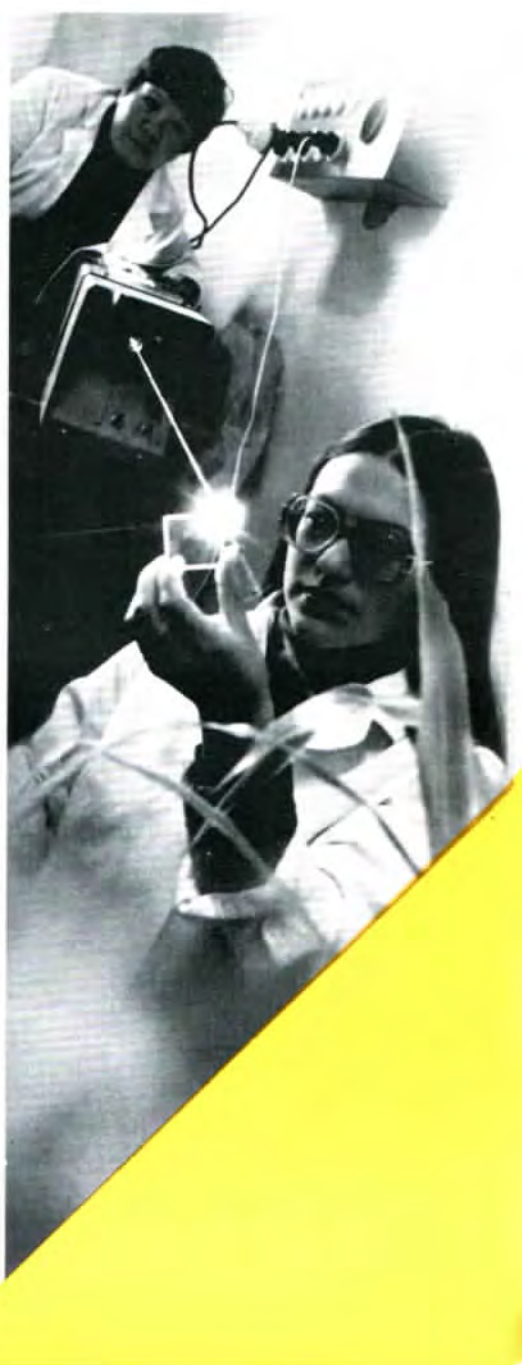
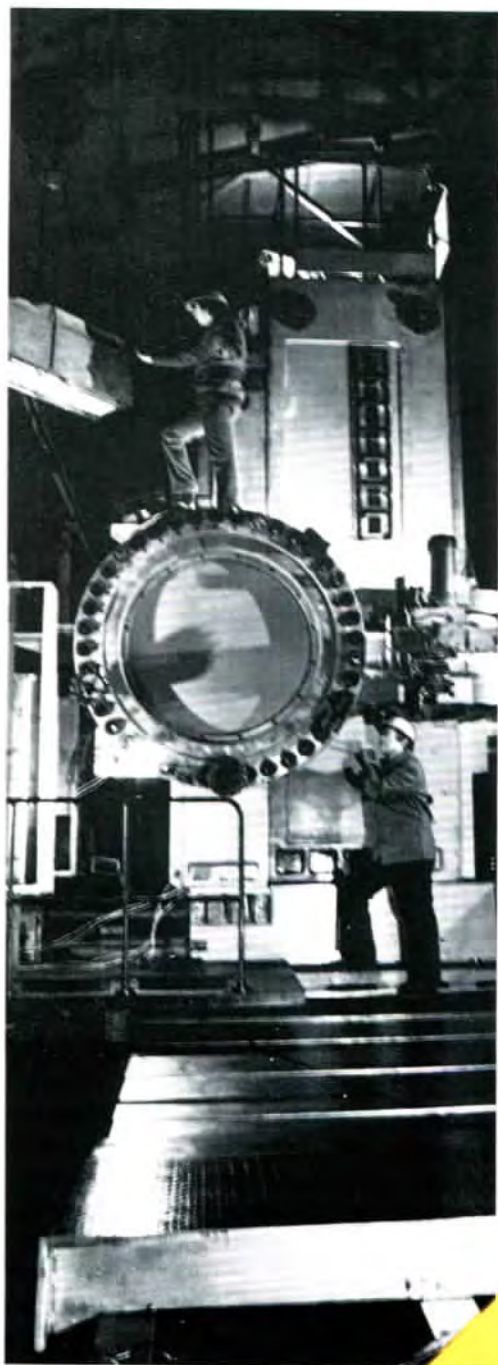




**THE SOVIET ECONOMY  
ON THE EVE  
OF THE 21<sup>ST</sup> CENTURY**





# THE SOVIET ECONOMY ON THE EVE OF THE 21ST CENTURY

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## Age of New Technologies

The turning point futurologists have long cherished is growing ever closer—the year 2000 is just a bit more than twelve years away. While the forecasts futurologists make are becoming more definite, they are at the same time becoming more conservative.

Life will not apparently differ in any major way from life today. More recent forecasts have put off to a somewhat later date the construction of exotic towns and cities that

hang in the sky, tours to the Moon and the building of antigravitational engines. We will spend the last year of this century in the same houses and streets we are living in now. The familiar look of factories, power plants, shops, railway and airway terminals, cars and aircraft will not change much.

But nevertheless the world will be different. For that matter, it is changing already and signs of these changes can be found everywhere.



## Computerisation in the USSR, from the School to Outer Space



A short while ago the traffic control inspectorate of Leningrad decided to introduce in one of its districts a traffic pattern that had been devised by schoolchildren. The girls and boys studied the movement of cars and pedestrians at various times of the day. They then processed the information they had gathered using computers and came up with the best way of eliminating traffic and pedestrian jams. This work was carried out by the members of a computer club formed at an institute in Leningrad several years ago.

Such clubs and classrooms equipped with video display systems were until recently experimental organisations that could be found only in big cities. But in September 1985 a course in the "Fundamentals of Information Science and Computer Handling" was introduced for all senior high school students in the Soviet Union. This is a very promising undertaking which is to prepare the younger generation for life in the "information society" in the 21st century.

"The electronic revolution has given rise to new trades and professions and a new

way of thinking," says Andrei Yershov, member of the USSR Academy of Sciences and head of the school computerisation programme. And therefore the computer, which expands man's capabilities, should become for children something as ordinary as a TV set or tape recorder. Although the computerisation of 140,000 schools has posed a wealth of problems, Andrei Yershov is optimistic about the prospects for the programme. "The main thing is that the machine is working towards the goal we have set ourselves," he says.

The computerisation of the school is a key element of the national programme for the expanded production and use of computer technology for the period ending in 2000.

This programme rests on a firm foundation—the country's electronic industry which manufactures virtually every known type of "brain" equipment—from microcomputers for book-keeping, to robots and sophisticated supercomputers for managing entire economic sectors.

Soviet specialists have realistically appraised the level of Soviet high technology today. In a televised interview Yevgeni Ve-



*For these 5-year-old kids a computer is merely a playmate. However, they will soon become first-graders, and then computers will be as indispensable to them as a note-book and a primer once were to their parents ...*

likhov, Vice-President of the USSR Academy of Sciences and an authority on physics, admitted that very many Soviet computers are not up to present-day world standards. He pointed out that organisational and psychological barriers are still holding back the broad use of computers.

"Some people have what could be called a mystic faith in computers, while others develop allergies to computers because they mercilessly expose a person's inability to think clearly, to formulate problems and plan actions."

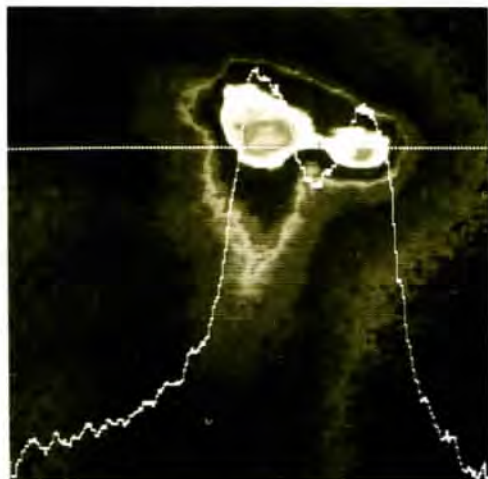
At the same time Yevgeni Velikhov emphasised that the Soviet Union manufactured some of the most sophisticated computing equipment. As an example he cited



the equipment used to launch two space probes—the *Vega-1* and *Vega-2*—to rendezvous with Halley's Comet. The calculations made for the launching were highly accurate. Although the flight lasted for more than a year and although the rendezvous point was more than 180 million kilometres away from Earth, one of the stations arrived only 20 seconds earlier than the estimated arrival time.

The USSR's first computer which was developed in the early 1950s performed 20,000 operations per second. Three years ago the USSR started serial production of supercomputers which perform 200 million operations per second. A scientific-engineering association of the USSR Academy of Sciences in Leningrad is working on a machine that will perform 10,000 million operations per second.

Commenting on the Soviet computerisation programme, Nikita Moissejev, Deputy Director of the Computing Centre of the USSR Academy of Sciences, remarked:



*This first-ever stillshot of Halley's Comet was taken by the Soviet "Vega-2" space probe in 1986.*

*An important trend in machine-building is the creation of flexible production systems. Pictured: the Ivanovo heavy machine-building plant.*



"Our objective is to build up a computer stock that would offer a wide choice of computers to any kind of customer. We don't want supercomputers to be used for jobs a microprocessor can handle. This is one of the more important tasks of the national programme."

Today a microprocessor—a silicon plate two square centimetres in size—can do everything a tube computer that takes up an entire room can do. Small, cheap and capable of doing all sorts of jobs, microprocessors have worked a revolution in industry. It is precisely these plates, called microchips, that have made the mass-scale manufacture and use of industrial robots economical.



*A graphic video display is something a designer cannot do without.*

*The experimental machine-building plant in Sumy, the Ukraine, uses the most up-to-date equipment. Pictured: mechanical treatment of a heavy-duty compressor on a compound-table milling machine.*





## Robots Are Moving in



The first attempt to make a "man-like" mechanism dates back to the middle ages, when the word "robot" did not even exist yet. They say that even the famous French philosopher René Descartes at one point tried to design such a mechanism. At any rate, he wrote back in 1637 that one day mankind would create "inanimate mechanisms" that would behave like live ones.

But until the 1970s robots were more like a toy for inventors than efficient industrial equipment. The revolution in microelectronics brought about a radical change in the situation. The world became witness to a real boom in robotics.

According to the estimates of CMEA\*

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\* Council for Mutual Economic Assistance. Its members are Bulgaria, Hungary, Poland, Romania, the USSR, Czechoslovakia, the German Democratic Republic, Mongolia, Cuba and Vietnam.

Although the CMEA member countries account for only 10 per cent of the world's population, they account for close to 25 per cent of the world's national income and over 30 per cent of the world industrial output.



*A 14-arm robot at the "Telemekhanika" plant in Nalchik gets radio components ready for installation.*

specialists, by 1990 the industries of the CMEA member countries will be outfitted with close to 200,000 robots. It follows that more than half of the world's robots will be concentrated in these countries. Even today Czechoslovakia has more robots than Britain, and the Soviet Union has more than the USA, although fewer than Japan.

Since 1975, when it produced only 120 robots, the USSR has increased its manufacture of robots more than a hundredfold. In the last two years alone it has made over 30,000. They are being used in a wide variety of jobs, such as welding, the painting of machines, the operation of presses, the stamping of plastic parts and the assembly of integrated microcircuits.

Practice has shown that a robot in and of itself is not an economical device. As a rule, it works at less than half its design capacity. Using a robot is often like running a high-speed locomotive on old, worn-out railway tracks. A robot's high cost makes it difficult to justify its use.

Of course, it makes sense to employ a robot to do jobs harmful or hazardous to human health. Economic considerations under such circumstances are of secondary importance. But under other circumstances it is important to make thorough calculations. Such calculations have shown that the most profitable alternative is to create flexible production systems.

What is a flexible production system? Such a system is made up, in the first place, of several (from two to 40) so-called "machining centres"—multioperational micro-processor-controlled machines; second, of element-handling robots which feed workpieces into the machine and remove the finished parts; third, of robotised trolleys that deliver the blanks to the work place and



carry the products to storage. The entire manufacturing process executed by this system, including storage, is controlled by a computer.

What are the advantages of such a system? Unlike the conventional, "inflexible" automated production lines, a flexible production system can be quickly switched over from one product to another, according to the demand at that given point. In addition, their economic effect does not depend on the scale of production. This is of special importance because, according to world statistics, over 70 per cent of all engineering products are turned out in small quantities.

At present close to 600 flexible systems of various degrees of sophistication are being used in Soviet industry. They are mainly concentrated in the engineering sector, be-



cause the level of this sector's development actually determines the rate of overall economic growth.

It is worth noting that robots are now appearing in a sphere very "foreign" to them, namely farming. In the late 1970s a team working in Moscow under Valeri Vasyanin developed the MAR-1 self-contained robot—the first of its kind in the world. It distributes fodder to domestic animals, cleans and disinfects barns, and handles (loads and unloads) materials.

*The assemblage and welding of the bodies of cars at the Levinsky Komsomol auto-plant in Moscow is done by robots. Having replaced 12 workers, a manipulator takes one minute to weld the body of a car.*

*This robot makes ... robots. It is used for the serial production of parts used in robotics.*



Mobile automations for poultry farms, the shearing of sheep and the milking of cows have been developed on the basis of the MAR-1. The engineers have even taught the robot to pick apples. The apple picker is an exciting piece of equipment that has 12 manipulators—"replicas" of an elephant's trunk. Each trunk combines the functions of an odour analyser, and a strong, flexible, "tactile" hand. Exciting discoveries have been applied in the building of other types of automatic manipulators used on tea plantations, in hothouses and on vegetable fields.

Although automation is very promising, scientists maintain that it will be biotechnology that will work a revolution in farming.



*"Iron helpmates" are used for a broad range of tasks. Top photo: a robot monitors a reactor to ensure it is operating safely at the Institute of Nuclear Reactors in Ulyanovsk. It is hard to imagine a modern production line without manipulator robots (bottom photo: at the "Konveyer" plant in Lvov, the Ukraine).*

# The Taming of Bacteria



Even Arthur Clarke, a science fiction writer with a very powerful imagination, could not foresee the present achievements in biology. He predicted that the development of biotechnology would begin not earlier than in 2030. He believed that this would coincide with the establishment of contacts with extraterrestrial civilisations and the extraction of minerals from space. Reality outstripped the prediction of the science fiction writer: the biotechnological boom started 50 years ahead of his estimate.

Aleksei Sozinov, Director of the Institute of General Genetics of the USSR Academy of Sciences, believes that the "construction" of plants with predetermined properties will become common practice within the next ten years. He says that "the idea is to increase crop yields by manipulating the genes in the crop cells and not those in the plants growing slowly in the fields." The institute he heads is slowly but surely approaching its goal. A short while ago the laboratory teams developed a method for the production from a single cell of wheat (or barley) several hundred whole plants. These have become splendid material for selection.



*The "designing" of plants with pre-determined properties will be possible in the near future, Soviet scientists contend. Pictured: a laboratory at the Institute of Bio-Organic Chemistry of the Byelorussian Academy of Sciences.*



The Institute of Biochemistry and Physiology of Micro-organisms in Pushchino, near Moscow, is working along different lines in pursuit of higher crop yields. If its efforts prove successful, it will be possible to replace nitric fertilisers with bacteria which will help plants assimilate nitrogen directly from the atmosphere. The experiments with new bacterial strains in the Ukraine have given rise to hope: the scientists have increased soy bean yields.

Biological technologies are being very widely applied. Micro-organisms are used for the extraction of valuable metals from waste copper ores, for the production of medicines and control of methane in coal pits.

Biotechnology offers tempting prospects for the electronic industries as well. Just like Japan and the USA, the USSR has long

*Putting bio-satellites into orbit is an important line in the Soviet space-exploration programme. Pictured: a mock-up of the bio-satellite "Kosmos-1667".*

been conducting work in the development of a biological computer. Researchers are trying to "train" protein molecules to act as memory cells, i.e. the basic components of a computer.

Of course, it is still early to talk about impressive achievements in this field. However, some of the discoveries seem to be very promising. Several years ago the Institute of Biophysics of the USSR Academy of Sciences produced a very thin protein film known as bacteriorhodopsin. If a laser beam is directed at this protein, each of its molecules will change colour. This film can be used many times, recording and erasing the image.



*The laser is indispensable in genetic engineering.*

Soviet researchers have developed new and better types of film. It would be tempting to develop a data-storage device on their basis. A disc made of this film, which would be the size of a long-playing record, could store the contents of many thousands of books.

*The "Phytotron" (a plant for generating artificial climate), which was designed by Siberian scientists, makes it possible to gather six harvests a year. It also enables plant-breeders to breed new plant varieties within a shorter period of time.*





# The Purpose of Restructuring the Soviet Economy

New technologies promising unprecedented possibilities are now being applied on a wide scale. However, there is a great deal more to the changes taking place in the Soviet economy. And furthermore, Soviet leaders have repeatedly emphasised the tremendous importance of scientific and technological progress for the development of the national economy.

A narrow "technocratic" approach will be of little help when trying to understand

completely all that is taking place. For instance, Abel Aganbegyan, member of the USSR Academy of Sciences and an authority on Soviet economics, says:

"Progress in science and technology is, beyond doubt, the main lever of accelerated economic growth. However, the direction of this progress and its rate depend on how the country's economy is organised and how efficiently it is managed."





## A Sharp Turn



The tremendous importance of the 27th CPSU Congress, which was held in February–March 1986, is becoming increasingly clear with each passing day. Having discussed the most difficult problems facing the country, the congress set the task of accelerating the USSR's socio-economic development. What is the purpose of this endeavour?

The meaning of the word acceleration, as we understand it, is far more complicated than that given in a school textbook of physics. Although the congress set the tremendous task of doubling the USSR's industrial potential and national income by the year 2000, i.e. accomplishing in 15 years the equivalent of what was done in the past 70 years of Soviet government, acceleration does not only involve the rate of growth of production or that of national income.

The main purpose is to achieve qualitative rather than quantitative growth, although the latter is also very important. The idea involves the modernisation of production on the basis of the latest equipment, improved management and planning, sweeping changes in the sphere of labour and living conditions and broader democracy. This all boils down to the restructuring and renewal of all aspects of society.

The key objective of the restructuring is to make radical changes in the entire system of production relations and to ensure that these relations correspond with the new productive forces. What does this mean?

The underlying objective of the economic management system that was formed for the most part in the 1930s–1950s was to achieve the most rapid growth possible of the economic potential and productive capacities. And this system helped the USSR to accomplish this task.

In those days it was imperative to centralise the economy to a maximum degree. This was conditioned by the limited manpower and material resources, and also by the shortage of qualified personnel. Under the circumstances there was no alternative but to concentrate all the resources in the hands of those at the centre.

However, the circumstances have changed (the Soviet economy now contributes one-fifth of the world industrial output). As a result, management by decree which worked successfully under extreme conditions gradually began to impede economic progress. In the 1970s the Soviet economy began to "mark time".

Addressing the 27th CPSU Congress, Mikhail Gorbachev said:

"The problems in the country's development grew more rapidly than they were being solved. The inertness and rigidity of the forms and methods of management, the decline of dynamism in our work, and increased red tape—all this was doing no small damage."

The congress discussed frankly what was impeding the progress of society. Cosmetic changes would not be any good; what is needed is radical economic restructuring. This conclusion is evidence of the Soviet leadership's political foresight.

The people regard the changes now taking place as revolutionary. Although these changes will take time, the most important thing is to make a start. As the ancient Greek philosopher and mathematician Pythagoras said, the beginning is half the accomplishment.

The guidelines for the restructuring effort have been formulated. However, progress has not been as rapid as we would like it to be. This is quite understandable, for it is impossible to solve overnight all the problems that have piled up over the years. Furthermore, it is even more difficult to set a big ship on a new course. Inertia cannot be overcome just like that, disregarding the burden of old habits and the concealed resistance of the bureaucratic machine. The government is therefore working changes gradually. It has passed a decision on the reorganisation of science, on the establishment of large research and development complexes to cope with key problems, on the improvement of economic relations in agriculture, in the heavy and light industries, in the sphere of construction and in trade. The management of foreign trade has undergone a complete overhaul. A reform of the wage policy in the sphere of production is

being carried out. Various forms of co-operatives are being supported. New forms of management which dogmatists once condemned as incompatible with socialism are being used more widely.

The June 1987 Plenary Meeting of the CPSU Central Committee put forward a programme of radical reform of the Soviet economy. It outlined the most comprehensive economic reform in the history of socialist construction in this country.

The essence of the reform lies in the adoption of economic methods of management at all levels, and in broad democratisation of the economic management. At the same time, in June 1987 the Law on State Enterprise was enacted. The Law eliminates interference in the routine affairs of enterprises and substantially increases their independence, giving them better opportunities for economic manoeuvring.

In speaking of democratisation in economic management, Mikhail Gorbachev stressed that it is in enterprises or amalgamations that the "principal economic processes take place, ... that all the goods and services needed by the people are produced and scientific and technological ideas materialise. It is in the work collective that economic and social relations really take shape and people's interests—personal, collective and social—intertwine."

The radical transformations of the economic system in the USSR began in an "upward" direction, from the economic base. It has, however, caused drastic changes to be introduced in all the higher echelons of the economic management.

## Centralism and Independence: Where is the Golden Mean?



The planned nature of the Soviet economy has become so natural a thing over several decades that it is accepted as an axiom. Moreover, being the first in the world to use the planning principle, the Soviet Union managed (as is generally recognised) to gain impressive successes.

The time has now come for the entire system of economic planning in the USSR to be drastically overhauled. It is not a matter of improving or "mending," but of a drastic reform. This spells the end of the "command" economy. The system of rigid administrative control gives way to regulation through prices, financial loan levers, economic norms. The discipline of command gives way to initiative from below.

Will this lead to the weakening of the planning principle in the socialist economy?

The question of how much independence enterprises should have in a planned economy has long caused a good deal of dispute. Some individuals have voiced anxiety as to whether greater independence



*The Law on the State Enterprise is to become the legal basis for economic restructuring, the guidelines for which were laid down by the 27th Congress of the Soviet Communists. The draft of the law has been discussed at every plant and factory, and by every work collective.*



meant an attempt to dismantle centralised planning.

According to Mikhail Gorbachev, "the point at issue is a new concept of centralism resting on activity of working people and independence of enterprises". Systematic control over the market within the constraints of its laws, and enhancing and raising the reputation of the rouble will be a real contribution to stronger socialism.

Leonid Abalkin, a prominent Soviet scientist, Director of the Institute of Economics at the Academy of Sciences of the USSR, said, replying to those who in one way or another oppose greater independence for enterprises and adhere to economic management by command: "Not a single serious economist in the USSR has ever considered discarding the centralised planning principle. Anyway, it is one of the pillars of the socialist economy. It is only on its basis that numerous economic and social targets can

*One of the most popular TV programmes is "Problems-quests-solutions". Statesmen and public figures, writers, eminent scientists, economists and sociologists reflect upon questions sent in by the TV audience and discuss the course of the country's socio-economic restructuring.*

be coordinated and adequate resources allocated. There are a number of issues requiring a common approach with regard to the interests of society as a whole." "Centralism," the scientist emphasized, "must not be understood as an endless flow of papers carrying directives from top to bottom, but as a system whereby the planning centre effectively controls real economic processes."

Without centralised decisions it would be impossible to estimate expenditure on fundamental research, devise a strategy for scientific and technological progress, to carry out major projects or resolve the energy resources problem.

## Figures and facts

### A SINGLE DAY IN THE COUNTRY

The Soviet Union produces daily over 1.6 million tons of oil (including gas condensate), about 2 million tons of coal, and nearly 700,000 tons of iron ore. The daily output of steel exceeds 400,000 tons.

On the average, 5,500 flats are commissioned in the country every day—enough for a town with a population of 20,000 people.

Soviet factories produce daily about 30,000 television sets, nearly 20,000 refrigerators, and over 2 million pairs of shoes. The daily retail turnover of state and cooperative trade in the USSR is nearly 900 million roubles.

### SPACE STATIONS HELP GEOLOGISTS

The "Space-view Geological Map of the USSR"—the world's first edition of this kind—presents the territory of the Soviet Union as a bizarre combination of giant rings held together by a cobweb of fractures and troughs. The map, which takes up 8 square metres, was made on the basis of stillshots taken from Soviet satellites and orbital stations.

The exploration of the planet's natural resources is one of the most important lines of the Soviet space programme. Remote sensing makes it possible to discover geological structures lying several kilometres under the earth's crust. Thus, this method was used to discover areas rich in oil and gas on the northern coast of the Caspian sea, new ore deposits in Kazakhstan, and coal deposits in the Soviet Far East.

Space geology is bringing great profits; the estimated annual economic benefit is about 30 million roubles. A whole range of space surveys have been carried out on board Soviet spacecraft at the request of 18 countries.

### A LASER ROBOT COMES INTO BEING

Laser technologies widely used by modern industries for strengthening metals can be made twice as cheap. A convincing example of this is the unique laser robot developed at the Institute of Machine Science of the Academy of Sciences of the USSR.

Scientists equipped the arms of a serially produced industrial robot, which is capable of lifting up to 20 kg, with a special holder enclosing an optical system of laser-beam control. The holder can be easily carried in an ordinary briefcase. The mirrors and the piezo-ceramic motor inside the holder are arranged in such a fashion that the new system consumes half as much electricity and is three times more efficient than its bulky counterparts produced in Federal Germany and Japan.

# Figures and facts

## A SOFTWARE BANK

The "Interfap" system which CMEA member countries are developing in a joint effort will offer the users of this system a wide choice of software for carrying out complex scientific and engineering calculations. It will be a system for mutual exchange and for storing and copying programmes; it will be based on unified organizational, legal and economic principles. Each member country will save a great deal of time and money by selling its own programmes and buying those developed by its partners.

## THE NEW GIANT HYDRO-POWER STATION ON THE YENISEI

A 20,000 megawatt hydro-power station, the largest of its kind in the USSR, has been designed by specialists in Leningrad. It is planned to be constructed on the Lower Tunguska—a tributary of the Yenisei, not far from the city of Turukhansk.

It will be the world's largest hydro-electric station to be constructed in the permafrost zone.

Powerful hydro-electric stations, such as the Sayan-Shushenskoye (6.4 million kW), the Krasnoyarsk (6 million kW) and the Bratsk (4.6 million kW) stations have already been built on the Yenisei and its tributaries.

## THE SUPER-DEEP DRILLING PROGRAMME

Although space vehicles have already visited the Moon, Mars and Venus, the bowels of the earth remain in many ways a mystery to us. This explains why specialists are particularly interested in the unique experiment on the Kola Peninsula where the deepest bore in the world is being drilled.

Today, the drill bit is "biting" at rocks lying thirteen kilometres below the surface. It has taken the drilling crews fifteen years to get there. But the game is worth the candle: the Kola project has yielded quite a few discoveries which have changed the traditional ideas about the Earth's structure.

The Kola bore is a kind of testing ground for proving new technical ideas. The unique drilling rig, the heat-resistant drill bits and the special aluminium-alloy pipes were manufactured specially for this project.

The experience gained during the drilling of the Kola bore has become the basis of the programme developed in the USSR for deep and super-deep drilling. The objective is to identify potential reserves of oil, gas and various ores in the country's principal mining regions. At present, the Saatinskaya bore is being drilled in the vast Kura depression in Azerbaijan, which has now been drilled to a 9-kilometre depth. Preparations are under way to drill super-deep bores (12–15 km) in Tyumen, in the Urals, in Krasnodar Territory, in Central Asia and some other areas.

## THE USSR ON THE FOREIGN MARKET

Today, the Soviet Union trades with 145 countries of the world. Over a half of its trade turnover falls on the socialist countries.

The Soviet-Chinese relations have been steadily improving in recent years. The Long-Term Agreement on Trade and Payments signed in 1985 envisages the

## Figures and facts

growth in the volume of trade to reach 12,000 million roubles during 1986–1990.

Federal Germany is the USSR's major trade partner among industrialized capitalist countries. The group of the USSR's five major trade partners in the capitalist world also includes Finland, Italy, France and Japan.

The cooperation between the USSR and the developing countries expands with every passing year. India traditionally holds first place here. Next in line are Argentina, Libya, Afghanistan, Iraq and Syria.

### EXPORTS OF THE SOVIET AEROSPACE INDUSTRY ARE GROWING

Soviet exports of civilian aircraft and airfield equipment have grown by 1.4 times over the last five years. There is a steady demand on the world market for Antonov planes created by Oleg Antonov's aircraft designers. Airlines in 42 countries in Europe, Asia, Africa and Latin America are flying over 1,300 Antonovs. These reliable machines are capable of taking off and landing on soil airstrips, which makes them particularly attractive to foreign customers. There is also continuous demand for Ilyushin, Tupolev-134, and Tupolev-154 planes. The medium-range Yakovlev-40 passenger plane is sold to 17 countries.

### THE USSR'S POLICY OF RESTRUCTURING AND FOREIGN TRADE

Restructuring in foreign trade has become a component part of the overall policy of economic restructuring in the Soviet Union. The general administration of the foreign-trade sector remains the prerogative of the Soviet government. It is, however, confined to making decisions that are general and strategic in nature. Alongside foreign-trade associations, over twenty ministries and departments and about seventy enterprises have been granted the right to carry out trade directly with foreign customers. In 1987 the above-mentioned enterprises and ministries accounted for 20 per cent of the country's trade turnover and for 40 per cent of its trade in machines and equipment.

### NEW TECHNOLOGY: LOOKING MAN IN THE EYE

Robots, computers, prodigious power plants, factories devoid of personnel—these and other aspects of the future are becoming increasingly visible. But does a person who spends many working hours tête-à-tête with a computer always feel comfortable?

The answer to this question is being sought by ergonomics. Ergonomics is becoming more intensive especially in the member countries of the socialist community. Numerous health checks and inspections of the working conditions of display operators revealed a high degree of eye fatigue, accompanied by headaches and spinal aches as a result of long hours in the same position.

The specialists in the CMEA member countries are making a joint effort to establish unified requirements for the new equipment. They are determining the optimum norms of illumination intensity at workplaces, the frequency of screen flicker, the brightness of the background, the readability of symbols, etc. In other words, scientists proceed from the unqualified primacy of man within the "man-computer" system.



# Energy Supply: Search for a New Model

Albert Einstein once said that what mankind needs most is a bench to sit down on and think. One of the biggest problems demanding that we think carefully is the energy problem.

Today the energy used to produce one kilogramme of grain, cotton or potatoes is ten times greater than at the start of the century. The energy consumption by industry, transportation and particularly the household has increased just as sharply. Otto Lácis, an eminent Soviet economist, has calculated that the housewives of a single neighbourhood in Moscow can, without leaving their kitchens, plug in household appliances whose total capacity is equal to the power developed by the atomic ice-

breaker *Arktika* as she crushed ice during her record voyage to the North Pole.

Trying to keep up with the soaring demand, industry has been increasing the extraction of raw materials. A conservative estimate shows that by the year 2000 the world's energy consumption will be one and a half times greater than it is today.

How long will the resources last? How will oil prices change? What are the prospects for nuclear energy? To what extent can man-generated energy affect the biosphere without ruining it? Questions such as these, which were once of interest only to specialists, are now being widely discussed in newspapers and magazines.





## Estimates and Forecasts



Several years ago an attempt was made to sum up the views of scientists on the future of the world energy supply. An international symposium held in Vienna examined 325 scenarios presented by governmental and non-governmental organisations, research institutes, commercial firms and independent researchers. These scenarios formed the basis for a "summarised" international forecast for the period ending in the year 2020.

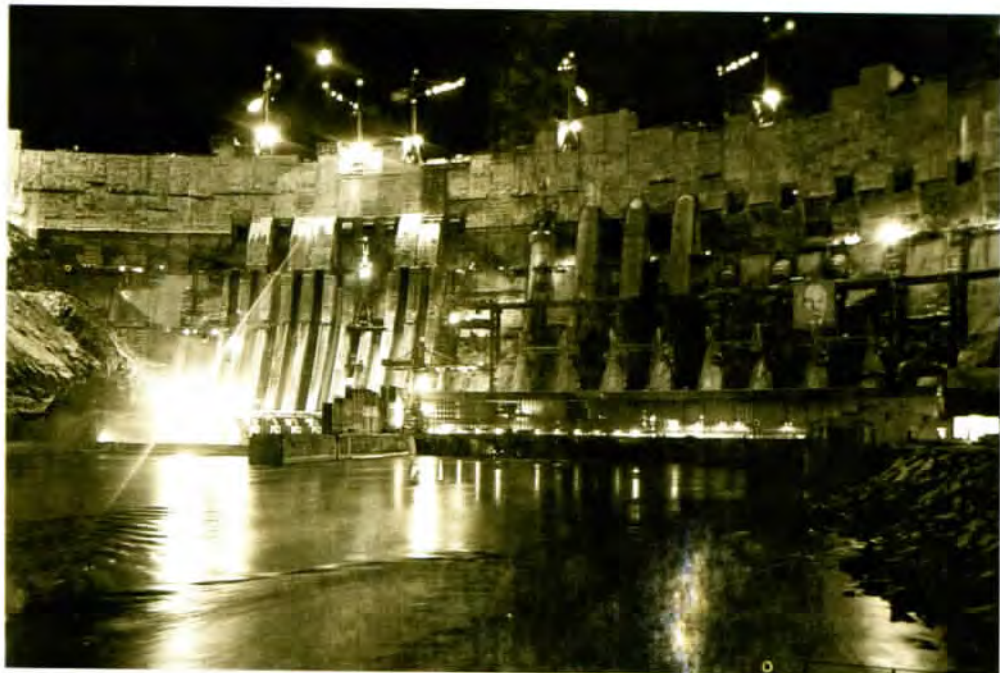
What were the results? Despite the great differences in opinion, the general upshot was unequivocal: the conventional fuels, especially oil and gas, will continue to play a decisive role in the energy supply at the beginning of the next century. Their consumption will keep on growing until the year 2000, although at a somewhat lower rate than before. According to the forecast, coal consumption will also go up. Nuclear power engineering will develop rapidly. Renewable energy sources, such as the sun, wind and geothermal bearers, will play a more noticeable role.

How accurate is this picture of the future energy supply? Considering that other forecasts did not prove to be correct, it is easy to

question this one as well. But Mikhail Styrikovich, who is a member of the USSR Academy of Sciences and who headed the Soviet delegation to the Vienna symposium, says that the scenario produced by joint efforts is credible.

Of course, many of the figures and indicators projected in Vienna are conditional, as they are based on present-day tendencies and demand, and also on the intuition of experts. The energy supply crisis of the 1970s showed that the situation in the sphere of energy resources may be affected by fuel producing countries, by the intrigues of raw material monopolies, the instability of the market and other factors.

The world energy supply is an extremely complicated, tightly knit system characterised by tremendous inertia. One should not, therefore, expect sudden changes in this system. Mikhail Styrikovich maintains that the basic conclusions made at the Vienna symposium are for this reason more valid. In general terms, the estimates of Soviet scientists are close to those of the Vienna symposium, although they do not fully coincide with them.



*The Sayan-Shushenskoye hydro-power station is presently the most powerful station generating electricity on the Yenisei River in Siberia.*



*The Neryungri coalfield (Yakutia). Experts believe it to be a most promising deposit.*

# Staking on the Saving of Energy



On the initiative of the Novosti Press Agency, the USSR Academy of Sciences held a round-table discussion on the problem of the energy supply. Leading Soviet scientists took part in this discussion, which was held in Moscow.

It lasted nearly five hours and covered a wide range of issues from the problems of heat-resistant steels for turbines to those of world oil prices. However, it was easy to determine the main topic of discussion, namely the saving of energy, because practically every speaker touched upon this issue in one way or another.

Why did this issue attract such attention? In the last quarter of a century the USSR's fuel output has trebled. Today the Soviet Union accounts for a quarter of the world output of oil (including gas condensate) and coal, and for one-third of natural gas production.

This has made it possible not only to meet the domestic demand, but also to sell large amounts of fuel on the world market. At the same time the USSR's indicator of fuel and



*Power generated by nuclear energy is today becoming as traditional as conventional power. In the photo: in a reactor room at the Smolensk nuclear power station, in the Russian Federation.*



*An experimental solar power station in the Crimea.*

energy consumption per unit of national income is inferior to the best world indicators. And this is true despite the sweeping measures taken during the last few years for saving fuel.

Thus simple economy has failed to solve the problem. What is necessary is major improvements both in the production and in the consumption of resources. The USSR's special-purpose, long-term energy programme provides precisely for such improvements.

The objective is not only the further perfection of the country's energy economy and the replacement of costly and limited resources with cheaper and more efficient ones. The main objective is the wide application of energy-saving technologies which promise to save many millions of roubles in various economic sectors. For example, the Novosibirsk-based Institute of Catalysis has developed a process of drying powdered materials and farm products. Preliminary estimates predict that this process will help

save an amount of fuel equivalent to 80 million tons of coal over a period of ten years.

The round-table discussion pointed out that the saving of energy is directly connected with the restructuring of the entire economy, the accelerated development of engineering, and the expansion of engineering's science-intensive branches where energy consumption is low, branches such as the manufacture of sophisticated instruments, computers, lasers and robots.

For many years energy consumption was seldom considered in decision-making, because the USSR is rich in natural resources. Psychologically this led economic executives to wastefulness. The time has come to change their psychology, but it is not easy to do.

## Is it Possible to Avoid Damage to the Biosphere?



The problem of saving energy also has an ecological aspect. The development of power generation promises more than just benefits; increasing environmental pollution is a tremendous evil that follows in its wake.

The fuel and power industries account for nearly 60 per cent of the harmful effects produced by human activity on the environment. Furthermore, many ecologists believe that fuel combustion, which "heats" the atmosphere, is responsible for the fact that droughts, cyclones and floods have become more frequent; in the last half a century droughts have become eight times more frequent and cyclones and floods now occur twice as often. Of course not everyone adheres to this severe opinion, but the facts cannot be ignored, for it is not yet known how much "pressure" the biosphere can endure without being damaged.

How can this problem be solved? Theoretically, the answer has been known for a long time: we must switch over to solar energy, the only fuel which is ecologically harmless. Perhaps, some day in the future scientists



*It is hard to believe that this lake, frequented by cranes, is only a short distance away from the large Novolipetsk iron-and-steel works.*



*The future belongs to solar power engineering, especially in such a "sunny" republic as Uzbekistan. In the photo: concentrator mirrors at the testing ground of the Tashkent Institute of Physics and Technology.*

will find ways for using solar energy on a commercial scale. But in practical terms there is no alternative today other than the development of conventional power generation based on combustion. The search for a compromise has once again focussed attention on energy-saving processes. On the one hand, they help to make more efficient use of the available resources, and on the other, to decrease the amount of harmful discharges released into the environment.

Here is a case in point. The main defect of fuel-burning power plants is that they release into the atmosphere sulphides which are the source of acid rain, the rapid corrosion of equipment and the increased incidence of lung disease. Removing the sul-





*This cottage gets all its electricity from a solar battery mounted on the roof.*

*This machine makes herbicides unnecessary. It kills weeds with high-frequency currents.*

phur from the smoke gases emitted by power stations is very costly. In fact, sulphur-removing installation costs about half as much as the power plant itself. And even still it will not remove all the sulphur from the discharges.

What have the scientists proposed? The building of the world's first commercial magnetohydrodynamic power station is now being completed in Ryazan. The magnetohydrodynamic generator is based on the direct transformation of heat into electricity. Working on the same "harness" with the conventional turbine, it helps cut fuel consumption by two-thirds and the water consumption used for cooling by half. The discharge of pollutants will also drop sharply.

Furthermore, the monthly magazine *Energiya* has reported that the Institute of High Temperatures in Moscow has developed a simple and economical combination comprising a magnetohydrodynamic plant and a few auxiliary devices which trap sulphur. And these devices cost only a fraction of the price of conventional gas purifiers.

Thus human ingenuity is quite capable of easing the conflict between the power-generating industries and the biosphere. All that is needed is a persistent and constructive search for the best alternatives.



## Foreign Trade. How Should It Work?

When nature dispersed its gifts throughout the world, the Soviet Union was lucky. Its vast expanses are rich in practically every kind of mineral and fuel. And although getting access to this wealth is difficult (most of it lies in Siberia's remote and

less developed regions), Soviet economists have something to choose from when planning fuel exports. Its oil, gas and coal reserves and powerful mining industries have made the USSR a traditional wholesale supplier of fuels to the world market.





# Problems of the Energy Market



The drop in the world prices of different types of fuel has presented the USSR with difficult problems. In terms of prices, fuels account for more than half of the country's exports.

Soviet experts maintain that there is no need to dramatise the situation. Just like many of their colleagues in other countries, they argue that the demand for conventional fuels will continue to rise in the long run. At any rate, this demand will continue to rise until scientists are able to harness the thermonuclear fusion reaction or to make solar energy produced on a commercial scale economical.

Soviet foreign trade executives think that in the next few years the prospects for expanding the sales of natural gas and electricity will be better than those for increasing oil exports.

Leonard Vid, Deputy Chairman of the USSR State Planning Committee, says:

"We have room to manoeuvre. It looks like the overall export of oil and oil products will be maintained at the present level. At the same time, the share of oil products in exports is to be increased."



*This country prospects for oil and natural gas on land and at sea, within the Arctic circle and in the hot Karakum desert.*

## ЧЕРЕДНОЕ ЗАСЕДАНИЕ СЕССИИ СЭВ



Of course, the objective is not simply to adapt our exports to the current market conditions. The point is that the share of raw materials in Soviet exports is much larger than that of other products.

There is nothing unusual about an industrially developed country exporting raw materials and fuel. For instance, the USA is one of the world's biggest coal exporters, Britain is among the leading oil exporters, the Netherlands is a major exporter of natural gas and Sweden is an iron ore exporter.

Dr. Yuri Shirayev, Director of the International Institute of Economic Problems of the World Socialist System, says:

"It should be taken into account that the CMEA member countries, which are not rich in fossil fuel resources, consume a large share of the USSR's oil, gas and electricity earmarked for sale abroad. Therefore, it is not possible even to consider reducing fuel exports at this point. But we can no longer

*Economic relations with foreign countries are an important factor in the intensification of the economy. In the photo: the 41st Session of the Council for Mutual Economic Assistance. It adopted a Comprehensive Programme for Scientific and Technological Progress of CMEA Member Countries till the Year 2000.*

continue to plan depending on the export of oil and other raw materials to the extent we do at present. It is vital to change the structure of exports and to increase the share in these exports of machines, other equipment, and sophisticated engineering products."

What are this country's potentialities here? Since many of the Soviet achievements receive little coverage abroad and are known for the most part only to specialists, it seems appropriate that this booklet examine this issue in detail.

## Joining the Leaders in the "Patents Race"



Most Americans would probably be surprised to learn that the rails of the Washington subway were welded together using unique equipment made in the USSR, that 100,000 of their fellow-countrymen were cured of myopia as a result of the purchase by the Medical Technology Development Corporation of a license for a surgical technique developed by the Soviet ophthalmologist Dr. Svyatoslav Fyodorov, that the Soviet coal gasification technique, electromagnetic casting, non-ferrous and steel-making processes are all being used in the USA.

It is Soviet knowhow in underwater welding that has enabled the British and the Norwegians to pump their North Sea oil through pipes ashore.

Western experts believe that unfavourable economic conditions had less of an impact on Japan's steel-making industry than on this same industry in other countries, because Nippon Steel, Kobe Steel and other Japanese companies were quick to purchase Soviet technologies, such as continuous steel casting, evaporation cooling of blast furnaces and electroslag refining.



*A microprocessor automated control system, designed and manufactured by the "Pnevmomatika" association in the USSR for the Hungarian firm Biogal.*

According to the World Intellectual Property Organisation, the Soviet Union and the USA keep abreast of each other in the development of patents—each of them registers close to 80,000 inventions a year. This is much more than Japan (close to 50,000), not to mention France and Britain (each registering 10,000 patents a year).

Although the USSR has many original scientific ideas and developments to its record, it has not implemented all of them in practice. Unfortunately, many industries are not, unlike the Japanese, in a hurry to take advantage of new developments in order to secure the world market.

There are many reasons for this. One is the imperfect economic mechanism. Until recently it failed, on the one hand, to provide adequate incentives for increasing exports and, on the other, to put up barriers to imports the country could well do without. That is why the USSR is taking measures to



*Quite a few countries use the achievements of the Kiev Paton Institute of Electrical Welding. In the photo: electron-beam welding.*



*The Moscow Institute of Eye Microsurgery, headed by Svyatoslav Fyodorov, Corresponding Member of the USSR's Academy of Sciences, was the first to introduce and make wide use of conveyor surgery.*

change the situation radically. Nikolai Ryzhkov, head of the Soviet government, has said that the new goals in the sphere of international economic relations have made it necessary to change the entire system of management in this field. He added:

"A lot of questions have piled up here. The effects of the conservative approach to foreign trade are still lingering. The main objective is to preserve and strengthen the state monopoly on foreign economic activity, but at the same time to extend the rights of the manufacturers, to do away with petty tutelage over them and to kindle their interest in exporting their goods."

## New Forms of Ties



The government has adopted a wide range of measures aimed at improving foreign economic ties. The key elements of these measures are the right of big enterprises to sell their products on the world market through their own foreign trade firms and the decision to establish joint enterprises in the USSR.

Vladimir Kabaidze, Managing Director of the Soviet-Bulgarian Ivanovo-Sofia Association which manufactures processing centres, says:

"It is inconceivable that there should be an international association turning out primitive equipment. We should join forces only in order to 'attack unconquered peaks'."

Vladimir Kabaidze turned a small works in Ivanovo into one of the industry's leading factories in just a few years' time. He was the one to propose that this association, which has been functioning since 1985, be set up. Have his hopes been realised? His comments follow below.

"I evaluate an enterprise's work according to how competitive its products are on the world market. Its failure or success shows what it's worth."

All indications are that things are going well for the association at this point. The

machine tools it manufactures have found markets in dozens of countries.

Soviet-Bulgarian joint enterprises were the first such enterprises in the socialist world. Agreements have just recently been signed on the establishment of joint enterprises with Hungary, Poland and Czechoslovakia.

Business circles in capitalist and developing countries have also shown an interest in the Soviet initiative. Close to 100 Dutch, Italian, French, West German, Finnish, Indian, Turkish, Japanese and US companies have announced their intention to participate in joint enterprises.

The Finns were the pioneers in this undertaking. The first agreement with them has been signed. Finnair will participate in the building of a hotel in Moscow with the joint stock company Intourist, a Soviet foreign travel agency. Jermu Laine, Minister of Foreign Trade of Finland, has announced that 20 other proposals of this kind are currently being discussed.

The FATA company of Italy has been co-operating with the USSR for over a quarter of a century. It is laying the groundwork for a joint industry which will manufacture equipment for cold storage in Volzhsk. The publishers of the fashion magazine *Burda*

have also not let their chance pass them by: a Soviet-West German enterprise has been publishing a Russian version of *Burda* since March 1987.

Other companies who would like to join in on this include the American companies Occidental Petroleum, Monsanto and Singer, West Germany's Siemens and Salamander, France's Thomson, Oréal and Interagra and some 15 Japanese companies.

Judging by the published documents on the establishment and operation of joint enterprises, the USSR will grant these enterprises considerable leeway in their businesses within the framework of the Soviet economic system. The USSR first of all studied the experience of joint companies in the European socialist countries and China, taking into account the recommendations of the UN economic agencies, in-

cluding the International Chamber of Commerce.

Commenting on this, Professor Ivan Ivanov, a senior executive at the State Foreign Economic Commission of the USSR Council of Ministers, says:

"At first relatively small production complexes will be created. They will play the role of pilot plants at which the operational mechanism can be adjusted with a minimum risk for both sides."

Ivanov's view is shared by Otto Wolff von Amerongen, a prominent West German businessman.

*Finnish firms took part in the construction of the Novotallinsky sea port (Estonia). The inauguration ceremony in 1986 was attended by Nikolai Ryzhkov, Chairman of the Council of Ministers of the USSR (second left), and Prime Minister Kalevi Sorsa of the Republic of Finland (right).*





*The control room of the Kozlodui nuclear power station (Bulgaria), which was built with the technical assistance of the Soviet Union.*



*Nuclear reactors for power stations produced by the "Atomash" plant have a good reputation both in the Soviet Union and abroad.*



*Soviet specialists assisted Indian friends in building the iron-and-steel works at Bokaro. In the photo: the new plant's coke-oven batteries.*

The fixed assets of joint enterprises will be based on joint stock capital, with the Soviet share being at least 51 per cent. The foreign partner's property will be protected: there will be no possibility of it being confiscated or requisitioned by an administrative order. Joint firms will be required to pay an income tax of 30 per cent. However, during the first two years of operation they will be exempt from taxes. Depending on their financial policies, joint enterprises will be granted other tax privileges as well. If profits are transferred abroad, a 20 per cent charge will be imposed.

*"Crab" is the name of a platform for laying and repairing railway tracks which was developed by specialists from the French firm Travaux du Sud-Ouest together with Soviet engineers from the city of Kirov.*







*Dump trucks produced by Japan's firm Komatsu are being used successfully at coal-mining projects in Yakutia.*



The USSR hopes that joint enterprises will not only put out products on Western licenses and use their own technologies, but also manufacture promising Soviet products. The main purpose is to expand the production of goods earmarked for export and improve the methods of selling these goods on the world market. Of course, a part of the products will be sold on the domestic market, above all in order to cut back on unjustified imports.

This is the essence of the changes in this sphere, which have been laid down in jointly produced documents. Some of the

*The Soviet Union renders assistance to the Syrian Arab Republic in strengthening the key branches of its national economy, primarily the oil-producing and oil-refining industries.*



*Participation in international exhibitions and trade fairs is an important aspect of Soviet foreign-trade policy. Such participation promotes trade and serves to consolidate friendship and mutual understanding between the peoples of the USSR and other nations.*

clauses might be in need of more clarity. But perhaps here we should agree with Otto Wolff von Amerongen who said in an interview with a *Handelsblatt* correspondent that flexibility in practical deeds is more important than the most perfect legislation. It is precisely in practice that the viability of the proposed projects will be proved.

Of course, one or two hundred joint indus-

# СКВА ЛОНДОН



И ОБЩЕСТВЕННЫХ  
ПРОЕКТОВ

История архитектуры СССР в городах  
Москва, Ленинград, Киев, Харьков, Сталинград  
и др. городов  
СССР



tries on the vast territory of the USSR don't mean all that much in the overall picture. The important thing here is that the USSR has agreed to establish such firms—this is another step towards broader peaceful cooperation.

The USSR has always looked upon the issue of foreign trade in the broad context of East-West relations. It has rightly consider-

ed foreign trade a stabilising factor. The present period is characterised by a search for new approaches and solutions in the sphere of trade and economic relations. And it appears that both sides need to display goodwill here, because of the definite economic interdependence and the common responsibility for the state of international economic relations.



**А. Путинцев**

**СОВЕТСКАЯ ЭКОНОМИКА НА ПОРОГЕ ХХІ ВЕКА**  
*на английском языке*

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