and land reclamation are problems of building modern engineering reclamation systems with fully automated and mechanized watering, also the development of effective drainage techniques and methods of regulating the water, air, and heat conditions of soils, as well as new means and methods of reclaiming alkaline land.

This is by no means a complete list of the important tasks facing agricultural science, the resolution of which will be of great importance to the economy.

In the formulation of the multiple problems of comprehensive acceleration of scientific-technical progress in agriculture, a vital role is played by the USSR Academy of Sciences and the academies of sciences of the union republics, scientists in all spheres of knowledge.

It must be stated that the scientists of the key institutes of the USSR Academy of Sciences, in collaboration with workers of the agricultural scientific-research institutions and the VUZ's and universities, have done a great deal to develop theoretical and applied research.

An integrated program of scientific-technical progress in agriculture has been worked out, dealing with its social and economic consequences over the long run and in coordination with the development of other sectors of the economy. As a result of many years of joint efforts, a State Soil Chart of the Soviet Union has been prepared. Substantial success has been achieved in the development of valuable forms of farm crops on the basis of remote hybridization, artificial mutagenesis, and polyploidy. Already developed and in the production stage is the cultivation of apical meristems to produce virus-free seed potatoes and certain other crops. Thorough scientific applications in the field of population genetics underlie the theory of selection of farm animals. Advances in general physiology are being widely used to develop the most rational possible systems of livestock feeding. The findings of microbiology research have made it possible to set up large-scale industrial production of feed protein and various kinds of enzymes.

The theory of liquid movement through porous media, as is well known, serves as the foundation for developing engineering methods of calculating hydroengineering structures for agriculture, and scientific substantiation of the laws governing the migration and metamorphosis of salts in vertical and horizontal movement of water flows have become the starting points for forecasting water and salt conditions on irrigated areas.

More and more direct practical agricultural use is being made of laser technology, advances in biochemistry and biophysics, mathematics, and economic cybernetics.

A remarkable example of creative collaboration among scientists is the Skryabin school of helminthology. The practical adoption of biologically substantiated measures to prevent and control helminthosis in animals has made it possible to sharply reduce its incidence among livestock and poultry and to prevent hundreds of millions of rubles worth of livestock product losses every year.

All of these examples indicate that efficient collaboration among scientific institutions of the USSR Academy of Sciences, VASKhNIL, and the republic academies is yielding excellent benefits and producing direct practical results. It is only reasonable, therefore, that as we now draw up the national economy plan of the country's economic and social development for the 11th Five-Year Plan our scientists ought to formulate combined, integrated programs of research for the forthcoming five-year period and, for some problems, for the longer term.

What, from our standpoint, are the most urgent agricultural problems requiring joint efforts and integrated resolution?

One such problem is to develop reliable methods of space inspection. This makes it possible to use manmade earth satellites to keep close track of the dynamics of farmlands and types of soil, to determine moisture availability and overall crop condition, to determine the phytosanitation condition in the fields, and to forecast farm crop yields.

The use of space advances is of much importance for more reliable weather forecasting. Agriculture is the biggest sector of the economy; production is carried out chiefly under the open sky, and it still largely depends on weather. Unfortunately, the accuracy of present forecasts leaves much to be desired. Scientists in this field must make more vigorous efforts to perfect existing methods, and develop new ones, for scientific forecasting of weather pheonomena.

All of the world's developed countries are now working diligently on improving the effectiveness of photosynthesis and biological fixation of nitrogen. In this country we are also conducting such research on a rather high level. The prospects are encouraging. Obviously, the results could be much greater if there were better coordination and closer cooperation between scientific institutions of theoretical and applied profile.

A problem of great significance to the state is that of increasing protein production. Intensification of livestock farming urgently requires all-round improvement of feed quality. We need feeds that are fully nutritious, balanced in all nutrients, especially protein. The shortage of feed protein, now about five million tons per year, results in substantial overconsumption of feed resources and increasing costliness of livestock products. Naturally, the main concern is to increase the production of vegetable protein, to expand planted areas and boost crop yields of alfalfa, clover, lupine, soy, peas, vetch, rape, and other high-protein crops, and to improve natural feedlands. The necessary measures are being taken.

At the same time, the chemical and microbiological, pulp and paper, meat and dairy, food, medical, and other sectors of industry must make a larger contribution toward supplying livestock farming with feed protein additives. This means that scientific research on the protein problem must be stepped up in every way. Although work in this field is being conducted extensively, it is still too scattered and uncoordinated. We believe it is necessary to concentrate and consolidate the efforts of scientists and provide them with everything necessary to resolve this problem successfully.

The next few years in farm production will involve advanced machine technologies in land cultivation and livestock farming. The advantages of such technologies are indisputable. As has been mentioned, however, they are not being adopted everywhere because there are not enough complexes of highly-productive machines and, a major factor, enough herbicides. Whether we wish it or not, increased applications of fertilizer feed not only crop plants but also weeds. It is no longer easy to control weeds with agro-technical measures alone, and weeding by hand is unthinkable. We need highly-effective chemicals and other means.

The July Plenum deemed it essential to draw up a state program on herbicides, to develop scientific research in this line and create production capacity, and to expand the production and application of microbiological means of plant protection. This is an urgent task, and we are confident that our scientists will join efforts to develop the compounds agriculture needs as soon as possible. It is also necessary to strengthen research in the use of biological methods of protecting plants against pests and diseases.

At the same time, it is essential to step up efforts in selective breeding for immunity, to develop varieties and hybrids having complex resistance to diseases and pests. Of course, it is difficult enough to determine the biological mechanism of immunity and breed for immunity; these matters require the collective efforts of the selective breeders and the physiologists, geneticists, biochemists, and other specialists.

Unquestionably, science must focus on problems of protecting the land, its resources, and the environment.

The land is the main means of production in agriculture. Farm lands in our country are vast but not unlimited; the farm land area is going down in terms of per capita. In 1934 there were 1.34 hectares of plowed land per inhabitant; now the figure is 0.87. This comes not only from increased population but also from diverting the land to nonagricultural purposes. We must be especially careful; we cannot permit excesses; and we must recultivate and restore the fertility of disrupted soils.

It is also important to strengthen research to resolve urgent problems such as the recovery of livestock wastes on large livestock farms and complexes, elimination of the leaching of fertilizer and other chemicals from the soil into the groundwater, improvement of the sanitary condition of farm lands, and prevention of residual pesticide buildup in feeds and food products.

The agrarian economists face very crucial tasks. Here, again, the best scientific forces must be focused on working out current problems of economic substantiation of the most effective measures of interfarm cooperation and agroindustrial integration, on determining the optimal sizes of interfarm enterprises and associations, on tasks of systematic and proportional development of agriculture in combination with other sectors of the agroindustrial complex, on improving planning and economic incentive, boosting labor productivity, and improving price-formation, cost-accounting relations, and forms of organization of labor and administration. Also requiring much more thorough and effective efforts are the social aspects of village development, the problem of keeping young cadres in agriculture, and wiping out present differences between the cities and the countryside.

The scope of activity for the scientists is broad. There is much to do, and it is all truly interesting, creative, and vital to our people. In light of the requirements of the July Plenum we must do everything to encourage and develop cooperation between various sectors of knowledge, to strengthen ties between science and practice.

In conclusion, V. I. Mesyats emphasized that workers in agriculture view the session of the General Meeting of the USSR Academy of Sciences as an event of great importance, and in connection with this he expressed sincere appreciation to USSR Academy of Sciences President Academician A. P. Aleksandrov and all members of the academy for organizing the session.

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FUNDAMENTAL SCIENCE FOR AGRICULTURE

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[Report by Academician Yu. A. Ovchinnikov]

[Text] Agricultural production is one of man's oldest spheres of conscious and deliberate activity, its roots going back centuries and millenia. Land cultivation and livestock farming have not only helped man to prevail in his struggle against the elemental forces of nature and supplied him with food in the early stages of civilization but also largely determined the development and progress of human society, the growth of its power and wellbeing in later epochs. Even today, in an era of steady flourishing of man's spiritual life, of the unique culture of peoples, the development and expansion of the most progressive social formations, agriculture, with its ancient art of tilling the land and breeding animals, largely retains its significance as a powerful and sometimes decisive factor in economic and social progress. This was eloquently stated by Leonid Il'ich Brezhnev in his book "Tselina" [Virgin Lands]: "Grain has always been a vital product, a measure of all values. Even in our age of great scientific-technical advances it constitutes the cornerstone of the life of nations. People have penetrated space, tamed the rivers, seas, and oceans, extracted oil and gas from the depths of the earth, mastered the energy of the atom, yet grain is still grain."

For all the industrial might of today's farm production, especially in the economically developed countries, and despite man's accumulated experience, agriculture still remains today probably the weakest link in man's chain of accomplishments today, a link which is still extremely vulnerable to the effects of the elemental forces of nature, to the vagaries of climate and the caprices of weather, the effects of many other unfavorable factors, and it gives man many concerns and sometimes is the cause of disillusionment and unhappiness.

Despite the enormous successes achieved by farm production on our planet, despite the sharp rise of its effectiveness and scale, it is not yet up to the tasks facing it today. According to the United Nations FAO, the world's annual production of food protein is about 75 million tons or about 60 grams per day per person, versus an average norm of 100 grams.

In other words, 60 percent of the world's people are not getting enough to eat, and about 30 percent are starving. In the last two decades, population growth rates in most of the developing countries show a tendency to run ahead of the growth of farm output. Considering that by the year 2000 the earth's population is expected to reach 6.2 billion persons, the shortage of agricultural productes could become acute if present growth rates are maintained.

Mankind is constantly seeking ways to surmount the difficulties facing agriculture, and is focusing his technical, material, and creative resources on this problem. Science, as a kind of concentration of accumulated experience, a reflection of all of the best and most advanced that man has created, and as one of the powerful means of resolving the problems facing mankind, today still owes a great deal to agriculture. It must be emphasized that large-scale science can deal with the problems of today's agriculture both in scope, significance, and complexity. In the long run, any major event or discovery in biology and a great deal of what is being done in chemistry, physics, and the earth sciences all have a direct influence on agricultural development. This also applies to many fields in the social sciences.

Improving the effectiveness of farm production at the present stage requires the involvement of substantial scientific authorities and powerful scientific collectives, otherwise this task cannot be properly resolved. For the scientist--whether he has already contributed to science or is just beginning his career--participation in resolving agricultural problems is determined by more than just a consciousness of his civic duty in view of the enormous importance of this field to the state. Also opened up to him is a broad array of unusually complex scientific problems giving him scope for imagination and flights of fancy, for the exercise of all his creative potential.

From the very first years of Soviet rule, our party and state have ascribed great importance to boosting farm production. At the Eighth All-Russian Congress of Soviets in December 1920, Vladimir Il'ich Lenin remarked that without a firm agricultural base there could be no "economic development, and the most grandiose plans would be as nothing" ("Complete Collected Works," vol 42, page 148). The course toward boosting agriculture, toward the utilization of the latest scientific advances in order to improve agricultural productivity, characterizes the more than 60-year history of the Soviet state; it is reflected in the vital decisions of our party's congresses and CC plenums.

The systematic implementation of our country's agrarian policy has yielded good results. In the years of Soviet rule, the total volume of farm production output has risen by 4.4 times and labor productivity has risen by 6 times.

While noting our country's successes in agriculture, we are today focusing special attention on existing shortcomings; we are seeking ways to boost agricultural production faster. It is no secret that in terms of the level and effectiveness of farm production we are still noticeably behind the leading countries in this regard. Thus, the per capita agricultural output in the USSR is only 75 percent of that indicator in the United States. Our agricultural labor productivity is also considerably lower. It is well known, of course, that natural and geographic conditions in the USSR are less favorable to the development of agriculture than in the United States and in many countries of Western Europe, but this only emphasizes the necessity of paying greater attention to the development of agriculture in our country, to the use of the best achievements of science and technology.

The July 1978 CC CPSU Plenum, which was a major landmark in the development and implementation of the party's Leninist agrarian policy at the present stage, emphasized the necessity of working out and implementing an integrated system of economic and organizational measures designed to speed up the development of all sectors of agriculture, to create a powerful agro-industrial complex in our country. The plenum focused attention on the necessity of improving the effectiveness of scientific research as one of the decisive factors in accelerating scientific-technical progress in farm production.

In his speech at the plenum, CC CPSU General Secretary and USSR Supreme Soviet Presidium Chairman Comrade L. I. Brezhnev said: "It is very important that the working out of the multiple problems of accelerating scientific-technical progress in agriculture continue to involve the active participation not only of agricultural workers but also the USSR Academy of Sciences, the academies of sciences of the union republics, and scientists in all sectors of knowledge. We have repeatedly stated that boosting agriculture is the common cause and concern of all the people."

In carrying out the decisions of our party and state, the institutions of the USSR Academy of Sciences and the academies of sciences of the union republics are taking active part in working out scientific problems relating to farm production. Ten out of 17 departments of the Academy of Sciences (including the Siberian Department) deal with agricultural problems. More than 60 institutions of the Academy of Sciences and its branches and scientific centers are taking part in working out fundamental problems of agriculture. In the republic academies, about 70 scientific institutions are involved with agricultural subjects. Agricultural projects are being coordinated by 20 scientific councils of the USSR Academy of Sciences. The academy is taking part in the preparation and implementation of vital state decisions involving agriculture, in the formulation of all basic scientific programs in this field. At present, the USSR Ministry of Agriculture and VASKhNIL have collaborated to work out a coordinated plan of research for the 1976-1980 period to deal with basic problems of agriculture. They are setting up an integrated program of agroindustrial development through the year 2000. To coordinate the work being done in the USSR Academy of Sciences, a Commission on Scientific Principles of Agriculture has been set up under the Presidium of the Academy of Sciences.

The new tasks assigned to agriculture by our country require the active participation of our academy's institutions in order to resolve the major, complex scientific problems which largely determine progress in farm production. In connection with this, we must focus more specifically on a number of problems, especially those which are vital to our agriculture, and to which the USSR Academy of Sciences can and must make a substantial contribution.

Land and water resources. The land resources on our planet are vast. According to specialists, the area of potential arable land in the world is 3.2 billion hectares--that is, about 25 percent of the land area; this is about 3 times more than the area being used to raise crops. Considering that about 700 million hectares comprise arid land and humid tropics, this leaves 2.5 billion hectares. In actuality we may consider that this area is considerably larger, because in many regions it is possible to harvest more than one crop per year. If on this land, assuming the allocation of 10 percent for industrial and timber crops, we could undertake intensive cultivation on the level of the best farms in the United States, Canada, and our country at the present time (with expenditures of about 800 to 1000 rubles per hectare), in this way we could provide food products for about 50 billion people (at a rate of 5,000 kcal [sic] per day per person). I will not presume to evaluate the accuracy of these calculations, but the fact is that with proper handling the land provides agriculture with large reserves.

The Soviet Union has substantial land resources, our most valuable asset. Our country has about 14 percent of the world's farmland area. At the same time, large areas are covered by tundra, swamps, deserts, and mountains; only one-third of our farmlands are located below the 48th parallel, 60 percent of the plowed land is located in areas with average annual temperatures of not more than five degrees C, 64 percent of the arable land gets less than 400 mm per year. For this reason it is very important to formulate and solve problems scientifically in order to achieve high effectiveness in agriculture under these not entirely favorable conditions.

Soil scientists of the USSR Academy of Sciences have collaborated with scientists in other fields in work to compile soil charts and determine which territories are suitable for agriculture, to determine the agrochemical characteristics of the soils, and so on. At present, the country is working out a long-range, scientifically-substantiated master plan of rational utilization of land resources on the basis of the characteristics of each region. Recently the CC CPSU and the USSR Council of Ministers adopted a special decree concerning agricultural development in the Nonchernozem Zone, where podzolic and soddy-podzolic soils prevail, characterized by low humus content and unstable structure. Institutes of the USSR Academy of Sciences, including the Institute of Agrochemistry and Soils Science, and institutes of a number of branches of the academy are now involved in working out measures designed to boost yields of farm crops on these soils.

In agriculture, one of the most urgent problems involves water, especially since the problem of fresh, in particular clean fresh water is of truly global proportions. In this century, as we know, the frequency of drought in our country has tended to rise. If we examine the 70-year period from 1900 to 1970, there were 14 drought years in the first 35 years and 16 in the second. The worst droughts in the past 100 years occurred in 1972 and 1975. And although our country possesses vast reserves of fresh water, it is essential to institute strict control over the state of the main water basins and keep track of the water balance throughout the country. Our academy can play a vital role in this regard.

In particular, the development of irrigation in the southern regions of our country having limited water resources requires major measures to regulate the flow and replenish local sources, probably from water-surplus regions. As is well known, we are studying the possibility of transferring some of the river water from the northern slope of the USSR's territory to southern regions of the European territory, also to Central Asia and Kazakhstan. Implementation of this kind of global project will require enormous outlays and can involve disruptions of the ecological balance, the consequences of which are now difficult to predict. For this reason, the Academy of Sciences has decided to collaborate with other departments in making a detailed assessment of alternative ways to transfer river waters in order to come to the right decision.

It is also very important to work out problems relating to determining the optimal conditions and new techniques of irrigation making it possible to maintain the necessary moisture in the soil's active layer. As is well known, unproductive losses of water in irrigation sometimes run as high as 50 percent. In addition, research conducted in the USSR and abroad confirms the theoretical possibility of using highly-mineralized ground water and even sea water for irrigation. But this requires thorough research relating to the study of the laws governing plant nutrition and soil behavior under such conditions, and so on.

Problems of water balance and rational utilization of water resources for agricultural purposes must be the focus of a special program of the USSR Academy of Sciences in collaboration with the Institute of Water Problems, the Institute of the Biology of Interior Waters, the Institute of Lake Science, the USSR Academy of Sciences Limnological Institute, a number of institutes in the union republics, and, of course, scientific institutions in other departments.

In discussing land resources and their proper evaluation and monitoring, mention must also be made of the possibilities of aerospace technology. The Academy of Sciences is doing work in this regard. The findings of the flights of the automatic space stations Zond-5 and Zond-7, the space ships Vostok, Voskhod, and Soyuz and the Salyut orbital stations, also aerial surveys, have demonstrated the possibility of making effective use of photographs of the earth's surface in order to study farm crops and natural feedlands at a distance, also to monitor their conditions--infestation by pests, the level of soil moisture, erosion, and so on. On this basis it is possible to forecast crop yields and to make proper decisions concerning agrotechnical measures. Experience in the United States concerning the use of information gathered by satellite for agriculture testifies to its high economic effectiveness.

Chemicalization of Agriculture. The production and use of mineral fertilizers in the country was three times greater in 1978 than in 1965. In 1973 the USSR emerged in first place in the world with respect to the total volume of mineral fertilizers produced. Their assortment was also improved and expanded. In terms of the average concentration of nutrients in fertilizers, our country has left behind such developed Western European countries as Great Britain, France, and the FRG, and only the United States is still ahead. Nitrogen and phosphorus fertilizers being produced by the Soviet Union's chemical industry are on par with foreign analogues in terms of most physical-chemical and mechanical properties.

Scientists of the USSR Academy of Sciences and the academies of sciences of the union republics have made a big contribution toward the development of promising integrated fertilizers such as ammophoska, nitrophoska, ammonium phosphates, defluorinated phosphates, and others.

Despite the success achieved in USSR in the production of mineral fertilizers, certain difficulties persist. Thus, the raw materials base for the production of nitrogen and potassium fertilizers does not restrict the growth of the Soviet Union's mineral fertilizer industry, whereas explored reserves of phosphorus containing ores (apatites, phosphorites) are by no means adequate. To meet agriculture's rising need for phosphorus fertilizers, institutes of the Academy of Sciences must collaborate with institutes of the USSR Ministry of Geology and the USSR Ministry of Chemical Industry to expand geological prospecting for deposits of phosphates, especially in Siberia and the Far East, and also step up scientific-research and experimental-industrial studies on the concentration and integrated use of phosphorus-containing ores.

One of the decisive factors in improving the effectiveness of mineral fertilizers is to improve the coefficient of utilization of active ingredient introduced into the soil along with the fertilizer. But in addition to monitored losses in the recovery and processing of the ore and in the transporting, storage, and application of the fertilizer about half of the nutrients introduced into the soil is lost due to chemical and biological factors. These involve leaching of the nutrients into deeper layers of the soil inaccessible to the plants, immobilization of the nutrients in the soil (retrogradation), denitrification, and so on. This is a problem which must be solved by agriculture, through agrochemical and agrotechnical measures, by the chemical industry, through improvement of the quality of the fertilizers and their physical-mechanical properties, and, of course, by the scientists, by creating new types of integrated fertilizers with predetermined release of nutrients by phases of plant development, slow-dissolving and capsulated fertilizers, inhibitors of denitrification, and so on.

In discussing the radically new approaches to the problem of producing fertilizers, mention must be made of the importance of work being done in the USSR Academy of Sciences with regard to bonding atmospheric nitrogen and oxygen in low-temperature plasma, synthesizing ammonia by means of organometallic catalysts (without high temperatures and pressure), and the biological fixation of atmospheric nitrogen. This research is very promising.

Pesticides. In essence, the use of pesticides is the second (after fertilizer) vital stage in the chemicalization of agriculture. Without pesticides, fertilizers frequently lose their effectiveness. In other words, further steady growth of farm production output is impossible without the expanded use of integrated means of combating pests, plant diseases, and weeds.

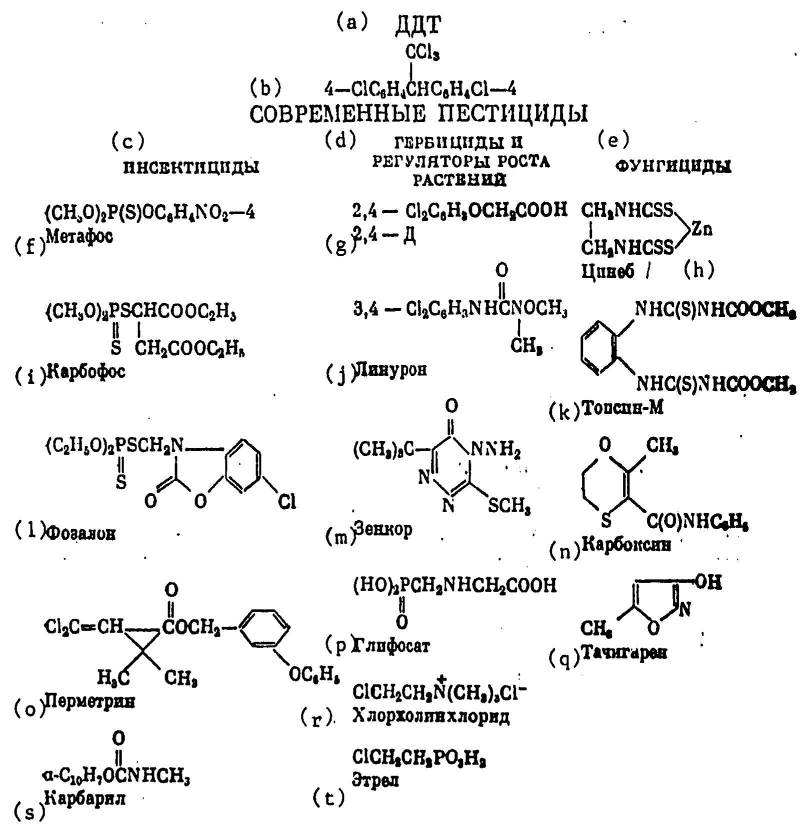
At present, the main method of controlling farm pests in our country and abroad is the use of chemicals. The problem of environmental pollution by pesticides has been repeatedly debated in the press of different countries, including the Soviet Union; the problem is an urgent one. It is true that sometimes emotions prevail, frequently based on obsolete information and inadequate knowledge. Of course, highly-toxic and persistent pesticides pollute the environment, especially when improperly used. At the same time, the average toxicity of pesticides authorized for use in the USSR in 1975 was six times lesss than in 1960. With the proper selection of the assortment of compounds and their proper sequence, the buildup of pesticides in the environment is reduced sharply. At the same time, we have now worked out and are using many extremely effective pesticides that are completely harmless to man and animals or decompose in the soil in a short time.

For the protection of farm animals and plants, various countries today are using about 600 chemical compounds serving as the basis for more than 1,000 different preparations.

What is the situation with regard to pesticides in our country? The assortment of pesticides produced in the USSR at present is quite limited, including very few original Soviet-made compounds.

Our country is producing only 18 forms of herbicides, whereas the United States is producing 125 and Japan is producing 226. At the July 1978 Plenum, Comrade L. I. Brezhnev stated: "Special mention must be made of herbicides and compounds to combat farm crop pests. Agriculture's need for them is not yet being met. Volumes of production are way too low and the assortment of herbicides is limited..."

Thus, the situation with regard to the production and use of pesticides is difficult and, it seems to us, this is today one of the main negative factors in our country's agricultural development. It is hardly possible to resolve the problem by buying pesticides abroad, and it is not a good idea--first of all because it makes us dependent on foreign firms in a vitally important field; secondly, because of sharply rising prices on pesticides and a tendency for prices to rise even more in the future, because new highly-specific pesticides of low toxicity are complex in structure and require many stages of synthesis and sophisticated technology. The only remedy is to rapidly organize the production of pesticides in the necessary assortment on the basis of Soviet scientific research.



Key on following page.

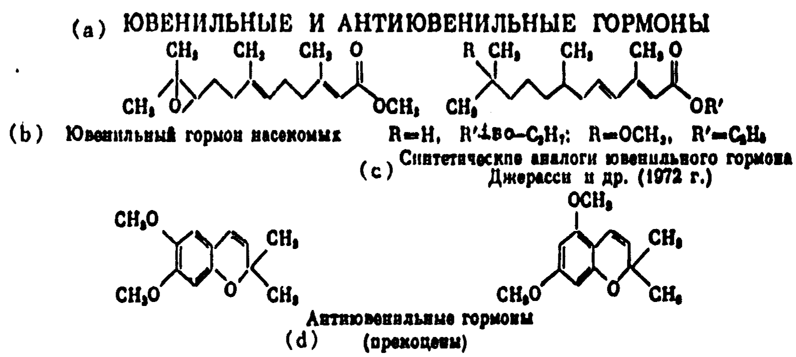
Key:

(a) DDT
(b) MODERN PESTICIDES
(c) Insecticides
(d) Herbicides and Plant Growth Regulators
(e) Fungicides
(f) Metaphos
(g) D
(h) Zineb
(i) Carbophos
(j) Linuron
(k) Topsin-M
(l) Phozalon
(m) Zencor
(n) Carboxyn
(o) Permetrin
(p) Glyphosat
(q) Tachigaren
(r) Chlorocholinchloride
(s) Carbaryl
(t) Estrel

In 1977, the USSR Academy of Sciences in collaboration with the USSR Ministry of Agriculture, the USSR Ministry of Chemical Industry, and other departments, drew up and submitted proposals on improving the development of scientific research in the field of plant protection, but up to now no decisions have been made with regard to this vital problem of agricultural production. It is essential to help the scientific institutions to strengthen their bases, because they are dealing with a big and complex problem. Without the participation of key institutes of the Academy of Sciences, this problem cannot be solved, because it is essential to develop effective methods of synthesizing pesticides, to study the mechanisms of their physiological effect, and to develop methods of breaking them down in order to prevent environmental pollution. Recently a number of institutes of the Academy of Sciences and the academies of sciences of the union republics--the Academy of Sciences Institute of Organic Chemistry, the USSR Academy of Sciences Institute of Organoelemental Compounds, the USSR Academy of Sciences Institute of Bioorganic Chemistry, and the Latvian SSR Academy of Sciences Institute of Organic Synthesis--have proposed for practical use a large number of pesticides (alvison, EOS-117, phenazon, dextramin, oxyamin, toluin, and others) that will undergo state testing. A number of academic institutes are working out highly-sensitive methods of determining residual quantities of pesticides. So far, however the path from the scientific development of a pesticide to its adoption in agricultural practice has been thorny. The herbicide alvison, for example, developed by the USSR Academy of Sciences Institute of Organic Chemistry in 1965, has not yet managed to go through state tests because of departmental conflicts.

It must be pointed out that most pesticides are developed as a result of empirical investigation. But this method is costly, because it requires mass synthesis and mass testing, and according to world statistics an average of only 1 out of every 10,000 compounds finds practical use. It is necessary to develop the scientific principles of the deliberate synthesis of pesticides having specified biological properties. This kind of work is being carried out successfully by the USSR Academy of Sciences Institute of Organoelemental Compounds in collaboration with the USSR Academy of Sciences Institute of Evolutionary Physiology and Biochemistry imeni I. M. Sechenov, the Institute of Bioorganic Chemistry, and the Uzbek SSR Academy of Sciences Institute of Zoology and Parasitology.

Good prospects for agriculture are to be found in the use of physiologically active substances encountered in nature which regulate the growth and behavior of animals. These might be termed third-generation chemical pesticides. For example, very low concentrations of pheromones (sex attractants of high specificity) are capable of attracting insects over great distances. The relative simplicity of their chemical makeup makes it easy to synthesize them and use them either with or without contact insecticides by acting on insect populations (disorienting them). At present, pheromones and their analogues are being successfully used in other countries.



Key:

(a) JUVENILE AND ANTIJUVENILE HORMONES
(b) Juvenile Insect Hormone
(c) Synthetic Analogues of Juvenile Hormone (Jerassy et al., 1972)
(d) Antijuvenile Hormones (Precocens)

Also of great interest are analogues of the juvenile hormone, which breaks up the normal course of development of insects and sterilizes mature specimens; at present a number of countries have started the production of certain analogues of juvenile hormones.

Both in the case of pheromones and juvenile hormones, the research being done in the USSR is lagging far behind research in foreign countries. In particular, research is going too slowly into the chemical nature of pheromones, and field tests of promising hormone compounds are delayed because of the lack of semi-industrial production of them. And although some academic and sector institutes have recently stepped up research efforts along these lines (the USSR Academy of Sciences Institute of Evolutionary Animal Morphology and Ecology imeni A. N. Severtsov, the USSR Academy of Sciences Siberian Department Novosibirsk Institute of Organic Chemistry, and others), the weak material base of these efforts makes it impossible to attain the necessary level.

It is also very important to work out a biological method of controlling farm plant pests. The USSR Acedemy of Sciences and and academies of sciences of the union republics must examine possibilities for expanding the front of scientific research in this problem.

It has been stated that a vital condition for resolving the problem of pesticides and other regulators of growth and development in plants and animals is the formulation and implementation of a prepared works program. Naturally, this program calls for sharply stepping up efforts along these lines in our academy, the intensification of research in existing institutes and laboratories, and the creation of new scientific collectives. In particular, recently the new USSR Academy of Sciences Institute of Physiologically Active Substances was set up near Moscow; one of its main research thrusts is the synthesis and study of new pesticides and pheromones. Plans called for setting up a new academic institute of chemical-biological profile in Saratov, which will deal with the tasks of farm production on the basis of fundamental theoretical research.

However intensively and successfully it develops, however, science by itself cannot resolve the pesticide problem. For this reason, a few words should be said about so-called " small-scale chemistry." This field, for which a suitable designation has not yet been found, is supposed to be engaged in the production of relatively complex and very vital substances--low-tonnage and costly production which frequently changes assortment--that which is called in English "fine chemical industry." In our country this field is lagging badly; it has not worked out its own ideology, has not found its own paths and solutions. Yet this industry--"small-scale chemistry"--must deal with the production of pesticides. We are also not producing enough medicines (their assortment is about five times less than what is needed), and we are not producing enough new semisynthetic antibiotics and synthetic hormonal substances, including those necessary for agriculture; we do not have enough reagents for color and self-developing photography, various stabilizers, antiknock compounds, inhibitors, and so on. The situation is very bad with regard to the production of chemical reagents and biochemical compounds for scientific research. And in all cases, one of the chief reasons is the weakness of "small-scale chemistry," which we might just as well call "small" in the literal sense of the word. It seems to us that this problem deserves prompt discussion on the highest levels; it requires the creation of a new sector built on the basis of relatively small, mobile enterprises with modern equipment that are similar in nature to experimental plants. Such enterprises could be set up within the system of special main administrations in the USSR Ministry of Chemical Industry and the Main Administration of Microbiological Industry or in the framework of a separate department. In connection with this, it is desirable to strengthen and modernize the experimental base of the corresponding academic institutes, bringing it up to the level of the best scientific collectives such as the Latvian SSR Academy of Sciences Institute of Organic Synthesis in Riga, the Armenian SSR Academy of Sciences Institute of Organic Chemistry in Yerevan, or the Ukrainian SSR Academy of Sciences Physical-Chemical Institute in Odessa. The problem of "small-scale chemistry" in our country must be resolved promptly and thoroughly.

The Feeds Base. To improve the level and quality of livestock nutrition it is essential to resolve problems relating to the adoption of full-value diets which are balanced in terms of their amino acid, vitamin, and mineral composition, including synthetic mineral and organic substances. At present, the status of the feeds base is unsatisfactory either in terms of quantity or quality. Especially urgent is the problem of feed protein, which can be largely resolved in the future by sharply increasing the production of corn and grain legumes, expanding feed grass plantings, and improving methods of procuring hay, haylage, and silage. In this case, however, the shortage must be made up through the industrial production of feeds in the form of mineral feed additives and feed yeasts.

Thanks to the efforts of chemists, biologists, and livestock experts in recent years the USSR has created a new chemical industry--the feed phosphate industry. At present the research institutes are working out processes for producing complex feed components containing several elements of animal nutrition, for example phosphates and polyphosphates of carbamide, sodium, and magnesium, with trace elements and physiologically active substances. At present, however, livestock farming demands for feed phosphates are not being fully met.

In addition to mineral feed additives, the lacking protein can be supplied to agriculture in the form of feed yeasts and other products of microbiological synthesis. The task of the microbiology institutions is to provide the theoretical principles of the technology of producing inexpensive feed protein. The scientific and technical conditions for producing microbial protein on hydrocarbons have been explained. A major contribution to this problem was made by the USSR Academy of Sciences Institute of Biochemistry and Physiology of Microorganisms in Pushchino. Production is already underway in the USSR. However, USSR Academy of Sciences institutes will have to collaborate with industry in setting up efforts to create effective technologies for synthesizing microbial protein on hydrogen, organic acids, and alcohols. It is also essential to step up research and technological experimentation in the field of producing and using various kinds of vitamins.

Problems of plant physiology and photosynthesis. The size of crops largely depends on the plant's ability to use the sun's radiation. Generally, however, less than one percent of the physiologically active radiation is utilized; plant photosynthesis productivity could be sharply increased by selecting forms having the most active chloroplasts, and also by modifying the genetic apparatus which controls photosynthesis. It is also very important to determine the most favorable photosynthesis conditions for each crop, to evaluate agrotechnical factors properly, to determine optimal concentrations of carbonic acid, and so on. In addition to thorough theoretical work in the study of the physical and chemical principles of photosynthesis, this research must play a vital role in resolving the problem of improving plant cultivation productivity. It is essential, moreover, that the appropriate institutes of the USSR Academy of Sciences and the republic academies deal with these problems more effectively.

The whole complex of plant physiology research, including problems of plant root nutrition, transport of substances in them, and problems of respiration and resistance to diseases, are of vital importance in influencing plants and controlling their development; they are of crucial importance in correctly forecasting crop yields. Mention must also be made of the importance of work being done to find the optimal conditions of raising plants in hothouses, because excellent results can be achieved in this way. By way of example, let me cite work being done in raising tomatoes in the USSR Academy of Sciences Institute of Plant Physiology imeni K. A. Timiryazev. In plant physiology research, increasing importance attaches to modern methods, including the use of cell and tissue cultures, and this approach is being taken successfully in the USSR Academy of Sciences Institute of Plant Physiology, the USSR Academy of Sciences Siberian Department Siberian Institute of Plant Physiology and Biochemistry, the Ukrainian SSR Academy of Sciences Institute of Botany, the Tadzhik SSR Academy of Sciences Institute of Plant Physiology and Biophysics, the Georgian SSR Academy of Sciences Institute of Plant Biochemistry, and other centers. These efforts deserve full support.

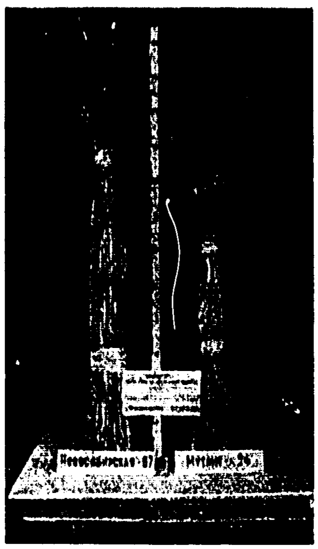
Problems of genetics and selection. The adoption of new varieties and breeds of higher productivity and better quality constitutes the main course of intensification of farm production. Our science deserves a lot of credit, and in connection with this mention must be made of the outstanding work being done by academicians P. P. Luk'yanenko, V. S. Pustovoyt, V. N. Remeslo, N. V. Tsitsin, M. I. Khodzhinov, and many others. But continued efforts must be made. In the future, farm production must be based chiefly on continuous replacement of varieties--every five to seven years. First of all, this will make it possible to rapidly and fully realize the latest advances in the science of selection and genetics; secondly, diseases and pests will not have time to regroup and form populations adapted to the new varieties. Of great importance for agriculture are methods of modern genetic selection worked out by scientists of the USSR Academy of Sciences in collaboration with scientists of VASKhNIL, among which special attention should be paid to experimental and natural mutagenesis, polyploidy, genetically regulated heterosis, and remote hybridization.

The use of these methods has made it possible to introduce a number of varieties into production: Grekum-114, a wheat-quackgrass spring wheat hybrid, Start winter rye, and Otrastayushchaya-38, a wheat grain feed, all developed in the Main Botanical Garden of the USSR Academy of Sciences; Novosibirskaya-67 spring wheat, developed by the USSR Academy of Sciences Siberian Department Institute of Cytology and Genetics; the Vesna variety of early potato developed in the USSR Academy of Sciences Institute of General Genetics; and varieties of wilt-resistant Tashkent cotton developed in the Uzbek SSR Academy of Sciences Institute of Experimental Biology. Also underway is the production propagation of a mutant variety of highly productive semi-dwarf winter wheat, Kiyanka, developed by the Ukrainian SSR Academy of Sciences Institute of Molecular Biology and Genetics. New, highly-productive varieties of wheat, barley, and tobacco have been develped in the USSR Academy of Sciences Institute of Chemical Physics by the method of chemical mutagenesis; they are now undergoing state varieties testing.

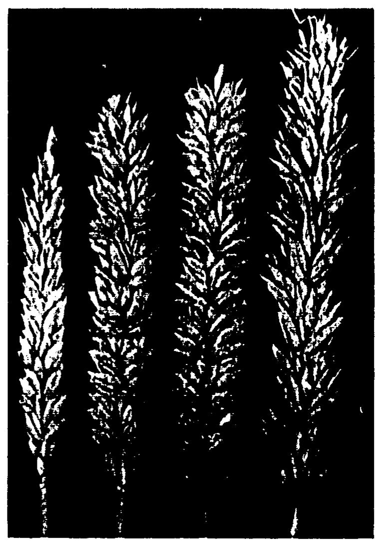
It is also necessary to emphasize the importance of work in remote plant hybridization. Interspecies hybridization makes it possible to create new forms not found in the plant world. Such, for example, is the new crop Triticale, developed by crossing wheat with rye. Triticale successfully combines wheat's high protein content and rye's high lysine content; the crop yield runs as high as 100 to 120 quintals per hectare. It is adaptable to severe conditions such as cold, sandy and acid soils, and rust. In 52 countries, Triticale occupies land totaling about 400,000 hectares; the main centers of cultivation are Mexico, Canada, the United States, and Ethiopia. In the USSR, rye-wheat hybrids were first developed by N. V. Tsitsin in the 1940's. But varieties of Triticale have been subjected to extensive state testing only recently, thanks chiefly to efforts of the Ukrainian Institute of Plant Husbandry, Genetics, and Selection. It would be desirable to intensify these efforts in the institutes of the USSR Academy of Sciences, in order to develop forms of Triticale that are not only highly-productive but also meet agrotechnical standards.

No less important is selective breeding and genetic work in livestock farming. Thus, the interspecies crossing of small, low-milk zebu with milk and meat breeds of cattle has made it possible to develop hybrids of up to 450 kg live weight which are resistant to various kinds of diseases and are distinguished by high productivity. Such work is underway in the Main Botanical Garden of the USSR Academy of Sciences, the Azerbaydzhan SSR Academy of Sciences Institute of Genetics and Selection, and the Georgian SSR Academy of Sciences Institute of Zoology. The work of the USSR Academy of Sciences Siberian Department Institute of Cytology and Genetics on hybridizing domestic swine with wild boars has made it possible to substantially improve the meat qualities and vigor of the hybrids. Unfortunately, we cannot yet say that this work has been widely adopted in practice.

Mention should also be made of mutagenesis. This is a very powerful method which yields excellent results. Radiation mutagenesis has played a vital role in developing new varieties of wheat during the "green revolution." Chemical mutagenesis has also become effective. Mention should also be made of work being done in this field in the USSR Academy of Sciences Institute of Chemical Physics and the Ukrainian SSR Academy of Sciences Institute of Molecular Biology and Genetics. The wide practical adoption of the findings of these institutes will undoubtedly yield substantial economic effect, and the academies of sciences must collaborate with the appropriate departments to speed up the process.



New Varieties of wheat developed by means of modern methods of genetic selection (on the left, Novosibirskaya-67, on the right, Mutant-404).



Triticale--a new farm crop developed by crossing wheat with rye.

In connection with the tasks of agriculture, we will focus on new directions in biology. New discoveries and advances in biology and the appearance of powerful methods of analysis are capable of revolutionizing agricultural science. In cases where such approaches and methods are adopted rapidly, results are not slow in coming. In this regard, the academic scientific institutions are making a large contribution to the intensification of agriculture, and this contribution will continue to grow.

Speaking in Alma-Ata in 1974, CC CPSU General Secretary and USSR Supreme Soviet Presidium Chairman Comrade L. I. Brezhnev said: "Agriculture needs new ideas capable of revolutionizing agricultural production, it needs the constant influx of fundamental knowledge provided by biochemistry, genetics, and molecular biology concerning the nature of plants and animals."

Above all it is necessary to work out new technologies of selective breeding in the shortest possible time, based on the broad use, at all stages of selection, of modern advances in biochemistry and molecular genetics, also mathematical analysis. Up to now, for example, selection has not made adequate use of polymorphous proteins as markers of genes or blocks of genes controlling the variability of economically valuable traits. Experiments carried out in VASKhNIL's All-Union Institute of Selective Breeding and Genetics have shown that a number of wheat and barley chromosomes manifest the phenomenon of multiple allelism of blocks of components of prolamines. It has been found that combinations of these blocks correlate to the quality of the grain, resistance to frost, resistance to diseases, and other properties. This makes it possible on the basis of the genetic formulas of the protein-prolamines, formulas based on recomputation of variants of blocks of components of protein of the line or variety under study, to judge their genotypically determined properties.

Of great practical importance now is molecular-cytogenetic research into the linear differentiation of chromosome structure. Such research was until recently dismissed as merely "academic." Thanks to microscopic determination of structural heterochromatin it has become possible to identify the chromosomes of the most important farm crops. It has been found that each variety of Triticale, wheat, and barley possess a specific karyotype, its own unique combination of morphological traits of the chromosome set. This opens up completely new possibilities for accelerating work in genetics and selective breeding based on the use of theoretically long-familiar methods of chromosome engineering--that is, the deliberate designing of karyotypes having an optimal, preselected array of chromosomes.

In connection with this, great interest attaches to the Morfokvant instrument, developed by the USSR Academy of Sciences of Biological Physics in collaboration with the GDR's Karl Zeiss Jena VEB. This instrument makes it possible in 20 minutes to plot the karyotype (classification chart of the set of chromosomes) of plants, animals or humans. It is, however, necessary to develop simpler and cheaper instruments for chromosome analysis.

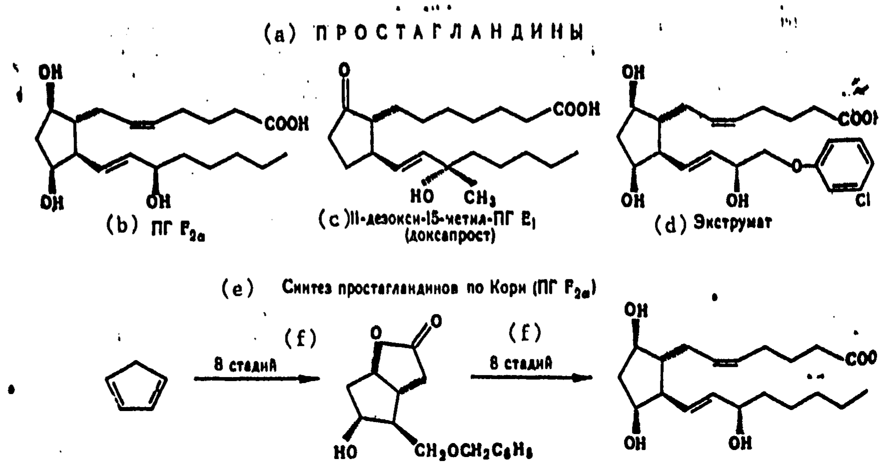
Recent years have seen the intensive adoption of several fundamental and technical advances in embryology and developmental genetics in livestock practice. Specialists have worked out new methods of animal reproduction based on the manipulation of egg cells and embryos. In principle these methods make it possible in a short time to increase herds of valuable breeds of farm animals. The nature of the technology consists of the fact that by means of hormonal treatments it is possible to obtain up to 60 embryos per year instead of just one or two from a single pedigree female. They can then be implanted in non-pedigree females, thus obtaining 20 to 30 calves per season from a single cow. Techniques have been developed for freezing embryos for storage and transport. All of this taken together has created the base for sharply increasing the effectiveness and the pace of pedigree work on the one hand, and for further, more delicate manipulations with farm animal embryos and their genetic apparatus, on the other. Although today's achievements in this regard are just the beginning, and although we are still dealing with relatively simple manipulations, research is proceeding very rapidly, and its adoption in practice promises to yield enormous economic effects in livestock raising.

There are firms adopting these techniques in livestock farming in the United States, Canada, Great Britain, France, Australia, and New Zealand. A number of specialized scientific centers are engaged in further research to create the prerequisites for more refined manipulations with egg cells, embryos, and their nuclear apparatus.

The adoption of the latest advances of cell biology and molecular genetics now underway in this field opens up broad prospects for resolving such problems as sex cloning, genetic manipulation, and so on. A program of fundamental work in this area is in preparation now by the USSR Academy of Sciences in collaboration with VASKhNIL and other departments.

Of great interest to animal husbandry are the prostaglandins, thanks to their high and variegated physiological activity. Prostaglandins are a group of related lipids that are widely dispersed in animal tissues, where they evidently serve as mediators of hormonal action. There are three basic ways to use prostaglandins: enhancement of the effectiveness of artificial insemination of farm animals, synchronization of their sex cycle, and artificial abortion, which is essential in certain pathological situations or, for example, in obtaining karakul. In the near future we can expect the massive use of natural prostaglandins and synthetic analogues of them in livestock farming; this should yield substantial economic effect. In our country, work on producing prostaglandins and using them in livestock farming began only recently and is proceeding very slowly, although in other countries, in particular the United States, prostaglandins are produced by industry and are beginning to be used in agricultural practice.

The mass use of prostaglandins in livestock farming requires methods of full chemical synthesis characterized by technological and patent purity. Successful work is being done in the Latvian SSR Academy of Sciences Institute of Organic Synthesis and the USSR Academy of Medical Sciences Institute of Endocrinology and Hormone Chemistry.



Key:

(a) PROSTAGLANDINS
(b) PG $F_{2\alpha}$
(c) 11-desoxy-15-methyl-PG E_1 (doxaprost)
(d) Extrumat
(e) Synthesis of prostaglandins after Cory (PG $F_{2\alpha}$)
(f) 8 stages

The Interdepartmental Scientific-Technical Council for Problems of Molecular Biology and Molecular Genetics under the State Committee for Science and Technology and USSR Academy of Sciences Presidium has set up a Prostaglandin Program participated in by nine institutes in various departments. It is essential to expand the front of research in this vital agricultural problem.

Large prospects in plant husbandry and possibly livestock farming are to be seen in methods of tissue culture, somatic hybridization, and genetic engineering. In particular, the USSR Academy of Sciences is broadly developing research in subject matter relating to genetic engineering. Altering the fine structure of nucleic acids and replacing some genes with others in a broad systematic range can revolutionize selective breeding, lead to the creation of completely new forms, and open up possibilities of programming the form-physiological characteristics of organisms. Also in the offing are such experiments as restructuring the genetic apparatus by "shifting" genes from one organism to another; this is already being done with microorganisms. Such work is being carried out in a number of institutes of the USSR Academy of Sciences, and it must be intensified.

Research in molecular biology and molecular genetics constitutes one of the cornerstones in today's biology, and consequently it is an essential basis for scientific agricultural operation. But such research requires that the institutes be provided with modern scientific equipment and reagents. Our industry, however, is not yet providing enough instruments or reagents. A CC CPSU and USSR Council of Ministers decree on molecular biology and molecular genetics in 1974 called for measures to develop Soviet scientific instrument making. Scientific and design organizations of the USSR Academy of Sciences and certain other departments have developed a number of instruments meeting today's high standards, but the organization of series production of new equipment has run up against unsurmountable difficulties. The Ministry of Instrument Making and a number of other departments which were supposed to institute the production of such equipment do not have available production capacities; meanwhile, construction has not begun on a single instrument making plant as stipulated in the decree. As a result, the USSR Academy of Sciences has been obliged to begin the construction of its own plants in order to resolve the problem at least partially.

It seems to me that the problem of carrying out the CC CPSU and the USSR Council of Ministers decree "Measures to Develop Scientific Research in Molecular Biology and Molecular Genetics and use their Advances in the National Economy" requires special discussion. This decree has brought enormous benefits to our biology and our science in general; it has made it possible to take the lead in several directions of biology and progress in many areas of agricultural and medical practice.

The storage and processing of agricultural products. The problem of reducing losses of farm products during transporting, storage, and processing was urgently raised at the November 1978 CC CPSU Plenum; it was the object of special attention in the speech at the plenum by Comrade L. I. Brezhnev.

With regard to the development of new technologies for storing grain and other products, one promising direction is the use of special accelerators capable of detoxifying grain products rapidly, chiefly by rapidly breaking down pesticide residues. The first models of such accelerators are already in operation, and further research needs to be done. It is also necessary to perfect drying processes so as to determine in each specific case, on the basis of detailed study, optimal, sufficiently mild and at the same time effective operating conditions which will not harm the germination of the seed, the quality of the protein components, and so on. Mention must be made here of the work of the USSR Academy of Sciences Institute of Biochemistry imeni A N. Bakh; this institute has developed methods of active ventilation for the storage of potatoes and vegetables. The USSR Academy of Sciences Institute of Petrochemical Synthesis has proposed semipermeable polymer film which is very effective in controlling the gas mixture in storage facilities. A number of institutes of the Ukrainian SSR Academy of Sciences in collaboration with the Scientific-Research Institute of the Sugar Industry of the Ministry of Food Industry have worked out a new method of storing sugar beets.

Mention should also be made of the necessity of developing high-speed automatic methods of evaluating and monitoring the finished product: the level of protein, toxicity, weed infestation, and so on. Many of these operations are now carried out by hand, although it would be best to use new methods involving computers.

Mechanization and automation. In terms of the production of tractors and farm machinery, our country holds first place in the world. Nevertheless, the fleet and nomenclature of tractors and farm machinery is still inadequate to provide integrated mechanization of all agricultural processes. For this reason, it is essential to further boost the productive potential of the machine building industry and to substantially improve the quality of the equipment being produced. These are especially urgent problems because of our agricultures's unfavorable labor situation.

There are many problems which have not yet been resolved by the agricultural machinery industry: increasing the durability and wear-resistance, using the latest methods of disgnostics, using new materials and coatings, using more effective systems and components, manipulators and robots, reducing the consumption of fuel and lubricants, and so on. The amount of metal used in making our farm machinery, as a rule, is substantially greater than in foreign models. Some kinds of farm equipment, in particular many types of combines, are too complicated and are not equipped with standard, easily interchangeable components; as a result, repair costs exceed permissable normatives. In terms of convenience, controls, and comfort our tractor cabs lag behind similar models of foreign make.

It is essential to find solutions to problems of mechanization and automation of processes of transporting, storage, and processing of farm products. This involves the development of automated plants to process grain and produce combination feeds, improvement of systems of in-plant transport, and, finally, the development of more effective technologies in the milling of flour and the manufacture of combination feeds.

Many problems that have not been resolved within the agricultural machinery industry frequently turn out to have been solved in other machine building sectors, and this experience ought to be utilized. However, the extensive dissemination of this experience and the application of the latest advances of science and technology, it seems to us, are hampered by the lack of a base institute within the USSR Academy of Sciences to deal with problems of machine building, a base capable of coordinating these efforts and directing them, in particular, into widespread use in agriculture. Very likely such an institute ought to be organized in the near future within the USSR Academy of Sciences.

Agricultural economics. The decree of the July 1978 CC CPSU Plenum notes the necessity of focusing attention on problems of agricultural economics, of improving the effectiveness of production and reducing product prime cost, on perfecting economic relations among sectors of the agroindustrial complex. At present, the process of forming this complex is proceeding without adequate scientific substantiation; for this reason, there is a clear lack of balance in its development. In particular, most of the workers employed by the agroindustrial complex are involved directly in agriculture. They amount to 61 percent of the total, while only 7 percent are engaged in the production of industrial means of production, and 32 percent are engaged in transport, storage, processing, and the sale of finished goods. This distribution cannot be considered optimal.

Institutions of the USSR Academy of Sciences are collaborating with institutes in other departments on important research in the field of the economics of agricultural production and, in particular, they are taking part in formulating problems of the future agroindustrial complex as stipulated in the integrated program of scientific-technical progress. But it is worthwhile to examine the question of strengthening the corresponding subunits in the key economic institutes, including in the union republics and the scientific centers of the Urals, Siberia, and the Far East, so that the contribution of the USSR Academy of Sciences can be substantial.

Very large problems will have to be resolved. In particular, the problem of labor supply is extremely important to the development of the agriculture in many areas of the country. I should also like to emphasize the necessity of fundamentally improving forms of organization of labor and wages for workers in agriculture and related sectors, also resolving a large number of tasks of a social nature. One serious problem is price formation on farm equipment and spare parts. We can state definitely that the resolution of these problems will largely determine the effectiveness of farm production in our country.

It is hardly possible to cover all problems relating to scientific-technical progress in agriculture and the application of fundamental scientific advances in this area. But we may already conclude that the problem we are discussing today is unusually complex and is of priority importance to our state. For this reason, the USSR Academy of Sciences must step up its efforts along these lines; it must above all strengthen its own ranks, refine and coordinate the thematics of its work, lay down the exact time tables for carrying the work out, and strengthen their base in the corresponding institutes of the USSR Academy of Sciences and the academies of sciences of the union republics. In order that the discussion at this session may lead to specific results, we propose that the works program of the USSR Academy of Sciences "Scientific Principles of Agriculture" for 1975-1985 be approved and that the work being done in the program be given priority importance. In the long run this document must reflect the development of the basic directions in science for the sake of agriculture, with the participation of institutes of the USSR Academy of

Sciences, the USSR Ministry of Agriculture, VASKhNIL, the Ministry of Chemical Industry, the Main Administration of Microbiology Industry, and other departments. A preliminary variant of this program has been worked out with the participation of departments of the USSR Academy of Sciences and is kept in the USSR Academy of Sciences Presidium. But the actual problems and tasks must be made more specific. The program should not incorporate all possible problems but only the most important economic problems in which the contribution of the academic institutions can be decisive. It is also advisable to provide for a special system to coordinate and control the research incorporated in the program.

In addition, it is advisable to specially earmark appropriations for the agricultural works program and provide for priority financing of the most important projects and problems. As a result of implementing such a program, undoubtedly, the USSR Academy of Sciences will make a substantial contribution toward boosting agriculture in our country. Both in spirit and in content, such a program will be consistent with the decisions of the November 1978 CC CPSU Plenum, at which Comrade L. I. Brezhnev said: "Fundamentally new scientific ideas and technical solutions, the concentration of efforts on key problems of the development of the national economy--these must be the focus of the efforts of our scientists, the USSR Academy of Sciences, and the State Committee for Science and Technology."

Members of the USSR Academy of Sciences assure the CC CPSU, the Soviet government, and CC CPSU General Secretary and USSR Supreme Soviet Presidium Chairman Comrade L. I. Brezhnev that our country's scientists will exert all their creative strength and knowledge to resolve the big tasks facing our agriculture; they will accomplish new goals in developing fundamental science and using its advances in practice; they will gratify their great Homeland with new discoveries and accomplishments for the good of our people, for the sake of peace, progress, and happiness on earth.

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TASKS OF AGRICULTURAL SCIENCE IN LIGHT OF THE DECISIONS OF THE JULY 1978 CC CPSU PLENUM

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 43-53

[Report by VASKhNIL President Academician P. P. Vavilov]

[Text] Our party is focusing constant attention on the country's agriculture and scientific research in this sector and manifesting constant concern for its development. New proof of this is seen in the report by CC CPSU General Secretary and USSR Supreme Soviet Presidium Chairman Comrade L. I. Brezhnev at the July 1978 CC CPSU Plenum and the decisions adopted there.

Formulation of the multiple problems of accelerating scientific-technical progress in agriculture has become so urgent that it has become necessary to focus the efforts of scientists in a variety of scientific disciplines in this direction. We face the task of substantially boosting the effectiveness of scientific research that will assure progress in agricultural development. The resolution of this task in the near future will be the focus of research work of both agrarian scientists and scientists in many other specialties.

I will dwell on several problems of agricultural science in light of the decisions of the July 1978 CC CPSU Plenum.

As is well known, the development of new varieties and hybrids is a powerful means of upgrading the effectiveness of farm production. In recent years, academicians P. P. Luk'yanenko and V. N. Remeslo, VASKhNIL Academician D. A. Dolgushin, VASKhNIL corresponding members I. Ya. Kalinenko and Yu. V. Puchkov, and others have developed and adopted in agricultural practice such high-yield varieties of winter wheat as Mironovskaya Yubileynaya, Odesskaya-51, Dneprovskaya-775, Krasnodarskaya-39, Severodonskaya, Il'ichevka, and many others which under high cropping techniques yield 60 to 70 quintals of grain per hectare (more than 80 quintals under irrigation).

In 1979, winter wheat varieties with shortened stalk will go into production; these are known as semidwarf, are not subject to lodging, and have a potential yield of up to 100 quintals per hectare (Polukarlikovaya-49, Odesskaya

Polukarlikovaya, Odesskaya-75, and Mironovskaya Nizkoroslaya). VASKhNIL Academician P. F. Garkavyy is completing work on the development of new, lodging-resistant varieties of spring barley, including six-row varieties with yields of 60 to 70 quintals per hectare. For example, the six-row barley variety Pallidum-90 on the Dondizhan State Varieties Testing Plot in Moldavia this year yielded 82.8 quintals of grain per hectare, surpassing the zone adapted varieties by 17.4 quintals.

On the basis of the mutant YeM-1, the Bashkir Scientific Research Institute of Grain Farming for the first time produced the short-stalk winter rye variety Chulpan, and the All-Union Institute of Plant Husbandry produced the Malysh-72; the stalk in these varieties is twice as short as in the older varieties--they are practically invulnerable to lodging and have potential yields of 50 to 60 quintals per hectare.

Selective breeding of spring wheat has become considerably activated. Recent years have seen the zone-adaptation of highly-productive varieties of this crop such as Saratovskaya-46, Saratovskaya-52, Tselinnaya-20, Sibiryachka-4, Omskaya-9, and others.

Breeders have developed millet varieties characterized by high panicle grain content and resistance to diseases producing yields of 80 to 90 quintals per hectare. In recent years they have developed rice varieties with yields as high as 100 quintals or more per hectare. Thus, the new variety Spalchik on the Krasnoperokopsk Varieties Testing Plot in Krymskaya Oblast in 1977 yielded 109.9 quintals per hectare, while the Solnechnyy variety on the Kharabali Varieties Testing Plot in Astrakhanskaya Oblast yielded 95.5 quintals. Advances have been made in the selection of corn, sunflowers, sugar beets, cotton, vegetables, and other crops.

We can state with confidence that in the selection of a number of crops our country holds a leading place in the world. But the present level is by no means up to current production requirements. It is sufficient to note that three varieties of winter wheat--Mironovskaya-808, Bezostaya-1, and Odesskaya-51--occupy about 70 percent of all areas planted in this crop in the USSR. These are unquestionably good varieties, but even their extensive adaptive capabilities are not able to assure maximum crop yields given the considerable variation in soil and climatic conditions in zones where they are cultivated. Practically all varieties of winter and spring wheat are susceptible to such diseases as stem and brown rust, root rot, powdery mildew, and others.

The situation is especially bad with respect to heterotic selection. We do not yet have in production sunflower hybrids and sugar beet hybrids based on cytoplasmic male sterility; we have a limited array of highly-productive early-ripening, medium-ripening, and late-ripening corn hybrids. We are not making adequate use of the heterosis effect in the selection of grain and especially feed crops. We are not finding adequate solutions to the problem of developing varieties of field crops having complex immunity and tolerance to the most aggressive diseases and pests. Selective breeding to improve crop quality is not proceeding fast enough. It has now become necessary to substantially intensify the selection process, to develop varieties and hybrids through the use of modern advances in genetics, molecular biology, molecular genetics, biochemistry, physiology, and other sciences. It is essential to substantially shorten the time it takes to develop new varieties and in the next few years reach a level of planned design of genotypes in accordance with a preset program. This entails substantially strengthening theoretical research carried out in scientific institutions of the USSR Academy of Sciences and VASKhNIL designed to resolve applied tasks of selective breeding.

The most valuable practical results can be expected along the following lines. Above all we must develop more effective methods of transferring genetic information from one plant genotype to another on the intraspecies and interspecies levels--that is, it is necessary to develop chromosome engineering. The long-term nature of such work is indicated by the research of Academician N. V. Tsitsin, who has developed a series of wheat-quackgrass, wheat-rye, and wheat-wildrye hybrids combining useful properties of different species in a single genotype.

We must step up efforts to develop the directed transfer of chromosomes from one variety to another by means of aneuploid series. The Krasnodar Scientific Research Institute of Agriculture has already produced lines of Bezostaya-1, in which individual chromosomes have been replaced by chromosomes of the highly frost-resistant variety Al'bidum-114. Similar work is underway with other varieties in the All-Union Selection-Genetic Institute and the Siberian Scientific-Research Institute of Agriculture. The All-Union Institute of Plant Husbandry has developed 42-chromosome allohexaploids of wheat (by crossing 28-chromosome species with einkorn), which are distinguished by high resistance to fungous diseases.

Polypoidy is a very promising line of research. In this field we have already achieved some success for a number of crops. Another promising technique is that of transferring the nuclear apparatus of one species into the cytoplasm of another. It has been demonstrated, for example, that the cytoplasm of soft wheat has a marked effect on certain traits of alloplasmic rye.

Broad possibilities are opening up to chromosome engineering in connection with the development of methods of embryoculture and the production of protoplasts and suspension cell culture. Breeders have developed wheat-barley and rye-barley hybrids. They are resolving many problems of combining in a single genotype genetic material from various species. Obviously, it is now time to combine the efforts of the scientists of the USSR Academy of Sciences and VASKhNIL in order to speed up the development of methods of chromosome engineering that are vital in resolving problems of practical selective breeding.

In order to develop heterotic selection, it is extremely important to have effective methods of forecasting heterosis in plants. Scientists have already done a great deal in this regard. Up to now, however, all heterotic selection has been based on conducting a large number of test cross breedings to determine genotypes having high combinatorial capability. This severely complicates efforts to develop valuable lines and highly-heterotic hybrids.

Substantial efforts are required of researchers in order to work out the theoretical principles of selecting plants to optimalize the selection process, including on the basis of active utilization of artificial climate. Here a major factor is work in the field of evolution and population genetics. In connection with this, I will focus briefly on possibilities of substantially expanding efforts in biochemical genetics.

As is well known, the primary product of the activity of genes or blocks of genes after transcription and translation is the polypeptides. Methods of separating and identifying protein molecules have been thoroughly worked out, opening up broad prospects for the extensive use of proteins as markers or signals (to use A. S. Serebrovski's terminology) of genes or blocks of genes conditioning the variability of economically useful traits and properties.

Theoretically important and practically valuable results in this regard have been achieved in the All-Union Selection Genetics Institute.

Because of our severe climate which is unstable over large areas, special importance attaches to selective breeding to increase frost-resistance, winter-hardiness, drought-resistance, and so on in farm crops. We must confess, unfortunately, that for many crops almost all new varieties of intensive type are less resistant to stress factors than the old aboriginal varieties. This involves the influence of a number of factors, in particular a certain negative correlation which is physiologically-genetically conditioned. But research in recent years has shown that in principle it is possible to combine high yields, frost-resistance, and drought-resistance in a single genotype. But realizing these possibilities will require special, integrated research.

In connection with the implementation of measures mapped out by the party to substantially boost deliveries of mineral fertilizer, a new problem has appeared on the agenda; directed development of varieties distinguished by the ability to make more effective use of mineral nutrients to build up an economically valuable crop. In resolving this problem, a key role is played by mineral plant nutrition genetics. This is a new line in biological science, and we intend to develop it in every way.

Among the most important long-range problems, mention must be made of the use of suspension cell culture in selection work. In essence, biological and selective breeding science stand on the threshhold of selecting valuable mutations and recombinants on the level of individual cells for subsequent regeneration and the production of fruit bearing plants.

Work along these lines is already underway in this country, but it is not developing fast enough. It is now necessary to combine the efforts of scientists in working out methods of suspension cell selection for such crops as wheat, corn, barley, soy, potatoes, and feed crops. The prospects of using these methods in selective breeding, especially for resistance to certain pathogenes, pesticides, salt buildup, and frost, are extremely high. The resolution of this task requires cadres, equipment, and reagents.

Unfortunately, hopes for qualitative advances in plant selection on the basis of using methods of genetic engineering on the level of manipulating fragments of DNA molecules are not being realized fast enough. But we are convinced that this problem will be solved successfully through the joint efforts of the scientists of our academies.

In the field of selective breeding for immunity, special importance attaches to studying the nature of non-specific resistance to pathogenes. Practical work has shown that the development of varieties having only what is known as vertical or race-specific resistance give rise to rapid adaptation and then increased virulence of the pathogene to genotypes having this type of resistance. A clear example is seen in the history of the Avrora and Kavkaz varieties. We need varieties possessing stable resistance to the most aggressive diseases. Very likely a big step forward in resolving this problem can be made by speeding up the formulation of the hypothesis concerning the link between plant resistance and the formation of phytoalexins. In any case, theoretical solutions in the field of studying the genetic nature of plant resistance to pathogenes and tolerance to pests are coming to be of increasing importance in selective breeding.

Let me inform you that our country has organized 44 selective breeding centers dealing with grain, legume, and feed crops. They are setting up (with difficulty, to be sure) the necessary conditions for selective breeding at the present level.

In the project planning of the complicated facilities for selective breeding centers, VASKhNIL is getting considerable aid from the USSR Academy of Sciences GIPRONII [All-Union State Project-Planning and Scientific-Research Institute for the Project-Planning of Scientific-Research Institutes, Laboratories, and Scientific Centers of the USSR Academy of Sciences and the Union Republic Academies of Sciences] for which we are sincerely grateful. Hothouses, phytotrons and facilities for processing selection material are being built; complicated scientific equipment has been installed and is in operation. All of this is making it possible to raise the question of developing essentially new technology for the selection process based on the active use of artificial climate conditions, and especially the use of modern advances in the natural sciences. In particular, the All-Union Genetics Institute in Odessa has completed the construction of the world's largest phytotron. We hope that scientists of the USSR Academy of Sciences will take active part in intensifying Soviet selection work. We are now building up real possibilities for qualitative changes in such work. The presidium of VASKhNIL is ascribing special importance to this research and will take the necessary measures to implement it.

Particular conditions are necessary to realize the potentials of the new varieties. They are being created on the basis of the use of modern technologies of crop cultivation. The conversion of plant husbandry to an industrial basis entails the necessity of developing technologies which will make it possible to produce high, stable yields per unit of land area at minimal cost. In developing such technologies, the scientists are encountering considerable difficulties. The fact is that modern technology combines in itself achievements in many sciences and technical progress. Complex problems arise at the interface of biology and the technical sciences, problems of protecting the environment, and so on. For example, increased doses of fertilizer strengthen the development of weed vegetation. Agrotechnical means of controlling weeds are by no means always effective. We need a broad spectrum of herbicides which suppress the weeds without having a negative impact on the crops and the environment. This has already been discussed by Agriculture Minister V. K. Mesyats and Academician Yu. A. Ovchinnikov. This problem is at the interface of biology and chemistry. Increasing the vigor of soil cultivation gives rise to rapid development of aerobic processes, which result in reduced potential soil fertility and the loss of nutrients. For this reason, it is very important to take an integrated approach to the development of new technologies of cultivating crop plants.

It is very important not to allow the development of bottlenecks in the sequence of techniques designed to produce high, stable crop yields. We hope that in the future the agrarian scientists will collaborate more actively with scientists working in various fields to resolve problems of plant husbandry.

A rational system of land cultivation serves as the long-term basis of plant husbandry development. Our scientists have made substantial successes in working out land cultivation systems.

In the field of land cultivation and its chemicalization, the efforts of scientists must be focused on the theoretical study of the physical, chemical, physiochemical, and biological processes taking place in the soil, on studying the soil's organic matter, development of the physiochemical mechanics of earth and soil systems (with the end goal of developing soil classification and methods of improving fertility), on the study of the moisture cycle and the water balance in the main farming zones of the country, on forecasting the level of soil fertility, and on working out ways to make rational use of land resources.

It is essential to scientifically substantiate and work out the optimal variant of agricultural zoning of the Soviet Union's territory.

The basic direction of scientific-technical progress in land cultivation and further intensification of this sector of agriculture will be the adoption of specialized crop rotation cycles, the improvement of soil fertility through the broad use of mineral and organic fertilizers, the liming of acid soils and gypsuming of alkaline soils, also the adoption of advanced cropping techniques in the cultivation of farm crops.

In connection with this, special importance attaches to more thorough formulation of the theory of mineral plant nutrition (relations between the root system and the soil solution, the mechanism by which mineral nutrients enter the plants and are converted there) and the study of nutrient metabolism in land cultivation.

Specialization and concentration of farm production obliges us to take a new approach to the structure of crop rotation cycles. The scientific institutions especially, must study problems of saturating specialized crop rotation cycles with key crops in each zone, subzone, and oblast and make appropriate recommendations. This will make it possible to obtain the maximum yield of high-quality output with minimal outlays of labor and funds and ensure expanded reproduction of soil fertility.

In arid regions of the country, the most effective means of ensuring high and stable grain crop yields is to include bare fallow in the rotation cycles. According to scientific data, the production of grain in areas of insufficient and unstable moisture is possible only under conditions of correct proportions between grain crop plantings and the bare fallow. Unjustified reduction of the bare fallow area brings about disruption of the grain fallow crop rotation cycle and leads to a slowing of the rate of growth of gross grain harvests in a number of farming areas of the country and to increased losses of grain crops. In the future we must spread the use of intensive crop rotation cycles which make it possible to harvest 1.5 crops per year in the southern parts of the European USSR and 2 or 3 crops on irrigated lands through the adoption of secondary sowing. In zones of sufficient moisture and on irrigated and drained lands, areas under perennial leguminous grasses in crop rotation cycles must be maintained at 20 to 25 percent.

In connection with intensification of agriculture, great importance attaches to strengthened theoretical and applied research into problems of mechanical soil cultivation. In the forefront of efforts in recent years is the search for ways to minimize soil cultivation without reducing crop yields. It is essential to continue research in the following basic lines of this problem: reduction in the number and depth of cultivation; combination of technological operations in a single process; reduction in the number of operations by developing unit equipment and combine machinery; reduction of the negative effect of the machinery's running gear on the soil and crops; reduction of the surface of the cultivated fields.

In areas of North Kazakahstan and Siberia, more than 31 million hectares are under a soil protection system developed by the All-Union Scientific-Research Institute of Grain Farming under the supervision of VASKhNIL Academician A. I. Barayev. This has made it possible to halt wind erosion in many areas, create conditions for moisture accumulation in the soil, boost the yields of various grain crops, and thus ensure an additional harvest of 5 to 6 million tons of grain every year in that area.

Under intensified farm production, water erosion has risen substantially; on eroded soils, crop yields, as is well known, decline by 50 and sometime 80 percent. About 38 million tons of nutrients are washed away every year. The annual loss due to soil erosion in the country exceeds ten billion rubles. We have a great deal of work to do in this regard. Almost 80 percent of our country's farm lands are to some extent subject to erosion. The problem of soil protection is an urgent one. It is essential to focus scientists' efforts on finding integrated solutions.

Of great importance to boosting the productivity of land cultivation in the southeastern zone of the country is the reclamation of alkaline lands, which add up to more than 100 million hectares. VASKhNIL research has shown that about 18 to 20 million hectares of such land could be rehabilitated and used to raise chiefly feed crops. This will require integrated research into chemical processes taking place under mechanical reclamation of alkaline soils; it will be necessary to study the effects of gypsum in alkaline soils of various types, the nature of hydrological cycle processes and so on. This complex, integrated task will require the joint efforts of scientists in various specialties.

The soils have begun to build up an excess quantity of nitrates introduced along with mineral fertilizers, also nitrification of the ammonia of livestock farm runoff. Nitrates are easily leached out and contaminate the environment. For this reason, it is of great practical importance to work on the problem of inhibiting microbial nitrification.

Also of great importance is research into the role played by micro-organisms in what happens to mineral fertilizer in the soil. It is also necessary to study micro-organisms capable of mobilizing the phosphorus of mineral and organic compounds that are not easily accessible. The microbiologists face a serious task--that of determining the ways of microbial degradation of organic matter discharged along with industrial and household wastes, also those that enter the soil when plants are treated with pesticides.

As V. K. Mesyats has stated, in the next few years the microbiologists wil have to make a substantial contribution toward resolving the problem of feed protein through intensification of biological nitrogen-fixation.

A basic goal of research designed to boost feed production must be future maximum intensification of field feed production on the basis of increased yields of feed crops, improvements of the structure of crop planting, and most productive possible use of plowed land through the use of intermediate crops making it possible, in areas of sufficient moisture or under irrigation, to produce several crops per year on the same land. At present, resolution of the feed problem depends more on organizational-economic measures than on scientific research.

Under conditions of concentration and specialization of farm production, when high-yield crops are being cultivated on large areas, a scientifically-substantiated system of plant protection plays an increasing role. In recent years, despite the increasing use of pesticides, grain shortfalls have been increasing because of root rot, powdery mildew, rust, and enzyme-mycotic depletion of the plants. It is of great importance in the system of plant protection, therefore, not just to destroy harmful types of organisms but to suppress and inhibit their population through the integrated use of chemical, biological, and agrotechnical methods. In this regard, we are not doing sufficient research. The development of integrated control systems combining all methods and taking account of the economic threshholds of disease and pest harmfulness is one of the main problems facing science in plant protection.

And, as follows from the decisions of the July 1978 CC CPSU Plenum, we must not slacken efforts to improve the chemical method of controlling harmful organisms and to find highly-effective and safe pesticides. Research being conducted along these lines by institutes of the chemical industry is not adequate. For example, the All-Union Scientific Research Institute of Chemical Means of Plant Protection has recommended hardly a single compound for practical use in recent years. The development of herbicides is lagging especially badly. Our situation with regard to herbicides and defoliants is especially bad. Institutes of the USSR Academy of Sciences and the USSR Ministry of Chemical Industry must take more active part in developing new compounds. It is essential to expand efforts to develop new, perfected forms of pesticides and advanced methods of applying them. Special attention must be focused on the development and adoption of biological methods of controlling harmful organisms in agriculture.

As Academician Yu. A. Ovchinnikov mentioned in his report, good prospects are to be found in new lines of research based on the use of biologically active substances such as hormones, pheromones, and others which control the growth, development and behavior of insects. Research has shown that substantial success has already been achieved in this regard, but the lack of modern equipment and instruments has been hampering research. Meanwhile, the use of pheromones yields substantial economic effect (reducing the number of chemical treatments by two or three times).

An important reserve for reducing crop losses is the organization of virus-free seed breeding for potatoes and vegetables and the creation of healthy conditions for fruits and berries that are frequently subject to virus infection.

It is essential to focus more attention on the development of agrotechnical methods of protecting plants against pests, diseases, and weeds. High-quality land cultivation and advanced technologies in crop cultivation constitute the basis of an integrated system of plant protection. It is important to work out more effective systems of plant protection on the basis of zonal systems of land cultivation and the latest scientific and practical advances with regard to the characteristics of development of farm production under conditions of concentration and specialization.

In the field of land reclamation, science faces the tasks of seeking out ways to boost the productivity of reclaimed land and developing methods of reducing water losses in irrigation and measures to protect the environment when building land reclamation projects.

But the main direction in research on problems of irrigation and land drainage, in our opinion, must include the development of methods of controlling the growth and development of farm crops in all stages of life. This will help to maximally optimalize the basic factors of the plant's life and make the fullest possible determination and utilization of the plant's biological potential. The initial stage should be to work on programming farm crop yields under conditions in which the two basic factors of plant life are regulated: water and nutrition. This kind of effort, carried out by the USSR Academy of Sciences and VASKhNIL deserves encouragement.

Modern integrated land reclamation measures are characterized by conversion to steady control of the growth and development of plants by regulating not only the water and nutrient conditions of the soil and the phytoclimate but also the soil's heat and gas conditions, also the plant's physiological processes. This problem is a vast one, and its solution will involve the efforts of specialists in various scientific fields.

Crucial tasks involved with improving the productivity of the forests and improving their qualitative composition face scientists in forestry. From the agricultural standpoint, great importance attaches to research into the environmental-protection and environmental-formation role played by natural and man-made forests within the complex of measures designed to boost the effectiveness of agricultural production, also research dealing with determining the social role played by protective forest plantings and their significance in efforts to combat drought, dry winds, and wind and water erosion of the soil. In this regard, the scientific institutions of the USSR Academy of Sciences can provide invaluable aid both to agricultural science and farm production.

Implementation of the party's master plan to further enhance the people's wellbeing largely depends on the development of livestock farming. The July 1978 CC CPSU Plenum noted that the present level of livestock development is not keeping pace with the rapidly rising needs of the people.

The overall direction of development in this sector is the conversion to industrial technologies of the production of meat, milk, eggs, and so on. In connection with this, the livestock breeders face the task of quickly developing breeds and strains of farm animals that are adaptable to such technologies. It is also necessary to work out improved methods of accelerating the development of new breeds, strains, types, and hybrids of farm animals, methods of early prognosis of animal productivity and recommendations on the use of these methods in selective breeding and hybridization on the basis of modern advances in population genetics, the analysis of genetic information by means of computers, and more precise methods of evaluating a genotype by means of modern selection technology. Life itself demands expanded research in problems of livestock selection designed to develop genetic immunity to a number of widespread diseases (leucosis, mastitis, and others) and to enhance the reproductive capabilities of animals and improve the quality of livestock products. Still not completely resolved are problems of selecting livestock for fast maturation and increased productivity.

Special importance attaches to the cycle of research and applications in the theory and methods of breeding livestock specialized for meat production, the development of new high-yield breeds of meat livestock adapted to specific natural and climatic conditions. It is essential to step up scientific effort in the theory of heterosis and the system of cross breeding making more extensive use of world genetic resources (in particular, Holstein Frisian cattle) in order to improve breeds of farm animals that are most widespread in this country.

Very promising at present is exploratory research on developing methods of cloning, genetic copying of farm animals by means of modern cytogenetic and transplantation methods.

In the field of feeding farm animals, more efforts must be made in research designed to improve the animals' assimilation of nutrients, especially protein, to raise the coefficient of feed nutrient transformation into high-quality livestock products. It is worthwhile to expand research into the microbiology of rumen digestion among ruminants in order to improve the effectiveness of the animals' assimilation of nutrients from coarse feeds, including straw, which in terms of the volume of annual production of organic matter constitutes an enormous and still inadequately utilized reserve for the production of livestock products.

It is very important to seek out new, nontraditional sources of feeds based on products of chemical and microbiological synthesis.

It is necessary to complete work on determining optimal dimensions of livestock complexes of various types in all zones of the country and to make specific scientific recommendations on problems of organizing technological processes and the recovery and proper use of livestock complex wastes.

It should be stated that in the years of Soviet rule our veterinary science, especially in recent decades, has made considerable success, for which our scientists in this field deserve much thanks. Nevertheless, the conversion of livestock farming to an industrial basis brings up many big new tasks. Special attention must be focused on developing systems to prevent animal diseases under conditions of large livestock farms.

Labor productivity in agriculture will in the future be largely determined by its level of mechanization and automation. Research by VASKhNIL scientists in the field of mechanization, electrification, and automation of agriculture in the next few years must be focused on developing and creating new technologies and technical means necessary to convert all farm sectors to an industrial basis. It is necessary to develop new-generation machinery that is 2 to 2.5 times more productive than present designs.

It is essential to design models of machinery complexes for the production and processing of livestock products. In the electromechanization of livestock farming, basic research should look for optimal methods of automating the operation of technological processes not only in industrial livestock complexes but in large kolkhoz and sovkhoz farm units.

Research by scientists of VASKhNIL and other departments must also promote accelerated development of new equipment for agriculture through the formulation of integrated, goal-directed economic programs.

The tasks of agroeconomic science in the 10th Five Year Plan and the longer-term future are mapped out in the decisions of the 25th CPSU Congress, CC CPSU plenums, and the CC CPSU and USSR Council of Ministers decree "Measures to Further Improve the Effectiveness of Agricultural Science and Strengthen Its Ties With Production" dated 26 August 1976.

I should like here to emphasize that agrarian economists must focus attention on more thorough formulation of problems of specialization and concentration of farm production on the basis of interfarm cooperation and agroindustrial integration, on theoretical and practical substantiation of optimal levels of concentration of specialized production, on formulation of the basic directions of systematic and proportional development of agriculture in conjunction with other sectors of the agroindustrial complex. Extremely great importance attaches to research designed to improve economic incentives to develop farm production, to equalize economic conditions of management, and also to improve price formation and cost-accounting relations on kolkhozes and sovkhozes and in interfarm and agroindustrial associations. It is essential to study the social aspects of agricultural development and certain other problems.

It must be acknowledged that in these respects, unfortunately, we do not yet have sufficiently precise, clear, and thorough theoretical solutions. Agrarian economists have published many books, pamphlets, and articles summarizing what has been done in practice, but what is really required of the scientists is illumination of ways to further develop these processes.

We believe that these problems must be the focus of attention of the agrarian economists, VASKhNIL's Presidium, and sector and regional departments of VASKhNIL, because they are of fundamental importance to agricultural development and Soviet society as a whole. The difficulty and complexity of these problems lies in the fact that there is a lack not only of well-trodden roads but even footpaths. There is practically no one we can turn to for help in this regard; we have to work out these problems from scratch, and in a vigorous manner. For this reason, the resolution of all agrarian-economic problems must involve the active participation of scientists not only in VASKhNIL but also in the institutes of economics of the USSR Academy of Sciences and the academies of sciences of the union republics and the institutes of the agricultureal ministries.

Not having the possibility of dwelling in detail on all the problems facing the scientists of VASKhNIL and the USSR Ministry of Agriculture in light of the decisions of the July 1978 CC CPSU Plenum, I have named just the basic ones as well as those which should be worked out in creative collaboration with scientists of VASKhNIL and the USSR Academy of Sciences.

It should be noted that collaboration between the USSR Academy of Sciences and VASKhNIL has been expanded in recent times. I am convinced that by joining our efforts we can resolve the tasks the party has assigned to science in the field of agriculture.

We must also step up research efforts in problems of the Nonchernozem Zone. This applies to scientists and scientific institutions regardless of affiliation. No one can remain uninvolved. Each of us must obey the call of our heart and mind in finding our place in efforts to help the agriculture of this important region.

In the name of the scientists of VASKhNIL, allow me to assure all those attending this meeting that we will exert all our effort and skill to promote the resolution of the tasks facing our country in accordance with the decisions of the July 1978 CC CPSU Plenum and the speech given there by CC CPSU General Secretary and USSR Supreme Soviet Presidium Chairman Comrade L. I. Brezhnev.

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EARTH SCIENCE FOR AGRICULTURE

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 54-59

[Report by Academician A. V. Sidorenko]

[Text] The session of the General Meeting of the USSR Academy of Sciences heard coreports by USSR Academy of Sciences Vice President Academician A. V. Sidorenko, academicians Ye. N. Mishustin and S. I. Vol'fkovich, USSR Academy of Sciences Presidium Chief Academic Secretary USSR Academy of Sciences Corresponding Member G. K. Skryabin, USSR Academy of Sciences Vice President Academician P. N. Fedoseyev, and USSR Academy of Sciences Corresponding Member K. V. Frolov.

Boosting the USSR's agricultural development is the cause of the whole party, the whole Soviet people. Guided by this directive of CC CPSU General Secretary and USSR Supreme Soviet Presidium Chairman Comrade L. I. Brezhnev, the scientists--geologists, hydrogeologists, geographers, hydrologists, climatologists, and specialists in the study of earth from space--consider it their duty to take active part in resolving this most vital problem of our time.

Of the great variety of problems relating to agriculture being dealt with by institutions of the Section on Earth Sciences of the USSR Academy of Sciences Presidium, we will dwell on the three most important ones.

The country's land holdings. The land is the main means of production in agriculture, the spatial basis for the location of industry, transport, the place where human beings live. We are accustomed to speaking of the limitless expanses of our Homeland, saying that the Soviet Union occupies one-sixth of the earth's surface, but we do not always keep in mind that our land resources are not unlimited, and land areas suitable for agriculture are limited. The effectiveness of utilization of land resources--boosting their productivity, protecting the land against destruction--constitutes a vital national economy task which requires all-out scientific effort. The land, the soil, the vegetation, the water--these are the main components of the biosphere.

In consideration of all this, KEPS [Commission for the Study of Productive Forces and Natural Resources] of the USSR Academy of Sciences in collaboration with the USSR Ministry of Agriculture, VASKhNIL [All-Union Academy of Agricultural Sciences], State Committee for Forestry, the USSR Ministry of Water Management, and other organizations recently held a scientific-technical conference on the country's land resources. Materials of the conference remind us once again that our agricultural lands must be used rationally. Half of the country's territory is forest land. Farm lands take up 607 million hectares or 27.2 percent of the country's territory, with plowed land constituting only 224 million hectares or less than 0.9 hectares of plowed land per inhabitant. It must also be kept in mind that almost three-quarters of our land is located in conditions that are extremely unfavorable for agriculture--in cold, arid, desert, and mountain regions. Of the arable land, only about 60 percent is located in favorable soil and climatic conditions. Despite the development of huge areas of virgin lands, the area of plowed land per capita is continuing to shrink because substantial areas are being set aside for nonagricultural use (industry, transport, cities, and so on).

Calculations show that by the year 2000 the locating of new industrial enterprises, roads, and population centers will require about 35 million hectares of farm land and forest land. Land reserves suitable for agriculture are limited--about 38 million hectares. From L. I. Brezhnev's work "Tselina" [Virgin Lands] we know about the enormous outlays of manpower, energy, and financial and material resources it took to develop the virgin lands in past years. And the development of new areas in the North (six million hectares), in the deserts and semi-deserts (about six million hectares), and in the Nonchernozem Zone of the European part and in the East (21 million hectares) will require more substantial outlays. For this reason, rational utilization of our land, even considering our vast expanses, is a most vital economic task.

A serious cause of concern is the destruction of the land. More than 150 million hectares of plowed land and about half of the natural pasture land are affected by deflation and erosion which impair soil fertility.

The Master Plan of Utilization of Resources of the USSR, now being worked out, places great responsibility on the institutes of geography, water problems, agrochemistry, and soils science, on the scientific institutions of the Siberian Department, the Far Eastern Scientific Center, branches of the USSR Academy of Sciences, the republic academies, and the scientific institutions of VASKhNIL for the scientific substantiation of the development of new lands and the rational utilization of lands put into farm production.

Our Soviet science has always been famous for its high level of soil and geographic research. The Dokuchayev School of Soils Science is known throughout the world. Now, soil-geographic research must be raised to a new level. Classic soil geography must be supplemented by space methods of investigating land resources and closely coordinated with physical and chemical methods of studying natural resources. Only on the basis of integrating the natural and exact sciences can we get a modern idea about the country's land potential and lay a scientific foundation for expanding the country's farm lands.

At the present stage it is possible to increase the output of farm products only by further intensifying the productivity of the land.

Providing the national economy with explored reserves of raw material for the production of mineral fertilizers. Scientists of the USSR Academy of Sciences have made a substantial contribution toward developing a reliable raw materials base for the production of fertilizers. Our country holds first place in the world with respect to the production of mineral fertilizers. At the present stage, fertilizer production is not held back by explored reserves. The main thing which hampers the production of potassium and phosphorus fertilizers is the status of industrial capacities and technologies for processing the raw material. This is especially true of Belorussia, which has a powerful potassium industry that produces half of all of the country's potassium fertilizers. The urgent problem there is the recovery of wastes from the mining of salt polluting the environment. Salt mining technology needs to be streamlined in the Solikamsk Basin this side of the Urals. But the geologists of the USSR Academy of Sciences and the USSR Ministry of Geology also face major theoretical and practical tasks in boosting reserves of mineral raw materials and improving their geographical deployment.

Special attention ought to be paid to the problem of prospecting for potassium salts in Siberia, a region where such salts have not yet been found--all reserves of the raw material for producing potassium fertilizers are located west of the Urals and in Central Asia. Scientists of the Siberian Department of the USSR Academy of Sciences have scientifically substantiated, and geologists of the Eastern Siberian Geology Administration of the RSFSR Ministry of Geology as a result of many years of work, have proved the possibility of discovering industrial potassium deposits in the Eastern Siberian salt basin. We need more intensive geological-exploration work in Irkutskaya Oblast. It is difficult to exaggerate the importance of prospecting for deposits of potassium salt to the development of the agriculture of Siberia and the Far East. Organizing the production of potassium fertilizers in Siberia will reduce long-distance hauling and yield substantial economic effect.

The main supplier of phosphates (up to three-quarters of all phosphate concentrate production) is the Khibiny apatite basin. Thorough scientific substantiation of prospecting for new ore in Khibiny begun by Academician A. Ye. Fersman and continued by scientists of the USSR Academy of Sciences Kola Branch imeni S. M. Kirov, has shown that new major phosphate deposits may be discovered in Khibiny. At present, ore reserves there will provide for reliable development of the mining industry for many years. Even the level of ore production estimated for the year 2000 will provide for at least fifty years.

Nevertheless, the geography of phosphate production also needs to be seriously improved. We have large reserves of phosphorites in Aktyubinskaya Oblast in Kazakhstan. But they are not being developed fast enough. Development is also going too slowly in Kazakhstan's huge Karatau phosphate basin. These ores are difficult to process. It is necessary to search more vigorously for new methods of processing the tough phosphorus ores of this area. This is a task which must be resolved by the chemists of the USSR Academy of Sciences and the technology specialists of the USSR Ministry of Chemical Industry.

Until recent years, Siberia did not have its own major phosphate deposits. Small deposits have been explored there, but it is not economically profitable to work them. In recent years on the USSR-Mongolian border efforts by the USSR Ministry of Geology and the Joint Soviet-Mongolian Integrated Geological Expedition of the USSR Academy of Sciences and the Mongolian Academy of Sciences have resulted in the discovery of a major new phosphate basin (the Khubsugul deposit in Mongolia and the Ukhagol in Buryatia). Development of this basin will radically change the possibilities of supplying phosphates to Siberia and the Far East as well as fraternal Mongolia. Preliminary estimates and exploration of these deposits have shown that the basin is comparable to the Karatau in terms of size. The ore is of high quality and is accessible to open-pit mining. Development is being delayed by a number of organizational-technical factors, chiefly the inadequate attention paid to this region by the USSR Ministry of Chemical Industry. We believe that in the framework of Soviet-Mongolian economic cooperation it is essential to step up the development of mining-concentration enterprises and chemical plants there to produce superphosphate and other kinds of fertilizers. This will provide the eastern areas of the country with scarce phosphorus fertilizers. Calculations of the Siberian Department of the USSR Academy of Sciences have shown that supplying Siberia and the Far East with adequate amounts of fertilizer will make it possible to boost grain production there to 30 million tons. The resolution of this task will be a specific answer to the directives of Comrade L. I. Brezhnev during his trip to Siberia and the Far East.

It is necessary to continue prospecting for phosphate ores.

In recent years we have found major deposits of phosphorites in Khabarovskiy Kray, apatites in Yakutia, and apatite-bearing alkaline intrusions in northern Krasnoyarskiy Kray. In order to assess the importance of these deposits for the future, the exploration and technological and economic evaluation work must proceed systematically, purposefully, without sensationalism and haste. We are deeply convinced that major new deposits of phosphorus material will be discovered in Siberia, especially in its ancient precambrian and lower paleozoic geological complexes.

In order to resolve the national task of boosting the agriculture of the Nonchernozem Zone, developing new lands there, and increasing the fertility of acid soils, it is necessary to have greater quantities of local fertilzers to lime the soil, also peat and sapropelites to use as organic additives. At one time, the All-Union Geology Inventory of the USSR Ministry of Geology drew up detailed cadasters of deposits of that raw material for each oblast. But the agricultural organs of the Nonchernozem Zone are not using these materials. The USSR Ministry of Agriculture must focus attention on the use of local fertilizers to improve the soil fertility in the Nonchernozem Zone.

Thus, our country's agriculture and chemical industry have a reliable raw materials base for developing the mineral fertilizer industry in the coming five-year plans. There is no reason to fear that potassium and phosphorus resources will be depleted even after 1990. But if we set ourselves the task of applying the same amount of phosphorus per hectare of plowed land and hay lands as they do in Europe and getting the same crop yields as they do there, the need for phosphorus will rise sharply. For this reason, it is essential to step up the search for new deposits. The USSR Academy of Sciences must collaborate with the USSR Ministry of Geology in drawing up a special integrated program to prepare the raw materials base for the phosphorus industry over the long term, and KEPS of the USSR Academy of Sciences must collaborate with VASKhNIL to draw up a scientific prognosis of the long-term mineral fertilizer needs.

Considering that the mineral fertilizer needs will rise rapidly, the USSR Academy of Sciences and the republic academies must collaborate with the chemical-technology organizations of the various ministries in working on the search for radically new types of minerals for the national economy, including agriculture. In Siberia, in the BAM [Baykal-Amur Railroad] area, we have found leucitic syenites containing up to 18 percent potassium and 28 percent aluminum. They can serve as complex raw material for the production of potassium fertilizers and an unlimited source for nonferrous metallurgy. Everyone knows of the high effectiveness of using bentonite clays as additives in combination feeds, zeolites to improve soil structure, and so on. Obviously, the initiator of this work in the interests of developing the economy should be the USSR Academy of Sciences.

Water resources. Large areas in the USSR comprise either arid or excessively moist land. In connection with this, the problem of rational utilization, regulation, and redistribution of water resources is an urgent one. The largest consumer of fresh water is agriculture. It accounts for about half of the total water consumption--160 to 180 cubic kilometers. By the end of the century, because of stronger development of artificial irrigation, these indicators will at least double.

Considering industry's water needs, supplying fresh water for farm production and supplying pure water for the population centers have become vital problems. Calculations show that in the next few years this problem will become just as crucial as that of supplying people with food, fuel and energy resources, and minerals. It is necessary to get rid of the idea that the country has a surplus of fresh water. Already a number of regions, even those outside the arid zone, are encountering serious difficulties in supplying water for industry and the population. Even in areas of Siberia and the northern European parts of the country there are difficulties in supplying water to the population, especially in the cities. Problems of redistributing surface water between various areas of the country and the creation of a unified system of managing water resources, about which so much has been said, require profound scientific analysis to predict the ecological consequences of such measures.

Man's global interference in redistributing water resources has in a number of cases led to serious changes in the environment that are difficult to correct. We are not against the redistribution of water between zones of excess and deficient moisture, but we do advocate that this be not only technically and economically but also ecologically sound. It is already beyond question, however, that we need more rational means of utilizing water for irrigation (the efficiency of many irrigation systems does not exceed 0.5--that is, irrigation consumes twice as much water as is necessary for plant growth), also fuller utilization of ground water and temporary surface runoff.

By directive of the USSR Academy of Sciences Presidium, a special commission has been set up under the supervision of Academician L. M. Brekhovskikh, academic secretary of the Department of Oceanology, Atmospheric Physics, and Geography; the commission is to collaborate with the organizations concerned in drawing up a program and the scientific principles governing the transfer of the rivers of Siberia into Central Asia, also procedures for forecasting the effect this transfer will have on the environment.

It must be stated that the work front on water problems has been slackening in the USSR Academy of Sciences. At one point, the academic scientific organizations involved with problems of hydrogeology, hydrology, limnology, and meliorative hydrogeology were transferred entirely over to the department. The Institute of Water Problems that was created within the Academy of Sciences several years ago, also other small scientific collectives, are still in the organizational stage, they do not have the materials base for scientific research and cannot deal with all the variety of scientific problems involved with supplying fresh water for agriculture, industry, and the population. It is urgently necessary to strengthen the institutes of water problems and limnology. It is also necessary to do everything possible to promote more effective cooperation in scientific research dealing with water problems on a national scale. Although a composite program of integrated research into the problem "Scientific Substantiation of the Feasibility, Scale, and Sequence of Projects for the Territorial Distribution of Water Resources, Taking Account of its Influence on Ecological, Physical-geographical, and Social-economic Processes" has been approved by the USSR State Committee for Science and Technology, it has not yet been given the priority water resources deserve. It is the task of the USSR Academy of Sciences and the USSR Ministry of Water Management to function as the organizing center of such research. Water problems are not the responsibility of the Earth Sciences Section alone but of the whole Academy of Sciences.

We will not discuss here many other problems that are closely linked to agriculture, in particular problems of the study of earth from space (the use of spacecraft and aircraft to study the state of agricultural lands, soil moisture, and crop yield estimates), agricultural weather forecasting, and so on. These are problems being dealt with by the institutes of the Earth Sciences Section of the USSR Academy of Sciences and the republic academies and the USSR Academy of Sciences Institute of Space Research. We will merely note that these efforts must be stepped up considerably, requiring broader cooperation between scientists and production workers.

Scientists of the Earth Sciences Section of the USSR Academy of Sciences understand the importance of the tasks the party and the government have assigned to them, and they will use all their strength, knowledge, and experience to resolve the national task of boosting the Soviet Union's agricultural production.

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BIOLOGICAL NITROGEN AND ITS IMPORTANCE IN AGRICULTURE

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[Report by Academician Ye. N. Mishustin]

[Text] The July 1978 CC CPSU Plenum, commenting on the scientific soundness and vital strength of the Leninist agrarian policy of the CPSU, stressed the necessity of continuing to keep strictly to the course of action mapped out at the March 1965 CC CPSU Plenum and subsequent plenums and party congresses. That plenum mapped out the ways of further agricultural development, in particular stressing the necessity of strengthening chemicalization, which must become one of the main levers for boosting farm productivity.

The effectiveness of chemicalization is indisputable. In the past ten years of extensive use of chemical fertilizers, farm crop yields have risen by 1.5 times; the 1978 grain crop set a record.

The volume of chemicalization must be increased intensively, but we must keep in mind that in many cases, especially with regard to supplying nitrogen for agriculture, the chemical industry's task can be made much easier by biology.

At the end of the 18th century, a prestigious commission of French scientists which included Lavoisier announced that a basic constituent of air is "nitrogen," which means "lifeless" in Greek. It turned out, however, that nitrogen compounds are essential for plants, animals, and humans to exist. Mineral compounds especially determine crop yield levels for most farm crops. Organic compounds of nitrogen, especially proteins, are essential for man and animals. As a rule, however, there is not enough protein. The "protein deficiency" syndrome is a frightening phenomenon of the 20th century for many countries. The population of the USSR has enough vegetable protein but not enough animal protein. Livestock animals do not have enough feed protein, especially complete protein. This brings about considerable overconsumption of feeds and reduces livestock productivity. The total protein deficiency for humans and farm animals in this country exceeds 9.5 million tons.[1]

As a practical matter, gaseous, molecular nitrogen is inaccessible to higher organisms and cannot be assimilated by them. But certain processes can convert this inert gas into fixed compounds that can be assimilated by animals and plants. Thus, the world production of farm crops annually takes out of the soil about 110 million tons of nitrogen. The world's chemical industry makes it possible to introduce into the soil about 44 million tons of nitrogen fertilizer (calculated as N_2), the utilization coefficient of which does not exceed 50 percent. Thus, about 90 million tons of nitrogen come from someplace else--chiefly, biological fixation of the air's nitrogen.

In soil that has not been agriculturally developed, the plants do not get nitrogen fertilizers and do not grow well, consuming nitrogen that has been built up biologically.

A great variety of free-living microorganisms and symbiotic microbes that generally live in the plant's root system can fix molecular nitrogen from the air. These nitrogen-fixing microorganisms have an enzyme complex called nitrogenase which makes it possible for them to assimilate N_2. One widely-used source of nitrogen in farming practice is legume crops that are in symbiosis with Rhizobium bacteria. There are other plants which also assimilate molecular nitrogen in symbiosis with particular microorganisms (so far these grassy and woody plants have not been put to agricultural use).

Without participation by the microorganisms, the higher plants could not assimilate molecular nitrogen. This is generally acknowledged, although there have been attempts to prove the opposite. In the 19th century, for example, during the time of Napoleon III, his favorite chemist Georges Ville claimed that N_2 is accessible to higher plants. It should be pointed out that the same view was held by the Soviet scientist F. V. Turchin, whose experiments however, were impossible to duplicate. In our times, Professor M. I. Volskiy went even further. He claimed that not only the higher plants but also man and animals, even without the participation of microorganisms, can assimilate gaseous nitrogen in quantities that are more than enough for nitrogen exchange. M. I. Volskiy even attempted to have his stidies registered as the discovery of the phenomenon of assimilation of gaseous nitrogen by all higher organisms.

A special commission of the USSR Academy of Sciences, after precise verification experiments, declared that the conclusions of M. I. Volskiy were erroneous. The same conclusions have been announced by a number of foreign researchers (J. Costa et al, 1974; D. Pierce, 1974, and others).

Many researchers have wondered whether man and animals might not be supplied with fixed nitrogen by free-living nitrogen-fixing organisms living in their gastrointestinal tract (there are no mass accumulations of microorganisms in the other organs).

On the basis of studies by many investigators we may consider it an established fact that in some insects which feed primarily on hydrocarbons (aphids, borers, termites, and so on) the nitrogen-fixing microbes living in the intestinal tract play a vital role in the organism's nitrogen balance. But this finding cannot be extended to man and farm animals. According to R. F. Hardy, one of the leading American specialists in nitrogen fixation, nitrogen-fixers in the gastrointestinal tract of farm animals are capable of providing the organism with only about 0.1 percent of the protein it needs.

The beneficial influence on soil fertility by symbiotic nitrogen fixers--legume plants--has been well known since ancient times. This is known from the writings of Theophrastus, Virgil, Pliny, Cato, and Columella. At the end of the 18th century, the Austrian monarch Joseph II elevated the agronomist I. Schubart to the Court for introducing clover to cultivation, leading to a sharp increase in yields of other farm crops. The Berlin Academy of Sciences awarded Schubart prizes for his work on the development of feed grasses. In the 19th century, G. Schulze from Lupitze became famous in Germany for cultivating heath lands, using lupine as green fertilizer. After conversion from the three-field system to crop rotation cycles with clover, yields were doubled in Europe between 1840 and 1910.

In Russia, the first legume crop was clover. Introduced in 1776 from England, it was first grown in gardens. Even then, the first Russian scientific agronomist A. T. Bolotov advocated and promoted the idea of using clover as a feed. In the 1820's, I. I. Samarin introduced clover sowing into Russia on large planted areas and developed the valuable Kanishchevskiy variety, which was further developed into today's Moskovskiy-1 variety. The Zemstvos and the Zemstvos agronomists advocated the sowing of clover. In his lecture "Sources of Plant Nitrogen" (1890), K. A. Timiryazev mentioned the names A. A. Zubrilin and V. G. Bazhayev. By the late 19th century and early 20th century, clover was already widely cultivated in this country. Before World War I, Russia was exporting up to 500,000 poods of clover seed.

At present, many countries are making extensive use of legume crops, in particular soy, to boost soil fertility and produce protein. The exceptional value of legumes as a rich source of protein accounts for the fact that in the United States the area planted in soy was increased from one million hectares in 1935 to 23.5 million in 1977 (the country has a total plowed land area of 140 million hectares). Large areas in the United States are also planted in alfalfa and other legumes (about 15 million hectares). It is worth noting that 80 percent of the income from United States farm product exports comes from soy, which is purchased by many countries in Europe and Asia. Other countries in the Western Hemisphere are also increasing their areas planted in legumes (Argentina, Brazil, and others), frequently at the expense of coffee plantations.

Legumes have a number of valuable properties. Their abundance of protein is evidenced by comparative data given in Table 1.

Table 1.

(1) Зерновые культуры	(2) Содержание белка, %	(3) Бобовые культуры	(4) Содержание белка, %
(5) Рис (зерно)	7,0	Люпин (зерно) (9)	32,0
(6) Кукуруза (зерно)	10,0	Соя (бобы) (10)	40,0–45,0
(7) Пшеница, рожь, овес (зерно)	12,0–15,0	Сено (11)	18,0
		Солома (12)	9,5
(8) Солома	2,8		

Key:

1. Grain Crops
2. Protein Content, percent
3. Legumes
4. Protein Content, percent
5. Rice (grain)
6. Corn (grain)
7. Wheat, rye, oats (grain)
8. Straw
9. Lupine (grain)
10. Soy (beans)
11. Hay
12. Straw

Legume protein is more complete than grain protein, and in terms of amino acid composition it surpasses grain protein in solubility (Table 2).

Legumes, especially perennials, leave rich post-harvest residues in the field and serve as excellent predecessors for other farm crops. They frequently function as sanitizing agents preventing plant diseases. Alfalfa, for example, clears the soil of the verticillium agent of cotton wilt. Alfalfa-cotton rotation cycles make it possible to combat this disease, which devastates monoculture cotton. Many legumes can be used as green fertilizer.

Another important factor is that legume protein is cheap. It is ten times cheaper than cereal grain protein and several dozen times cheaper than animal protein; feed yeast protein is also more costly than legume protein.

In his report at the July 1978 CC CPSU Plenum, CC CPSU General Secretary and USSR General Supreme Soviet Presidium Chairman Comrade L. I. Brezhnev focused specially on the protein problem. He spoke of plans to expand crop areas and increase the legume crop harvest. L. I. Brezhnev said that soy is a valuable crop and that it is necessary to seek out ways to expand crop areas and perfect the technology of soy cultivation.

Table 2.

(1) Культуры	(2) Содержание аминокислот, г/кг					(8) Растворимость белка, %
	(3) Лизин	(4) Метионин	(5) Цистин	(6) Триптофан	(7) Всего	
(9) Зерновые:						
(10) кукуруза (зерно)	3,6	2,1	1,6	0,5	7,6	30
(11) пшеница (зерно)	3,9	2,2	2,0	1,8	9,9	60
(12) ячмень (зерно)	5,5	2,2	1,9	1,7	11,3	50
(13) Бобовые:						
(14) люпин (зерно)	18,9	4,2	4,6	3,8	31,5	80
(15) соя (бобы)	21,0	4,6	5,3	4,3	36,1	85
(16) люцерна (сено)	11,6	2,3	3,8	8,2	25,9	90

Key:
1. Crop
2. Amino Acid Content g/kg
3. Lysine
4. Methionine
5. Cystine
6. Tryptophan
7. Total
8. Protein Solubility, percent
9. Grains:
10. Corn (grains)
11. Wheat (grain)
12. Barley (grain)
13. Legumes
14. Lupine (grain)
15. Soy (beans)
16. Alfalfa (hay)

The theoretical and practical significance of the nitrogen-fixation process is such that international conferences are held every year to deal with the problem. In the United States, some private organizations (the DuPont Company, the Kettering Fund, and others) have special laboratories studying the problem of biological air nitrogen fixation.

Nitrogen fixation has drawn the attention of many outstanding foreign and Soviet scientists, in particular D. I. Mendeleyev, K. A. Timiryazev, D. N Pryanishnikov, and others.

In 1890, K. A. Timiryazev stated in his public lecture "Sources of Plant Nitrogen" that there are few phenomena in nature whose scientific study is more closely linked to practice than nitrogen assimilation and the cultivation of legumes.

The founder of our agrochemistry, D. N. Pryanishnikov, emphasized that it is wrong to set the use of mineral fertilizers off against the use of biological nitrogen: they complement one another, but they cannot completely substitute for one another. To this we may add that the effectiveness of mineral fertilizers increases strongly on backgrounds cultivated with legumes.

In this country, the scientific institutions of the USSR Academy of Sciences, the USSR Ministry of Agriculture, VASKhNIL, and other departments are doing a great deal of coordinating work on the problem of nitrogen fixation. They are studying the biology and physiology of the nitrogen fixers, the biochemistry of the process, and the genetics of the nitrogen-fixing microbes and legume crops (this work now ties in with genetic engineering, attempts are being made to transfer nitrogenase from nitrogen fixers to microbes that do not assimilate N_2) and modeling the process of nitrogen fixation in order to find ways to fix N_2 under "soft" conditions.

In this case I will confine myself to just one aspect of the problem of biological nitrogen--its practical aspect--explaining the role of the nitrogen fixation process in our land cultivation. First of all, a few comparative figures.

According to 1977 data, the USSR had 21.1 million hectares planted in perennial grasses and 15.8 million in annual grasses--a total of 41.9 million. From the aggregate data we can judge that legumes take up about 25.8 million hectares or about 11.4 percent of the plowed land. In the United States, legume crops take up 27.5 percent of the plowed land. Average yields there are higher than in this country, chiefly because of climatic conditions.

Our rough calculations show that legume crops in this country produce about 21 percent of all the protein produced on arable soil.

Table 3. shows the amount of protein produced from arable soil in 1977.

Table 3.

(1) Небобовые культуры	(2) Количество белка, млн. т	(6) Бобовые культуры	Количество белка, млн. т (7)
(3) Зерно	26,2	Бобы (8)	2,9
(4) Солома	5,2	Сено: (9)	
(5) Сено	3,0	многолетних культур (10)	5,2
		однолетних культур (11)	1,1
(12) Всего	34,4	Всего (12)	9,2

Key:

1. Non-legume crops
2. Amount of Protein, millions of tons
3. Grain
4. Straw
5. Hay
6. Legume crops
7. Amount of protein, millions of tons
8. Beans
9. Hay:
10. Perennials
11. Annuals
12. Total

The meadows of the USSR can produce hay containing about 3.0 million tons of protein, including about 0.8 million tons from legume grasses.

Thus, the land area in agricultural use can produce 46.6 million tons of protein, including 10.0 million from legumes (legume pastures produce about 1.5 million tons of protein).

In the United States, 140 million hectares of plowed land yield about 68 million tons of protein, with 36 million coming from grain and about 32 million from legume crops--that is, legumes produce 47 percent of the protein.

In the world production of protein, according to FAO data, legume grains account for about 20 percent; in this country the figure is only 5.8 percent.

The protein our livestock animals get in feeds is chiefly grain crop protein. But these crops are poor in protein, thus accounting for considerable feed overconsumption. Of the total cereal grain harvest, the population consumes 35 to 37 million tons; livestock animals get at least four times as much.

Available data make it possible to determine the approximate amount of molecular nitrogen fixed by legume crops on our fields under present conditions. The amounts of nitrogen fixation--that is, the amount of N_2 fixed by legumes on all land areas--are given in Table 4. In compiling it, account was taken of differences in the amount and chemical makeup of after-harvest residues of perennial and annual legume crops, and it was assumed that 70 percent of the protein is built up by the legumes by fixing molecular nitrogen.

Symbiotic fixation of N_2 on agricultural lands yields a total of about 3.0 million tons of nitrogen. This means that at present prices on mineral fertilizers, our country's agriculture is getting about 0.7 billion rubles from legume crops. Income from legumes can be substantially increased if crop yields can be doubled.

We have determined quite clearly what agronomic measures promote increased legume crop yields. These crops react very well to phosphorus fertilizers and certain trace elements (molybdenum and boron); many of them require liming of the soil. It is useful to introduce small doses of nitrogen fertilizer for legume grain crops. Perennial legume grasses do not need nitrogen fertilizer, although sometimes relatively authoritative organizations have given the opposite recommendations; this is not only useless but also harmful, because mineral nitrogen suppresses nitrogen fixation.

Table 4.

	(1) Количество азота, млн. т	
	(2) общего	фиксированного из воздуха (3)
(4) Пашня		
(5) Урожай бобовых	1,5	1,1
(6) Пожнивные остатки бобовых	1,5	1,0
(7) Естественные луга и пастбища *		
(8) Сено, собранное с лугов, и трава, потребленная животными при выпасе	0,4	0,28
(9) Корневые остатки бобовых	0,7	0,49

(10) * Принимается, что бобовый компонент составляет 12,5% массы травостоя.

Key:

1. Amount of Nitrogen, millions of tons
2. Total
3. Fixed from the Air
4. Plowed Land
5. Legume Yield
6. After-harvest Legume Residue
7. Natural meadows and pastures *
8. Hay harvested from meadows and grasses consumed by grazing livestock
9. Legume Root Residues
10. *It is assumed that the legume component constitutes 12.5 percent of the grass stand mass.

Recently, plantings of legumes have doubled in certain areas of the USSR: Odesskaya, Chernigovskaya, Kustanayskaya, Krasnodarskaya, and a few other oblasts. But not enough grain legumes are being planted. Our main crop is peas, but peas could be utilized to a greater extent. Areas planted in lupine and feed beans are inadequate. We must substantially increase plantings of soy beans in areas suitable for this crop. Green beans, which took up 160,000 hectares before the revolution, are now planted on a considerably smaller area. Land planted in lentils has been reduced by eight times since before the revolution (from 420,000 to 50,000 hectares).

The total area planted in beans in recent years in the USSR has been declining, as seen in data presented in Table 5, which shows the harvested area planted in certain bean crops (in millions of hectares). These are approximate data, because we have only generalized material on hand, and these do not always clearly define the status of individual crops.

Table 5.

(1) Культуры	1960 г.	1973 г.	1976 г.	1977 г.
(2) Все бобовые	26,0	20,7	23,3	25,8
(3) В том числе:				
(4) многолетние травы	13,0	14,8	14,2	15,1
(5) однолетние травы	7,2	7,6	2,8	4,5
(6) зернобобовые (с соей)	6,7	7,3	6,3	6,2

Key:
1. Crops
2. All Legumes
3. Including:
4. Perennial Grasses
5. Annual Grasses
6. Cereal Legumes (including soy)

Legumes fix nitrogen properly only if their root system is infested with bacteria-forming nodules. For this reason, when sowing legumes it is recommended that they be inoculated with rhizobia. Our country produces a compound of such bacteria, nitragin, which must be applied when sowing legumes on land new to them.

However, the situation is not very good with respect to the manufacture of nitragin. In 1978, agriculture received 0.5 million hectare batches of nitragin versus requirements of about 4 to 5 million. We are now taking steps to boost production, but so far industry's nitragin target has not been specified.

Expansion of the cultivation of legumes in our country is being hampered by a number of objective difficulties (lack of seed, fertilizers, herbicides, new systems of machinery, and so on). But it seems the main difficulty here is that some leading agrochemists claim that the nitrogen problem in our land cultivation can be resolved only on the basis of using mineral fertilizers.

For example, Professor V. N. Prokoshev, speaking at the Pryanishnikov Lectures in 1975, declared that legumes have outlived their usefulness. He recommended that high doses of nitrogen be applied to grain crops and that the resulting straw be used to feed livestock. Nitrogen fertilizer increases the protein content in the grain and straw of cereal crops, but nevertheless this "rationalization" of the feeding of livestock is doubtful.

Wrong ideas about the importance of legumes are based on a number of errors. In particular, it is often claimed that the countries of western Europe do not cultivate legumes on a large scale. But these countries purchase enormous quantities of soy in the United States. If, for example, the FRG wanted to produce the legumes it needs on its own it would have to use half of its arable land.

D. N. Pryanishnikov emphasized that to resolve agricultural problems it is necessary to proceed on the basis of our own country's interests and not blindly copy foreign practice. This is true also of the nitrogen problem.

At present, the USSR Ministry of Agriculture, implementing the decree of the CC CPSU and the USSR Council of Ministers "Measures to Increase the Production and Improve the Quality of Feeds," published on 11 July 1978 plans to carry out a number of essential measures designed, in particular, to expand legume plantings and boost crop yields.

Our calculations show that the role of legumes in protein production will increase strongly. In 1977, legumes accounted for about 20 percent of the vegetable protein produced by this country's agriculture; in 1980 the figure should reach 24 percent, and in 1985--28 percent. This is fully consistent with the decisions of the 28th CEMA Session in 1977, which recommended that CEMA countries expand land areas planted in cereal legumes, in particular soy.[2]

Recently VASKhNIL President Academician P. P. Vavilov and Candidate of Agricultural Sciences G. S. Posypanov[3] published an article titled "Legumes, Nitrogen, and the Protein Problem." The authors are of the opinion that eventually area planted in cereal legumes in this country should reach 20 to 25 million hectares. Even in this case, however, there will not be enough complete protein (about 2.5 to 3.0 million tons) considering the growth of livestock farming planned by the USSR Ministry of Agriculture.

Of course, the deficiency in complete protein can be made up partially by microbial synthesis. Nevertheless, in our opinion, for boosting the production of protein it is advisable to make more intensive use of the legume component on natural meadows and pastures. So far, only 50 million our of 380 million hectares of such land have been cultivated. Most of this area, in essence, is virgin land, the development of which is quite promising but requires substantial efforts. In this connection we recall the heroic era on the virgin lands of Kazakhstan, so brilliantly described by CC CPSU General Secretary and USSR Supreme Soviet Presidium Chairman Comrade L. I. Brezhnev in his work "Tselina" [Virgin Lands].

All soils have many free-living nitrogen-fixing microorganisms. These are mostly bacteria feeding on organic substances. Inhabiting the plants' root zone, where the roots release various organic compounds, the bacteria can accumulate a certain quantity of nitrogen. Experimental data indicate that amounts of such nitrogen accumulation are not great and have no substantial influence on the size of the crop.

To a greater extent the activity of the nitrogen-fixers is determined by the soil's organic compounds and plant residues. Until recently it was believed that these sources of nitrogen-fixer nutrition were also incapable of ensuring adequately high nitrogen accumulation in the soil (not more than 6 kg of nitrogen per hectare of soil per year), but a cycle of research carried out in recent years abroad and in the USSR compel us to change this point of view.

Table 6 shows data on amounts of nitrogen fixation by free-living microbes utilizing plant residues and, in part, products of humus mineralization, in different soils of the USSR (kilograms per hectare per year).

Table 6.

(1) Почвы	(2) Азотфиксация		
	(3) за счет продуктов минерализации гумуса	(4) за счет растительных остатков	(5) всего
(6) Дерново-подзолистые	1,8–8,0	5–7	6,8–13
(7) Серые лесные	3,0–9,0	15–20	18–29
(8) Черноземы	9,0–18,0	28–35	37–53
(9) Каштановые	3,0–10,0	15–20	18–30
(10) Сероземы	3,0–9,0	15–20	18–29

Key:

1. Soil
2. Nitrogen Fixation
3. From Products of Humus Mineralization
4. From Plant Residues
5. Total
6. Soddy-Podzolic
7. Grey Forest
8. Chernozems
9. Chestnut
10. Serozems

Approximately the same data are cited by other investigators (I. G. Zakharchenko, G. S. Pirozhenko, 1970; J. Day et al., 1975; I. S. Shatilov, 1978; and others) on the basis of analyzing many years of field experiments.

Nitrogen fixed by free-living microorganisms should be viewed as a soil replenishment: it is consumed more slowly than mineral nitrogen. If we assume rather modest amounts of nitrogen fixation by free-living microbes (15 kilograms per hectare per year for arable soil, 6 for cultivated meadows, and 2 for virgin meadows), the nitrogen accumulation on agriculturally developed land in the USSR will be expressed in the following amounts (calculated for N_2): 3.5 million tons of nitrogen per year for arable soil, 1.0 million for meadows and pasture lands, total 4.5 million. The equivalent amount of mineral fertilizers costs 1.2 billion rubles.

The question arises as to whether it is not possible to strengthen the soil activity of the free-living nitrogen-fixers? This can be accomplished by introducing organic matter into the soil. Most feasible for this purpose is the use of straw, the amount of which in the USSR comes to more than 100 million tons annually. As a rule, this straw is burned. There is a reluctance to plow it into the soil, because straw causes fixation of mineral nitrogen and thus reduces crop yields.

However, techniques have been worked out for avoiding this unfavorable effect of straw and making it possible even in the first year to obtain positive results from its introduction. The positive effects of straw are also apparent in the next one or two years. Straw can be used successfully as an organic fertilizer for rice, legumes, and grains. Introduced into the soil as a fertilizer, 100 million tons of straw are equivalent to 0.5 million tons of nitrogen. Soil microorganisms fixing N_2 can fix at least five kilograms of nitrogen for every ton of straw that is introduced. This results in another 0.5 million tons of fixed nitrogen. Consequently, 100 million tons of straw put into the soil will enrich it with compounds containing 1 million tons of nitrogen which can be used by the farm crops. The only cost will be outlays on plowing the straw in. In terms of the coefficient of assimilation by the plants, nitrogen fixed by microbes is approximately equal to mineral fertilizers.

If we compare the amount of nitrogen produced in this country by the chemical industry and by biological means, it turns out that the contribution of biological nitrogen to agriculture is quite substantial. According to data from 1977, the chemical industry supplied agriculture with 7.7 million tons of nitrogen calculated as N_2, while soil nitrogen-fixers supplied about 7.5 million tons (about 3.0 million tons from symbiotic and 4.5 million tons from free-living nitrogen-fixers).

The importance of mineral nitrogen as a more effective factor in boosting crop yields will undoubtedly increase, but we cannot ignore biological nitrogen. It is essential to find ways to make more extensive use of it.

The academic institutions must determine the possibility of using not only legumes but also other plants capable of fixing N_2 in symbiosis with microorganisms; they must determine the symbionts of these plants, find out what factors determine the energy fixation of molecular nitrogen, determine the structure of nitrogenase, expand efforts on the genetic engineering of nitrogen-fixers, and resolve a number of other tasks.

The research institutions of the USSR Ministry of Agriculture, VASKhNIL, and other departments must determine what zones are suitable for cultivating legumes, develop varieties that efficiently fix nitrogen under certain conditions, and develop equipment for their cultivation and harvesting. Glavmikrobioprom will have to substantially expand the production of bacterial fertilizers.

Let us hope that these responsible projects will be carried out.

FOOTNOTES

1. See P. P. Vavilov and G. S. Posypanov, VESTNIK SEL'SKOKHOZYAYSTVENNOY NAUKI, No 9, 1978.

2. See Kh. Goranov, MEZHDUNARODNYY SEL'SKOKHOZAYSTVENNYY ZHURNAL, No 4, 1977.

3. See VESTNIK SEL'SKOKHOZYAYSTVENNOY NAUKI, No 9, 1978.

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FORTHCOMING TASKS OF AGRICULTURE CHEMICALIZATION

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 68-75

[Report by Academician S. I. Vol'fkovich]

[Text] The chemicalization of agriculture in the USSR in recent years has been developing on a steadily rising scale and at an increasingly faster pace.

In 1973, the Soviet chemical industry emerged in first place in the world in terms of total volume of mineral fertilizer production. In terms of the output of synthetic carbamide, potassium salts, and feed phosphates, our country holds a leading place; the production of pesticides and the number of physiologically active substances is not developing fast enough.

With each passing year, especially since 1965, there has been an increasingly marked rise in the number of integrated measures to intensify farm production, to chemicalize, mechanize, electrify, and reclaim the land, to improve the quality of land cultivation, all factors which strengthen one another. An analysis of today's status of chemicalization indicates that in addition to substantial progress in this area there are also some shortcomings. The level of agricultural development is not yet keeping pace with our rapidly rising needs, and requires further vigorous efforts to boost it.

One of the most important scientific-technical and economic tasks facing our nation today in the area of the production and use of mineral fertilizers and livestock feeds is that of raising the level of use of natural raw materials and combating significant mechanical, chemical, and biological losses of products. Over the next few years, plans call for major capital investments in building mining and chemical enterprises to produce mineral fertilizers. And increasing levels of production and larger amounts of capital outlays make increasingly intolerable enormous losses of raw minerals containing nutrients, especially phosphates and potassium salts.

Natural mineral resources are limited and non-renewable. Meanwhile, irretrievable losses are so great that everyone involved in the mining, processing, and utilization of fertilizer in agriculture must urgently and vigorously tackle the task of substantially boosting the efficiency index of both raw materials and fertilizers.

Industrial experience indicates that from 25 to 50 percent of the mineral is left in the ground when mining natural phosphates. Up to 30 to 40 percent of the mineral is lost in the process of primary and secondary concentration of phosphorite ore (washing, crushing, grinding, flotation, and so on). After flotation concentration of the apatite-nepheline ores of the Khibiny deposits, the phosphate has been reduced by six to eight percent. With mechanical and chemical operations in the processing of natural phosphates for phosphoric acid or concentrated fertilizers, five to six percent of the phosphorus is lost.

Phosphorus losses are also great in the soil, because of retrogradation (the binding of easily soluble, mobile forms of phosphorus to forms that are insoluble or assimilate slowly) and other processes that are not fully studied. In the first year of application of phosphates to the soil, the plants assimilate 20 to 40 percent of the phosphorus, depending on the soil type and the fertilizer; in subsequent years the figure is even lower. But several dozen years of field experiments at the Dolgoprudnyy Experimental Station imeni D. N. Pryanishnikov (Moscow Oblast), Rothamstead Station (Great Britain), and elsewhere indicate that phosphates, especially in acid soils, continue to nourish the plants for a long time.

Losses are also great in the mining and concentration of potassium salts, running as high as 30 to 40 percent; the shortage of chlorine-free potassium fertilizers reduces the quality of potatoes, buckwheat, grapes, citrus, and other industrial crops.

The storing, transporting, and use of ammonium nitrate also involve substantial losses. Rain and irrigation water convert the nitrate into solutions which soak through the filtering soil down to depths that are inaccessible to the plant roots.

To a lesser extent such losses, also hydrolysis releasing gaseous ammonia, occur in the use of carbamide (urea). In contrast to ammonium nitrate, moreover, carbamide is not flammable or explosive when mixed with certain organic substances, and it contains eleven percent more nitrogen than ammonium nitrate. For this reason, the production of carbamide ought to be developed further, especially since the cost per unit of nitrogen in carbamide and ammonium nitrate is now comparable in a number of plants;in some foreign plants, the cost of carbamide is even ten to fifteen percent lower.

Biological losses of nitrogen contained in fertilizers, due to processes of nitrification and denitrification of ammonia, and the use of the nitrogen by microorganisms in the soil, alter the original accessibility of the fertilizers to the plants and cause the gaseous products of its conversion to evaporate. Research by F. V. Turchin and other agrochemists has shown that total losses of nitrogen run as high as 15 to 30 percent.[1]

In the past ten years, the Soviet Union has created a substantial network of agrochemical laboratories (more than 200) and a number of scientific-research institutes of agrochemistry and soils science and experimental stations; they have been doing considerable work on charting soils to determine the sufficiency or deficiency of nutrients in the soil.

What is astonishing is that for several five-year periods the planning organs have been using the same fertilizer effectiveness standard--1.1 quintal of grain yield increase per quintal of fertilizer (in standard units). This figure is lower than yields on many leading kolkhozes and sovkhozes, also farms in a number of foreign countries, where yield gains run as high as three to four quintals or more.[2]

It must be stated, regretfully, that despite efforts to combat mechanical losses of fertilizers in transporting and in warehouse storage (10 to 15 percent), these losses have remained practically unchanged for several years.

Not enough attention is being focused on efforts to combat losses of fertilizer nutrients due to their consumption by weeds. Because of poor weeding and inadequate use of herbicides, large quantities of fertilizer never reach "their intended recipient."

Because of the variability, both in time and terms of varying climatic and soil conditions, of data concerning losses and inadequate utilization of fertilizer nutrients, it is difficult at present to calculate precisely the total efficiency of fertilizer and total losses. We can state without exaggeration that the average practical efficiency of mineral fertilizers does not exceed 50 to 60 percent of the total nutrients contained in the raw mineral. Consequently, enormous capital investments in mining and chemical enterprises are not being fully utilized. If we could produce and use mineral fertilizers on a completely scientific, systematic and thrifty basis, our national economy could save large amounts of capital investments and labor.

In the future we must make a deeper and more thorough analysis of the possibility of replacing some of the sulfuric acid with nitric acid in the production of phosphoric acid and fertilizers, also the possibility of developing thermal and alkaline-thermal methods of production, including the hydrothermal method using natural gas or fuel oil, and, as power engineering becomes further developed and electricity becomes cheaper, the use of electrothermy. Losses may also be reduced in the future by working on the production of polymer phosphorus fertilizers that are not fixed by the soil, and nitrogen fertilizers that are not washed away by rain and irrigation water.

In recent years, exploratory and theoretical research has been carried out to determine the possibility of binding the nitrogen of the air (with the participation of catalysts) with various compounds into ammonia and other compounds, also the possibility of synthesizing ammonia from nitrogen and hydrogen at low temperatures and pressures.[3]

Plans call for developing the production of carbamide and its derivitives, ammonium polyphosphates, carboammophoska, potassium, polymetaphosphate, phosphorus acid amides, and other new economical concentrated and integrated fertilizers; plans also call for substantially developing the production of mineral fertilizer mixes.

Also being studied is the possibility of mining potassium salts by dissolving them in the ground and carrying out integrated processing of potassium-containing salts.

It is also possible to conserve in the production of fertilizers by using production wastes: phosphogypsum, fluoride gases, carbon monoxide, slag, rare elements, and other substances. This is not only of economic but also of great ecological importance.

Draft plans for the production of mineral fertilizers call for boosting their output to 135 to 140 million tons in 1985 (in standard computation), with production to be increased in the 12th Five-Year Plan. Attaining the necessary level of fertilizer production in the 11th Five-Year Plan will require the inauguration of plants having a capacity of at least 40 million tons of fertilizer. Raw material and energy resources are enough to accommodate the construction of nitrogen and potassium enterprises of large capacity. The situation is different with the production of phosphorus fertilizers because of limited proven reserves of high-quality raw material. It is partly because of this that in recent times there have been difficulties in meeting the phosphorus fertilizer production plan both in terms of quantity and quality. Some of the phosphorites that are mined contain a low percentage of phosphorus and are distinguished by variegated composition. The shortage of phosphates, compared with nitrogen and potassium, is also due to the lack of the mean ratio of nutrients in the soil, especially nitrogen and phosphorus, required by agrochemistry. The July 1978 decree of the CC CPSU Plenum emphasizes the necessity of eliminating this disproportion and ensuring the necessary raw material for the production of phosphorus fertilizers.

The shortage of phosphoric acids has made more urgent the task of producing phosphorus fertilizers by acid-free and waste-free methods.

In the last fifteen years, the Soviet chemical industry has, on the basis of Soviet scientific-technical developments, created a sector for the production of feed phosphates, chiefly on the basis of what is known as the hydrothermal or pyrohydrolytic process, also what are known as acid methods. In 1978, feed phosphates were being produced by fourteen Soviet chemical plants. Many years of comprehensive research by the agrochemists have shown that melted defluorinated phosphates made of Soviet raw materials, with bulk application to the soil, is equal in effectiveness to superphosphate, a water-soluble fertilizer. Just as effective are products from caking or fusing phosphates with alkaline salts and natural aluminosilicates.

To reduce nitrogen losses due to the high solubility of ammonium nitrate and carbamide, methods have been developed for fusing them with formaldehyde, urotropin, or other substances in order to produce fertilizers that dissolve slowly; these are especially effective in cotton farming. To some extent, granulated fertilizers also help to accomplish the same purpose. Successful experiments have been carried out in modifying and capsulating fertilizers, especially carbamide in composition with elementary sulphur. For reducing losses of gaseous nitrogen oxides, the use of inhibitors has been proposed.

As a result of many years of vegetative and field experiments, we have now essentially proved the effectiveness not only of phosphorite meal of a certain geological age, chiefly on acid soils, but also thermophosphates that have been defluorinated with steam at high temperatures, and melted phosphates. Because the production of these fertilizers does not require acids, and the defluorination process does not require alkali, there is no formation of many tons of production wastes. All of this indicates that the production of these types of fertilizers deserves substantial development.

In the near future it will be necessary to develop mechanical fertilizer mixing in order to turn out products having a specified ratio of nutrients and required physical and chemical properties. It is necessary to expand the output and use of liquid compound or mixed fertilizers. The production of these items is increasing too slowly despite the fact that there is no doubt about their technical and economic effectiveness and other advantages.

Several years of industrial experience in the hydrothermal processing of phosphates in cyclone furnaces to make feed have demonstrated its economic advantages over acid processes. Among citrate-soluble phosphorus fertilizers, many countries have long been using phosphate slag from steel production. In the USSR, phosphorus-containing iron ores from Kerch' annually yield several hundred thousand tons of phosphate slag. We also have other phosphorus-containing iron ore deposits -- Lisakovskoye, Ayatskiye, and others. The next vital task facing our metallurgists is that of producing phosphate slag from these ores in order to increase reserves of phosphorus fertilizers.[4]

Because of the low percentage of phosphorus in most Soviet phosphorites and the substantial amount of undesirable impurities in them, we face the urgent task of developing economical methods of concentrating low-grade phosphorites. Electrothermal methods of processing phosphates into fertilizers are costly. It is much more promising, as is indicated by Soviet and foreign practice, to process nitric acid phosphates to produce compound nitrogen-phosphorus and nitrogen-phosphorus-potassium fertilizers.

In addition to exploratory and more intensive chemical-technological research into the use of low-grade phosphates, it is essential to step up geological-exploration work in order to find abundant deposits of phosphates and intensively develop effective processes of mechanical, thermal, and chemical phosphate concentration.

An important technical-economic task facing the potassium industry is the use of enormous wastes of sodium chloride, magnesium chloride, and other substances formed in flotation or halurgical processes of making potassium chloride from sylvinite. Major forces must be mobilized to resolve this task, which is not only of economic but also ecological importance. Contests should be held for the best solution.

Up to now we have not found satisfactory solutions to the task of processing compound potassium ore, which also contains sulphates, from deposits in the western Ukraine and the southern Urals.

In the last few five-year periods, scientific-technical applications in the nitrogen industry have achieved substantial economic effectiveness thanks to the use of natural gas, improved equipment, a higher degree of utilization of energy in the synthesis of ammonia, and increased equipment unit capacity. It is essential to further develop the production of carbamide and carbamide salt, including phosphates which are used not only as compound fertilizers but also as effective supplementary feed for livestock.

It is also necessary to expand work on introducing into complex and mixed fertilizers trace elements of particular composition and quantity, in accordance with the recommendations of the biochemists and agrochemical services. Also deserving support is work on the rational production of mineralorganic mixes which include peat, coal, and other types of raw material.[5]

Standing somewhat apart are problems of developing hydroponic plant husbandry and hothouse farming on closed ground.

Despite the already proven enormous technical and economic prospects of plant husbandry without the use of natural soil, and the presence in the USSR and other countries of many years of industrial and agrochemical experience, it seems to us that hydroponics is developing suprisingly slowly. Hydroponics provides continuous, year-round and round-the-clock automated plant husbandry which does not depend on climatic and soil conditions--a genuine product of integration of chemicalization and electrification of intensive plant husbandry. Hydroponics makes it possible to grow vegetables, berries, and certain feed and industrial crops not only in present farming areas, but also above the artic circle, in desert and mountain areas, and on waste land. Hydroponic hothouses can be multi-level and placed even on the upper stories of large buildings.

Hothouse installations are being used successfully both in the USSR and in other countries, in many enterprises and around large cities and plants, especially in the North. Hydroponics represents the next advance in industrial hothouse farming. Because in hydroponics the soil is replaced with gravel, sand, and other mineral or organic materials of constant composition that are insoluble in water there is no worry about the composition of the earth. By means of automatic monitoring, the plants are periodically irrigated with solutions of fertilizers of a given composition. Electric lighting and heating are also dosed automatically. Hydroponics makes it possible to boost plant productivity considerably and to reduce outlays of labor and consumption of water per unit of output. It is possible that some plants should be nourished with solutions of mineral-organic fertilizers with physiologically active substances (vitamins, growth regulators, and so on).

Although capital outlays on hydroponic hothouses are higher than for ordinary ones, their technical-economic advantages over the latter are substantial in operation.

According to data of the Institute of Agrochemical Problems and Hydroponics of the Armenian SSR Acedemy of Sciences (the first Soviet institute of hydroponics), in the near future all nursery cultivation of fruit and industrial crops should be converted to hydroponics, also year-round production of fresh green feed for livestock and poultry. The institute has designed several such plants made up of several levels and sections with six to eight day cycles for germinating fresh green feed from grain seeds. One installation can produce 250 to 300 kilograms of green grass per day, rich in enzymes and biologically active and mineral substances.

Because of the importance of boosting livestock farming in our country it is appropriate here to cite data from the report of Armenian SSR Academy of Sciences Academician G. S. Davtyan in the State Committee for Science and Technology Council for Chemicalization of Agriculture (June 1978). One hydroponic installation is sufficient for the healthy feeding of 60 to 80 milk cows or about 800 suckling pigs or sheep, or 12,000 laying hens. Such installations are now operational for large poultry plants in Yerevan; they have a daily productivity of 500 to 600 kilograms of green mass. Capital investments for the construction of such plants should be recouped in seven to eight months.[6]

In recommending the development of industrial hydroponics, of course, we are not placing it in opposition to ordinary farm production; we are viewing it as a branch of plant husbandry which not only opens up promising economic prospects but also makes it possible to grow crops under conditions where ordinary soil cultivation is impossible or not worthwhile.

Recently, the Scientific-Research Institute for Fertilizers, Insecticides, and Fungicides imeni Ya. V. Samoylov and several laboratories in other institutes have worked out processes for producing water-soluble integrated fertilizers of varying composition for hydroponic and closed hothouses. Hydroponic installations of varying productivity are being designed.

Chemicalization of livestock farming began to develop later than chemicalization of plant husbandry. The experience of the leading livestock farms as well as biochemical and zootechnical research have shown that the use of chemical means of feeding and treating animals and poultry is very effective.

Chemical and biological preservation of vegetable feeds along with drying, feed enrichment, and air conditioning in storage have become one of our most urgent tasks, because improper procurement and storage of feeds cause losses of nutrients in many cases to run as high as 25 to 50 percent. With chemical preservation of moist vegetable feeds (according to data of VASKhNIL's Institute of Animal Biochemistry and Physiology), nutrient losses do not exceed two to ten percent.

According to the decree of the July 1978 CC CPSU Plenum, the production of supplementary mineral feeds in the 11th Five-Year Plan should be raised to 7 million tons per year. The assortment of supplementary feeds should also be expanded, including complex feeds containing not only phosphorus, calcium, and nitrogen but also sulphur, magnesium, certain trace elements, and, possibly, other physiologically active compounds (vitamins, hormones, amino acids, and so on). It is these directions, also the development of veterinary means, that should be the focus of efforts of chemists, biochemists, microbiologists, collectives of enterprises of Glavmikrobioprom, and the medical and chemical industry ministries.

To intensify feeds production it is extremely important to improve the quality of vegetable feeds and enrich them with supplements. Up to now we have not properly evaluated the nutritional effectiveness of compounds of magnesium, sulphur, silicon, and certain trace elements.

Problems of protecting plants, animals, and the environment are linked by many strands to the use of fertilizers, feeds, and cropping techniques. With the development of chemicalization and industrialization, therefore, they have acquired great urgency and complexity. As a result of the efforts of a number of authoritative commissions in the USSR Academy of Sciences, the USSR State Committee for Science and Technology, VASKhNIL, and various ministries, a number of decisions have been made on integrating chemical, biological, and mechanical (agrotechnical and zootechnical) methods of protecting plants and animals; unfortunately, these decisions are not being implemented fast enough.

It has been decided to substantially increase the amount and assortment of insecticides and fungicides, especially herbicides and compounds to use against plant diseases and pests that have not yet been conquered. Along with empirical trials and screening it is necessary to develop theoretical work to determine dependencies between the composition, properties, and mechanism of action of the basic classes of bioactive compounds on living organisms in order to shorten the time and reduce the amount of research and experimental work necessary and, consequently, to save considerable funds. According to published data, at present only one out of every 10,000 to 12,000 laboratory-synthesized compounds meets all agricultural requirements. It is necessary to expand the network of testing of pesticides using accelerated methods of research and to improve the quality of the testing.

Organizational-technical measures are necessary to speed up agricultural medical, and economic testing of new compounds to combat pests, diseases, and weeds. To do this it is essential to substantially expand the network of experimental-production installations in industry.

Closely linked to tasks of plant and animal protection are tasks of regulating the reproduction and development of organisms. It is essential to make broader use of defoliants and desiccants and compounds to speed up the growth and development of plants, especially grain crops in unfavorable conditions, and cotton. Considerable success has been made in chemical mutagenesis, which makes it possible not only to speed up the selection of plants and microorganisms but also to change some of their properties for the better.

In the field of pesticides and other physiologically active substances, we face the particular tasks of developing new methods of sterilizing insects, using hormones, pheromones, attractants and repellents, developing new forms of application of physiologically active substances.

The USSR Academy of Sciences is collaborating with its branches, the republic academies and VASKhNIL, the ministries of agriculture, chemical industry, health, and so on within the integrated Pesticides Program. These tasks have been elucidated in previous reports, but let us emphasize that the work volume is not adequate.

It is essential to develop research and practical work on protecting animals against diseases and pests, especially in the North, Siberia, and the Far East.

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In conclusion I should like once more to remind you that success in resolving most of these tasks largely depends on the level of qualifications of workers on the sovkhozes, kolkhozes, and other farming operations. Meanwhile, higher and secondary specialized education for agrochemists, livestock farmers, specialists in animal and plant protection, and analytic chemists needs to be expanded and deepened.

At the new stage of development of chemicalization of agriculture it is essential to strengthen the joint efforts of chemists, biologists, microbiologists, molecular biologists, geneticists, selective breeders, ecologists, and environmentalists.

The chemists also face substantial but as yet inadequately formulated tasks in the development of fishing and forestry management, in efforts against soil erosion and many other problems.

Chemicalization is not a short-term but rather a long-term, continuous, constantly growing trend in agricultural progress and associated sectors of the national economy. Under the influence of decisions by the party and government, work on chemicalizing agriculture in conjunction with other measures to boost agriculture is broadly supported by all the people and has become a vital, nationwide course of action which will grow stronger year by year, enhancing the productive forces of our country and the well-being of our people.

FOOTNOTES

1. See F. V.Turchin, "Azotnoye pitaniye rasteniy i primeneniye azotnykh udobreniy" [Nitrogen Nutrition of Plants and the Use of Nitrogen Fertilizers], Moscow, 1972, pp 252-258.

2. See, for example, the article by RSFSR Minister of Agriculture F. Florent'yev (IZVESTIYA, 9 November 1978), pointing out that many farms and rayons in the RSFSR have achieved crop yields of 30 to 36 quintals per hectare, and nine oblasts have achieved 38.

3. This research is being carried out in the USSR Academy of Sciences Institute of Organoelemental Compounds and the Institute of Chemical Physics. Laboratories of the Academy of Sciences and the institutions of the Ministry of Chemical Industry are studying processes of synthesizing nitric acid directly from the air in plasma, but the economics of these processes are as yet unclear. Other work is also underway on fixing atmospheric nitrogen via nitrides and other compounds.

4. By melting Kovdor apatite with soda, alkaline, or magnesium aluminosilicates it is also possible to produce fertilizers that are completely soluble in a two-percent solution of citric acid.

5. It is appropriate to note here that with the industrialization of the economy there has been a sharp increase in resources of waste carbon dioxide which, although it is being used in some cases as a fertilizer, as a cooling agent, and as a reagent, it is not being used enough, especially in hothouse and hydroponic farming.

6. The economic effectiveness of hydroponic hothouses is confirmed by many years of experience at the Kiev Vegetable Plant and the work experience of other Soviet and foreign installations.

7. For example, improper drying of hay can reduce the nutritional value by 25 to 30 percent. Substantially the same kind of losses occurs when storing coarse feeds out in the open.

8. This research is being developed successfully by the USSR Academy of Sciences Institute of Chemical Physics in collaboration with sector institutes of agriculture.

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MICROBIOLOGICAL PRINCIPLES OF OBTAINING PROTEIN AND PHYSIOLOGICALLY ACTIVE SUBSTANCES FOR LIVESTOCK NEEDS

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 76-81

[Report by USSR Academy of Sciences Corresponding Member G. K. Skryabin]

[Text] The present General Meeting of the Academy is dedicated to a discussion of the possible contribution of various sciences to the nation's efforts to further develop agriculture in our country.

Very likely, many of you attending have never before thought about how the existence of mankind and the plant and animal worlds depend on living beings that are unseen by the naked eye--the microorganisms. Many of us have not completely realized that life on earth would be destroyed if the world of the microorganisms were to cease existence at some moment.

In examining certain burning problems facing mankind today, one cannot help seeing that their resolution to a large extent depends on the successful efforts of the microbiologists. They include new sources of food, new highly-effective medicines, new sources of fuel. Finally, they involve the preservation and rational use of the resources of the biosphere.

Since we don't have the time to survey microbiology's contribution to the resolution of all these global tasks, although many if not all of them are directly related to agriculture, we will dwell only on problems of the industrial production of protein and some--by no means all--physiologically active substances of microbial origin; these are problems of extreme importance in boosting the productivity of livestock farming in our country.

Before analyzing the technical possibilities of our science in these areas, I will dwell briefly on certain characteristics of microorganisms which to a large extent determine their biological activity and practical significance.

In contrast to the higher animals and plants, microorganisms possess an astonishing ability to adapt to the most varied, frequently extreme, conditions of their habitation.

Obtaining energy by oxidizing inorganic compounds, fixing molecular nitrogen, living in anaerobic conditions, the ability to assimilate the energy of light and build its body either out of carbon dioxide or complex organic compounds--these are just a few examples of the unique physiological variety encountered in the world of microorganisms. If to this we add the ability of enzymatic degradation and transformation of a great variety of chemical compounds and, finally, the ability of supersynthesis of a great variety of physiologically active compounds--antibiotics, hormones, pheromones, and vitamins-- then we can understand scientific advances in the use of microorganisms in a great variety of human activities.

Speaking of the biological characteristics of microorganisms, I have not yet mentioned their unusual growth activity. The rate of cell division in microorganisms is very high and varies in a broad range depending on the taxonomic position of the culture and the conditions under which it is grown. Among bacterial forms there are "record-breaking" strains which double their cells every five to eight minutes. Naturally, the rate of growth of the biomass of microorganisms is accompanied by the same rate of formation of protein substances, the content of which in the biomass runs as high as 85 percent. For a real idea about the rate of synthesis of protein in yeast organisms, let me cite one example: a cow weighing 500 kilograms forms about 0.5 kilograms of protein in a day; in the same period, yeast mass weighing 500 kilograms will synthesize 50,000 kilograms of protein.

Now I shall examine in more detail the accomplishments and prospective use of microorganisms to improve the protein value of feeds.

Protein of microbial origin. It is well known that the most deficient component in feeds is protein. A balanced animal diet should include the necessary quantity of protein with a certain ratio of essential amino acids. Cereal grains, the basic fodder, contain little protein; they also have few of several amino acids, especially lysine. For this reason, feed based on cereals must have added to it protein having a surplus of those amino acids which are especially lacking in cereals. Soy can be used for the purpose, but the use of feed yeasts is even more effective. In making up feed diets what is important is not the origin of the protein (animal, vegetable, or yeast) but rather its content in the additive and the possibility of this additive's compensating for the lack of certain amino acids in the cereal proteins. These purposes are served by protein additives of microbiological origin.

In the 1960's, the institutes of the USSR Academy of Sciences, the republic academies, and Glavmikrobioprom and institutions of a number of ministries and departments conducted research in the field of obtaining feed yeasts on petroleum hydrocarbons.

The results of this research made it possible to organize in the Soviet Union the world's first large-tonnage facility producing feed yeasts on normal alkanes drawn from petroleum. At present, hundreds of thousands of tons of feed protein are being produced on an industrial scale and gigantic plants are in operation.

A great deal of work has been done on the medical-biological and veterinary-zootechnical study of feed yeasts and livestock products obtained from them. Accumulated experience on hundreds of thousands of animals has shown that the use of these feed yeasts in livestock farming is harmless and highly effective.

The basic, fundamental scientific problems of producing yeasts on hydrocarbons have been solved. But scientists still face a large number of specific tasks with respect to intensifying the technological process on the basis of integrated automation, the choice and selection of highly-productive cultures with a high protein content and a large quantity of lysine in its composition, also strains capable of effectively utilizing a broad spectrum of normal paraffins. Naturally, problems of further improving the quality of feed yeasts must remain at the focus of attention of both scientists and all industrial workers. It is essential to resolve the problem of improving the forms of the end product, in particular the output of feed yeasts in granulated form; this is especially important in order to make the most effective possible use of them in poultry farming.

Another type of raw materials used to produce feed yeasts are the chemical hydrolysates of wood and other cellulose-containing materials.

With its timber resources, our country has a vast potential and advantage in this regard over any other country. In assessing the strategic prospects, it must be kept in mind that vegetable resources are the only renewable resources on earth. If properly used they constitute an inexhaustible source of raw material for the microbiology industry.

Using this raw material, our country produces annually hundreds of thousands of tons of hydrolyzed yeasts for livestock farming. The development of large-tonnage production is being held back primarily by the lack of a technology for continuous chemical hydrolysis of wood. For this reason, our scientists face the very important task of developing a process of enzymatic hydrolysis of cellulose-containing materials. This requires expanded fundamental research on cellulose-disintegrating microorganisms and the specific enzymes they synthesize--cellulase.

Speaking of the prospects of supplying the microbiology industry with a raw materials base, it is necessary to dwell primarily on new types of raw materials--ethyl and methyl alcohols.

Ethyl alcohol is an excellent substrate for growing various microorganisms, including yeast. Because of the high effectiveness of using a substrate in one fermentation apparatus operating on ethanol, it is possible to produce almost twice as much yeast as on normal paraffins.

Yeasts raised on ethanol possess a very favorable chemical composition which determines both the nutritional value and the safety of the finished product. The low toxicity of ethyl alcohol and its excellent solubility in water media make for comparative simplicity of the technology of growing microorganisms on this type of raw material. Ethanol must be viewed as an excellent substrate for producing protein-containing additives for human food in the USSR.

The other promising substrate for growing microorganisms is methyl alcohol. Modern techniques of continuous cultivation of microorganisms make it possible to carry out the process without the methanol volatilizing on the fermentation medium; this prevents it from escaping into the atmosphere. The amount of methanol in the biomass is small; it does not exceed the methanol content in such food products as fruit juice and sea fish, and it is considerably lower than in Armenian cognac or scotch whiskey.

Another advantage of methanol and ethanol as a raw material is that they are individual compounds. This makes it possible for the microbiology industry to organize steadily operating large facilities to produce a product of strictly constant quality. A vital task facing scientific and practical workers is that of implementing a complex of measures to organize the experimental-industrial and then large-tonnage production of feed yeasts on these alcohols.

Among other promising types of raw material for large-tonnage production of feed protein, special mention should be made of hydrogen and methane. Naturally, cultivation on gaseous or even flammable substrates somewhat complicates the production technology. It is possible to cultivate only bacterial organisms by oxidizing these gases.

Methane-oxidizing hydrogen and certain other bacteria can prove to be even more promising biosynthesis organisms than yeasts. Bacterial cells contain even more protein than yeast cells. For this reason, it is essential to intensify medical and biological research into bacterial biomass, focusing especially on the toxicological evaluation of a number of specific components of the bacterial cell, the safety of which must be investigated.

The production of microorganism protein is distinct from agricultural production: it does not require crop land, it does not depend on climatic and weather conditions, it can be carried out on an industrial basis, planned precisely, and automated easily. In terms of its equipment layout and the intensity of the process, the production of unicellular protein is similar to the chemical industry.

In essence, however, it is a biological process. For this reason, products of the microbiology industry should not be called synthetic. The biological nature of cultivating microorganisms is similar to the cultivation of plants or animals, but microbiological production does not make use of pesticides; it makes better use of fertilizers than agriculture does, and better use of water than field irrigation.

A new concept has come into our life--protein from single-celled animals, protein from microorganisms, in English Single Cell Protein. Many thousands of years ago, man mastered the art of crop and livestock farming to supplement hunting, fishing, and the gathering of wild fruit. This brought about the creation of the food base for modern civilization. It is now time to take the next step in expanding society's food base. This step involves cultivating the lower forms of life--microorganisms.

Amino acids for livestock needs. In addition to microbial protein, livestock feed can have added to it amino acids obtained both chemically and by microbiological methods. The addition of amino acids to feed, especially essential amino acids, leads to a sharp reduction in feed consumption per unit of animal weight gain. Lysine and threonine in amounts of tenths of a percent increase the feed value of millet by eight times, wheat by 2.5 times, and oats by 1.5 times. Balancing corn grain with tryptophan and lysine reduces consumption per unit of weight gain by almost two times. Adding methionine to poultry feed yields substantial effect.

The production of amino acids in the Soviet Union at the present time is by no means meeting the needs of Soviet livestock farming. The country's present need for these biologically active compounds is considerably higher than even those figures planned for 1985.

Researchers of the Latvian SSR Academy of Sciences Institute of Microbiology imeni A. Kirkhenshteyn and the USSR Academy of Sciences Institute of Biochemistry imeni A. N. Bakh, in collaboration with scientists of the institutes of Glavmikrobioprom, have worked out and are adopting a method of obtaining lysine feed concentrate containing up to 12 percent of the basic substance.

In the fermentation stage, on media with molasses, we have obtained record yields of lysine exceeding the figures obtained by foreign researchers. Tests in livestock farming have demonstrated the high effectiveness of the concentrate. Nevertheless, expansion of the production of lysine feed concentrate is going much too slowly here.

Despite the advantages of the lysine feed concentrate, the compound has a number of serious drawbacks. The most important is the hygroscopicity of the product; to overcome this, fillers must be added to the concentrate, leading to a substantial reduction in the lysine content in the commercial product. Because of the instability of the chemical composition of the molasses, moreover, the production process in the fermentation stage itself is difficult to regulate.

It is necessary to emphasize definitely that the production of lysine feed concentrate does not do away with the important problem of obtaining crystal lysine for livestock needs. The situation in this regard is, to put it mildly, not good.

Scientists of the Institute of Genetics and Selective Breeding of Industrial Microorganisms of Glavmikrobioprom have successfully continued work begun in the Institute of Atomic Energy imeni I. V. Kurchatov in finding and breeding microorganisms that produce lysine and working out the laws governing the production of crystal lysine. Despite all this, the Soviet Union does not yet have well-ordered production of crystal lysine, a situation which cannot be tolerated.

Institutes of the USSR Academy of Sciences and certain republic academies as well as Glavmikrobioprom and the Ministry of Chemical Industry are conducting research designed to expand the production of feed amino acids, but this research must be sharply intensified. It would appear to be desirable to expand this work in the USSR Academy of Sciences Institute of Microbiology and Institute of Biochemistry and Physiology of Microorganisms, also the microbiology institutes of the academies of sciences of Armenia, Belorussia, and the Ukraine. Considerable help can also come from the microbiologists of the universities, especially the Moscow State University.

Microbiological production of amino acids includes many purely chemical stages of separation and purification, while chemical processes in some stages are much more successfully handled by means of microbiological and enzymatic methods. Very natural and necessary, therefore, is the alliance between microbiologists, biochemists, and organic chemists in this field of research, so very vital to the development of Soviet livestock farming.

Antibiotics for feeding farm animals. At present, all of the developed countries are introducing antibiotics into feeds and diets in order to boost the productivity of farm animals. For feed additives, use is made of a broad array of antibiotics of microbial origin, primarily those not used in medical practice, which do not build up residues in food products and do not give rise to forms of microorganisms that are resistant to therapeutic antibiotics.

The Soviet Union is using about 1,000 tons of antibiotics per year in feeding farm animals, with a yield of more than 500 million rubles of profit annually. But the assortment of non-medical antibiotics in this country is rather narrow. We can point to only two antibiotics--zinc bacitracin and kormogrizin. The production volume of these two compounds does not exceed ten percent of all antibiotics used in feeding livestock.

Despite the generally-acknowledged and obvious effectiveness of using antibiotics in feeding livestock and the extremely inadequate array of non-medical compounds being produced, the academic microbiology institutes are not working on the search for new and, let me emphasize, non-medical antibiotics. Even those institutes which have a tradition of searching for antibiotics and the necessary highly-qualified cadres--even they have curtailed such efforts in recent years.

Vitamins. Speaking of physiologically active substances of microbial origin, we cannot ignore vitamins, whose influence on the growth, development, and normal life cycle of animals is difficult to exaggerate.

It seems useful at this time to use at least one concrete example to point up the unutilized reserves for producing vitamins being discovered by microbiology. Betacarotene of microbial origin will serve as such an example.

The USSR Academy of Sciences Institute of Biochemistry and Physiology of Microorganisms and the USSR Academy of Sciences Institute of Microbiology in collaboration with the Vitamin Institute and the Krasnodar Biochemical Combine of the USSR Ministry of Medical Industry found and selectively bred a culture of the fungus Bl. trispora. This culture produced betacarotene--provitamin A. A technology for producing betacarotene was worked out, and the microbiological process of producing it was adopted in production at the Krasnodar Combine.

More than ten scientific-research institutes of the USSR Ministry of Agriculture, VASKhNIL, and other departments were engaged in checking on the effectiveness and safety of the fungous biomass in feeding farm animals. The resulting biomass, added to animal feed as a replacement of vitamin A, was found to be economically effective and safe. According to data of VASKhNIL's All-Union Scientific-Research Institute of Livestock Farming, the use of one ton of compound yields 2.3 million rubles in profit. According to testimony of the All-Union Scientific-Research and Technological Institute of Poultry Farming, microbiological carotene replaces vitamin A, and its effective use in premixes and combination feeds is indisputable.

It would appear that we had everything--an active strain of a producer, a technology to produce the compound, available raw material, plants capable of producing the compound, even a directive by the USSR Ministry of Agriculture to use microbial carotene as a vitamin A additive. Just one thing is lacking--the kolkhozes and sovkhozes don't have it! And this, despite the fact that agriculture's vitamin A requirements are only being met by a maximum of 60 percent. These are the facts. They need to be thought about by the ministries and departments responsible for the production and adoption of vitamins in agriculture.

In summarizing, I should like once more to emphasize the basic postulate on which is built the prospective development of theoretical research in technical microbiology and further progress in the microbiology industry. We can and must in the future develop microbiological production of feed and food substances not only because we do not have enough vegetable and animal sources of such substances, and not just because mankind faces a demographic explosion; I emphasize that the shortage of protein is merely an additional stimulus of microbiological production. The objective factor motivating the development of the microbiology industry is the fact that microbiology makes it possible to go further in producing feeds and physiologically active substances and, in the future, food products, on an industrial basis--that is, on a level corresponding to the present level of scientific-technical progress.

Mankind must supplement agricultural production with microbiological production not because of the threat of starvation but because such a path is determined by the level of our knowledge and the development of technology, because such a path makes it possible to produce food of better quality with less outlay.

In his speech at the historic July 1978 CC CPSU Plenum, CC CPSU General Secretary Leonid Il'ich Brezhnev set forth the task of creating a modern feeds industry. The Plenum's decisions specifically reflected the party's general agrarian line toward all-round intensification of agriculture. Development of the microbiology industry is a powerful means of resolving this task. Allow me to express confidence that the microbiologists of the Academy of Sciences will respond to the Plenum's decisions with effective and specific actions.

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SOCIAL SCIENCES FOR AGRICULTURE

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 82-87

[Report by Academician P. N. Fedoseyev]

[Text] Profound qualitative changes have taken place in agricultural development since the March 1965 CC CPSU Plenum. Its material-technical base has been substantially strengthened, cadres of highly-qualified specialists have been developed, production specialization is being broadly developed, and the level of concentration is rising, signaling further socialization of production and a rise in the productivity of social labor.

It may be that the most essential characteristic of the new stage of agricultural development is the formation of the agroindustrial complex, which incorporates not only farm production but also sectors of industry involved in producing fertilizer, equipment, and other means of production for agriculture, also those sectors engaged in the procurement, processing, transporting, and storage of farm goods.

In connection with the formation of the agroindustrial complex, rapid development characterizes intersector production relations in agriculture, exerting an increasing influence on the course and rate of expanded reproduction.

Now more than 60 percent of all material outlays on kolkhozes and sovkhozes relate to paying for deliveries of industrial means of production and services coming in from nonagricultural sectors. At the same time, an increasing portion of agricultural production is channeled into industrial processing in the form of raw materials, while the proportion of the product being delivered for final consumption by the population without processing is declining all the time.

The problem of increasing the pace of development and effectiveness of farm production is of great social importance. It must be kept in mind above all that in the system of modern economics agriculture is a basic sector whose output goes to form the end consumption fund.

In the nation's economy at the present time the proportion of food, clothing, footwear, and other goods whose production requires the use of agricultural raw materials adds up to more than two-thirds of the total retail goods turnover. Only on the basis of a steadily rising farm production can we reliably supply the country with food and agricultural raw materials and build up adequate reserves.

Another social aspect of agricultural development is the systematic rise of material and cultural-service conditions of life in the countryside to the urban level.

The standard of living in the countryside is still substantially lower than in the cities, in particular with respect to such indicators as the availability of modern housing, communal and service facilities, the network of schools, child-care facilities, and cultural-educational institutions and sports complexes, the condition of the roads, the layout of population centers, and so on. Much is being done to improve these conditions.

It is impossible to raise the standard of living in the village to that of the cities solely through increased state subsidies and enterprise sponsorship. It is possible to radically resolve social problems and meet the rural population's rising cultural and service needs only on the basis of systematically boosting the productivity of agricultural labor. Labor productivity determines the well-being of each worker and the whole rural and urban population.

All of this demands of the social sciences, like all sectors of science, profound research and exploration in the field of agriculture. The status of social-economic research on the countryside is not yet up to today's higher requirements and growing tasks.

These days, agriculture is a huge and complicated sector of the economy, the proportion of which in the nation's economy is still rising.

The following data are characteristic. The financing of the whole national economy from the state budget, from internal funds, and from bank credit will amount to 280 billion rubles in 1979. Expenditures on agriculture from the state budget, from sovkhoz and kolkhoz funds, and from bank credits will amount to 58.8 billion rubles--21 percent of the total expenditures on the nation's economy. If to this we add expenditures by subunits of the agroindustrial complex engaged in manufacturing the means of production for agriculture, procurement, transport, storage, processing, and sale of finished farm goods, the expenditures of the agroindustrial complex add up to at least 40 percent of all outlays on the national economy.

It is clear what enormous importance attaches to the problem of the correct proportions within the agroindustrial complex, of perfecting these proportions in accordance with changing conditions of farm production.

Scientific-technical progress in agriculture requires a steady rise in the proportion of industrial sectors serving farm production. Although in recent times these sectors have considerably expanded, their proportion is still clearly inadequate.

Most workers employed in the agroindustrial complex are still used directly in agriculture. They make up 66 percent of the total number of workers in the complex, whereas only 11 percent are involved in the production of industrial means of farm production, and 23 percent are employed in the procurement, transporting, storage, processing, and sale of finished goods.

The inadequate development of sectors producing the means of production for agriculture is hampering the implementation of integrated agricultural mechanization and slowing down labor productivity; as a result, agricultural projects drag on too long and the necessary conditions are not created for releasing some of the work force engaged directly in agriculture in order to use them in other sectors of the complex.

The weak development of sectors involved in the processing and storage of farm goods is resulting in enormous losses. A substantial portion of some land cultivation products which require enormous labor, material, and financial resources to produce is being lost due to improper storage and delayed processing. These shortcomings in the development of the agro-industrial complex were criticized at the recent November 1978 CC CPSU Plenum by Leonid Il'ich Brezhnev.

All of this means that because of qualitative changes taking place in agricultural development, it is impossible to improve its effectiveness without accelerated development of sectors serving agriculture; this will require increasing their material and financial resources and eventual redistribution of labor resources within the agroindustrial complex.

One of the central tasks in improving the effectiveness of farm production is the scientific substantiation of optimal rates of development of sectors in the complex, substantial improvement of its structure, perfecting of intersector and sector proportions, and rational utilization of what is procured and produced in agriculture.

The CPSU has comprehensively substantiated the postulate which stipulates that it is possible to accelerate the rate of growth of agricultural output only on the basis of comprehensive intensification.

But some agrarian economists are still not convinced that agriculture can carry out all its economic and social functions only by way of primarily intensive development. The work of the commission drawing up the integrated program of scientific-technical progress over the long term through 1990-2000 shows that the economic institutions of some departments continue to be oriented toward the extensive path of development of this sector. We cannot consider as satisfactory the state of affairs with respect to economic substantiation of agricultural deployment and the creation of specialized zones for the production of key commodities.

The search for ways and means to speed up the pace of development of agricultural production through preferential utilization of factors of intensive growth, the extensive use of specialization and concentration of production of the basis of interfarm cooperation and agroindustrial integration as a main line of development--these constitute one of the most vital tasks of economic science.

The growth of interfarm relations confronts scientists with another problem--that of optimalizing economic relations between agriculture and the industrial sectors of the complex.

Intensive development of sectors of the agroindustrial complex creates favorable conditions for the further development of specialization of agriculture in the field of plant husbandry and livestock farming; it helps to relieve land cultivation of certain production functions that are not proper to it, it enhances the marketability of farm production and further raises the level of socialization of production and labor productivity. But at the same time it strengthens the dependency between agriculture's economic results and the nature and proportions of intersector exchange. "Under such conditions," said Comrade L. I. Brezhnev at the July 1978 Plenum, "cooperation among the partners needs to be well organized. Unfortunately, we have not yet managed to get completely rid of certain negative phenomena in this regard."

Conditions of intersector exchange in 1969-1977, as was mentioned at the plenum, did not develop entirely favorably for agriculture. The price per unit of capacity of the means of production supplied to agriculture, also prices on production services, have been rising practically every year. As a result, the overall level of production profitability on the sovkhozes and kolkhozes has been declining, and their long-term indebtedness to USSR Gosbank has risen.

Agriculture, in turn, frequently turns over to the processing industry goods which are not up to current standards and consumer requirements and are poorly adapted to transport, storage, and processing. All of this points to the inadequate development of a system of reciprocal ties which could have a substantial influence on improving the work of all interrelated stages of reproduction of the end product of the agro-industrial complex.

In working out measures to perfect the economic mechanism of intersector relations in the agroindustrial complex, economic institutions of the USSR Academy of Sciences ought to take account of the necessity of creating for the consumer (whether it is a question of raw materials and supplies, machinery and equipment, or consumer goods) broader opportunities to influence the production and the delivery to agriculture of essential means of production.

What we need now is thorough scientific research making it possible to scientifically substantiate measures to perfect the system of planning in the whole chain of agroindustrial production, to substantiate the distribution of resources and select rational forms of intersector relations, to substantially improve the economic mechanism of management of the whole agroindustrial complex. This is a problem not only on the sector level but also the intersector, the national-economy level, because it affects not only agriculture but also industry and other sectors of the economy; it relates directly to securing the optimal balance in our nation's economy, it must become one of the main thrusts of integrated economic research within the USSR Academy of Sciences. In addition to the USSR Academy of Sciences Institute of Economics, the resolution of this problem must enlist the participation of the USSR Academy of Sciences Central Economic-Mathematics Institute, economic institutes of the academies of sciences of the union republics, the USSR Academy of Sciences Siberian Department, USSR Gosplan, and other departments involved with problems of intersector production management.

In implementing the CPSU's modern agrarian policy, designed to boost socialist agriculture, an important role is assigned to legal means of influencing the development of agriculture and improving management and administration in this sector.

Many problems of the organization and administration of farm production require legislative regulation. Present agricultural legislation does not take account of and does not regulate certain new phenomena characteristic of today's industrial type of agricultural development; it does not assure equality in economic relations between agricultural enterprises and enterprises and organizations in other sectors of the complex. We can hardly justify a situation in which relations in agriculture are regulated by normative acts of ministries and departments which are either partners of agricultural agencies or else are called upon to serve the needs of agriculture on the basis of economic contracts. In practice this procedure of regulating property relations frequently leads to infringement of the lawful property interests of the farm enterprises.

In his report at the July 1978 Plenum, L. I. Brezhnev emphasized the importance of problems of perfecting the administration of farm production and raising the level of responsibility and expanding the rights and duties of the farm agencies.

It is essential to define theoretically the nature of the general administration systems for the nation's agriculture, also in the union republics and individual regions.

Of great importance is the problem of perfecting the administration of the nation's agroindustrial complex. The opinion has been expressed that it is necessary to create a single organ of administration for the entire agroindustrial complex. At first glance this proposal seems to be logical. But the question is not so simple that it can be answered without profound scientific study. Obviously, the scientific institutions ought to look more deeply into the experience of organizing agroindustrial integration in the Baltic republics, in Moldavia, the Ukraine, and other regions of the USSR and on this basis work out general methodological approaches to the organization of the program-goal administration of agroindustrial production which can serve as the basis for the practical creation of such a system.

Special attention must be focused on problems of changing the social structure of the rural population, problems of labor resources and upgrading the production qualifications of the workers, problems of organizing labor and socialist competition in the sphere of the agroindustrial complex.

The sphere of activities of Soviet social scientists undoubtedly includes the working out of scientific principles and forms of ideological work, integrated problems of labor, ideological-political and moral indoctrination of farm workers.

L. I. Brezhnev's memoirs concerning the important historic events in the life of our country clearly demonstrate the enormous significance of moral-political stimuli in enhancing the creative involvement of the Soviet people. The abundant historical experience depicted in these memoirs serves as an essential textbook of life and creativity.

The country has created many scientific-research institutions which are or will be engaged in working out the specifically economic problems of the country's agricultural development: scientific institutions of the USSR Academy of Sciences and the academies of sciences of the union republics, sector institutes of the USSR Ministry of Agriculture and other agricultural departments, VASKhNIL, institutes of the USSR Gosplan system, and a number of state committees and ministries. But scientific research in these institutions is not yet properly coordinated. On the one hand, this leads to duplication and dispersion of efforts; on the other, it brings about a situation in which some very urgent and complex problems relating, in particular, to the system of intersector relations in the composition of the national economy's agroindustrial complex and its economic effectiveness are either oversimplified or else are being researched by very few scientific groups. Social, legal, and agrarian-economic problems are being studied by specialists in isolation, in scattered fashion. In addition, experience in agricultural development in the fraternal socialist countries and throughout the world is not being adequately studied; research is frequently conducted without the participation of specialists working in institutes of international profile.

In October 1978 the Section of Social Sciences of the USSR Academy of Sciences Presidium examined proposals of the USSR Academy of Sciences Economics Institute concerning the main directions of agrarian-economic research for the near future. The decision was made to draw up a unified integrated program of research into rural social-economic problems, to involve the participation of all scientific institutions of social-economic profile. The formulation and implementation of this program will make it possible to activate research into social-economic problems of agricultural development and the agroindustrial complex as a whole; it will give these problems the necessary directionality and create the possibility of speeding up the completion of this research and the adoption of its findings in practical work.

Obviously, it would be worthwhile for the USSR Academy of Sciences to have a base institute for integrated rural social-economic research, to be responsible, in particular, for the study and generalization of practical experience in resolving rural social-economic problems.

Of course, all of this research activity by the social scientists must become a component part of the overall program to work out the scientific principles governing agricultural development, the creation of which was discussed by USSR Academy of Sciences President Academician A. P. Aleksandrov in his introductory speech.

We have every reason to believe that Soviet social scientists will do their duty for agriculture and manifest the necessary involvement in this crucial sector of the building of communism.

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AGRICULTURAL MACHINE BUILDING AND PROBLEMS OF EXTENDING THE SERVICE LIFE OF AGRICULTURAL MACHINERY

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 87-96

[Report by USSR Academy of Sciences Corresponding Member K. V. Frolov]

[Text] One of the most important stages in our party's modern agrarian policy is the implementation of a broad program of integrated mechanization of farm production to convert it to an industrial basis. The July 1978 Plenum again confirmed this course of action.

Of increasing importance to the development of agricultural equipment is fundamental scientific research. In his report at the plenum, CC CPSU General Secretary and USSR Supreme Soviet Presidium Chairman Comrade L. I. Brezhnev said: "It is important that the formulation of the manifold problems of accelerating scientific-technical progress in agriculture continue to involve the active participation not only of workers in agricultural science but also the USSR Academy of Sciences, the academies of sciences of the union republics, and scientists in all spheres of knowledge" (PRAVDA, 1978, 4 July).

The July Plenum set forth an extremely vital task--that of completing in the next five-year plan the integrated mechanization of cultivation of the most important crops, raising to a higher level the mechanization of all types of farm work. This involves the systematic conversion from the creation of individual machines and technological processes to the design and production of highly-efficient systems of machinery and production lines. At present, agriculture does not have even one-third of the types of machinery and equipment necessary to implement integrated mechanization.

The plenum also called for a fundamental solution to problems of quality in agricultural machinery, stipulating decisive measures to improve the technical level of agricultural machine building.

Basic Problems of Agricultural Machine Building

At present our country is producing more tractors than the United States, the FRG, Great Britain, and Italy combined. The total capacity of the USSR's tractor fleet adds up to 68 percent of the installed capacity of all our hydroelectric, thermal, and nuclear power plants. Since 1965, the average horsepower per tractor has risen from 48.1 to 69.5; the power-to-worker ratio in agriculture has risen from 7.6 to 20 horsepower. The Ministry of Tractor and Agricultural Machine Building and the Ministry of Machine Building for Livestock Farming and Feed Production alone include more than 300 plants and 100 institutes and special design bureaus chiefly involved with the mechanization of field operations, livestock farming, and feed production.

Unresolved major problems of agricultural mechanization still remain, however. One such problem is the creation of an optimal array of farm machinery to carry out the entire complex of agricultural work within scientifically-substantiated agrotechnical periods. It must be added that the technical level, quality, reliability, and durability of many machines do not yet meet modern standards; as a result, equipment productivity goes down and material and monetary outlays go up in the production of farm goods.

Farm equipment is generally operated under very unfavorable conditions due to:

the seasonality of the work (during limited crop harvesting times or planting campaigns, the machines are operated at a forced pace);

the mobility of the farm machinery and, in connection with this, the high vibration and dynamic load on the components (as a result of the interaction of the units, the soil, the terrain, and other operating factors);

great amounts of dust and dirt which cause intensive abrasive wear on inadequately protected components and friction pairs in the machinery;

the practice of storing the equipment outside without adequate protection against corrosion;

the lack of effective means of mothballing the machinery prior to long-term storage.

Despite our country's high level of automation of production processes, the proportion of manual labor, especially in agriculture, is still too high. For this reason, the formulation of the theoretical principles governing the design and development of promising equipment (automated machine complexes, robots, and manipulators), and special walking machinery and systems of machinery for field operations--machinery designed to perform hazardous and socially unattractive operations in mechanized and automated farm complexes of the industrial type--is a priority task.

Mention should be made of the fact that agricultural machine building is not making adequate use of scientific-technical advances in other sectors. In order to sharply improve the technical level of modern farm machinery it is necessary to resolve a number of major tasks of an industrial nature, involving both research and design, and also problems of ergonomics, ecology, and the training of appropriate specialists.

Directions and Ways of Extending the Service Life of Machinery for Agriculture.

The making, operation, and repair of manufactured farm machinery. One of the most important tasks facing agricultural and other sectors of machine building is that of fully meeting agriculture's need for basic types of machinery and equipment in the required volume. It is of substantial importance in agricultural machine building to raise the speeds of machinery and tractor units. As a result of increasing these speeds in the 10th and 11th five-year plans (up to 15 kmh), machinery productivity should rise by 1.5 to 2 times, but this will bring about a substantial rise in dynamic loads.

Radical improvements must be made in organizing technical control in many plants producing farm machinery. It is now time to examine and resolve the question of creating a special system for the acceptance of machine products, a system in which the acceptors are not subordinate to the director of the enterprise.

Losses due to the inadequate level of project planning, testing, adjustment, and operation of farm machinery are characterized by the following data:

farm machinery idleness due to breakdowns and repairs runs as high as 35 percent of the work time in plowing and 50 percent in harvesting;

overconsumption of fuel and lubricants due to unsatisfactory design and quality of the engines runs as high as 10 to 12 percent;

the metal-consumption of the support components of the machinery and mechanisms is 10 to 12 percent over the calculated.

Improving the quality of farm machinery requires systematic qualitative analysis of the causes of breakdowns in farm machinery that has been manufactured and is in operation, the formulation of measures to improve the design of the weakest components, to use new materials and designs, in particular expanded use of hydraulic transmission systems to replace belt-driven variable-speeds, modernization of transmission components, the development and extensive use of test stands and grounds, optimalization of the machinery's operating modes, and the extensive use of laser and plasma methods of machining components. The resolution of these tasks ought to be the focus of efforts of the sector design bureaus, the scientific-research institutes, and the farm machinery enterprises.

In recent years, the problem of reliability in farm machinery operation has come to be of special importance; this is due to the increased complexity of the machines and the forced operating modes of their seasonal work, the development of new areas and regions characterized by difficult climatic and terrain conditions, and inadequate initial quality of the machinery. As a result, the utilization coefficient of farm machinery is too low; idleness is rising, and outlays on preventive and restoration repairs are going up.

At present our country is spending enormous sums on repairing machinery and manufacturing spare parts. Plants manufacturing new tractors account for only 22 percent of the productive capacity, while the repair enterprises account for 44 percent. Because of the lack of substantiated monitoring methods, machines are frequently brought in for repairs even though they do not need it, and on the other hand newly-manufactured machinery is unfit to be operated. More than one-third of all machine tools and one out of every four workers in the country are engaged in repairs. This is due to the fact that the repairs are not made by the manufacturing plant itself but by small repair shops that do not do good-quality work.

The fact that the accuracy of manufacture and assembly during repair operations is reduced by two to three times, the frequent use of substandard and random materials, and the low quality--and sometimes complete absence--of heat treatment of parts lead to a situation in which machinery operation after the first (capital) repair it is economically disadvantageous. It is accompanied by four to seven times more consumption of spare parts, a 2.5 to 5 times shorter service life of the machinery or the basic units, three to four times more idleness, and three to five times more medium and current repairs. For most tractors and engines, the guaranteed service life up to the first repair is set by normative at 6,000 hours: in actuality, it is between 3,000 and 5,000 hours. After capital repairs the guaranteed service life drops to 2,000 hours; the number of breakdowns rises and the quality of the machinery work goes down.

Improvement of the quality of operation and repair of farm machinery--and this is an essential condition on effective use in agriculture--must be the focus of efforts of agricultural machine building enterprises, Sel'khoztekhnika Agencies, sovkhoz and kolkhoz workers, and suppliers of farm technological equipment.

In formulating measures in the area of manufacturing, upgrading, and repairing manufactured farm machinery it is necessary to make use of advances in related sectors of science and technology.

Fundamental scientific research into new principles of creating machinery and machinery systems for agriculture. The development of new promising farm machinery meeting all higher requirements must be based on fundamental scientific research carried out by the USSR Academy of Sciences, the republic academies of sciences, and key scientific-research, design, and technological institutes.

The essence of a scientifically substantiated approach to the development of machinery involves the integration of various contradictory requirements and criteria--design-technical, functional, ergonomic, production-technological, and social. In turn, each such requirement consists of a number of specific criteria. Thus, design-technical criteria include specified operating movements, vibration activity, dynamic load, wear resistance, durability, strength, efficiency, weight, dimensions, metal-consumption, and so on.

For carrying out labor-intensive farm operations, special urgency attaches to the problem of developing promising models of machinery--next-generation machinery. Such machines must include mechanized complexes for field operations and livestock farm operations, vegetable farming, and cotton growing. Vital constituent elements in these complexes will be manipulators, robots, and walking machines. Of interest in this regard is an operating model of an orthogonal-layout six-leg walking machine developed by the Institute of Mechanical Engineering to provide horizontal placement of the carrier's chassis. Such a machine is promising for work on mountain slopes and under other conditions (Figure 1).

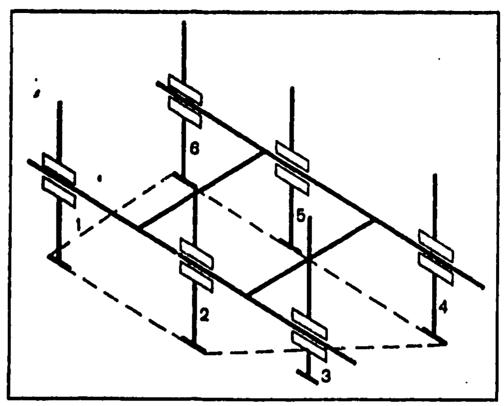

Figure 1. Functional Diagram of Operating Model of Six-Leg Walking Machine

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The formulation of fundamental functional and dynamic diagrams of such complexes and their components and the creation of prototype models using advances in various sectors of science (applied mathematics, computers, theory of machinery and mechanisms, theory of control of operating processes, physics, mechanics, and so on) must be concentrated within the system of the USSR Academy of Sciences, VASKhNIL, and the scientific institutions of union and republic ministries.

The effectiveness of these applications will be reflected in substantial increases in machinery productivity and the quality of farm work, the replacement of labor-intensive manual labor with machine labor, improved working conditions, and conservation of the country's labor resources.

The project planning and development of new farm machinery with longer service life based on advances in materials mechanics and design must be viewed as one of the most important directions in improving the quality of farm machine products.

Scientific research to determine the strength, service life, capacity, productivity and maneuverability of new farm machinery must include:

the development and adoption of likely methods of calculating strength, durability and reliability of machinery on the basis of analyzing operational load and the characteristics of scattering of resistance to breaking in order to substantiate norms on the service life, repair and restoration work, and spare parts;

the development of methods to calculate shock and random vibration loads;

optimalization of structural forms of support components on the basis of model and full-size tensometry and tests for strength, taking account of the use of new high-strength materials, including composition (plated) materials, also the use of effective technological processes (surface, chemical-thermal, plasma, and laser machining, and so on)--all of which reduce material-consumption by five to twenty percent and extend the service life by many times;

conversion to machinery operation under constant monitoring of their condition by means of systems of sensors to extend the service life up to 30 percent;

assimilation by the farm machinery scientific-research institutes and design bureaus of methods and means of calculation and testing for strength widely used in shipbuilding, aviation technology, nuclear and metallurgy machine building, and other sectors of machine building.

The USSR Academy of Sciences Institute of Metallurgy imeni A. A. Baykov has worked out methods for substantially improving the mechanical properties of pig iron and steel by adding rare-earth metals (cerium, lanthanum and others) to their composition. These methods have been adopted in production and make it possible to replace forged steel shafts in farm machinery with pig iron shafts; this provides substantial advantages: conservation of rolled steel, reduction in the labor-intensiveness of manufacture, and extended service life thanks to improved wear-resistance in components and parts.

It is essential to ensure the service life of farm machinery with respect to criteria of uniform strength of all components and wear-resistance for the machinery's moving joints and operating parts in interaction with objects such as the soil, animals, seeds, fruit, and so on.

Coupling sleeves and brakes are among the leading items presently used in farm machinery with respect to the frequency of breakdowns as a result of wear and breakage. Standard service life requirements for tractor coupling sleeves and brakes are set at 6,000 motor-hours, with the potential of being upgraded to 8,000 to 9,000. But the actual service life of tractor brake components is only 1,000 to 2,000 motor-hours, and for the DT-75S tractor the figure is even below 1,000.

Analysis and research data from the Institute of Mechanical Engineering show that it is possible to extend the service life of friction components in farm machinery in the following ways:

by perfecting the designs of sleeves and brakes so that minimal amounts of lubricant, moisture, and abrasive material get into the friction pairs;

by calculating and designing the whole engine-braking system so as to eliminate unwanted self-oscillations and resonance frequencies in the friction zone, also to eliminate normal, tensential, and torsion vibrations;

by deliberate conversion, in heavy-duty machinery, from belt-driven designs of friction units to more energy-intensive designs, for example disk;

by the creation of an artificial optimal water and gas medium in the friction component, for example replacing the air with a gas medium of higher CO_2 content (Figure 2);

by developing new friction materials containing special components which disintegrate in the friction process and create in the friction zone a special gas medium (for example, CO_2) which increases the wear-resistance of asbofrictional materials by a factor of almost ten.

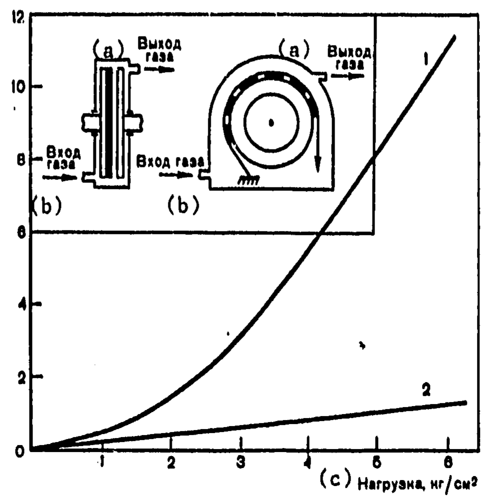

Figure 2. Increasing the wear-resistance of asbo-frictional materials of brakes and sleeves by changing the tribochemistry through the use of gas of high CO_2 content (vertical access-wear)

1--air; 2--gas with CO_2

Key:
- (a) Gas outlet
- (b) Gas Inlet
- (c) Load, kilograms per square centimeter

Considering that it is generally the most vulnerable and weak components and parts that go out of commission, one of the most important measures in the system of improving machinery wear-resistance in order to ensure the reliable operation of individual components and the unit as a whole is to organize repair and rehabilitation work so as to use effective means and methods, especially for the weaker components and friction pairs.

Among the tried and proven methods and means are the following:

laser and plasma machining of component surfaces;

induction surfacing of wear-resistant alloys;

chemical-thermal treatment;

the use of alloy steels in the most heavily-loaded components;

the replacement of existing pasture land water-pump equipment (cable-driven, belt-driven, diaphragm, and other installations) with reliable new installations of the Rodnik type with friction components operating on the water lubricant developed by the Institute of Mechanical Engineering, providing a service life of up to 50,000 hours (this will yield an annual economic effect of 10 to 12 million rubles and reduce metal consumption by 8,000 to 10,000 tons);

the use of special seals to protect friction pairs against dust and sand, to reduce abrasive wear and other types of wear, to eliminate minor local repairs (this is a matter of rational complication of design for the sake of simplicity in repair and preventive maintenance work);

the use of new special materials which do not require lubrication for slide bearing bushings, for example metal fluoroplastic (Figure 3);

the use of special seals to protect friction pairs against dust and sand in order to reduce abrasive wear and other types of wear;

the use of magnetic and other traps and means of protecting the cutting tool against the accidental invasion of metal objects.

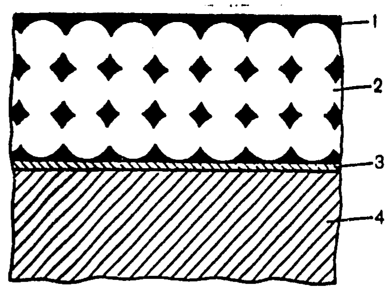

Figure 3. Structure of metal fluoroplastic material (cross section)

1--Fluoroplastic; 2--bronze; 3--copper underlayer; 4--steel base

For the development of uniformly strong and uniformly wear-resistant machinery it is necessary to organize appropriate efforts in the scientific-research and project-design organizations of the USSR Academy of Sciences, VASKhNIL, and the union and republic ministries.

The effectiveness of these measures relates to the reduction in the machinery's metal-consumption and savings in metal, reduction in the amount of machinery breakdown idleness, reduction in the volume of spare parts needed for repairs, reduction in the amount of time necessary to refine and adopt new designs, and substantial lengthening of the machinery's service life--by three to six times.

Further development of machine building, in particular for agriculture, is largely determined by the level of scientific-research work designed to find ways to improve the machinery's operating parameters promoting productivity. This primarily involves work on developing fundamentally new machines and new methods of designing them in accordance with ergonomic criteria which meet environmental standards, minimize the level of vibrations and noise, create normal conditions for the operator's work, and so on.

In developing farm machinery, not enough consideration is paid to certain characteristics of operation, and the project-planning of high-speed and heavy-duty machinery is frequently conducted by traditional methods. As a result, the machinery's mechanisms develop intensive oscillation processes giving rise to noise and vibrations leading to dynamic overload and reduced service life and comfort. Because of this, problems of perfecting mechanism design are of priority importance. In the development and modernization of farm machinery it is essential to take account of deformation and vibration in the machinery's frames not only with respect to conditions of performing technological functions but also with respect to various operating factors (uneven terrain, nonuniform soil composition, and so on) and to design the machinery to take shock loads and random vibration loads.

Vibration phenomena lead not only to reduced durability (the build-up of fatigue damage and wear) but also to harmful effects on the operator. This latter circumstance makes it difficult to increase the speeds and capacities of the machinery. Because of inadequate vibration protection, truck transport on rough rural roads suffers considerable losses due to oscillations and vibrations, thus boosting the prime cost of truck shipping.

One of the main lines of research in the ergonomics of agricultural machinery is the development of systems of vibration protection for the human operator, methods of designing machinery and systems of optimal parameters with respect to criteria of vibration activity, methods and means of vibration dosimetry.

The Institute of Mechanical Engineering and certain other organizations have lately been carrying out such research, and the broad adoption of their findings will make it possible to resolve a number of important problems. Thus, effective systems have been worked out for protecting the human operator of self-propelled farm machinery of the new type against vibration, active vibration-protected devices with a high degree of vibration insulation (up to 20 dB) in the range of infra-low frequencies (up to 10 Hz), methods of synthesizing basic circuits, methods of calculating optimal parameters depending on the nature of the incoming vibration effect, and methods of designing them. Work is being done to develop radically new types of vibration dosimetry--a method of evaluating the danger posed by vibrations to the human being in his working activities. An operative vibration dosimeter has been developed and manufactured which substantially simplifies the routine evaluation of actual vibration phenomena acting on the human operator and evaluation of the effectiveness of the system of vibration protection for the human operator under field conditions. It is vital that agricultural specialists make use of these methods in order to organize the series production of new devices and instruments.

The task of resolving problems of ergonomics in agricultural machine building must enlist the key scientific institutions of the USSR Academy of Sciences, VASKhNIL, and union and republic ministries.

Agriculture is one of the main consumers of energy and fuel. Volumes and specific consumption levels of energy will continue to rise as the mechanization and automation of agricultural processes continues to rise. Because of this, it is of primary importance to reduce fuel and energy costs in agriculture.

Fuel consumption can be reduced by improving the heating process in diesels, in particular by using a turbosupercharger (it is necessary to adopt the findings of research in this area), by enhancing the wear-resistance and elastic properties of piston rings, and by developing devices for recirculating spent gasses and using them to dry grass and grain.

It is essential to expand research work into the use of electrically-driven transport, in particular the development of electrical drive systems for tractors, for vegetable farming on closed plots, for horticulture and livestock farming. It is essential to develop batteries that are comparable to petroleum fuel in energy capacity.

Also very promising is the use of wind, solar, and geothermal energy. By the year 2000, agriculture in the United States plans to provide for 50 percent of all low-temperature processes (space and water heating) with equipment operating on solar energy. This is a very vital problem for our southern areas, but work on it is going too slowly.

One very vital problem in agriculture is that of maintaining soil fertility, in particular through minimal cultivation (including moldboardless cultivation). In the United States by the year 2000 plans call for using minimal cultivation on about 90 percent of the land area.

In resolving tasks of minimal soil cultivation, a vital role is played by the modeling of processes that take place when the working parts of farm machinery interact with the soil. The propelling systems of farm equipment compact and disrupt the soil, resulting in a 10 to 15 percent decline in crop yields. It is necessary to work out normatives of permissable impact on the soil, also new systems which disrupt the soil as little as possible. The All-Union Scientific-Research Institute of Agricultural Mechanization (VIM) has developed an experimental model of a tractor with rubber tracks. These tracks disrupt the soil less, reduce fuel consumption, and improve the operator's working conditions, but they require highly-reliable materials, and so it is up to the chemical institutes of the USSR Academy of Sciences to make a contribution.

The development of farm machinery is becoming increasingly complex, because it requires extra labor resources and bigger volumes and longer timetables in research. Because of this, one of the most important tasks is that of transferring a substantial portion of calculation and design work to computers functioning in dialogue between man and computer.

Of great importance is the use of the system of automatic project-planning (SAPR) in the design of farm machinery. But this requires calculations on basic criteria and systems analysis of optimal solutions taking account of the interaction among the basic components of the human-machine-environment system.

The use of the SAPR will make it possible to shorten the project-planning time and substantially enhance its quality thanks to the selection of optimal parameters of machinery functioning and operation. Substantial experience along these lines has been accumulated in the Institute of Mechanical Engineering.

Scientific-Organizational Measures to Improve the Technical Level of Agricultural Machine Building

The creation of promising machines (the machinery of the future) involves the adoption of scientific-technical advances and rapid organization of their production. For this reason it is advisable to draw up special legislation regulating the procedures for the creation of new models of machinery and instituting series production and acceptance.

For this purpose it is obviously necessary to organize an appropriate interdepartmental center and assign to it the responsibilities of systematic analysis and forecasting of problems relating to the development of the equipment of the future.

In order to adopt scientific-technical advances in agricultural machine building it is necessary to organize the training of highly-qualified agricultural specialists in various sectors, assigning workers in enterprises of the corresponding union and republic ministries to directed graduate work. It is not possible to substantially improve programs of training for engineering cadres for agricultural machine building in specialized VUZ's or in departments of machine building in other VUZ's and agricultural academies. For workers in industrial enterprises, design bureaus, and farm machinery testing centers it is necessary to organize special publications which will reflect the latest advances in machine building.

The USSR Academy of Sciences could become the center for coordinating scientific research in areas relating to machine building.

A session held in October of last year by the USSR Academy of Sciences Scientific Council for Machinery and Machinery Systems Theory and the Institute of Mechanical Engineering to deal with problems of agricultural machine building has made it possible to determine the most urgent directions of development in this sector:

fundamental research relating to the formulation of new principles governing the development of highly-mechanized and automated machinery systems, including manipulators, robots, walking machines, and other equipment for automating operations in farm production involving large outlays of manual labor;

integrated project-planning of farm machinery through the interaction of humans and computers in order to select the optimal parameters under conditions of conflicting criteria of machinery quality, functioning, and operation;

problems of improving machinery service life and reliability with regard to the criterion of strength and wear-resistance through the broad use of laser and plasma machining, powder metallurgy, and so on;

problems of power engineering, ecology, and ergonomics in agriculture;

investigation and modeling of processes taking place when the working parts of farm machinery interact with the soil.

The USSR Academy of Sciences Section of Physical-Technical and Mathematical Sciences and Department of Mechanics and Processes of Control have worked out a draft master program of research relating to extending the service life of farm machinery. Substantial experience in this regard has been accumulated by the Institute of Mechanical Engineering, the Ukrainian SSR Academy of Sciences Institute of Mechanics, the USSR Academy of Sciences Institute of Problems in Mechanics, VIM, the State All-Union Tractor Scientific-Research Institute (NATI), the All-Union Scientific-Research Institute of Agricultural Machine Building (VISKhOM), the Central Scientific-Research Motor Vehicle and Vehicle Motor Institute (NAMI), the All-Union Scientific-Research Institute of Construction and Highway Machine Building (VNIIstroydormash), and others. Implementation of this program is entirely feasible and will constitute a substantial contribution by science toward the further development of agricultural machine building.

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AGROINDUSTRIAL COMPLEX DEVELOPMENT IN THE UKRAINE

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 97-99

[Abridged Speech by Ukrainian SSR Academy of Sciences Academician I. I. Lukinov]

[Text] In the time since the March 1965 CC CPSU Plenum we have seen not only substantial increases in gross farm output but also substantial changes in the material-technical base of social agriculture and improvement in its structure and the system of relations and economic ties with other sectors and spheres of the national agroindustrial complex. At the same time, production growth is held back by a number of limiting factors.

The decisions of the July 1978 CC CPSU Plenum are designed to do away with these factors; they call for comprehensive intensification and industrialization of farm production, improvement of its effectiveness and quality on the basis of modern machine technologies, highly-productive hybrids, varieties, and breeds, and the creation of appropriate economic conditions to stimulate increased labor productivity.

The Ukrainian SSR Academy of Sciences Presidium and its president Academician B. Ye. Paton are focusing much attention on the resolution of the food problem. The Ukrainian SSR Academy of Sciences Institute of Economics is doing a great deal of scientific research into vital agrarian problems in close coordination with other scientific institutions. Already completed and submitted to management and planning agencies is a long-term program of development of the agroindustrial complex of the Ukraine up through 1990 and 2000. On the basis of fundamental research into modern economic processes and determination of the most advanced tendencies and multi-variant calculations of future economic development, optimal variants have been chosen on the basis of criteria of the effectiveness of utilization of resources and the feasibility of implementation.

The Ukraine is one of the most developed and intensive links in the unified nationwide agroindustrial complex. Although it has less than five percent of the agricultural land area in the country, the republic produces about 24 percent of the nation's gross crop and livestock output, including about

60 percent of its sugar beets, more than 50 percent of its sunflowers, and 30 percent of its flax fiber. Very stable growth rates are being maintained, especially in grain production. In 1978 the grain harvest was 50.6 million tons--more than one ton per capita. The average annual volume of gross farm output in the first three years of the 10th Five-Year Plan rose by 10.5 percent versus a planned 8.7 percent.

Plans call for further intensification of all sectors of the republic's agroindustrial complex, improvement of its structure, elimination of disproportions, deepened specialization and a higher level of concentration, and the formation of cooperative and integrated economic systems. The republic's contribution to the nation's complex will rise substantially.

In forecasting applications we have encountered a number of difficult problems relating to the deficiency of energy and water resources. Resolving these problems will require major capital investment. In addition, about 44,000 hectares in the republic are taken out of farm production every year to accomodate industrial, city, highway, and other construction; there is also a decline in the number of those employed in agriculture. These losses must be made up only by the adoption of modern technologies and technical equipment; unfortunately, this is not always possible because of the lagging pace of development and improvement of the industrialized block of the agroindustrial complex.

Our industry will have to convert to a qualitatively new stage of progress--it will have to begin to produce and deliver to agriculture not just individual, separate product items but systems and complexes of machinery and equipment and chemical and other industrial products specially designed for highly-intensive technologies with specified parameters on the quantity, quality, and prime cost of farm products. It is time, finally, to understand that even the most ideal machine or implement, by itself, not part of a system, cannot resolve problems of overall effectiveness. Systematicity and strict, balanced coordination also apply to the whole agroindustrial complex. Today, for example, the lag in the microbiology and combination feeds industry is complicating the resolution of the grain problem. Given our present level of gross grain yields, by converting all grain fodder into full-value combination feeds and increasing their content of industrial (nongrain) additives to the required norm it would be possible to save substantial quantities of grain; this would make it realistically possible to boost meat production, curtail imports, and even increase exports of grain. Moreover, considering our enormous land resources, with the proper degree of technology, full technical support, comprehensive use of highly-intensive varieties and hybrids, and the application of substantiated norms of high-quality fertilizers, the USSR could and should become a major grain exporter, converting this sector into a vital source for replenishing the state's foreign exchange resources.

In order to reduce losses of valuable raw materials and products, it is also necessary to increase the capacity of the processing industry. The Ukrainian SSR Academy of Sciences Institute of Economics has submitted a proposal on the more rational distribution of capital investments within the agro-industrial complex, in particular with respect to accelerated development of the sphere of processing farm goods and delivering products to the consumer, also with respect to changing the proportions of investments on the creation and assimilation of reclamation systems, increasing outlays on development by 1.5 to 2 times in order to sharply increase the overall effect of land reclamation.

Implementing the decisions of the July 1978 Plenum, the institute is also working out a method of economic monitoring of the movement of wholesale and purchase prices, a method based on the introduction of an index coefficient of proportionality of the exchange between industry and agriculture. In addition to researching theoretical aspects and creating macroeconomic models, we are working out model types and structures of agroindustrial-trade complexes and associations on the lower microeconomic level. On the basis of individual regions, we have worked out rational types of specialized enterprises and interfarm associations and complexes that are balanced and tied in to a unified system of the territorial-sector type. We are at the same time working out measures for the formation and improvement of narrowly-specialized economic systems of the Ptitseprom, Plodovinprom, Ovoshchekonservprom, and others.

We ascribe special importance to working out economic relations within cooperative and integrated systems so as to prevent any kind of depersonalization and irresponsibility, comprehensively develop cost-accounting relations and principles and maintain the correlation of social and individual interests.

At the same time, we have markedly expanded and deepened research into the social problems of the countryside, the working and living conditions of farm workers, development of the infrastructure, and adequate stimuli to boost labor productivity and retain young people.

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CHEMICAL MEANS OF PLANT PROTECTION

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 99-101

[Abridged Speech by Academician M. I. Kabachnik]

[Text] The prevention of crop losses due to pests, diseases, and weeds is among the most important economic tasks of our time. It is possible to protect plants effectively against harmful organisms only by means of an integrated system of measures which include the use of chemical, biological, agrotechnical, and selection techniques along with appropriate forecasting.

Such integrated systems are being worked out for application to various crops and soil-geographic zones, and a key role in the battle against harmful organisms is assigned to chemical means of protecting plants--pesticides. A comprehensive analysis of this problem, both in this country and abroad, has shown that pesticides will retain their key role in protecting plants in the forseeable future.

In the last ten years there has been broad discussion of the danger of harmful consequences of excessive pesticide use. The propagandizing of this danger has had a positive effect: safety standards for humans, domestic animals, and the environment have stimulated the evolution of chemical means of protecting plants. Pesticides of the first generation (from the 1950's to the early 1960's) were mostly highly toxic to humans and animals and very persistent--that is, they would persist in the environment for a long time and circulate within the food and water-food chains, ending up in the human organism. Many of them--organochlorine products of diene synthesis DDT, arsenic compounds, and so on--are banned in the USSR, and only restricted use of some of them is allowed in exceptional cases.

In the last twenty years, intensive scientific research and technical applications carried on throughout the world have led to the development of pesticides of the second and, recently, the third generation. They do not have the negative properties of first-generation pesticides. Their average toxicity for humans has been reduced by 100 times or more. Their persistence has been sharply reduced. Even now, however, the existing assortment of pesticides is not completely satisfactory.

The assortment of plant protective chemicals now being delivered to our agriculture is too narrow and does not fully meet the needs of crop protection.

In some cases the lag in the development of pesticides is due not to the inadequate development of production but rather to the fact that the problem is unresolved. Nowhere in the world, for example, has anyone yet managed to develop a compound that can fully substitute for DDT. This has proved to be exceptionally difficult. Individual chemical substances have been found which, in terms of their useful properties, could be used instead of the DDT and do not have its drawbacks. But the technology for producing these substances is complex and, consequently, they are costly.

In addition to assimilating the best pesticides known to us and abroad it is essential to intensively develop the search for new compounds meeting today's standards. This vital task is of an integrated nature. It will require the combined efforts of the synthesizing chemists and experts in a variety of specialties.

There are three ways to find new pesticides. The first involves screening, massive synthesis, and mass testing. It is a long and costly method, but with adequate capital investments it eventually accomplishes its goal. A screening system is organized in the USSR Ministry of Chemical Industry All-Union Scientific-Research Institute of Chemical Means of Plant Protection. The second method is trial and error. It is distinguished from screening by the systematic varying of the structure of the molecule of the substances being synthesized; each time, the synthesis is adjusted on the basis of the results of the tests of the preceding substance. In this method, mathematical planning of the experiment helps a great deal.

The third and final method is rational, directed synthesis on the basis of studying the physiological and biochemical mechanism of the action of various types of compounds, their metabolism in the organisms of plants and animals, toxicodynamics, and other principles of selective toxicity. This method is within the capabilities of the academic institutions, and in the initial stages it requires considerable effort and outlays, but it becomes cheaper and easier as knowledge is accumulated. In actuality, of course, these methods complement one another, but the third method is becoming increasingly promising as time goes on.

The third method is being used to find new pesticides in the USSR Academy of Sciences Institute of Organoelemental Compounds. In just a few years the institute has managed to organize an interdepartmental collective which besides the institute itself includes scientists of the Institute of Evolutionary Physiology and Biochemistry imeni I. M. Sechenov and VASKhNIL's All-Union Institute of Plant Protection (in Leningrad), the All-Union Scientific-Research Institute of Chemical Means of Plant Protection of the Ministry of Chemical Industry (in Moscow), and a number of other institutes and VUZ's in Moscow, Kiev, Nal'chik, and Tashkent. The institute's work is dedicated to finding new organophosphoric insectoacaricides characterized by high selective action and low toxicity for humans and which do not persist as harmful residues in the environment. This research has led to pesticides of a new class--the phosphadepsipeptides. A number of highly-effective compounds have been found and subjected to successful field testing on cotton in Uzbekistan and, an especially important point, a rational system has been worked out for finding new insectoacaricides. The system is also being successfully applied to insectoacaricides of certain other classes.

Thus, we have achieved interesting and important results. It must be stated, however, that the work is going much more slowly than we would desire. The reason is that the research is being done with inadequate forces that are inadequately supplied with the necessary modern instruments. As far as I know, the same thing is happening in projects to find new pesticides in other academic institutes.

At the initiative of USSR Academy of Sciences President Academician A. P. Aleksandrov, Chemical Industry Minister L. A. Kostandov, and Agriculture Minister V. K. Mesyats the USSR Academy of Sciences has enlisted the active participation of the ministries and departments to draw up a long-range program of scientific research into the whole complex of plant protection problems. This program was drawn up by a collective of highly-qualified specialists--chemists, biologists, agriculture workers, medical people, and so on; the program incorporates a broad range of research, tests, adoption projects, and so on. Naturally, it also contains the necessary organizational measures designed to speed up the work.

Unfortunately, more than 1.5 years have already gone by yet the program has not yet been approved; consequently, the projects are not properly organized and are not provided with the necessary material-technical support.

Decisive measures are needed to strengthen research into plant protection, in particular the study of new means of protection. The USSR Academy of Sciences, the republic academies, and VASKhNIL have the task of providing scientific support for plant protection, a task which can be resolved only by focusing more attention on this work. It is essential to strengthen laboratories of this profile: they must be provided with cadres and instruments (including imported instruments). We know how to resolve the tasks facing us, and with the proper attention and support we can work out an agriculturally essential and environmentally safe assortment of means of protecting the crops against pests, diseases, and weeds.

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FORECASTING, INFLUENCING WEATHER CONDITIONS

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 101-102

[Abridged Speech by USSR Academy of Sciences Corresponding Member Yu. A. Izrael']

[Text] Agricultural productivity is to a large degree determined by the environment; although crop yields are rising as the quality of land cultivation improves, the extent to which farm production depends on natural conditions is as strong as ever. A comparison of gross crop yields in the 1940's and the 1970's confirms this assertion.

Since 1946, average grain crop yields in this country have varied substantially--from 7 to 18 quintals per hectare. Annual reductions in yields during dry years in the 1940's came to 1.7 quintals per hectare, versus 5.7 quintals per hectare in recent years; that is, the absolute level of fluctuations varied by three times while the relative value increased from 25 to 30 percent.

True, this statistical series is not large, and it would be wrong to claim on its basis that the dependency is growing stronger, but it is certainly not growing weaker.

Resolution of the tasks set forth at the July 1978 CC CPSU Plenum with regard to ensuring the further growth and greater stability of farm production unquestionably requires taking fuller account of information concerning the environment and making use of advances in hydrometeorology.

Most of the scientific-research institutes of the USSR State Committee for Hydrometeorology and Environmental Control are doing work relating to the study of environmental conditions. As a rule, this work is being carried out in close contact with institutions of the USSR Academy of Sciences.

One of the most important and difficult problems being worked on by the committee's institutions is long-range weather forecasting. At present, monthly and seasonal weather forecasting is 65 to 70 percent accurate. But this is not enough to meet the needs of the economy, especially the agricultural sectors.

In order to develop new hydrodynamic methods of long-range weather forecasting, researchers are working out mathematical models of atmospheric circulation for the whole globe, taking account of the interaction between climate-forming and weather factors, the hydrological cycle, the heat influx, the global distribution of cloud cover, and the influence of the underlying surface. At the same time, work is being done to develop systems of global meteorological survey--observations on environmental conditions. In the future, such systems should incorporate geostationary meteorological satellites.

Implementation of the ideas of Academician G. I. Marchuk relating to the definition of zones of the World Ocean which to a large degree determine the weather in our country many months in advance requires special observations and research in a number of zones of the World Ocean. Such work has already begun in part on Soviet research vessels, and such efforts must be intensified.

A vital task in long-range weather forecasting involves predicting arid phenomena in various agricultural zones of the Soviet Union. This kind of forecasting is essential for long-range planning of farm production, to reduce losses inflicted by drought.

It is essential to institute thorough climatic investigations relating to natural and man-caused changes in climate. Institutes of the USSR State Committee for Hydrometeorology and Environmental Control and the USSR Academy of Sciences have drawn up a master program to study the earth's climate; in particular, it calls for studying the influence of possible climatic changes and fluctuations on farm production.

One of the main tasks of the program is that of determining the laws governing possible climatic changes under the impact of man-made factors. Scientists have not yet come to a unified viewpoint concerning possible climatic changes in the next few years and decades. It is obvious that even small changes, for example an average temperature change of 1 degree C in the Northern Hemisphere could lead to substantial disruption of the environment, having a considerable impact on farm production. Although it is difficult to forecast changes in man-made factors themselves, determining the relationship between man-made factors and climatic changes is a vital task in the program of climatic studies.

It will be necessary to keep very close watch over potential climatic changes and take steps to prevent changes that have begun or are beginning. It will probably be necessary to work out definite criteria on the maximum permissable growth of man-made factors. It may be necessary to draw up recommendations on the management of the national economy under changing climatic conditions, also recommendations designed to prevent climatic changes. Thorough research will be required into potential regional climatic changes relating to the transfer of northern river waters.

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The Environmental Monitoring Laboratory created jointly by the USSR Academy of Sciences and the USSR State Committee for Hydrometeorology and Environmental Control, as well as a number of the committee's institutes, is now studying and scientifically substantiating problems of ecological and climatic monitoring.

An important section of the research, finally, is active influence on hydrometeorological processes. Measures to prevent hail are already in practical use in the various republics. Of exceptional agricultural potential are methods making it possible to induce additional precipitation. Such experiments are under way in the Ukraine, are in preparation in Armenia and Georgia, and in the planning stages in Central Asia. According to preliminary estimates (which must be treated with a certain amount of caution), the cost of one cubic kilometer of water obtained as a result of such measures will be several times less than the cost of water gained through transferring northern river water.

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UKRAINIAN RESEARCH IN TRANSPORT, STORAGE, PROCESSING

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 102-104

[Abridged Speech by Ukrainian SSR Academy of Sciences President Academician B. Ye. Paton]

[Text] In his speech at the November 1978 CC CPSU Plenum, CC CPSU General Secretary Comrade L. I. Brezhnev noted that as the scale of farm production rises more and more importance attaches to tasks of bringing farm goods to the consumer with the least possible losses.

The results of fundamental research make it possible to map out ways to reduce such losses. In particular, scientists of the Ukrainian SSR Academy of Sciences have carried out fundamental research making it possible to develop a number of technological processes and corresponding equipment to resolve problems relating to the processing, transporting, and storing of farm goods.

Let me cite a few examples. On the basis of research in low-temperature physics, researchers have developed nitrogen systems for cooling and freezing perishable goods--systems that can be extensively used in agriculture and the food industry. They are distinguished by reliability, simplicity of design, convenience of operation, and a wide range of speeds and temperatures of cooling. They have already been tested in intercity haulage of fruit and have been highly evaluated by specialists.

Because of the prospects of substantially increasing container shipping, scientists have developed and tested special containers with self-contained cryogenic equipment that can also be used as refrigerators in the trade network. The use of nitrogen cooling systems in the economy will yield a substantial economic effect. It is estimated that the operation of just one refrigerator equipped with such a system in a large city will yield a savings of about 4,000 rubles per year. Consequently, our task is to develop various cryogenic systems and make extensive use of them in farm production.

Research into processes of heat and mass exchange have resulted in the development of new and improved methods of processing farm goods. In particular, methods have been proposed for drying sugar beet shavings for subsequent dispersion. The powder that results contains more than 70 percent sucrose and other valuable substances and can replace sugar as an industrial feedstock.

This application is very promising, because without increasing areas planted in sugar beets it affords a substantial savings in sugar for meeting the population's rising needs.

Our scientists have worked out new methods of heat treatment for sugar beets, dehydration of the sugar syrup, extraction of sugar from molasses, and crystalization of sugar in crystalizers; these methods make it possible to substantially shorten the technological cycle and increase the output. The adoption of these applications would make it possible to produce an additional 1.5 million tons of sugar per year in our republic's refineries alone. We propose that the main way to resolve the problem of supplying our country with sugar is not to expand areas planted in beets and build new refineries but to perfect the technology of production. A major factor here is the role played by science and the creative association of scientists of various profiles.

A promising way to reduce the sugar shortage is to make extensive use of substandard fruit and fruit squeezings in the canning plants, but because of the lack of rational methods and installations for processing them they are being wasted.

Our academy has worked out a method and developed technological equipment for making complete use of the squeezings that remain in the production of fruit juices. An experimental-industrial production line has already been tested in the Voroshilovgrad Confectionary Plant. Every year, more than 500,000 tons of apple residue go to waste in the Ukraine. The proposed method of processing them will make it possible to produce apple powder which is rich in sugar and other valuable substances. In some forms of production this powder can be successfully used in place of sugar, margarine products, and citric acid; this can yield a savings of millions of rubles per year. When the proposed methods and installations are used in other republics, the total effect will rise by several times. Adoption of technologies for producing fruit powders on a nationwide scale would yield an additional one million tons of sugar and other valuable food products per year. Of special interest is the production of valuable fructose by this method.

Fundamental research by our thermal physicists lies at the basis of development of the technology of monodispersion granulation of mineral fertilizers. This method was developed jointly with institutes and enterprises of the Ministry of Chemical Industry and has been assimilated under industrial conditions. This year, 1.5 million tons of high-strength monogranulated fertilizers have been produced. In the next few years the output should reach two-thirds of the country's mineral fertilizer production. Experience has shown that improving the form and increasing the strength of the granules increases grain crop and sugar beet yields by ten percent.

The findings of research chemists have been used in developing a new method for storing vegetables and fruit. In a regulated gas medium and at low temperatures it is possible to substantially slow down the process of after-harvest ripening of vegetables and fruit, extend their storage life to eight or nine months, reduce losses, and maintain high nutritional and taste qualities and their commercial appearance.

Our scientists have developed the country's first recirculation generator; with it, cheap natural gas is oxidized and fed into the storage space to create a regulated gas medium of given composition. One such generator is enough to operate a storage facility accomodating 6,000 tons. Considering that cooled storage facilities in our republic contain about 600,000 tons of vegetables and fruit, equipping one-quarter of all such facilities with these generators would yield an economic effect of over 20 million rubles.

Experience accumulated in the republic with regard to storing vegetables and fruit in refrigerators equipped with recirculation generators allows us to recommend this method for extensive adoption in the country's specialized procurement enterprises.

Also coming into practical use are the findings of our research biologists. In collaboration with the USSR Ministry of Food Industry All-Union Scientific-Research Institute of Sugar Industry they have worked out new methods of storing sugar beets. When placed in clamps, the roots are treated with special chemical preservatives which suppress the intensity of physiological and microbiological processes. This helps to reduce natural losses of the beets' sugar content and leads to increased sugar output.

Among the most effective preservatives is ammonium carbonate--a water-ammonium solution of urea and ammonium bicarbonate. This compound is already being produced on an industrial scale in the Severodonetsk Azot Production Association of the Ukrainian SSR Ministry of Chemical Industry and is being used in agriculture to fertilize the soil. The use of ammonium carbonate makes it possible to substantially reduce losses of sugar content when beets are stored in clamps.

Biologists have proposed a method for clarifying the blood of slaughtered animals; it is already being used in production. The new clarification method makes it possible to use the blood to make dry protein mixes. The nationwide use of the method would make it possible to substantially increase food protein resources. Our republic alone could produce up to 20,000 tons of protein annually. The necessary conditions have already been created, because the highly-refined enzyme catalase, the shortage of which only recently held back the extensive adoption of the blood clarification method, is now being industrially produced in the Ukraine.

Other research relating to agricultural problems has been carried out. In particular, the scientists have proposed feed additives to supplement livestock diets and worked out a technology for producing feed yeasts from vegetable wastes. A machine has been developed for dehydrating milk residues in dairy facilities in order to produce protein in feeds for young livestock, and a new technique and equipment have been developed for processing flax fibers.

It was specially emphasized at the November 1978 CC CPSU Plenum that efforts against losses constitute not only an economic but a vital political problem, and scientists in all sectors of knowledge can and must make a substantial contribution to solving it. It is essential to exert every effort to do our duty to the party and the people.

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ADVANCES IN PLANT PHYSIOLOGY

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 104-106

[Abridged Speech by Academician A. L. Kursanov]

[Text] The agricultural importance of research into plant physiology must be viewed in two aspects.

First, enriching agricultural science with the necessary knowledge concerning the organization of life processes in plants. This knowledge is essential to agricultural science and practice to the same extent that physiology is essential to medical science and practice. In its many-year history, plant physiology has discovered such cardinal phenomena as photosynthesis and plant mineral requirements; it has found accessible sources of nitrogen and ways to assimilate them, detected and studied water-exchange in plants and the hormonal mechanisms of their growth and fruiting, determined the possibility of regulating physiological processes by means of temperature, lighting, and chemical compounds, and so on. This fund of knowledge, which is now inseparable from the theory and practice of plant husbandry, determines their overall quality level and the possibility of continuous progress.

Because of advances in general experimental biology and accomplishments in scientific instrument making, plant physiology has now been given new possibilities for penetrating into the more intimate, profound organization of biological processes; this promises agricultural science and practice an even greater store of fundamentally new ideas and practical opportunities. For this reason, institutes of plant physiology must focus especially on fundamental research in this science, for which, as has been mentioned, favorable conditions have been created. Such work is under way, and much of it has already come into practical use or at least is of interest to practical workers and is undergoing practical tests. For example, a physiological theory of increasing photosynthesis productivity, worked out jointly by the USSR Academy of Sciences Institute of Plant Physiology imeni K. A. Timiryazev, VASKhNIL, the Estonian SSR Academy of Sciences, and certain other institutions, designed to reveal the maximum productivity of farm crops and work out the principles of realizing these potentials, is already being widely discussed and tested among selective breeders and plant husbandry specialists.

In recent times our country has created and developed a new field of plant physiology which studies plant metabolism under conditions of anoxia--that is, under conditions where plants are not getting enough oxygen. The resulting data are closely linked to practical tasks of regulating the soil's oxygen conditions under irrigation, when ice crusts over the surface of the soil, and when tree stands develop in zones of nearby ground water. In this way it has been possible to lay down the physiological principles for many economically vital measures.

Thorough studies have been made of the movement of organic matter in the plants and its accumulation in the storage organs--that is, the physiological process which ultimately determines the quality of the crop, for the crop yield is determined by those parts of the plant where the nutrients are stored.

Unfortunately, the findings of plant physiology are not being assimilated fast enough in agricultural science, to say nothing of agricultural practice, although these studies have been published in the appropriate journals. In connection with this, our institute has begun to prepare a series of books reporting on new advances in plant physiology for the benefit of workers in agricultural science and practice.

Problems worked on in the institute include research which opens up radically new approaches to the resolution of practical tasks. For example, methods of immunoelectrophoretic division of proteins to select parent pairs of particular properties, the production of plants of new types from dedifferentiated vegetative cells, remote hybridization through the merger of protoplasts, and more profound transformation of species by methods of microsurgery or cell engineering.

The second aspect of physiological research involves the direct resolution of practical tasks. This concern occupies a broader range of research institutions, especially agricultural institutes, experimental stations, and departments in agricultural VUZ's, and, in part, republic academies of sciences. Incidentally, the biology institutes of the USSR Academy of Sciences are also directly involved in adopting the findings of their research in practice, relying for aid and cooperation on the production institutions.

In particular, the Institute of Plant Physiology has adopted its own physiologically-based methods of intensifying plant husbandry on protected ground by means of selecting sources of light of a particular spectral composition and feeding the plants on a sliding scale--that is, in accordance with their changing requirements in ontogenesis. These methods make it possible to produce high yields.

Another project involves producing active strains of chlorella and introducing them into the crop under conditions which make it possible to direct the metabolism toward preferential accumulation of starch, fat, or protein.

Making use of N_1N-dimethylmorphinium chloride to remove late ovaries from cotton plants, our institute has managed to speed up the ripening of the bolls by three weeks and boost crop yields. Accelerated cultivation of cotton has made it possible to incorporate winter grasses into the rotation cycle on the cotton fields of Tadzhikistan; this provides for year-round use of the land and improved soil quality.

As a result of physiological research, many other physiologically active substances have been proposed and are in wide use in plant husbandry. The research has served as the basis for working out optimal modes of irrigation and sprinkling, also methods of diagnosing the plants' water needs.

Researchers have found a new way to produce certain medicines from callus tissues artificially grown in synthetic environments, bypassing the agronomic operation of raising the plants themselves.

This list could be extended. But it is probably more important to note that the successful penetration of physiological research into agricultural science and practice largely depends on properly organizing reciprocal information concerning scientific research and practical testing. The coordination of these efforts, carried out on the one hand by academic institutes of plant physiology engaged primarily in working on general problems and, on the other hand, by collectives concerned primarily with the physiology of particular crops, constitutes the basis of rapid movement of scientific findings into practice. For this reason, we ascribe serious importance to the academy's recently-formulated program of research through the year 1990 on the problem "Physiological and Biochemical Principles of Increasing Productivity in Plant Husbandry." Research under this program will involve the active participation of practically all collectives of plant physiologists in the Soviet Union who are more or less associated with this particular problem.

In conclusion I should like to express the hope and confidence that Soviet plant physiologists will make a substantial and essential contribution to our common cause of increasing the productivity of our agriculture.

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RESOLVING THE LIVESTOCK PROTEIN FEED PROBLEM

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 106-108

[Abridged Speech by VASKhNIL Corresponding Member A. I. Tulupnikov]

[Text] The July and November 1978 CC CPSU plenums raised the urgent issue of the necessity of making more economical and productive use of resources. In connection with this, I should like to dwell on the problem of raising the effectiveness of utilization of combination feeds in livestock farming as one of the vital reserves for boosting meat production.

World experience shows that the conversion to intensive production of livestock products entails fundamental rearrangement of the feed structure. Its essence involves improving the quality of all types of feeds, increasing the proportion of concentrated feeds--which mainly consist of grain--in the feed balance, and perfecting the structure of combination feeds. Moreover, balancing combination feeds with respect to high-value protein from animal feeds (fish and bone meal, milk and dairy products) and soy cake is becoming one of the main factors in the effective utilization of feed grain. This is especially important for hog and poultry farming, major consumers of feed grain. The protein balance for fattening hogs and poultry should include a minimum of 25 percent of high-value protein for hogs and 35 percent for poultry.

Worth noting in this regard is the United States experience, where the proportion of soy cake and animal feeds in the composition of concentrated feeds rose to 10.4 percent by 1977 versus 4 percent in 1940; the figure was 30 percent for meat poultry, 15 percent for egg poultry, and 12 percent for hogs. It was chiefly thanks to this that the United States managed to reduce outlays of feed per unit of output by 1.5 to 2 times in the post-war period in hog and poultry farming. Calculations show that if United States livestock farming had the same soy cake and animal feed level today as in 1940 the country's current scale of livestock farming production would require additional outlays of concentrated feeds in the amount of about 50 million tons.

Similar changes in the structure of concentrated feeds are taking place in western Europe, where the combination feed industry gets 70 percent of its high-value protein from imported soy beans and soy cake.

Grain feed resources are constantly rising in our country. Our livestock farming dispensed 143 million tons of concentrated feed in 1977--2.2 times more than in 1965. This is about 550 kilograms per capita, considerably more than the corresponding figure in western Europe and only 26 percent below the United States level. Nevertheless, the kolkhozes and sovkhozes are still experiencing a shortage of concentrated feeds; one of the main reasons is the overconsumption of such feed due to their imbalance in high-value protein. This not only weakens our livestock feed base but also makes the products more costly. According to our calculations, overconsumption of concentrated feed in hog and poultry farming alone runs to about 25 million tons. This amount of concentrates would be enough to produce five million tons of pork.

The proportion of high-value protein feeds in concentrate resources in this country is still very low: it is only one-quarter of the United States figure. This gives a partial answer to the question as to why the United States in 1977 used only 11 percent more concentrated feeds than our country yet produced 75 percent more meat.

Obviously, resolving the problem of high-value feed protein is an urgent task. In examining possible ways to resolve it, we must consider that the experience of the United States and western Europe, where soy is widely used, does not apply to us. Our country's natural and climatic conditions do not allow us to organize the raising of soy on a large scale. And it is possible to import beans and cake only in limited amounts. In the next five to seven years, soy resources of our own production can cover no more than 8 to 10 percent of our livestock farming's high-value protein needs (in the United States soy covers 80 to 82 percent of these requirements). We do not have reason to hope that the scale of soy production will change substantially in the forseeable future.

Also limited in raw material is the amount of production of animal feeds, resources of which in this country will meet only 19 to 20 percent of our high-value protein needs by 1985. It is worth noting, incidentally, that the animal feeds inventory in the United States has also remained unchanged in relative terms over almost the entire recent period due to limited raw materials, constituting roughly the same 18 to 20 percent of requirements.

Thus, traditional sources of high-value protein--animal feeds and soy cakes--can provide us with only 28 to 30 percent of requirements.

Given this situation, the entire burden of providing livestock farming with high-value protein rests on the microbiology industry, which must provide the combination feeds industry with at least 70 percent of its needs.

In terms of its composition and quality characteristics, microbiological protein is equivalent to feeds of animal origin, and year-round production is based on practically unlimited resources. The high economic effect of using this product justifies the high priority being given to the sector of industry producing it with regard to capital investments.

The use of one ton of feed yeasts and 180 kilograms of premixes in combination feeds for hogs reduces grain consumption by about 12 to 13 tons. The effectiveness of microbiological protein is even higher in poultry farming. The study of scientific and practical data has made it possible for VASKhNIL's presidium to conclude that the use of microbiological protein and other biologically active substances in livestock farming makes it possible to produce 1.5 to 2 times more meat with the same amount of feed.

It must also be kept in mind that because of our extremely limited animal feed and soy cake resources, microbiological protein remains the only feasible source of high-value protein, without which it will be impossible now or in the future to utilize the rising genetic potential of animals and poultry. We must be aware that boosting the capacity of the microbiology industry is the only possible way to resolve the problem of high-value protein in our country's livestock farming.

Meanwhile, the capacities of this sector are being increased too slowly, and its output is meeting only a small portion of livestock farming's needs. Even up through 1985, the production of microbiological feed protein will meet only one-fifth of our high-value protein requirements; we will continue to be 50 percent deficient in high-value livestock protein. It is very likely that this deficiency can be compensated only partially through temporary increases in imports of soy beans and soy cake. It is urgently necessary to seek out ways to boost the production of microbiological protein. We must help the microbiology industry in making use of new types of raw materials, we must develop new and more productive technologies of production.

The scientific research program of the USSR Academy of Sciences must stipulate expansion of the volume of work promoting accelerated development of the microbiology industry, the development and utilization of new types of raw materials, improvement of the technology of production, and improved quality and reduced prime cost of the production of microbial protein, lysine, vitamins, and other biologically active substances. It is also essential to find ways to allocate additional capital investments for the microbiology industry. This will make it possible in the near future to boost the production of microbial protein and other feed substances.

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MEASURES AGAINST COTTON WILT IN UZBEKISTAN

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 108-110

[Abridged Speech by Uzbek SSR Academy of Sciences President Academician A. S. Sadykov]

[Text] The tasks of further development of agriculture were set forth in the report by CC CPSU General Secretary L. I. Brezhnev at the July 1978 CC CPSU Plenum and in the decree adopted on the basis of that report.

The decisions of the July 1978 Plenum were discussed by the plenums of the central committees of the cotton farming republics of this country. Considerable attention was focused on a complex of problems relating to the development and improvement of cotton farming--boosting crop yields and improving the quality of the cotton, safeguarding the crop.

Scientific tasks with regard to further development of agriculture were examined in detail at general meetings of the academies of sciences of the cotton farming republics. The general meeting of the Uzbek SSR Academy of Sciences (September 1978), in particular, drew up specific measures to aid agricultural scientists.

Allow me to focus on one vital problem--that of controlling wilt. It is estimated that wilt afflicts 640 types of different plants. Verticillium wilt, in particular, does considerable damage to cotton.

The Uzbek SSR Academy of Sciences Institute of Experimental Plant Biology, under the guidance of VASKhNIL Academician S. M. Mirakhmedov, has worked out a new method of cotton selection by remote intraspecies hybridization using as the initial forms the industrial variety S-4227 and a wild variety of cotton that has always been immune to wilt, decrossing the resulting hybrids, and subsequent multiple selection on a wilt background. Researchers developed the Tashkent variety, providing a sixth variety change in cotton farming. This variety is now being sown on wilt-infested areas. The epiphytotia of verticillium wilt has retreated considerably. Adoption of the Tashkent variety made it possible to produce an additional 900 million rubles worth of cotton in Uzbekistan in the first three years of the Ninth Five-Year Plan alone. The economic effect has also been considerable in the other cotton farming republics.

In subsequent years, however, the Tashkent variety has also been increasingly infested by wilt. One reason for the increased intensity of wilt infestation of the cotton is the intensive formation and spread of a highly-virulent race of the wilt-causing organism, to which the Tashkent variety is also susceptible.

This example testifies to the importance of an effective means of combating cotton wilt. Coordination of the research being carried out in about 50 scientific-research institutions is handled by the Coordination Council on Cotton Wilt. Work is under way on selecting wilt-resistant varieties; effective chemical, biological, and agrotechnical means of combating wilt are being sought, and so on.

In studying intraspecies differentiation of the wilt-causing organism, researchers have detected two races of verticillium and several races of fusarium. They differ both in terms of cultural-morphological features and in terms of the degree of infestation of varieties of medium-fiber and fine-fiber cotton of varying wilt-resistance. Physiological and biological research has demonstrated that in a plant infested by wilt there are profound changes both in its structure and in the functioning of the photosynthetic apparatus of the cell, these are what lead to the cotton's subsequent wilting.

As a result of integrated research into phytoalexins (antibiotic substances in cotton), conducted in the Uzbek SSR Academy of Sciences Institute of Bioorganic Chemistry, the USSR Academy of Sciences Institute of Biochemistry imeni A. N. Bakh, the Uzbek SSR Academy of Sciences Institute of Experimental Plant Biology, and the Tashkent State University imeni V. I. Lenin, four phytoalexins were isolated from infected plants: isohemigossypol, hemigossypol, hemigossypolon, and gossyvertin. These substances are highly toxic to the agent of verticillium wilt and suppress its development. The chemical structure of the phytoalexins has been deciphered, and their physiochemical properties have been studied. It has been found that large amounts of these substances are formed especially rapidly in varieties resistant to wilt; their maximum development occurs in the first days after the plant becomes infested.

Scientists of the Tashkent University have managed to interpret the role of lipid exchange in development of the pathological process in cotton wilt and have found ways to regulate lipid exchange. For this purpose they have proposed antioxidants and phytoalexin inducers (including fungus metabolites, natural substances extracted from the plants, and synthetic compounds of high antioxidation activity capable of shifting the concurrent ratio of free-radical and enzymatic lipid oxidation). On the basis of these studies, researchers have issued recommendations on the development of inhibitors of radical and certain enzymatic processes.

One promising direction in the search for ways to combat wilt is the use of structural analogues of phytotoxic metabolites of wild varieties of cotton (which are absent or insignificant in varieties susceptible to wilt).

Much work is being done on the selection of new wilt-resistant varieties. One such variety--AN-402, which has a hard fiber of type 5--was developed in the Uzbek SSR Academy of Sciences Institute of Experimental Plant Biology by VASKhNIL Corresponding Member N. N. Nazirov. This variety was obtained by radiating the cotton seeds with radioactive phosphorus followed by multiple selection on a wilt background. In addition to high crop yields, the variety is characterized by a considerable natural defoliation, which runs as high as 70 to 80 percent in September at harvesting time. Further successful development of selective breeding will require new initial stock with genetic immunity to wilt; this can be obtained by organizing expeditions abroad to collect cotton seeds.

In order to shorten the time necessary to select wilt-resistant varieties, the Uzbek SSR Academy of Sciences Institute of Bioorganic Chemistry has developed an original method of determining the wilt-resistance of samples of various varieties of cotton; the method is based on determining the level of paramagnetic manganese ions by the electronic paramagnetic resonance method. Another new method has been worked out in the Uzbek SSR Academy of Sciences Institute of Experimental Plant Biology. It is based on molecular hybridization of DNA-DNA to determine the extent of dependency between the level of homologus nucleotid series in the DNA of the fungus and the cotton and the resistance of the latter to wilt. The use of these methods considerably speeds up the diagnosis of the degree of wilt-resistance of cotton forms and hybrids under study. Our republic's scientists have also worked out other methods helping to shorten the selection timetable.

Chemical methods of combating cotton wilt are also being worked out. The Uzbek SSR Academy of Sciences Institute of Vegetable Matter Chemistry has synthesized the systemic fungicides algin and uzgen, which possess high anti-wilt activity.

As a result of thorough research it has been found that rotating cotton with alfalfa is very important in treating fields that have been infested with the wilt organism and in retaining the wilt-resistance of new varieties. It is possible to combat wilt successfully only through the combined use of two measures: the introduction of cotton-alfalfa rotation and the planting of new wilt-resistant varieties.

Also very promising is work being done on the use of electrical current to disinfect plants that are infested by wilt. Tests of an electrosterilizer designed by engineers of the Central Asian Institute of Mechanization and Electrification of Agriculture, have demonstrated the possibility of making effective use of this new electrical means of combating cotton wilt.

Vegetative organs of the cotton which are left in the fields (up to eight million tons of stems and five million tons of leaves) increase the content of infestation in the soil. Meanwhile, stems and leaves are a promising raw material for the microbiology, construction, chemical, and other sectors of industry, also for feed production. The leaves can yield large amounts of organic acids, vitamins, growth stimulants, plasticizers, and so on. The Uzbek Scientific-Research Institute of Veterinary Science imeni K. I. Skryabin of the Central Asian Department of VASKhNIL and the Uzbek SSR Academy of Sciences Division of Microbiology have worked out and are successfully testing a method of producing feeds by fermenting cotton stems. A plant has been constructed for the production of building boards from the stems, and so on.

Scientific substantiation of the necessity of processing cotton stems and leaves to make fuller use of them, the development of essential technological processes, and the organization of appropriate production facilities will provide substantial aid in combating cotton wilt.

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DEVELOPMENT OF PLANT SELECTIVE BREEDING

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 110-112

[Abridged Speech by VASKhNIL Academician D. D. Brezhnev]

[Text] Selective breeding holds a prominent place in measures to boost agriculture. In recent years we have developed outstanding varieties of crop plants. But increasingly higher requirements are being imposed on these varieties. In connection with this, new selective breeding centers have been created and research programs have been drawn up. Of decisive importance to these programs is the genetic inventory of plant resources--that is, the initial stock on which new varieties are created.

The initial stock problem is coming to be of special importance, because genetic resources on our planet are becoming impoverished, and varieties and wild relatives of cultivated plants which took dozens of years for man and nature to create are disappearing. The world community is seriously concerned about the situation and is seeking ways to maintain plant resources. This problem is being worked on by the governments of many countries and scientific societies and associations. The United Nations has set up a special International Committee for Genetic Plant Resources.

Our country's scientists are actively working to maintain and propagate plant resources and the selective breeding inventory.

The All-Union Institute of Plant Husbandry (VIR),as the head institution in the field of research into the plant world, must step up its work every year in the development of new initial stock. In connection with this, increased responsibility is placed on the plant husbandry resources of other organizations and botanical gardens and the selective breeders and scientists in related spheres of science.

The VIR is working on various aspects of collecting plant resources. Almost every year it sends scientific expeditions to all continents, conducts surveys in various areas of the world, and brings into our country a new initial stock, including cotton. A group of the institute's scientists, for example, is now working very fruitfully in Mexico, where VIR has set up its own support station. The USSR has acquired varieties of all crops essential for our selective breeding work.

The VIR's scientists have accumulated the world's largest collection of plants, numbering 270,000 samples. This inventory has been accumulated since the first days of the Soviet state on the basis of V. I. Lenin's personal directive. It is at the disposal of the selective breeders, thus creating the basis for developing new Soviet varieties suitable for cultivation in various zones of the country, varieties meeting the various requirements of our farm lands.

Much remains to be done in the genetic inventory research to realize this potential. It is impossible for the institute alone to study the enormous quantity of material available in this area; this work, of crucial importance to the nation, must be carried out in various areas of the Soviet Union. It is essential that the USSR Academy of Sciences and the republic academies and specialists of the botanical gardens take active part in this.

More extensive genetic research is essential. We must not only provide initial stock with an evaluation of its physiology, immunology, and winter-hardiness but also determine the suitability of particular plants in various zones and areas of our country; we must determine how the plant organism reacts to various factors of the environment. This is a very vital and complex problem, because the selective breeders must simultaneously resolve a complex of tasks; in essence they must create new forms of plants capable of making more active use of the sun's energy as well as everything today's intensive land cultivation can provide.

Qualitative evaluation of the genetics fund is of great importance. Our collection now has samples of varieties of wild plants containing 25 to 30 percent protein. The selective breeders face the task of increasing the protein and other substances in cultivated plants. In this, genetics must come to the aid of the selective breeders. Unfortunately, the latest advances in genetics, cytology, biochemistry, and other sciences have not yet become a component part of operative selective breeding programs.

It is essential that the institutes of the USSR Academy of Sciences and the academies of sciences of the union republics take active part in resolving selective breeding problems. Substantial contributions, for example, have been made by the academic institutions in studying the content and quality of nutrients and biologically valuable active substances in various crops.

The USSR Academy of Sciences must take more active part in resolving problems of increasing sugar and oil content and so on. It is necessary to develop varieties suitable for mechanized harvesting. Theoretical research by scientists of the Academy of Sciences in the field of selective breeding ought to be the compass for each selective breeder in the country.

Our agriculture has now entered a new stage of development--it is converting to an industrial basis. It is desirable, therefore, that the present session mark the beginning of a huge joint effort by scientists of the USSR Academy of Sciences working in various spheres of science as well as scientists involved only in agriculture. Agriculture can make use of the discoveries and research findings of various scientific sectors: biology, physiology, automation and telemechanics, nuclear physics, mathematics, cybernetics, and so on. And the sooner scientific advances are put to use the more rapidly we can resolve the tasks assigned to agriculture by the party and the government.

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NEW DEVELOPMENTS IN WHEAT HYBRIDIZATION

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 112-113

[Abridged Speech by Academician N. V. Tsitsin]

[Text] The status of selective breeding and genetics today makes it possible to boldly formulate and resolve very substantial and serious tasks of transforming the nature of plants. There are many methods and means to do this, but the most effective is remote hybridization. This is essentially the only method which makes it possible to develop not only new species, forms, and varieties but also new farm crops.

In the many years of its development, selective breeding has been enriched by the latest advances in biology and has become a powerful force. Only recently a 100-pood wheat yield per hectare was considered high; now, thanks to new, tested methods of selection, relatively large areas are producing 100 quintals--that is 600 poods--of grain or more per hectare; and the grain is of high quality with respect to milling and baking indicators. Only recently, sunflower seeds contained 27 to 28 percent oil; varieties developed by remote hybridization now contain more than 50 percent oil, and in some varieties the oil contains so much olein that it is not inferior to olive oil in quality. Because of its inherited susceptibility to the dangerous disease wilt, cotton used to produce practically no crop at all in some years. Techniques of remote hybridization have resulted in cotton varieties capable of resisting wilt and producing bumper crops.

All of this has resulted from enormous efforts. Many scientists are studying the subtleties of the synthesis of inherited features and traits of organisms in the process of their development, especially from the standpoint of selective breeding. Making use of all modern techniques of biological science and developing their own, the selective breeders are making detailed studies of each marked feature in the creation of new forms at all stages of the form-creation process, directing it toward the desired end. Frequently, processes of inherited transformations proceeding in accordance with a given program lead to unexpected results. In directing the processes, the selective breeder makes extensive use of reinforcement and recession in manifesting and fixing features. Selective engineering creates profound transformations both of individual features and the components which make them up, ending with the establishment of coordinated ratios of all features of the new organism.

The development of a hybrid plant of the first generation lays the foundation for all processes of creating future forms. By this act, man collaborates with nature in starting a chain of form-creation processes which will make it possible to develop better organisms of perfected design.

Now we have developed a number of varieties of both winter and spring hybrids that are distinguished by outstanding properties: high yields, high immunity, essentially absolute resistence to lodging, and high quality grain and flour. One of our spring hybrids (No 800) produced average yields of 43.3 quintals per hectare over a three-year period; another (No 1239) yielded 40.3. We will recommend these varieties for the Nonchernozem Zone and certain other areas. Among winter hybrids, exceptionally high yields are produced by No 44 and No 71.

We are doing considerable work on radically redesigning wheat and rye. The results of work on redesigning the wheat spike can be demonstrated on wheat-elymus hybrids. Incomplete amphidiploids of them contain 46 or more spikelets per spike instead of 25 as in wheat. The spike contains 70 to 120 and sometimes even 160 grains, whereas wheat only contains 30 to 50. The weight of 1,000 grains is 50 grams or more, and the grain contains 24 percent protein and 40 percent gluten. Because one species of wild giant elymus contains up to 600 or 700 grains in the spike, we have set ourselves the task of developing a wheat whose spike will contain at least 200 grains.

Another vital task which we have begun to work on is that of combining multi-grain wheat spikelets with large grains. All soft varieties of wheat in the world contain an average of two to three grains in the spikelet; our hybrid plants have six to eight grains. Doubling the number of grains per spikelet will make it possible not only to boost wheat crop yields but also to reduce sowing norms, and this savings in seed grain would also benefit overall crop yields.

We have now gone even further in redesigning the wheat spike. Each individual wheat spikelet has been transformed into a spike containing ten to fifteen grains. We now have such wheat hybrids, and intensive work is being done on them.

Speaking of remote hybridization, it must be emphasized that there are no crops now to which this very effective method does not apply. Biologists are astonished by the extent to which the form-creation process resulting from remote cross breedings is saturated with inherited changes whose variations seem endless.

One of the most important tasks in our activities in the field of remote hybridization is the creation of perennial wheat. Despite a large variety of difficulties, this problem has been essentially solved. We have developed a variety of wheat which will yield for two or three years from one sowing. Eleven varieties are undergoing testing. We are not far from the development of a production variety of perennial wheat, but frankly we need a little help by way of money and equipment.

Thus, the appearance on earth of the first perennial wheat, developed by Soviet scientists by means of remote cross breeding, is now an accomplished fact!

Another task of great practical importance is the development of a hybrid feed grain. From perennial wheat we have derived the variety Otrastayushchaya-38, capable of growing back after each mowing; this makes it possible to use it as a "green conveyer." In the past five years this wheat has yielded an average of 80 to 100 quintals of hay per season, and the hay contains as much protein--12 to 14 percent--as does the grain of ordinary wheat. The State Commission for Varieties-Testing of Farm Crops zoned this new crop in Belgorodskaya and Gor'kovskaya oblasts in 1978.

The selective breeding arsenals have many outstanding developments that are very promising with regard to boosting grain crop yields. Of course, science always runs ahead of the times. What seemed incomprehensible and difficult yesterday is now becoming ordinary and accessible, and the technique of remote hybridization deserves a lot of credit.

Working in close cooperation, our country's selective breeders and geneticists are doing everything they can to serve the people, directing their creative energies toward implementing the decisions of the July 1978 CC CPSU Plenum.

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NEW METHODS OF PEST CONTROL

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 114-115

[Abridged Speech by Academician M. S. Gilyarov]

[Text] One of the most important reserves for boosting agricultural productivity is to protect plants against insect pests and diseases, because losses due to insects and diseases add up to between 5 and 20 percent or more every year in various sectors of plant husbandry.

Until recently, the main means of protecting plants was to poison insect pests with insecticides or, as they are not more commonly known, pesticides. However, the mass use of "first-generation" insecticides (compounds of arsenic, lead, barium, and mercury) led to poisoning of the soil on large territories in areas of intensive cultivation. Chemical advances in subsequent years have given rise to the massive synthesis and use of "second-generation" pesticides (organochlorine and organophosphorus compounds) which destroy not only pests but also useful insects such as entomophags. In addition, many types of pests develop an immunity to certain pesticides. Now our task is to suppress the number of plant pests with minimum contamination of the environment by pesticides, and the basic way to resolve this task involves what is known as the integrated control of pests, which combines chemical and biological techniques of suppressing the vital activities of harmful organisms. In this case, chemical techniques are used on small areas during short periods when the insect pest population rises. Systems of integrated control worked out by academic institutes to deal with cotton pests, for example, have already been used and yielded excellent results, in particular in Tadzhikistan and Turkmenia.

The development of integrated systems of pest control requires extensive participation by the biological institutes of academic profile, because these efforts need data from the fundamental biological sciences.

One of the main links in integrated pest control is the use of natural enemies of pests (entomophags and also agents causing diseases in insect pests). What is needed, therefore, is broad systematic and ecological-biological studies of various groups of insects to determine potential agents of biological control that are local or can be brought in from elsewhere. This kind of work is only within the capability of large academic collectives of taxonomists working with the support of abundant museum collections and special libraries. It must be pointed out, however, that the decision of the USSR Academy of Sciences Presidium to organize a laboratory of entomophag taxonomy within the Zoology Institute has never been implemented.

What is needed is profound ecological and physiological research into pests and their enemies--entomophags and the insects on which they feed. It is also necessary to organize broad regional biocenological research into basic rotation crops to study the ecological links between agrocenoses and ecosystems (biogeocenoses) of the particular terrain that are less subjected to man's impact. Such research is essential for the organization of pest control, for forecasting their population, and so on. The work must be integrated in character and proceed by uniform programs drawn up by the problems councils of the USSR Academy of Sciences and VASKhNIL.

Since integrated control also includes destructive measures, it is essential to carry out much broader research into attractants and especially pheromones, the use of which makes it possible to concentrate pests in restricted areas.

Special attention must be focused on species-specific and taxon-specific biologically active substances such as hormones and their analogues. Hormone analogues, especially what are known as juvenoids, are now considered to be "third-generation" pesticides and are coming to be more and more frequently used in controlling pests. Observations on the eurygaster conducted by Ye. N. Polivanova in the Institute of Evolutionary Morphology and Ecology of Animals imeni A. N. Severtsov have shown that juvenoids are especially effective during the pest's embryonic development; either the embryo is destroyed or else the larvae that hatch are incapable of life.

Also of interest are what are known as antihormones. These are, in essence, "fourth-generation" pesticides--biologically active compounds which suppress the insects' hormone secretion, disrupting their development and leading to destruction of the pest. The first tests conducted in the laboratory of soil zoology and experimental entomology of the Institute of Evolutionary Morphology and Ecology of Animals on antihormones synthesized by academic chemical institutes have yielded encouraging results.

Also very promising for integrated pest control are techniques of radiation and chemical sterilization of part of the pest population and, later on, genetic techniques based on the use of lines having lethal genes. Genetic techniques of pest control, the theoretical outlines of which were proposed by A. S. Serebrovskiy in the 1940's, are now attracting more and more attention, especially in the United States and Australia. We are also mapping out other ways besides the Serebrovskiy technique to find genetic principles of pest control based on work with silkworms now being done by USSR Academy of Sciences Corresponding Member V. A. Strunnikov.

All of the above-listed aspects of research, without which it is impossible to make progress in protecting plants against pests, require the creation of a special material base for entomology work in the academic institutes. We need insectaria to breed entomophags and for work with genetically balanced material which is needed to test pesticides. As Academician M. I. Kabachnik has mentioned, in the United States, Canada, Australia, and certain other countries researchers seek new pesticides by means of gross empirical comparison testing of new compounds on abundant genetically balanced material, and even this blind search by the trial and error method yields valuable results.

Our biological institutes are inexcusably ill-equipped with the necessary equipment for experimental-ecological research (they have no climatrons or polythermohygrostats).

There are substantial defects in the organization of research into physiologically active substances; we do not have a large enough assortment of such substances synthesized in our own chemical institutes; both the quantity and the purity of compounds of this type submitted for biological testing are inadequate. It is now time to organize integrated work by chemists, entomologists, and phytopathologists. The USSR Academy of Sciences system should create bases for experimental research into problems of the ecology, physiology, toxicology, and genetics of insects, and this research should be tied in with the work of chemists and biochemists in order to develop techniques of pest control in an integrated way.

It is essential to train cadres who combine profound entomological, phytopathological, and ecological knowledge with certain skills in the field of physiochemical biology. The training of such cadres should begin primarily in the Moscow and Leningrad universities.

All of this applies to research relating not only to insect pests but also to ticks, nematodes, fungi, and other pathogens and their natural enemies.

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GENETIC RESEARCH IN PLANT BREEDING

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 115-117

[Abridged Speech by VASKhNIL Vice President Academician A. A. Sozinov]

[Text] Rising requirements on new varieties and hybrids of crop plants and the necessity of shortening the time it takes to develop them have confronted biological science with the task of developing new, nontraditional methods and techniques of selection, the development of a new technology for the whole selection process making it possible to begin "designing" the necessary genotypes. At present, when plant genetics is experiencing a period of rapid change in conception and methods, the resolution of this task is becoming a reality.

To accomplish new goals in selective breeding it is essential to intensify research in several promising directions. It is especially necessary to make vigorous use of the fundamental heuristic principle of reductionism in selective breeding (the principle of interpreting the complex by separating it into simple components).

For practical selective breeding it is necessary to have express methods of identifying genes or blocks of genes which cause change in economically valuable and biologically useful traits and features. The theoretical possibility of resolving this task is based on the working hypothesis that any quantitative feature results from the metabolic processes which give rise to its formation. Most of these processes proceed uniformly in all genotypes of a given species. However, there are other processes which can proceed in alternative ways; it is this variability, as a rule, which makes selective breeding possible. Our task is to find such "hot spots" of change, to identify variants of genes or blocks of genes "at work" at a given stage in the population of a particular species of plants, or to create new variants by means of induced mutagenesis and then by hybridization and deliberate selection to ensure the inclusion of the best alleles in the genotype.

The first consequence of the gene's action after transcription and translation is the synthesis of polypeptide in the ribosomes. For this reason, the most reliable method of identifying genes or blocks of genes is to identify the protein or proteins whose synthesis they control. It is important to note that the result obtained through identification on the protein molecule level is not affected by the cultivation conditions of the genotype. For this reason, by a one-time analysis the researcher can determine which variant of the allele gene or polygenic locus is present in the genotype. This working hypothesis was confirmed by experiments studying the genetically determined polymorphism of the prolamines of wheat and barley conducted in the Odessa All-Union Selection-Genetics Institute.

Variants of allele blocks of proteins (and consequently blocks of genes) have been found localized in six chromosomes of wheat and two loci of the fifth chromosome of barley. Links have been found between variant prolamine blocks and such important properties as grain quality, frost-resistance, and so on.

It is now possible in one day to record about 100 genotypic formulas of wheat gliadin or barley hordein, using just half of the grain for analysis if necessary. By these formulas, which systematically record variants of blocks of prolamines in a given genotype, it is possible without cultivating the plants to determine with sufficient accuracy the genotypically determined level of grain quality: frost-resistance, resistance to particular diseases, and productivity. When using ordinary methods to obtain this information, it used to be necessary to analyze the plants for several years. The principle is already in practical use and is yielding excellent results.

Interesting results have been obtained in identifying genes which control the winter or spring type of plant development and the plant's reaction to the photoperiod. Researchers have developed analogues of known varieties of winter wheat into whose genotype different variants of genes of the type of plant development (spring and winter) have been introduced. This has resulted in spring wheat varieties characterized by vegetative periods of differing length which retain the properties of their initial winter forms.

Good possibilities are opened up in utilizing the principle of reductionism on the level of identifying genes or blocks of genes causing resistance to th most aggressive types of diseases as well as tolerance to pests. This will make it possible to get prompt information concerning genes of vertical (or race-specific) and horizontal resistance. The successful resolution of this problem very likely entails the study of genetically conditioned polymorphism of phytoalexins and inhibitors.

On the basis of experience in the use of heterosis in the selection of certain crops we may assume that lines possessing a high level of heterosis are bearers of small-quantity variants of allele blocks of genes which in the heterozygotic state cause sharp activation of a number of metabolic processes. In all numerous lines of corn, for example, we will likely encounter 8 to 10 such blocks of genes. If we could find the marker proteins of these blocks of genes, substantial qualitative changes would take place in heterotic selection.

The resolution of all these problems, so important to the development of the theory and practice of selective breeding, above all entails the necessity of combining the efforts of the selective breeders, geneticists, biochemists, biophysicists, physiologists, phytopathologists, and mathematicians, who must take part in resolving integrated programs to develop methods of identifying genes and blocks responsible for the heterotic effect and the mutation of economically valuable plant features.

A key role in these developments, in our opinion, will be assigned to biochemical genetics--a science at the interface of biochemistry, organic chemistry, physics, and genetics. In this connection, it is essential to create an institute of biochemistry for biochemical genetics within the USSR Academy of Sciences to accomodate biochemists and geneticists who can resolve key problems in directing plant heredity.

Our country has laid a firm foundation for new qualitative changes in selective breeding: we have organized selective breeding centers which have favorable conditions for synthesizing the theory and practice of selective breeding, and we have completed the world's largest phytotron in Odessa.

To resolve the crucial tasks assigned to science by the decisions of the July 1978 plenum it is essential to combine the efforts of the USSR Academy of Sciences, VASKhNIL, and the USSR Ministry of Agriculture. This will lay the groundwork for qualitative changes in the development of biological science, which will successfully resolve the tasks confronting modern farm production.

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TASKS OF ENSURING QUANTITY, QUALITY OF FARM OUTPUT

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 117-118

[Abridged Speech by V. P. Mozhin, Director of RSFSR Gosplan Central Scientific-Research Institute]

[Text] Systematic implementation of the party's agrarian policy as mapped out by the March 1965 CC CPSU Plenum has made it possible to achieve remarkable success in our country's agrarian sector. At present, our country holds a leading place in the world with respect to per capita production of such vital farm crops as grain, cotton, potatoes, sugar beets, milk, and wool. In 1978, the Soviet Union's per capita grain production was about 900 kg. This is twice as much as in the countries of the European Economic Community.

New goals in the development of agriculture were mapped out at the July 1978 Plenum. The postulates contained in Leonid Il'ich Brezhnev's report and the plenum's decree are of priority importance in preparing an integrated program of scientific-technical progress and its social-economic consequences in sectors of the agroindustrial sector up through the year 2000--programs which are being drawn up by the USSR Academy of Sciences and the USSR State Committee for Science and Technology. This preparation work is being participated in by many scientific institutions of the USSR Academy of Sciences, VASKhNIL, and various ministries and departments.

The task set forth in the program is this: in the shortest possible time and with the greatest possible effectiveness to achieve a volume of production of food and agricultural raw materials which will meet the population's food requirements on the level of scientifically substantiated norms. Calculations show that consumption on the level of rational norms for most products (except meat) can be achieved in 1990; that level can be attained in the early 1990's for meat and somewhat later for vegetables and fruit.

Calculations also show, however, that if the present tendency of growth of capital-intensiveness of production continues in the future the development of farm production will require considerable additional resources:

production output per ruble is systematically declining--such is the present tendency. It has been mentioned here that the agroindustrial complex now takes up about 40 percent of the total capital investments in the economy. If the growth of capital-intensiveness continues, attaining rational norms in supplying the population with food will require that this proportion be increased, something which is unfeasible in terms of the economy's capabilities. Only a decisive turn toward intensive factors--increasing the effectiveness of outlays on the basis of scientific-technical progress, perfecting the structure of the agroindustrial complex, improving the economic mechanism--can place everything on a feasible basis.

It is necessary to focus constant attention not only on boosting the volume of raw materials produced but also on improving the quality, safekeeping, and rational utilization of these materials. It must be stated that the quality of many products has declined somewhat in recent years. For example, the sugar content of beets and the starch content of potatoes have declined. The quality of farm produce is impaired in the harvesting, storage, and transport processes. In our opinion, the main reasons for the decline in quality include the lack of coordination in the economic and legal relationships among sectors of the agroindustrial complex, in many cases improper organization of selective breeding work, and low quality specifications in present standards.

In speaking about improved quality, naturally, we are referring not only to farm produce but also the means of production for agriculture. For example, some of the fertilizer being delivered to agriculture does not meet State Standards and Technical Specifications. A check by the State Committee for Standards has shown that more than 10 percent of the fertilizer that was checked contained too much moisture and acid; 15 percent caked during storage.

An especially vital problem is that of reducing product losses throughout the entire chain of the agroindustrial complex. Losses are generally due to the lack of balance in individual production facilities, and one of the main causes is the lagging infrastructure. According to our estimates, losses due to bad roads alone add up to one billion rubles yearly. It is also very important to improve the quality of the harvesting equipment in order to reduce losses. This has already been discussed in detail at the meeting.

Finally, it is essential to strengthen the integrated approach to the development of the agroindustrial complex; it is essential to implement a unified technical policy, to develop all links of the complex harmoniously, to distribute capital investments rationally among its sectors, and to reconcile the economic interests of the sectors. These tasks were spelled out at the July CC CPSU Plenum. The tasks of improved planning and incentive in all sectors of the agroindustrial complex are extremely important.

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SELECTING FOR IMMUNITY IN FRUIT, BERRIES

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 118-120

[Abridged Speech by V. A. Gryazev, Director of All-Union Scientific-Research Institute of Horticulture imeni I. V. Michurin]

[Text] Advances in agriculture are closely linked to scientific development. The fact that our country this year harvested an unprecedented crop is to the credit of our scientific institutions. But our scientists also bear a share of responsibility for unresolved problems in agriculture.

In my talk I should like to dwell not on the successes but on the unresolved problems facing the sector closest to me--horticulture.

In the past 15 years, the production of fruit and berries in this country has risen by 2.8 times, reaching 10.1 million tons in 1977. No other sector of agriculture has developed so rapidly. This success is of great importance to the food industry.

At the same time, fruit and berries represent not only food but also medicine. It is no accident that we have the saying "an apple a day keeps the doctor away." During cultivation of these crops, however, they are treated at least 10 times with poison chemicals. Of course, it is essential to protect fruit trees and berries against pests and diseases. About 80,000 tons of fungicides are used every year on the kolkhozes and sovkhozes for the chemical protection of fruit and berry crops.

Let us recall that when pesticides are applied to most other farm crops they are not sprayed directly on those parts of the plant used as food; in horticulture, however, pesticides are sprayed right on the fruit until they are ripe. As is well known, fresh fruit contains the most vitamins, but it must also be kept in mind that there are more and more pesticide residues in fresh fruit. And there is one other circumstance relating to the use of pesticides on fruit and berry plants: no other farm product requires the same quantity of chemical means of plant protection per unit of weight as fruit and berries. It is sufficient to note that in 1977 more than one kilogram of fungicide alone, to say nothing of insecticide, was used for every 100 kilograms of fruit.

Obviously, selective breeding for immunity is one of the most important and highest-priority tasks in horticulture. There is evidence that it is possible to develop varieties which do not require protection, at least against diseases. Our institute, for example, has developed the Russkiy variety of gooseberry. It is now planted on 2,500 hectares in the country. The reason for the popularity of this variety is that it does not need to be protected against diseases and for this reason is distinguished from other varieties of higher yield. This provides a net profit of at least one million rubles. Let us note that outlays on developing this variety added up to only 10,000 rubles.

I will cite another example. In 1977-1978 the institute developed elite seedlings of black currant, the crop yields of which are substantially better than those of present zoned varieties. But the main characteristic of the new varieties is that they are completely immune to powdery mildew, a disease which is the scourge of producing plantations. Protection against this disease annually requires 4.5 million rubles worth of fungicides, including imported. If we could replace present currant plantings on 80,000 hectares with varieties developed in the All-Union Scientific-Research Institute of Horticulture, we could cover expenditures on chemical plant protection means, to say nothing of keeping the environment cleaner. And considering the higher yields of the new varieties, the economic effect could run as high as 50 to 60 million rubles. Yet outlays on selecting the black currant added up to only 165,000 rubles.

These examples testify not only to the possibility of selecting for disease-resistence but also to the high economic effectiveness of selective breeding as a scientific discipline--one of those disciplines in agricultural science where the product is produced with what is known as a constant factor. Among such products we can name high-yield technological and immune varieties, efficient and highly-productive machinery, highly-productive breeds of livestock, and so on. These are the results of scientific research which serve to boost production output regardless of other factors.

Selective breeding for resistence against diseases and insect pests is a very difficult task, because it involves not only the evolution of the plant but also the evolution of the parasite which "contends" with it. Obviously, the selective breeder can win only if he is armed not only with knowledge in the field of genetics, physiology, biochemistry, and other sciences, but also with perfected scientific instruments and equipment. The lag in efforts against diseases has brought it about that in recent years the infestation of fruits and berries by fungous diseases has increased. In Moldavia, the Crimea, the southern Ukraine and the North Caucasus these diseases are more widespread than ever before. And they are spreading northward, especially powdery mildew. Until recently, the main zoned variety of black currant--Pamyat' Michurina--met all production requirements; now it will have to be replaced because of infestation by powdery mildew.

Selective breeding is a long-term process; the breeder will not always live to see the fruits of his labor. Some years ago the decision was made to build selective breeding centers in many sector scientific-research institutes to speed up the selection process and variety renovation.

There are now 44 such centers dealing with almost all farm crops. But the horticulturists have not yet been given a single selection center. But the need to speed up selective breeding work in horticulture is no less than in other sectors of agriculture. It is sufficient to note that the selection process in berry crops takes at least 15 years, and twice as long in fruit crops.

The necessity of selective breeding work is also confirmed by the fact that in the future horticulture will require twice as much chemical protection. This is also due to the fact that more aggressive forms of disease-causing agents are coming into being, causing considerable fungous disease damage, also the necessity of further increasing fruit production. At present we are producing 42 kg of fruit, berries and table grapes per capita; in the future this norm is to be raised to 110-115 kg.

It is necessary to decide whether to increase the production of pesticides by developing the chemical industry or to build 8 to 10 selective breeding centers working on immunity. It should be kept in mind that at present the kolkhozes and sovkhozes are spending more than 140 million rubles on pesticides for horticulture alone, while the construction of selective breeding centers would cost 25 to 30 million rubles. Obviously, Gosplan ought to compare these figures and find the necessary funds for capital investment.

The problem of selective breeding in horticulture must be elevated to the rank of priority state tasks. Selection for immunity is not just an economic but also an ecological problem, for it prevents contamination of the biosphere and ultimately protects people's health.

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PROGRESS, PROSPECTS IN GENETIC ENGINEERING

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 120-122

[Abridged Speech by Academician A. A. Bayev]

[Text] The extent to which fundamental research is oriented toward applied purposes can vary, and there are several echelons of fundamental research--from those close to applied tasks to those whose practical purpose is hardly discernible. But the latter are also significant--they work or can work for the future, both the near and the long term.

The brief history of molecular biology, a second-echelon science, is marked by outstanding discoveries which have led to fundamental restructuring of many biological ideas. Above all, the development of molecular biology has created a new sphere of research and served to enhance related scientific disciplines, especially on the cell level. The most astounding, yet by no means the only discoveries, in this field apply to the laws governing heredity. This applies especially to genetic engineering.

The natural way to obtain feed protein, essential amino acids, vitamins, and other biological stimulators is to use microorganisms. Genetic engineering proposes a unique method of creating microorganisms that are super producers of essential compounds, by colonizing the microbial cell with appropriate genes. If the stability of the genetic structure introduced into the microorganism is stable, this technique can be both effective and profitable.

The synthesized compound does not have to be a natural product of the host cell. Observations point to the possibility of heterological synthesis--that is, synthesis that is not proper to the cell which provides haven to the alien gene which, like an invading force, imposes its own type of metabolism on the cell. This, of course, considerably broadens the possibility of using this technique. Incidentally, on 4 April 1978 the United States issued the first patent for producing human insulin from the fungus pseudosaccharomycete TS-1176 into which a gene of this hormone had been introduced. It is difficult to say how serious and substantiated this patent is, but many laboratories throughout the world are now working on the production of human insulin by genetic engineering techniques.

Until recently, genetics had only one method of boosting the productivity of microorganisms--by isolating natural mutants which appear with a frequency of $1:10^7$. Genetic engineering can design such mutants deliberately, in accordance with a plan. This constitutes its superiority.

Biological fixation of nitrogen is another application of methods of genetic engineering. It is hardly possible to attempt to introduce into some plant organ nitrogen-fixing genes borrowed from their natural hosts, the nitrogen-fixing bacteria. Fixation of nitrogen from the air requires substantial energy outlays, and the introduction of nitrogenase genes (the enzyme system promoting this process) into the smoothly operating physiological mechanism of the plant's cell would likely cause severe perturbation of its metabolism and would hardly lead to a desirable outcome. It is another matter to create symbiont bacteria adapted to plants which do not have their own bacteria to supply nitrogen. These are cereals, sunflowers, and other plants.

It would be tempting, of course, to reduce the amount of mineral nitrogen applied to the soil after combining the activities of the nitrogen-fixing bacteria and the plant itself. But on this path we might encounter obstacles not only of a genetic but also of a biochemical nature.

Work on developing symbiont bacteria is under way. And I am confident that it will be successful. However that may be, it is one more nontrivial way to resolve applied tasks. The likelihood that unusual nitrogen-fixing microorganisms will appear in nature and that we will detect them is vanishingly small. Genetic engineering provides a technique for designing new microorganisms in the test tube. And although we are obliged to proceed by trial and error, it will not always be that way.

New prospects are being opened up by genetic manipulation on the cell level--hybridization of unrelated cells to overcome the barriers placed in our path by nature to prevent mixing of species. So far, however, the subsequent process of forming stable systems looks chaotic and unpredictable. But hybridization of closely-related plant cells which can be used to produce a whole plant in culture is in principle capable of leading to the development of new plant varieties.

It is not yet clear how useful it will be to agriculture to introduce animal nucleic acids into the cell, but this path is feasible, and experience has shown that some portion of the genes so introduced proved to be functional.

At present, genetic engineering is attractive primarily to biologists; it is not especially popular among those involved in agricultural science. It is difficult to say why this is--perhaps the unusual nature of the theoretical principles and techniques involved or the current worries which distract agrobiologists away from concerns of the future. Genetic engineering, like a number of biological disciplines generally lumped under the name "physiochemical biology," is truly oriented toward tomorrow. Very soon, undoubtedly, geneticists will be serving as chemical synthesizers who have long since given up samples provided by nature and created an enormous world of organic compounds which can be considered the exclusive creation of man.

The fate of physiochemical biology will by and large be determined by the relationship between man and the environment. If the original nature is ultimately disrupted by man's activities and a man-made environment comes into being which is distinct from the natural environment and to some extent in opposition to it, then physiochemical biology will become one of the bases for restructuring the world around us. If man follows the conservative path of preserving the living world, then physiochemical biology will just as successfully serve the cause of preserving the original nature in all of its fullness and abundance. The near future will reveal which path man chooses, but in any case physiochemical biology will be his faithful tool.

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RATIONAL ZONAL DEPLOYMENT OF FARM CROPS

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 122-123

[Abridged Speech by VASKhNIL Academician N. P. Aleksandrov]

[Text] With the development of technical progress in agriculture, the conversion of a number of its sectors to an industrial basis, and the growth of further processing of products, more and more importance attaches to concentration and specialization of production, the necessity of mass production of standard raw materials provided regularly by agriculture for processing and for the trade network.

One of the most important forms of specialization is zonal specialization, based on the most logical deployment of farm production in all zones of the country. Research into this problem has been conducted broadly in both theoretical and applied aspects since the 1960's. This research is being conducted both in scientific institutions of agroeconomic profile and the academic institutes. A great many scientifically substantiated recommendations have been worked out and are being extensively used in forecasting and planning.

In the deployment of agricultural crops in our days, however, full account is not always taken of all factors affecting the deployment, in particular the environmental factor. To a greater extent it is taken account of in the deployment of crops of limited regions (cotton, citrus, tea, grapes, ambary, essential oils, and to some extent rice, soy, flax, and hemp), although in the deployment of these crops adjustments, sometimes substantial ones, are necessary. Other crops that are more widespread are cultivated everywhere. In resolving problems relating to their deployment there are still many unutilized reserves. The seeking out of these reserves must involve the participation of representatives not only of economic but also biological science.

The most reasonable deployment of farm production is also hampered by a certain amount of routineness in the formulation of prognoses and plans of economic development reflected in the vernacular as "from the present level." The volume of production of any type of farm product in a particular region or area of the country is set on the basis of the results obtained in the preceding period and the anticipated increase in resources. People frequently fail to consider the possibility of producing new types of farm goods in that region. This leads to a situation in which the structure of production and the deployment of individual sectors and crops change only very slightly.

These days, when possibilities of shipping goods and raw materials have risen sharply, there is still a tendency toward autarchism. The suburban zones of cities and industrial centers continue to concentrate the production not only of types of goods that are essential there but also those which would be much more beneficial to deploy in other areas that are more favorable in terms of natural conditions. Heat-loving fruits and vegetables, for example, ought to be cultivated in the southern areas of the country characterized by lengthy growing seasons and high solar radiation instead of the Nonchernozem Zone. Fuller use ought to be made of the exceptionally favorable natural conditions for fruit farming and the cultivation of table grapes on the mountain slopes of the Central Asian republics. At present, however, low-productivity pasture lands predominate there. The development of commercial vegetable farming requires more extensive use of some of the irrigated lands in those republics.

For further intensive development of fruit farming, grape farming, and vegetable farming more extensive use ought to be made of lands in certain areas of the Ukraine, the North Caucasus, and the Transcaucasian republics. There are enormous possibilities for the production of fruit, vegetables and grapes in Moldavia.

In some of the northern oblasts of the Nonchernozem Zone it is more advantageous to cultivate perennial grasses yielding 5,000 to 6,000 feed units per hectare. These oblasts ought to be converted into large-scale producers of goods for livestock farming operations in areas where it is more beneficial to produce vegetables and fruit than feed.

In recent years there has been a substantial increase in possibilities for intensifying agriculture. Fuller use of the natural potential is the cheapest method of increasing the production of farm goods. In resolving tasks with respect to the most rational placement of farm production, a substantial role must be played by selective breeding.

It is essential to draw up a long-range plan for the deployment of farm production. This requires fundamental analysis of its structure, a determination of the feasibility, the adjustments and refinements that will have to be made.

It is essential to exert maximum efforts to further develop the production of fertilizers.

The resolution of all these problems is inseparably linked to further improvement of the structure of farm production and its enterprises and organizations. This effort will require the active participation of specialists in various profiles who are involved not only in applied but also in fundamental research.

An important factor in resolving the problem of further developing farm production is the specialization of enterprises. Substantial advances have been made, especially in sovkhoz production.

Along with the construction of state-industrial complexes, recent years have witnessed the extensive practice of creating interkolkhoz enterprises in which the interests of individual farms are organically combined. There is an ongoing process of intrasector specialization and intersector integration. These trends in the organization of production play a vital role in agriculture.

Further development and improvement of the cooperative system under conditions of developed socialism are of vital importance. In particular, cooperation can sharply boost not only the effectiveness of farm production as a whole but also on individual sovkhozes and kolhozes; it can influence optimal organization of private plot farming and promote conservation of labor resources and means of production.

It must be kept in mind, however, that the improvement of cooperation is inseparably linked to the optimal organization of the production infrastructure. Shortcomings in the development of the production infrastructure can hamper the further development of agriculture.

One serious task is that of organically combining the sector and territorial principles in the organization and administration of farm production. Successful resolution of the problems of agroindustrial administration will require the combined efforts of many specialists; their cooperation will be essential in working out this complicated program.

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MEANS OF IMPROVING GRAIN PROTEIN

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 124-125

[Abridged Speech by USSR Academy of Sciences Corresponding Member V L. Kretovich]

[Text] One of our most vital problems is that of boosting the production of protein and improving its quality. The source of most of our food and feed protein, of course, is grain. As has been mentioned, however, cereal crops are characterized by relatively low natural protein content; moreover, the protein is not complete--that is, its amino acid composition is unsatisfactory.

To boost overall production of protein it is necessary to increase the yield of grain crops and the protein content in the grain. This confronts biochemistry, genetics, and grain crop selective breeding with tasks whose resolution is of vital practical importance. There is a widespread notion that two indicators--high yields and high protein content-- are negatively correlated. But reduced protein content in the grain of the more productive varieties is in most cases due to the deficiency of nitrogen in the soil and can be eliminated by appropriately increasing fertilizers or top-dressing. In any case, it has been demonstrated that a number of varieties of wheat (Atlas-66, Avrora, and Kavkaz) are capable of combining high crop yields and high protein content in the grain.

Another most important and difficult task in resolving the problem of overcoming the protein deficiency is that of improving the quality of the protein in grain crops--that is, improving its amino acid composition. Grain proteins contain very low amounts of certain essential amino acids, for example lysine and tryptophan, which reduces their food and feed value. It is possible to substantially improve the amino acid composition of grain proteins, especially more lysine, only on the genetic level. Research is under way throughout the world to find mutants of various grain crops having higher lysine content. Such mutants have been found for corn, barley, and sorghum; they contain 1.5 to 2 times more lysine in the protein than ordinary varieties and are characterized by higher protein content. Low crop yields and certain other negative properties of these mutants make it impossible to use them as production varieties, but they are incorporated in selective breeding programs as sources of genes controlling the biosynthesis of biologically complete proteins. Efforts along these lines have already led to certain positive results.

Triticale, the interspecies wheat-rye hybrid mentioned by Academician Yu. A. Ovchinnikov, is the first new cereal "synthesized," so to speak, by man. Production varieties of Triticale have already been developed; they combine a number of extremely valuable economic traits, for example high crop yields (100 quintals per hectare) and high protein content containing larger quantities of lysine (this is being worked on by A. F. Shulyndin in the Khar'kov Institute of Plant Husbandry, Selective Breeding, and Genetics imeni V. Ya. Yur'yev). It has been reliably proven that Triticale is clearly superior to wheat and rye in terms of its amino acid makeup and the biological value of the protein.

There is no doubt that Triticale has a great future as a feed crop. As for using it as a cereal used in baking, the prospects here are not so clear. The fact is that in addition to a balanced amino acid composition food protein needs several other physiochemical properties that are essential to the technology of making certain food products. For example, the bread-baking qualities or "potency" of wheat flour are based on the rheological properties of the gluten, its flexibility and elasticity which, as has been shown by studies in the Institute of Biochemistry imeni A. N. Bakh, are determined by the composition and compactness of the protein components of the gluten complex interacting with the formation of disulfide and carbon bonds, also hydrophobic interactions. It is important to determine which characteristics of the structure of the gluten protein are determined genotypically and which are subject to variation under the influence of environmental factors in order to conduct purposeful selective breeding work and control the formation of protein properties determining the quality of the gluten by means of cropping techniques on the plant and ripening grain.

A. A. Sozinov spoke here of the electrophoresis of gliadins. This technique is already being used in practice: in France, grain is accepted by large milling operations on the basis of electrophoregrams of the gliadin fraction.

I should like to touch upon one more vital problem in our grain farming operation--the drying. Some time ago, researchers in many institutes (the Institute of Mechanization of Agriculture, the Institute of Grain, the Institute of Bread Baking Industry, and a number of institutes of the USSR Academy of Sciences), headed by the USSR Academy of Sciences Institute of Biochemistry imeni A. N. Bakh (this has been discussed by Yu. A. Ovchinnikov), designed rational conditions for drying seed and food grain. These works have demonstrated that drying seed grain is an exceptionally effective means of boosting grain crop yields. In practice, however, the grain is frequently not dried satisfactorily either because the specified conditions are not complied with or else there is not enough grain drying equipment, especially in the agricultural system. This situation is becoming especially urgent in areas of Western Siberia, North Kazakhstan, and the Nonchernozem Zone of the European territories, where high humidity frequently causes the grain to be not only moist but also damp, as the practical workers put it. I should like to draw the attention of participants here to this problem, because it is of extremely vital practical importance.

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DEVELOPMENT OF IMPROVED WHEAT VARIETIES

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 125-127

[Abridged Speech by Academician V. N. Remeslo]

[Text] A vital role in resolving the problem of further boosting grain production and other farm goods is played by selective breeding and seed breeding. In implementing the CC CPSU and the USSR Council of Ministers decree on problems of further boosting the effectiveness of farm production, the USSR Ministry of Agriculture and VASKhNIL have implemented a number of measures designed to radically improve the efforts of the selective breeding centers and other selective breeding institutions.

One of the main directions in scientific-technical progress in agriculture is the development of new varieties of winter wheat yielding 80 to 90 quintals per hectare, characterized by high winter-hardiness, excellent grain quality, responsiveness to the application of high doses of fertilizer and irrigation, and resistance to diseases and lodging. In recent years, many of our country's selective breeding centers and scientific-research institutions have developed and submitted for production a number of highly-productive varieties of this crop. When scientifically substantiated technologies of cultivation are used, the new varieties provide high and stable crop yields.

Data from variety testing plots in Cherkasskaya, Zhitomirskaya, Khmel'nitskaya, Volgogradskaya, and other oblasts testify to the high, consistent crop yields of Mironovskaya-25. The Zolotonosha Variety Testing Plot in Cherkasskaya Oblast in 1978 produced 86 quintals per hectare; the Korsun'-Shevchenko Plot in the same Oblast produced 75.2; the Kalachevskiy Plot in Volgogradskaya Oblast produced 85.9. Mironovskaya-25 also produces high yields in production testing on kolkhozes and sovkhozes. This year on Sinyavskiy Sovkhoz (Rokitnyanskiy Rayon, Kiev Oblast) this variety produced 71.7 quintals per hectare; on Kolkhoz imeni V. I. Chapayev in Tarashchanskiy Rayon it produced 75.6.

Mironovskaya-11 also showed good results in testing; on the Kalachevskiy Variety Testing Plot in Volgogradskaya Oblast it produced 88.2 quintals per hectare.

Also undergoing successful production testing is the improved Mironovskaya-808, which is producing more than 60 quintals per hectare on kolkhozes and sovkhozes. For example, Kolkhoz imeni S. M. Kirov (Lokhvitskiy Rayon, Poltavskaya Oblast) produced 65 quintals on each of 100 hectares.

In recent years, the Mironovka Scientific-Research Institute of Wheat Selection and Seed Breeding has undertaken work to develop intensive varieties of spring wheat. This year, Mironovskaya Yarovaya was zoned in Kiev and Zhitomirskaya oblasts; under production conditions this variety produced yields of 40 to 45 quintals per hectare. This variety has proven itself on variety testing plots and on kolkhozes and sovkhozes of Bashkiria. According to data from specialists of that republic's Ministry of Agriculture, the zone where the variety's yield surpasses that of other zoned varieties by 7 to 10 quintals per hectare covers about 500,000 hectares. Last year, the Mironovka Institute collaborated with our base farms and gave the republic about 100 tons of seed of the new varieties; this year the figure has been raised to about 1,000 tons. Calculations show that by 1980 the amount of land planted in Mironovskaya Yarovaya in Bashkiria will be increased to between 250,000 and 300,000 hectares.

Mironovskaya Yarovaya has also produced excellent results on virgin lands in Kustanayskaya and Aktyubinskaya oblasts, where it is undergoing broad production testing. In Kustanayskaya Oblast this wheat was cultivated on more than 20,000 hectares this year, and the average yield was 19.6 quintals per hectare. On some farms the yield went as high as 28.3.

One other variety of spring wheat--Mironovskaya Rannyaya--has been submitted for state testing; it has a yield of 50 to 60 quintals per hectare. A new variety of spring wheat, Eritrosperum-465, has been prepared for submission to variety testing in the institute. In three years of testing, the average yield was 55.5 quintals per hectare and the maximum was 72.

In recent years, the Mironovka Institute has been making extensive use of a new, perfected technique of producing seed stock--deliberate changing of spring forms into winter forms. The technique involves yarovization of initial spring varieties in the first stage, making it possible to obtain more than 80 percent winter forms by sowing at optimal times in the fall. Mention should be made of another vital characteristic of the new technique--it substantially increases the output of short-stem forms 75 to 80 cm high.

Many years of repeated methodological experiments with preliminary yarovization in the course of directed changing of spring forms of wheat into winter forms permit us to conclude that the selection process is accelerated, because constant forms are obtained as early as the third generation. In the conventional technique of hybridization, it took five or six and sometimes eight or nine generations to develop such forms.

It is interesting to note that many constant lines combine the complex of properties and traits characteristic of the high-yield Mironovskaya-264 and Mironovskaya-808 varieties (better winter-hardiness, short stems, and resistance to diseases).

Soviet and foreign selective breeding practice has shown that in selective breeding work only the use of a great variety of genetic material in combination with progressive techniques can result in high-yield varieties of intensive types of wheat. Bezostaya-1 and Mironovskaya-808, which are adaptable to broad areas of cultivation, deserve special attention in this regard. By hybridizing varieties and lines obtained by changing spring forms into winter forms with varieties and lines of hybrid origin it is possible to develop varieties of winter wheat that are close to the indicated type. By carrying out the selection process in two cycles it has been possible to develop a large number of promising lines yielding 80 to 90 quintals or more per hectare; they are now undergoing competitive testing.

Many selective breeding institutions are also hybridizing short-stem spring varieties with high-yield winter varieties. In the Mironovka Institute this technique has resulted in high-yield and frost-resistant lines by crossing varieties of winter wheat such as World Seeds-1827, Red River-68, Inia-66, and others with winter varieties Mironovskaya-808, Mironovskaya Yubileynaya, Il'ichevskaya, Odesskaya-51, Kavkaz, and others.

The present stage of selective breeding work is characterized by concentration and specialization by zones, by expanded research cooperation among institutions conducting fundamental and applied research. In recent years the Mironovka Institute has been working on the development of high-yield varieties of winter wheat and winter barley in collaboration with the Bernburg and Hadmersleben institutes in the GDR. They have developed two high-yield and disease-resistant varieties of winter wheat yielding 80 quintals per hectare that are being broadly tested in this country and the GDR. Researchers have developed a new variety of winter barley which is distinguished by winter-hardiness and high yields. It is being tested widely under production conditions in this country and in 1978 yielded [illegible] quintals per hectare.

Research on the problem "Genetic and Physiological-Biochemical Principles of the Development of High-Yield Varieties of Wheat" is being done by collectives of the Mironovka Institute and seven institutes of the Ukrainian SSR Academy of Sciences. Our country's scientific institutions, especially during the 10th Five-Year Plan, have substantially expanded the exchange of selective breeding material and scientific information.

Special attention is focused on the further development of theoretical research in the field of applied molecular biology and genetics, the physiological-genetic principles of productivity, the genetics of immunity, and also grain quality, winter-hardiness, and drought-resistance, improved selection techniques and the broad practical adoption of a radically new technological pattern of selection using climatic chambers and hothouses which make it possible to accelerate the process by 1.5 to 2 times. It is very important to conduct selective breeding work in accordance with unified integrated programs.

Now, when the country's scientific-research institutions are broadly engaged in socialist competition for successful implementation of the decisions of the July and November CC CPSU plenums, we face the task of ensuring the further development of Soviet selection and seed breeding science, speeding up the development of new high-yield varieties and hybrids. The Mironovka scientists are doing everything in their power to complete the program of the 10th Five-Year Plan with respect to the development of high-yield wheat varieties.

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PROGRESS, PROBLEMS IN THE AGRICULTURAL SUPPLY SYSTEM

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 127-129

[Abridged Speech by A. V. Prokhorovich, deputy chairman, USSR State Sel'khoztekhnika Committee]

[Text] With the ongoing development of today's large-scale mechanized agriculture, processes in it are coming to be increasingly separated into production and service processes. The mechanization of production processes has gone much faster than service processes, where manual labor continues to be high; this has substantially reduced overall labor productivity on kolkhozes and sovkhozes and, accordingly, the effectiveness of farm production.

The creation of the specialized engineering organization State Sel'khoztekhnika Committee has promoted greater economic effectiveness in the division of these processes. Now, a single state organ combines functions of supplying equipment, apparatus, mineral fertilizers, and production goods and functions of repair and technical machinery maintenance, the installation, start-up and adjustment of equipment on livestock farm sections, the industrial mining of peat, lime, and gypsum for fertilizers, the delivery of mineral and organic fertilizers to the fields, and various kinds of cropping and transport operations.

The State Sel'khoztekhnika Committee has relieved management and specialist cadres of many chores, making it possible for them to concentrate directly on the organization and administration of farm production.

The big new tasks involved in further boosting agriculture as mapped out at the July 1978 CC CPSU Plenum and in the speech by CC CPSU General Secretary and USSR Supreme Soviet Presidium Chairman L. I. Brezhnev at the November 1978 Plenum require substantial improvement of the performance of the enterprises and organizations of the State Sel'khoztekhnika Committee.

At present the committee is doing most of the work on capital repairs to farm machinery and the installation of livestock farm equipment. Its rayon associations have created specialized stations for automotive and tractor maintenance. Technical maintenance of livestock farm equipment, especially, has grown substantially; on 90 percent of the farms, our enterprises take part in handling it.

Mechanized detachments of the committee are doing earth moving operations for the kolkhozes and sovkhozes, hauling organic fertilizer onto the fields, and liming and gypsuming solonetz soil. About 90 percent of all production goods are delivered directly to the kolkhozes and sovkhozes by our transport. More than 300,000 of our vehicles are hauling more than one billion tons of freight annually.

Annual volumes of production activity by the committee already total 10 billion rubles, and the annual commodities turnover exceeds 21 billion. The whole system has 8,600 organizations and enterprises, including 351 repair plants. They employ more than 1.6 million persons, including 265,000 engineers and technicians.

Most of the committee's production activities involve repairs and technical maintenance. The main and overriding principle in organizing this work is specialization and concentration of repair production, the creation of large-scale repair enterprises outfitted with modern highly-productive equipment and possessing qualified cadres. The committee has a technical exchange outlet in each rayon, which takes in equipment for repair and returns it to the farm after the work is completed. These outlets have an inventory of exchange components, units, and sets of machinery that can be issued immediately to the farms in exchange for those coming in for repairs.

An important principle in organizing the work of the repair enterprises is the restoration of worn parts. In actuality, a part will generally weigh 50 to 100 kg, while the amount of wear totals only some few dozen grams. Most of the part goes to salvage. This is a problem of great significance to the economy. The committee is now restoring parts totaling about 300 million rubles. Calculations show that it is quite possible, although difficult, to increase this amount to 700 or 800 million rubles. It would yield a savings of more than one million tons of metal and greatly alleviate the shortage of spare parts.

To ensure integrated mechanization of livestock farming processes, the committee has a specialized service to outfit projects with equipment, start it up and adjust it, and train kolkhoz members and sovkhoz workers in its proper use. The annual volume of installation work now exceeds one billion rubles.

One of the committee's main concerns is to improve agriculture's material-technical supply. The kolkhozes and sovkhozes are getting an enormous flow of material-technical supplies coming from 3,000 suppliers. The total delivered products list now comes to about 200,000 items. With this kind of volume and ties, it is very difficult to administer supply effectively without the use of ASU's [automated control systems]. Information from processing and the resolution of administrative tasks are handled by 107 information-computer centers. Adoption of a system of routine record-keeping on spare parts provides broad opportunities for maneuvering resources; this is especially important during times of intensive field operations, when the timeliness of data concerning spare parts largely determines how successfully equipment can be kept in good working order at all times.

No less important is a complex of tasks involving the determination of tractor and farm machinery requirements and optimalization of the farms' machinery and tractor fleet. In evaluating the adoption of ASU's, we cannot fail to see that so far we are by no means using all possibilities of production and supply administration afforded by electronic computers.

In accordance with the system worked out by the committee, integrated mechanization of operations in all processes of farm production require almost 3,000 items of machinery, equipment, and various kinds of tools. So far, however, only 1,800 items have been developed and are being produced by industry. In the remaining years of the 10th Five-Year Plan, therefore, we will have to develop and assimilate about 1,200 items. This is not an easy task for the sector institutes of the machine-building ministries.

In connection with this, a great deal of work has to be done by those involved in testing new farm equipment, the state testing of which is the responsibility of the State Sel'khoztekhnika Committee. All-round evaluation of new machinery is handled by institutes outfitted with measurement equipment and computers. However, shortcomings in a number of diagnostic instruments and devices and the impossibility of reliably checking all parameters of a machine as a whole and its component parts are to a large extent responsible for the inadequate technical reliability of series-produced machinery and weak links in machinery design.

Directly subordinate to the committee are 13 scientific-research and project-technology institutes which have a substantial scientific base and qualified cadres. In their work, the institutes rely on fundamental research being done by institutions of the USSR Academy of Sciences and the republic academies. Contacts with the academies have made it possible to resolve many problems. Thus, the technology of restoring many parts is based on the research findings of the Institute of Electric Welding imeni Ye. O. Paton.

The State Sel'khoztekhnika Committee has established close contacts with the Institute of Mechanical Engineering and the Institute of Problems of Control (Automation and Telemechanics). This is helping to improve techniques of equipment testing and the use of new materials in repairs; progress has been made in developing an automated control system, and a number of tasks in agricultural supply have been resolved.

There are some problems which are difficult and sometimes impossible to solve with the sector's scientific resources alone. Obviously, the academic institutes could get involved in many urgent and promising problems having to do with economic effectiveness, such as the development of radically new types of engines using nontraditional types of energy, more extensive use of wind, solar, and geothermal energy in agriculture, more extensive use of automatic devices to control machinery operation, reduction of energy losses through internal mechanical friction, and the development of more reliable means of protecting machinery against corrosion.

It is still essential to help the academic institutions in working out new technologies to restore parts, in developing wear-resistant materials and using them in the restoration of worn surfaces, and in diagnosing machinery and equipment without having to tear them down in order to detect defects and determine the extent of wear. Problems of great concern to the State Sel'khoztekhnika Committee include the development of methods of accelerated testing of machinery, also a system for routine finding and maneuvering of spare parts inventories on the basis of computers.

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SIBERIAN RESEARCH IN GENETICS, HYBRIDIZATION

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 130-131

[Abridged Speech by Academician D. K. Belyayev]

[Text] The basis of selective breeding and the development of new varieties, hybrids, and strains, in the case of microorganisms, naturally involves the control of the form-creation process--that is, control of the evolutionary process. For as N. I. Vavilov put it, selection is evolution directed by man's will. The main factors and, consequently, the levers of this control, are variation, heredity, and selection, and we must master these in order to develop a theory of the form-creation process and develop new forms of organisms. Consequently, in order to resolve cardinal problems of agricultural production, agricultural science, and selective breeding practice, it is necessary to develop the whole front of general biology, and in particular (perhaps especially) general genetics.

In his report Yu. A. Ovchinnikov expressed concern about the outfitting of molecular biology and molecular genetics. We share his concern, but we must add that general genetics and the theory of selection are in even worse shape. Yet certain sectors of modern livestock farming, for example fur breeding and colored karakul breeding, could not even come into being let alone exist if it were not for the experimental formulation of the genetic principles governing the breeding of fur animals and karakul sheep.

The application of techniques of modern genetics and its resulting technologies makes it possible to resolve completely new selection problems. This has to do not only with livestock farming but also certain other sectors of agriculture, especially plant husbandry.

The USSR Academy of Sciences Siberian Department Institute of Cytology and Genetics has implemented a program for the development of an interline (let me emphasize, interline) hybrid of sugar beets which yields 700 to 750 kilograms per hectare; in terms of sugar yield it can surpass any other variety by 20 percent. The development of this hybrid required the study of the genetic principles governing the plants' reproductive systems and the development of techniques making it possible to overcome the beets' incompatibility property--that is, it was necessary to work out the technology for obtaining such a hybrid.

On the basis of studying the genetics of sheep productivity traits, the same institute collaborated with VASKhNIL on a program to develop sheep of the crossbred type; they are characterized by large live weight and high wool yields: the average weight of producers in the pedigree nucleus of animals of the new type is about 150 kilograms, and the average wool yield is 8 kilograms at an average length of 18 centimeters. Now these animals number several tens of thousands; they are being bred on many farms in Siberia. Recently the Scientific-Technical Council of the RSFSR Ministry of Agriculture recommended drawing up the necessary documents to certify animals of the crossbred type as a new breed group.

The breeding of these animals required enormous work on the genetic analysis of sheep productivity traits; it was necessary to find the essential combinations of traits to accomplish the task.

Many more such examples could be cited, but the foregoing illustrates that in order to resolve major problems it is essential to develop the entire genetics front and the theory of form-creation.

One very urgent problem is that of developing animals suitable for industrial complexes. It cannot be resolved without bringing in new advances in genetics--data of the genetics of behavior, the genetics of stress-resistance, the genetics of various physiological functions. Because of the state of the experimental base, however, we are not adequately ready to tackle these problems.

And now, another range of tasks also relating to livestock farming and also requiring a special experimental base.

We talk a great deal about intensifying livestock farming. However paradoxical it may seem, however, intensification also requires extensive forms of livestock farming. Extensive livestock farming , especially meat livestock, will continue to exist for many years to come in the vast expanses of Siberia. For this reason, in particular, intensification of livestock farming in Siberia will have to be accomplished by developing forms of animals that are suitable for the severe conditions specific to Siberia. In principle, the possibilities for resolving this task exist.

Our institute developed an interbreed cattle hybrid by crossing such remote breeds as Yakut and Jersey. At the age of 1.5 years, the hybrid animals weigh 380 to 400 kilograms at a cost of 6 to 6.5 feed units per kilogram of weight gain.

Work on the genetics and hybridization of livestock must be developed in every way. But this will require a base where gene funds of great variety can be collected. Measures are now under way to develop such a base in the Siberian Department of the USSR Academy of Sciences. For this purpose, the department has been allocated the large Cherginskiy Sovkhoz in Gorno-Altayskaya Oblast, which has 80,000 hectares of land. Plans there call for collecting large gene funds essential for selective breeding, especially disappearing aboriginal breeds that must be preserved.

Problems of preserving gene funds are quite correctly viewed as urgent ones, and this applies not only to plants but also animals. We cannot allow the results of the labor of folk selective breeding to die out (Yakut stock, gray Ukrainian stock, and so on). It is this task, also the task of developing genetics and the theory of livestock selection, that we are going to resolve at this base. We are also hoping for help from the USSR Academy of Sciences Presidium and the Ministry of Agriculture, because in our opinion this is a very serious matter. We in the Siberian Department are inclined to view the organization of this base as an act of major magnitude, one which probably goes beyond the bounds of our department.

And finally, the directed development of organisms. Mention has been made here of tasks in the realm of chemicalization of agriculture, fertilizers and pesticides, but no mention has been made of the necessity of studying the regulators of plant growth--the phytohormones, yet they require serious attention. In principle this is not a new matter. A great deal of work has been done by Academician M. Kh. Chaylakhyan to formulate the theory of hormonal regulation of plant development. Members of our institute have collaborated with the Institute of Organic Chemistry to develop several chemically modified growth regulators, worked out the technology for producing them in such a fashion as to produce more than a quintal of these substances, and tested them on several crops not just on hundreds but on thousands of hectares. The results: in Moldavia, for example, when these substances were tested on tomatoes (and their use is simple and technologically convenient), the amount of additional output per hectare was equivalent to 2,000 rubles. Special tests have shown that the compound is completely safe. Now it is necessary to undertake its production, and we have a preliminary agreement with Glavmikrobioprom, which will meet us halfway in this matter.

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PROBLEMS, PROSPECTS IN RESEARCH WITH TAGGED NITROGEN FERTILIZERS

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 131-133

[Abridged Speech by Academician V. M. Tuchkevich]

[Text] The problem of boosting yields is closely linked to the proper and effective use of mineral fertilizers. A scientifically substantiated approach to resolving this problem is impossible without adequately accurate quantitative data concerning the balance of fertilizers to be introduced in the soil-plant-environment system. The only accurate method that can yield such information is the tagged fertilizer technique. Discussion below will deal chiefly with nitrogen fertilizers, which to a large extent determine the make-up of protein matter in plants--that is, the quantity and quality of the crop.

Nitrogen contained in the fertilizer applied to the soil is not completely assimilated by the plants. Some of it is washed away with the fertilizer, some of it escapes into the atmosphere, and some of it remains in the soil.

In order to work out substantiated recommendations on fertilizer use it is essential to know the extent to which the plant's nitrogen assimilation coefficient depends on the amount of fertilizer introduced, its chemical make-up, and many other factors. Major roles in this are played by the soil (its composition and cultivation) and climatic and weather conditions.

To determine these dependencies it is necessary to organize and conduct a series of experiments under field conditions with appropriate statistics for the major farm crops of all climatic zones of the Soviet Union and for a variety of soil conditions. Obviously, the implementation of such programs will require an adequate amount of isotope-tagged nitrogen fertilizers of a particular degree of enrichment and the ability to measure isotope ratios of nitrogen with the required accuracy by means of mass spectrometers.

(Tagged nitrogen fertilizers are those in which the ratio of the isotopes ^{14}N and ^{15}N have been altered from those occurring in nature).

It can be shown that there is in effect a linear dependence between the degree of isotope enrichment in the nitrogen fertilizer and the accuracy of the analyzing mass spectrometer--that is, the level of measurement error, from which it follows that the smaller the error of the analyzing mass spectrometer the smaller the enrichment needed to conduct the experiments.

The cost of tagged fertilizer depends very strongly (nonlinearly) on the degree of enrichment. Consequently, the cost of the experiment also depends strongly on the accuracy of the instrument, that is the allowable error.

At present, the USSR's production of isotope-tagged nitrogen fertilizers enriched with ^{15}N Nitrogen does not exceed several kilograms per year. Because of their extremely high cost, only a few laboratory experiments have been carried out. And no field experiments have been carried out, because the cost of just one field experiment is estimated at around 100,000 rubles.

The series mass spectrometers being produced by our industry do not afford the necessary accuracy of measurement of isotope ratios even under conditions of high concentration of nitrogen in the fertilizers. They can allow a measurement error on the order of several percent.

The USSR Academy of Sciences Physical Engineering Institute imeni A. F. Ioffe has developed mass spectrometric instruments which make it possible to reduce measurement error by at least a factor of 10. Thus, just by reducing the measurement error it is possible to reduce the cost of the experiments by at least a factor of 10.

At the same time, the sensitivity and accuracy of mass spectrometer measurements make it possible to use not only ^{15}N-enriched fertilizer but also ^{15}N-depleted fertilizer (nitrogen which is poor in the ^{15}N isotope is a by-product of the production of enriched nitrogen and cannot be used without accurate mass spectrometers).

The use of depleted nitrogen in the production of nitrogen fertilizers reduces the overall cost of tagged fertilizers by at least a factor of two.

Analysis shows that by employing mass spectrometers developed by the institute it is possible to use tagged fertilizers with an enrichment or depletion degree not exceeding a factor of 10.

This circumstance also promotes a reduction in the cost of tagged nitrogen fertilizers and, consequently, the cost of field experiments.

Thus, mass spectrometers developed in the institute make it possible to reduce the cost of field experiments using tagged nitrogen fertilizers by a factor of several tens.

This reduction in the cost of research makes it possible to raise the question of conducting mass field experiments using isotope-tagged nitrogen fertilizers to obtain quantitative data relating to the use of mineral nitrogen fertilizers in agriculture.

It should be mentioned that the question of implementing a program for making the most effective use of nitrogen fertilizers was raised by us more than three years ago.

So far, unfortunately, nothing has been done along these lines. Meanwhile, the United States has already undertaken the production of enriched and depleted nitrogen fertilizers on the order of several tons per year and also developed mass spectrometers necessary for the analysis.

Because of the importance of the problem, our institute has proposed and does now propose to undertake experiments on the sole existing mass spectrometer developed by the institute. In the future the institute may collaborate with one of the instrument-making organizations on developing a relatively cheap special mass spectrometer to supply all stations which must be set up by the Ministry of Agriculture within the framework of this program. The institute can also help to train cadres necessary to conduct the analyses.

At our request, Academician I. K. Kikoin has conducted preliminary experiments on the isolation of isotopes. These experiments have yielded good results. But the necessary funds have not been allocated to organize the experimental production of tagged nitrogen fertilizers.

Implementation of the program on the use of isotope-tagged nitrogen fertilizers will require the participation of the Ministry of Agriculture, the Ministry of Instrument Making, the Ministry of Chemical Industry, and also institutes of VASKhNIL and the USSR Academy of Sciences.

Implementation of the program will not only ensure a scientific, quantitative approach to the effective and most economical possible use of nitrogen fertilizers but will also no doubt lead to improved crop yields and make it possible to raise the coefficient of nitrogen fertilizer utilization--that is, to reduce the cost of producing such fertilizer.

The savings that should result from boosting crop yields and reducing the cost of producing nitrogen fertilizer, according to estimates by workers of VASKhNIL's Scientific-Research Institute of Fertilizers and Agricultural Soils Science imeni D. N. Pryanishnikov (VIUA), should be substantially higher than the costs of producing tagged nitrogen fertilizers, manufacturing the necessary specialized mass spectrometers, and organizing all work relating to the accomplishment of this major and essential state program.

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RESEARCH IN LIVESTOCK PHYSIOLOGY, BIOCHEMISTRY, NUTRITION

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 133-135

[Abridged Speech by N. A. Shmanenkov, Director, All-Union Scientific-Research Institute of the Physiology, Biochemistry, and Nutrition of Farm Animals]

[Text] In recent times, because of our party's course of action toward accelerated development of livestock farming followed by livestock industrialization, it has become necessary to work out the theoretical principles governing the development of this sector, for which a network of special institutes and problems laboratories has been set up in association with animal husbandry and veterinary science VUZ's, and training of scientific cadres has been stepped up.

Much has been done in the last while. In particular, Soviet farm animal physiologists and biochemists and veterinary scientists have studied the basic laws governing the development of farm animals--a field which until recently was hardly represented in scientific research.

Meanwhile, several sectors of industry relating directly to livestock farming have been created or else developed to an unprecedented extent: the microbiology industry, which produces yeast protein from petroleum hydrocarbons, many sectors of the chemical industry oriented toward the chemicalization of livestock farming, and others. As a result, the front of theoretical research has been greatly expanded in the applied institutions, and these institutions now need more and more help from the fundamental sciences. It is these needs that have been addressed by the decisions of the July 1978 CC CPSU Plenum and the CC CPSU and USSR Council of Ministers decree concerning agricultural science and its links to production. These documents contain the directive of the USSR Academy of Sciences to provide aid to agricultural science in resolving the most important problems of boosting agriculture.

A certain amount has already been done to implement this directive. In September of 1977 an all-union symposium on "Biochemistry and Livestock Farming" was held in Kaluga and Borovsk by the Central Council of the

All-Union Biochemistry Society, the USSR Academy of Sciences Scientific Council on Problems of Human and Animal Biochemistry, the USSR Academy of Sciences Department of Biochemistry, Biophysics, and Chemistry of Physiologically Active Compounds, VASKhNIL, and the All-Union Scientific-Research Institute of the Physiology, Biochemistry, and Nutrition of Farm Animals. Participants summarized what had been done and mapped out a plan of joint efforts on this problem for the near future. The participation by representatives of institutes of the USSR Academy of Sciences imparted special meaning to this symposium and made a big impression on representatives of the animal husbandry sciences.

Animal husbandry scientists have long maintained firm contacts with the vitamin laboratory of the USSR Academy of Sciences Institute of Biochemistry imeni A. N. Bakh, headed by USSR Academy of Sciences Corresponding Member V. M. Bukin, scientists of the USST Academy of Sciences Institute of Bioorganic Chemistry imeni M. M. Shemyakin, and the laboratory of the USSR Academy of Sciences Institute of Geochemistry and Analytic Chemistry imeni V. I. Vernadskiy, headed by VASKhNIL corresponding member V. V. Koval'skiy, which is a center for studies on trace elements in livestock farming. Traditional cooperation in the field of feed microbiology is maintained with the collective headed by Academician Ye. N. Mishustin, and in the field of chemicalization of livestock farming active cooperation is being developed with Academician S. I. Vol'fkovich and his co-workers.

Scientific institutions of livestock profile are studying the feed values of yeasts cultivated by enterprises of the microbiology industry; this accounts for their close contacts with corresponding scientific institutions of the USSR Academy of Sciences and Glavmikrobioprom.

Active cooperation is maintained with institutes of the Latvian SSR Academy of Sciences on problems of amino acid nutrition of monogastrics and poultry, with the Ukrainian SSR Academy of Sciences Institute of Biochemistry imeni A. V. Palladin on the reversion of end products and the metabolism of carbon and nitrogen compounds in the animal organism, with Leningrad University and the Kirgiz SSR Academy of Sciences Institute of Biochemistry and Physiology on problems of lactation, and with the Kazkah SSR Academy of Sciences Institute of Physiology on problems of ruminant digestion.

Obviously, these relationships will continue to develop. As for us representatives of agricultural science, we are happy to maintain them. It seems to us, however, that these relationships are not perfect in all cases. For this reason, we are very hopeful about the idea of organizing research in accordance with integrated programs now formulated by institutions of the USSR Academy of Sciences. In supporting this form of cooperation, we have made contact with the Interdepartmental Scientific-Technical Council on Problems of Molecular Biology and Molecular Genetics, headed by Academician Yu. A. Ovchinnikov, and we have already submitted our proposals for the "productivity" program.

In collaboration with the Embryology Department of Moscow State University and a number of other scientific institutions we have undertaken to draw up the "Egg Cell" Program.

For many years, the Scientific Council on the Physiology and Biochemistry of Farm Animals has worked with the USSR Academy of Sciences Scientific Council on Problems of Human and Animal Biochemistry. Although this cooperation is useful, unfortunately what it chiefly boils down to is an exchange of information. Among several present programs on physiology drawn up by this council, farm animal physiology is directly involved only in the program titled "Homeostasis," headed by Academician V. N. Chernigovskiy. This program is in full accordance with the instructions and directives of the party with regard to the most important trends in the development of agricultural science, and the All-Union Scientific-Research Institute of the Physiology, Biochemistry, and Nutrition of Farm Animals considers its participation in the work of the complex of scientific collectives in this program to be quite desirable.

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BETTER ENERGY SYSTEMS NEEDED IN RURAL AREAS

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 135-136

[Abridged Speech by Academician M. A. Styrikovich]

[Text] One of the main problems in the development of the Soviet Union's agriculture is the shortage of manpower. In particular, the problem is especially urgent in Western Siberia, Northern Kazakhstan, and certain oblasts of the Nonchernozem Zone. Despite the mass recruitment of city workers for farm work, which costs the economy a great deal, manpower is still not adequate, and this is causing substantial losses in farm output.

The problem is getting worse because of the outflow of qualified cadres from the villages--machinery operators and drivers who can easily find work and even housing in the cities. As a result, during times of intensive labor on the farms it is impossible to utilize all tractors, combines, and trucks in two shifts or sometimes even one shift.

Sociological studies have shown that to a large extent this migration out of the villages is due to the clearly unsatisfactory energy and heating conditions in rural areas. Some 99 percent of the rural population has electricity, but less than 20 percent of the housing has central heating and less than 5 percent has centralized hot water.

Not enough fuel is being allocated to rural areas, and the fuel that is provided is of inferior quality. As a result, people in the villages still frequently heat with pressed dung, straw, and low-grade local fuel. This requires considerable labor. The efficiency of the heating installations ranges between 30 and 40 percent, whereas it should range between 70 and 80 percent in accordance with today's technical capabilities.

As a result, the time spent in heating operations--that is, space heating and hot water, including the procurement and delivery of the fuel, also the extra time (compared with cities) spent on cooking food, adds up nationwide to roughly 15 billion man-hours per year. At least two-thirds of this labor could be avoided if heating operations were properly organized.

Consequently, proper organization of heating operations in rural areas is a task of great importance. Unfortunately, it is unrealistic to count on a mass conversion to electricity for heating and hot water because of enormous capital investments and the almost triple overconsumption of primary energy resources relating to considerable losses in the generation of electricity. In the near future, evidently, it will be necessary to confine ourselves to the introduction of electric ranges for the preparation of food in population centers where it is too costly to install gas. It is also impossible to orient ourselves toward the extensive use of scarce and costly liquid fuel.

Obviously, the best way is to provide farm communities with high-quality solid fuel, the use of which under conditions of the mass output of modern semiautomated heating units can reduce by several times the amount of labor involved in supplying space heating and hot water.

Such measures will not only conserve scarce manpower but will also substantially enhance the comforts of rural life, which in turn will reduce the out-migration from the villages.

Of course, radical improvement of rural heating systems will require the organization of the mass production of new equipment, involving substantial outlays. We can state confidently, however, that these outlays will soon more than pay for themselves.

Funds for carrying out measures to improve the rural heating and energy situation can be found by redistributing investments. To determine the sequence of these measures and single out as priority those which will yield the maximum effect, extensive technical and, especially, social-economic research is needed.

A special problem is that of developing optimal systems of energy supply, based on cheap energy resources, for large-scale agroindustrial complexes. These systems are especially effective in conjunction with nuclear power plants, which yield such cheap energy resources in the form of partially spent low-temperature heat. Over the next 10 to 15 years, huge new rapidly developing livestock farms and especially hothouse farms will require tens of millions of tons of fuel per year. These costs can be fully met by withdrawing low-pressure steam from nuclear power plant turbines.

The Leningrad Nuclear Power Plant alone could supply heat for a gigantic hothouse combine serving all Leningrad and adjacent regions. But in order to make extensive use of methods making it possible to reduce energy consumption by 7 to 10 times without altering the design of standard hothouses it is necessary to halt the construction of large-scale combines with independent boiler facilities in which fuel is burned to generate low-temperature heat without preliminary utilization of the combustion heat for power. The resolution of this task promises great benefits, because

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low-temperature heat (in conjunction with the generation of electricity) can be produced several times more effectively.

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INTEGRATED SOILS SCIENCE RESEARCH AT MOSCOW UNIVERSITY

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 136-138

[Abridged Speech by G. V. Dobrovol'skiy, dean, Department of Soils Science, Moscow State University]

[Text] Comrade L. I. Brezhnev's report at the July 1978 CC CPSU Plenum emphasized the necessity of scientists in all branches of knowledge taking active part in working out the mul faceted problems of accelerating scientific-technical progress in agriculture. L. I. Brezhnev's directive has been vigorously approved by scientists of Moscow State University imeni M. V. Lomonosov.

The University has long traditions of close links between research in the field of the natural and social sciences and the needs of agricultural science and practice. These links have become stronger since the March 1965 CC CPSU Plenum.

Since 1969, the University has had a successfully operating Council on Problems of Training and Scientific Work in the Field of Agriculture. The Council coordinates and supervises the scientific and training work that is most essential to agriculture, work being done by many departments and laboratories of the university's natural science and humanities departments. In order to summarize the results of research, the university regularly holds accountability conferences under the rubric "Moscow University for Agriculture".

In 1973, Moscow State University opened a new Department of Soils Science, the first in the country. Its creation was the culmination of the whole history of development of soils science in the university from Lomonosov's teachings about the earth's layers to the work done by soils scientists of our day to compile the USSR State Soils Chart and the World Soils Chart, to sample the virgin lands, and to develop textbooks, teaching aids, and supervision for many aspects of soils science, reclamation, and agrochemistry.

Creation of the soils science department has made it possible to substantially expand research work in the university dealing with problems of agriculture and the environment.

In organizing such work, the university has focused special attention on integrated interdepartmental themes requiring the participation of scientists and specialists in various disciplines. This makes it possible to make the best possible use of the capabilities and specifics of the university as a multifaceted training and scientific center which is structurally best adapted for the handling of integrated problems.

For example, the Chemistry Department's Chair of Chemical Technology and the Soils Science Department's Chair of Agrochemistry are conducting joint research on the development of new concentrated and integrated fertilizers and effective application of them to podzolic soils. The Chair of Chemical Technology has synthesized nitrogen-containing polymer phosphates and ammonium ultraphosphates having various ratios of the nutrients phosphorus and nitrogen, which are being tested by the Chair of Agrochemistry in the fields of the experimental station of the Department of Soils Science near Moscow.

The problem of controlling soil erosion is an integrated one. The combined efforts of scientists of the departments of geography, physics, and soils science have made it possible to study a number of new theoretical problems involving erosion control and to draw up practical recommendations for resolving this urgent economic task.

Moscow State University has undertaken a large-scale integrated project to study the environmental conditions of the Nonchernozem Zone and to predict its utilization and alteration in connection with the prospective economic development of the area. This project is also being carried out jointly by the departments of geology, geography, and soils science in accordance with a program coordinated with institutions of the RSFSR Ministry of Geology, the RSFSR Ministry of Water Management and Reclamation, and the RSFSR Ministry of Agriculture.

In addition to working out integrated problems relating directly to the resolution of economic tasks today, the university is focusing much attention on exploratory research. Such research includes, for example, the work of the Chair of Genetics of the Department of Biology and the Chair of Soil Biology of the Department of Soil Science into the microbiological synthesis of physiologically active substances and the application of techniques of molecular genetics to nitrogen-fixing microorganisms.

Another example of exploratory research which is of great importance in resolving a number of agricultural problems is research in the field of infra-red radiation carried out by the Chair of Wave Processes of the Department of Physics. This research has proved to be extremely important in developing new techniques of pasteurization and pre-canning processing of a large range of farm products.

I should also like to focus attention on the importance of conducting stationary research into the dynamics of natural processes and the impact of man's activities on these processes. This research lays a firm foundation not only for understanding these processes but also for predictive judgements. This research is especially vital for the agricultural and economic sciences.

On the basis of many years of field research, the university's agrochemists have shown convincingly that the long-term use of mineral fertilizers containing ammonium forms of nitrogen and potassium chloride on unlimed acid soil gradually leads to deterioration of the soil's properties and the quality of the farm products. And it is important to note that these negative consequences cannot always be eliminated by subsequent liming.

Such stationary research has made it possible for soils scientists and agrochemists to work out an integrated method of upgrading the fertility of soddy-podzolic soils; the technique has been recommended to the Moscow Oblast Administration of Agriculture and adopted on the sovkhozes and kolkhozes of Moscow Oblast on more than one-half million hectares.

The foregoing by no means covers all of the work being done in the university along these lines. I have mentioned only a few of these projects being carried out in the natural science departments of Moscow University.

I believe that Moscow University and other universities in the country have the possibility of further developing scientific-reserach work on agricultural problems. But this will require that at least two essential conditions be met. First, unconditional expansion and strengthening of ties between the university and the institutes of the Academy of Sciences, VASKhNIL, and other scientific institutions and departments. Second, the unconditional necessity of substantially improving the material-technical support for research conducted in the universities.

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IMPORTANCE OF SOCIOLOGICAL RESEARCH FOR AGRICULTURE

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 138-139

[Abridged Speech by USSR Academy of Sciences Corresponding Member T. I. Zaslavskaya]

[Text] Today's agroindustrial complex represents not just a production but also a social-economic system. To improve production effectiveness, social factors are at least as important as technological and biological factors, perhaps more. No advance in scientific-technical progress can yield any effect until it is implemented by hundreds of thousands and millions of ordinary workers in the sector. Questions of how worker cadres are formed, their level of training, their attitude toward labor, their living conditions, their needs and interests constitute the essence of social problems in the village.

The 25th CPSU Congress formulated the tasks of village production and social development as being equal in value and significance. It was correctly emphasized that neither of these tasks can in principle be resolved without resolving the other.

Since the March 1965 CC CPSU Plenum, the party has focused a great deal of attention on the social enhancement of the village, but there are many unresolved tasks. The July 1978 Plenum emphasized once more that the tasks facing this sector are truly enormous. The best way to resolve them would be to draw up an integrated program of social-economic development of the villages which would be included as a planning document in the overall program of development of the agroindustrial complex.

Projects preceding the structuring of this program include the long-term multi-variant forecasting of social development of the village, implemented by the appropriate commission of the USSR Academy of Sciences Scientific Council on Problems of Scientific-Technical and Social-Economic Forecasting and the State Committee for Science and Technology.

Scientists of the USSR Academy of Sciences Siberian Department's Institute of Economics and Organization of Industrial Production and the USSR Academy of Sciences Institute of Problems of Administration have worked out a social-economic model making it possible to forecast the importance of more than 200 indicators of village development and their interrelationships. The model makes it possible to determine what the social development of the village will be like under specific conditions of demographic and production development in the villages.

The model has been used to analyze new variants of agricultural development. One of them calls for basically retaining existing methods of administration and the present economic mechanism; the other calls for intensifying the sector's development as a result of perfecting the economic mechanism, expanding the economic independence of the enterprises, and development of the initiative of the primary labor collectives and individual workers.

Calculations show that the villages will continue to lag somewhat behind the cities even under the intensive variant, a lag which is due, in particular, to differences in worker qualifications. If the present mechanisms are retained, the gap will widen.

Thus, the model social-economic analysis completely confirms the conclusion of economists concerning the necessity of converting as fast as possible to new techniques of administration, to perfected economic mechanisms. And since such a conversion is quite complex, it is essential to prepare carefully for it. One way to prepare is to conduct social surveys.

Four scientific-organizational problems are of extreme importance. The first involves the necessity of perfecting state social statistics, which ideally should serve as the "daily bread" of social research. So far, unfortunately, such research is on "short rations." Many of the complex social processes taking place in our country are not adequately reflected in social statistics. Several years ago, the Central Statistical Administration collaborated with the USSR Academy of Sciences on compiling comparative statistics of urban and rural development, but so far no appreciable results have emerged. It is important to reactivate this effort.

The second problem involves the organization of large-scale, representational, regularly repeated sociological-statistical surveys on problems of the village. The USSR Academy of Sciences Siberian Department Institute of Economics and Organization of Industrial Production has accumulated considerable experience in conducting such surveys in collaboration with the RSFSR Central Statistical Administration. Three surveys have been carried out: in 1967, 1972, and 1977. All of them were based on uniform sampling from about 200 communities, also on programs which varied from period to period but were sufficiently comparable.

Such surveys provide information that is unique in breadth and specificity. They make it possible to study in an interrelated way, first, the entire complex of the people's living conditions; second, their behavior at work, in everyday life, at school, and in the family; third, their consciousness, their system of values, needs, behavior motives, and plans. So far, however, this kind of survey has been conducted only in Siberia, yet the conditions under which agriculture and the villages develop are infinitely varied. Effective administration of the development of the USSR's agroindustrial complex requires regular all-union sociological-statistical surveys of the village on the basis of sampling and a unified scientific procedure that is representative for the entire country. Methodologically and procedurally, the conduct of such surveys has been prepared already, and if the academy consents, these problems can be resolved.

The third problem relates to tasks of processing the sociological information. The results of large-scale sociological surveys are recorded in data files numbering millions of digits. They can be processed only on computers. Yet the computers we have are not adapted for processing large masses of information; they have weak inputs, they do not have optical input, and they are not suitable for long-term storage. And there is a lack, in effect, of specialized software designed for processing and storing large files of data. It is not efficient for individual institutes to resolve these problems on their own, and this work ought to be included in the overall program of scientific surveys in this field.

The fourth and final problem involves social-economic experimentation. Unquestionably, social statistics and sociological surveys are a valuable source of information, but their importance is limited by the fact that they only reflect reality passively. In order to check the real effectiveness of new economic relations and evaluate their social consequences it is necessary to set up special experimentation to show what consequences can result from particular changes in the nature of economic relations. And, of course, the USSR Academy of Sciences, especially its Department of Economics, is just the organization that can take over this work. In preparing such experiments and monitoring their implementation, a major role is played by the economists, but the role played by the sociologists is also very important, and we are eager to take part in this work.

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DECREE ADOPTED BY THE GENERAL MEETING

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 139-140

[Text] The general meeting of the USSR Academy of Sciences, having discussed the tasks of Soviet science in implementing the program of further boosting agriculture in our country, adopted an elaborated decree.

Noting that the decisions of the July 1978 Plenum map out the basic directions of the party's agrarian policies at the present stage, the General Meeting fully approved these decisions and the statements in the report by CC CPSU General Secretary Comrade L. I. Brezhnev at the plenum.

Implementation of the decisions of the July Plenum is closely linked to the use of the entire arsenal of knowledge, including the latest advances in biology, chemistry, and other fundamental sciences. The decree states that the scientific institutions of the USSR Academy of Sciencies and the academies of sciences of the union republics have made substantial advances in working out problems that are vital to agricultural production, and in many cases they have achieved substantial practical results. At the same time, the development of modern agriculture requires that the USSR Academy of Sciences and the academies of the union republics do more to strengthen fundamental research and work out and solve problems to create the basis for resolving applied tasks in the development of the agroindustrial complex.

The general meeting decreed that one of the most vital tasks facing the USSR Academy of Sciences and the academies of sciences of the union republics is that of working out fundamental scientific problems in the country's agriculture in light of the decisions of the July 1978 Plenum, focusing the efforts of the scientific institutions on the development of the main directions of scientific research listed in the decree with regard to the chemical-technological, biological, physical-engineering, mathematical, earth, and social sciences.

The decision was made to draw up an integrated program of fundamental research in the academic scientific institutions with regard to problems directly involved in agricultural development, also a unified plan of scientific-research work in this field to be conducted jointly with scientific institutions of the USSR Ministry of Agriculture, VASKhNIL, the USSR Ministry of Higher and Secondary Specialized Education, and other departments for 1979-1985.

The decree of the General Meeting of the USSR Academy of Sciences also reflected tasks relating to the training of cadres, the organization of new scientific institutions, publishing activities, and other problems.

The General Meeting of the USSR Academy of Sciences called on all scientists and workers of the USSR Academy of Sciences and the academies of sciences of the union republics to exercise all their strength, knowledge, and abilities to implement the program of further boosting agriculture adopted by the July 1978 CC CPSU Plenum for the good of the Soviet people and the sake of the grand goal of building communism.

To the Reader

All materials of the General Meeting of the USSR Academy of Sciences "Science for Agriculture" will appear in a collection which will soon be published by Nauka.

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SCIENTISTS, INSTITUTION HONORED BY SUPREME SOVIET

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 141-142

[Ukases promulgated by USSR Supreme Soviet Presidium]

[Text] Ukases of the USSR Supreme Soviet Presidium Awarding the Order of Lenin to the Belorussian SSSR Academy of Sciences

For success in the development of Soviet science, economics, and culture, in the training of highly-qualified scientific cadres, and in connection with the 50th anniversary of its formation, the Belorussian SSR Academy of Sciences is hereby awarded the Order of Lenin.

USSR Supreme Soviet Presidium Chairman L. Brezhnev.

USSR Supreme Soviet Presidium Secretary M. Georgadze.

Moscow, Kremlin, 26 December 1978.

Ukase of the USSR Supreme Soviet Presidium Awarding the title Hero of Socialist Labor to Belorussian SSR Academy of Sciences President Comrade N. A. Borisevich

For outstanding service in the development of science and the training of scientific cadres, Belorussian SSR Academy of Sciences President Comrade Nikolay Aleksandrovich Borisevich is hereby awarded the title Hero of Socialist Labor, the Order of Lenin, and the gold medal "Hammer and Sickle."

USSR Supreme Soviet Presidium Chairman L. Brezhnev.

USSR Supreme Soviet Presidium Secretary M. Georgadze.

Moscow, Kremlin, 27 December 1978

N. A. Borisevich

Ukase of the USSR Supreme Soviet Presidium Awarding the title Hero of Socialist Labor to Comrade F. I. Fedorov, Academic Secretary of the Department of Physical and Mathematical Sciences, Belorussian SSR Academy of Sciences

For outstanding service in the development of science and the training of scientific cadres, Comrade Fedor Ivanovich Federov, Academic Secretary of the Department of Physical and Mathematical Sciences of the Belorussian SSR Academy of Sciences, is hereby awarded the title Hero of Socialist Labor, the Order of Lenin, and the gold medal "Hammer and Sickle."

USSR Supreme Soviet Presidium Chairman L. Brezhnev.

USSR Supreme Soviet Presidium Secretary M. Georgadze.

Moscow, Kremlin, 27 December 1978.

F. I. Federov

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SCIENTISTS HONORED ON BIRTHDAYS

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 3, 1979 pp 142-143

[Text] Academician N. A. Pilyugin is 70

Twice Hero of Socialist Labor and Lenin and State Prize Winner Academician Nikolay Alekseyevich Pilyugin is 70 years old.

N. A. Pilyugin is the chief designer of autonomous control systems and one of the founders of a new branch of science and technology. He supervised the development of control systems for the first and several of the subsequent rocket carriers which launched earth satellites into orbit, automatic interplanetary stations, and many other spacecraft. Fundamental research by N. A. Pilyugin has resulted in formulation of the theory for designing precision control systems for aircraft, the development of techniques of analysis and synthesis of complex dynamic systems that have been widely adopted in the designing of control systems, formulation of the principles governing the designing of control systems with computers, and development of scientific methods and technical complexes for experimental testing of them.

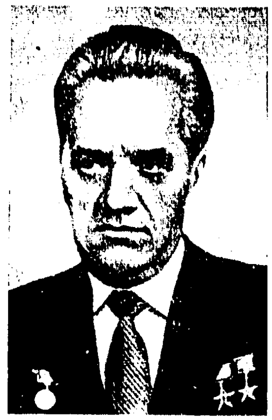
The USSR Academy of Sciences has awarded N. A. Pilyugin the gold medals imeni K. E. Tsiolkovskiy and S. P. Korolev.

N. A. Pilyugin is a member of the USSR Academy of Sciences Presidium.

N. A. Pilyugin has headed a large scientific-research collective for many years. Serving as department director in the Moscow Institute of Radio Equipment, Electronics, and Automation, N. A. Pilyugin has devoted a great deal of time to the training of engineering and scientific cadres.

N. A. Pilyugin is also involved in service to the state--he is a deputy to the USSR Supreme Soviet.

In its greeting, the USSR Academy of Sciences Presidium wished the honored scholar good health, many years of life, and further success in his work.



N. A. Pilyugin

Academician L. S. Pontryagin is 70

For outstanding service in the development of the mathematical sciences, the training of scientific cadres, and in connection with the 70th anniversary of his birth, Academician Lev Semenovich Pontryagin was awarded the Order of Lenin by Ukase of the USSR Supreme Soviet Presidium dated 1 September 1978. L. S. Pontryagin is famous throughout the world for outstanding achievements in mathematics and its applications. L. S. Pontryagin's works in the field of algebra, geometry, topology, the theory of differential equations, and the theory of control are fundamental. The topological principles of duality he discovered have launched a new scientific discipline--topological algebra.

L. S. Pontryagin formulated the theory of the characters of commutative topological groups. His name is linked to fundamental contributions to algebraic topology.

L. S. Pontryagin is responsible for the formulation of the modern mathematical theory of optimal control. A central result of this theory is the well-known Pontryagin Principle of the Maximum, which has become part of the world literature on problems of control. Techniques based on this principle are acknowledged worldwide and are used today in all tasks of control, in particular in resolving problems of docking and soft landing of space ships.

In recent years L. S. Pontryagin has obtained important results in the field of the theory of differential games which is developing rapidly at present. His basic works in this area are considered fundamental.

The USSR Academy of Sciences Presidium's greeting to the honored scholar notes L. S. Pontryagin's services in training scientific cadres of high qualification in this country. The school he founded in the field of differential equations and the theory of optimal control is widely acknowledged.

L. S. Pontryagin's works have nourished a generation of outstanding Soviet and foreign scientists, many of whom enjoy considerable authority throughout the world.

Also well known is the varied scientific-organizational activity of L. S. Pontryagin on the Executive Committee of the International Mathematics Union, on the Main Editorial Board for Physical and Mathematical Literature of Izdatel'stvo Nauka, and in his post as chief editor of the venerable Russian mathematics journal MATEMATICHESKIY SBORNIK.

L. S. Pontryagin

L. S. Pontryagin's services are highly appreciated by the Soviet government. He is a Hero of Socialist Labor and a Lenin and State Prize Winner and has been awarded many orders of the Soviet Union.

The USSR Academy of Sciences Presidium wished Lev Semenovich Pontryagin good health, happiness, and further creative success.

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END