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TRANSLATION

ALONG THE ROAD OF TECHNICAL PROGRESS

By P. G. Moskatov

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CHAPTER I

IN THE NAME OF THE WELFARE OF THE PEOPLE

The Aims of Socialist Production

Socialism has proved in actual life that public ownership of the means of production opens up unlimited vistas for the development of the productive forces and unbounded perspectives for the most complete satisfaction of the material and spiritual necessities of the entire people. Production for the sake of man himself, for the sake of the all-sided fulfillment of his needs, proves in the clearest light the far-reaching advantages and the superiority of socialism over capitalism.

In the name of the welfare of the people, the Communist Party of the Soviet Union is realizing in life a program of versatile development of the productive forces of our country, showing equal concern for the technical progress of industry, and is achieving a sharp rise in socialist agricultural production.

The interests and demands of the Soviet people are great and varied. They increase with every new year. The Soviet peoples require a wide variety of foodstuffs, industrial commodities for general consumption, well-lighted spacious living quarters, good conditions for recreation and spiritual development.

The problem of the ways and means for most complete satisfaction of the requirements of society under socialism was elaborated and developed in its many-sided aspects in the works of V.I.Lenin, in the resolutions of the Communist Party.

V.I.Lenin laid the scientific foundation for the basic assumption that the only possible means for the solution of this problem lies in the rounded development of the productive forces and the rapid growth of the productivity of labor.

"Previously", stated V.I.Lenin before the Third All-Russian Congress of Soviets, "all of man's intellect, all of his genius, was occupied in giving some all of the wealth of technology and culture and in depriving others of the bare necessities, of education and development. Now however, all of the miracles of technology, all of the conquests of culture have become the public domain, and from now on man's intellect and genius will never be brought to bear as a means of violence, as a means of exploitation" (Bibl.1).

In the past, none of the revolutions created conditions necessary for the improvement of the welfare of the common people, for the development of the talents latent in the people. The benefits of culture were appropriated preponderantly by the ruling classes. Immediately after the seizing of power in 1917, the Communist Party declared to the workers of Russia: "From now on, all of the wealth of the country is your property, from now on you are the owners of the factories and mills". Only after the conquest of power by the people, could the working people devote their forces to free and independent creativity, to active participation in governmental and social activities. The working people of town and countryside began to have at their disposal all of the prerequisites for reaching out to the highest attainments of human culture.

It is impossible to carry out the profound transformations in the sphere of economics without a revolution in the area of culture. In order to transform an economically backward agrarian country into a leading industrialized socialist power, it was necessary to create a massive industry and transportation network serviced by up-to-date technology, to bring into cooperative labor millions of small-scale and tiny peasant enterprises, to achieve the electrification of the entire country. These historical tasks could be fulfilled only by a people in possession of modern knowledge, science, technology, the ability to run the government and the national economy, the ability to make use of the latest developments in technology, and the ability to make strides forward.

V.I.Lenin pointed out that the toiling masses themselves step out to the forefront as the creators of the cultural revolution, and in that lies the great unconquerable strength of the cultural architecture.

Having awakened the cultural energies and activities of the Soviet people, the Communist Party of the Soviet Union proved able to carry out, within a short historical period, profound social, economic, political, and cultural transformations in our country.

The Communist Party found the source of the strength and means for building socialism and of realizing the cultural revolution, in the superior features of the Soviet order, in the superiority of the socialist system of economy over capitalism, in that thirst to acquire culture which was inculcated in the popular masses by the victory of the proletarian revolution, in the replacement of slave labor for the benefit of exploiters by the joyous creative labor for oneself, for the entire society.

Socialist industrialization in our country has contributed to the unheard-of rise of the entire national economy, to the rise in material well-being, and has at the same time transformed the culture and the living conditions of the Soviet people. The working class is building not only industrial, agricultural and transportation enterprises, it is building cities and villages, schools, technical schools, institutes, theaters, clubs, and libraries. The Soviet Union became a country with a high level of general and technical literacy. Higher and secondary technical educational institutions graduated hundreds of specialists, engineers, technicians, doctors, teachers, and agronomists. The army of skilled workers increased manyfold.

Beginning, in the aftermath of the Great October Socialist Revolution, with the campaign to liquidate illiteracy, the working class under the leadership of the Communist Party registered outstanding successes on the educational and cultural

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fronts. The vast country radically altered its appearance within a short historical period, not only in the economic sense, becoming one of the most advanced cultural centers of the world. Today, not only elementary and public school education over a seven-year period, but also ten years of education have become commonplace for citizens of the Soviet Union.

A new kind of worker has made his appearance in the plants and kolkhozes, ever narrowing the difference, in cultural level, between himself and the intellectual worker. By this time, it is no longer a cause for admiration when an advanced worker delivers lectures, when a contributor to industrial or agricultural advances speaks from the chair of an institute, when working people write books in which they reveal the "secrets" of their productive successes. Science is being advanced in these days not only by scientists, but also by innovators engaged in the practical work. Could anyone disagree in that the studies performed by the Leningrad foundry worker A.S.Podmostkov, discovering techniques for reducing copper losses in melts, are genuinely scientific accomplishments? Is not T.S.Mal'tsev, the kolkhoz practical worker, who discovered new biological regularities and advanced agrobiological science a step ahead, to be regarded as a scientist in the true sense of the word?

The building of socialist economy in the countryside required the creation of a host of cadres of organizers capable of carrying out collective production smoothly. These cadres rose from the ranks of the working class and from the peasantry on the kolkhozes. The fact that the bulk of the talented directors of large-scale and complex agricultural production rose from the ranks of the peasants, who for long centuries had been carrying on their husbandry on tiny plots of ground, where they were unable to develop their innate capacities, is of extreme significance. Life has shown how rich were the creative possibilities which lay hidden in the working peasantry, and how these became manifest under the conditions of the dictatorship of the working class; the vigor of the peoples, the fraternal aid of the great Russian people extended to the previously repressed (and therefore left in a retarded state of development) peoples of our country helped them in coping with their economic and political backwardness, their dearth of culture, their primitive-patriarchal and semifeudal relations, and aided them in lifting themselves up to the heights of an advanced socialist economy, ideology, and culture.

As a result of the subsequent realization of the Leninist policy on nationalities, the Communist Party achieved tremendous successes in the development of science in all of the Republics of the Union. In thirteen of them, Academies of Sciences have been founded, who have to their credit the solution of a number of important problems of practical significance for the development of the national economy of the sister republics.

One of the most important problems facing the Soviet government was the creation of a new intelligentsia.

The Party attracted to the support of the Revolution the best elements among the old intelligentsia, helped them in finding their proper place in the new life, and at the same time prepared the cadres of the new intelligentsia issuing from the bosom of the working class and the toiling peasantry.

The formation of a national intelligentsia appeared as one of the foremost results of the cultural revolution; it served as irrefutable testimony to the fact that the toiling masses, under the guidance of the Communist Party, unfolded their richest spiritual forces. While, in pre-revolutionary Russia, there were less than 200,000 specialists boasting of higher education, the number of specialists having higher and secondary educational background presently employed in the national economy of the USSR is in excess of 5.5 million.

Previously, people originating in the nonpossessing classes had to force their way through to creative activity against the greatest possible obstacles. Socialism has removed all of the handicaps encumbering the path of the talents issuing from the people, has created real possibilities for the toiling people to obtain an education and to develop their capabilities. The intelligentsia now draws its numbers from the very midst of the people. The continuous supply of new forces flowing into the intelligentsia accelerates the development of science, technology and art, and of all branches of culture.

The creative forces of the people are inexhaustible. The people make a colossal contribution to science, technology, art, over the entire extent of human knowledge and culture. Art takes its most magnificent examples from the creativity of the people. Science advances forward by means of the generalization of practical experience, and above all by the experience of the productive activities of the people.

Under the guidance of the Communist Party, our people have experienced an unprecedented flowering of culture. It has now become simply impossible to compare Tsarist Russia, where the vast majority of the toilers was deprived of almost all material and spiritual benefits, with the Soviet Union, the land of socialism, where all of the people are literate, where the intelligentsia is more numerous than in any country on the face of the globe, where literature, science, and art serve the purposes of peaceful creative labor, imbued with hatred toward the use of coercion over human beings.

In the socialist state, the continuous rise in cultural level is innate to the very characteristic of the system. The laborers of the USSR, led by the working class under the guidance of the Communist Party, demonstrated to the whole world that they were not only capable of successfully governing their affairs in their country, but that they could also multiply the public wealth and develop a new culture, the most advanced in the world.

The development and strengthening of the material-productive base of socialism has an overall effect on the raising of the material and cultural level of the people. The fact that, under socialism, production is directly subordinated to the national requirements does not lessen but, on the contrary, enhances the importance of production in the development of society.

The peaceful economy of our socialist power grows and prospers, being free of the incurable ulcers and vices inherent in the capitalist system; it makes it possible to provide the utmost for the satisfaction of the continually expanding material and cultural requirements of Soviet Man.

The most general criterion applying to the economic development of a country and the growth of the social wealth is, as we know, the national income. Under socialism, the entire national income is in the true sense the income of the people. During the course of the fifth Five-Year Plan, the national income of the USSR increased by 68%. The real take-home pay of the workers and wage earners rose during that time by 39%, and the real incomes of the kolkhoz workers rose by 50%.

On the basis of the expansion of production and the growth of the productivity of labor, the national income of the society as a whole and the incomes of the laborers experience further increases from year to year.

The living standard of the toilers in our country is determined not only by their direct incomes and by the cost of living. The Soviet peoples are assured of free medical assistance and free tuition. Workers and wage earners receive vacations with pay, disability benefits, exemptions from social security payments, pensions, rest periods in sanatoriums and rest homes at reduced prices or free, unwed or widowed mothers and mothers with large families receive State assistance. According to the extent of the growth of the economic capabilities of our country, the toilers receive ever greater shares of these cost reductions and payment exemptions.

In 1955 alone, the total area covered by living quarters built in cities and workers' settlements during that year included 35 million square meters, not including 600,000 new housing units in farm districts. The number of hospital beds increased by more than 60,000, the number of places in permanent child nurseries increased by over 45,000, the accommodations available in sanatoriums and rest homes by 14,000. Secondary schools accommodated 157,000 more students than in 1954, and higher technical institutes increased their student body by 135,000. The circulation of newspapers and magazines increased. The total printing of books exceeded a billion copies.

While the number of libraries in Russia in 1914 numbered 12,600, the total in 1955 exceeded 390,000. There were 222 recreation clubs in 1914, as against over 120,000 in 1955.

The year 1955 brought further success in all fields of Soviet culture. During that year, higher and secondary special educational institutes graduated about 640,000 young specialists, an increase of more than 70,000 over 1954.

Over 250,000 of the specialists received higher education. Approximately half of that number of specialists was channeled into plants in heavy industry, almost another quarter into agriculture. The total number of specialists, graduated during the fifth Five-Year Plan, was in excess of 1,121,000 persons. It is worth remembering that, prior to the start of the Great Patriotic War, Soviet higher educational institutes gave the Soviet Union 100 - 110,000 specialists per year, while before the Revolution, the annual number of graduates from higher educational institutions did not exceed 10,000.

In the 1955/56 school year, 1,867,000 students in the USSR were enrolled in higher educational institutions, and 3,757,000 students were enrolled in technicums and other secondary-level special educational institutions. There are now many more students in the Soviet Union that there are in Britain, France, Italy and the other capitalist countries of Western Europe, all taken together. For purposes of comparison, we may cite the figures released in the "Bulletin of the International Association of Universities": 221,000 students were enrolled in the higher educational institutions in Britain, 166,000 in France, and 226,200 in Italy.

The Soviet peoples, by dint of their self-sacrificing labor, have immeasurably strengthened the economic capabilities and multiplied the social wealth of the country. The Twentieth Congress of the Party laid down plans for bringing to life extremely important measures for the further raising of the standard of living of the laborers and the improvement of working conditions.

The sixth Five-Year Plan has before it the task of achieving the transition to the seven-hour work day and, for workers in leading categories in the coal and mining industry engaged in underground work, to the six-hour work day. Starting on 1 January 1957, the minimum wage of the lowest-paid workers and salaried workers was raised and excesses in the pay scale of some categories of workers were removed. A law effecting a significant improvement in retirement benefits went into force in 1956, and the working day was shortened (by two hours) on days preceding vacations and holidays, while the six-hour work day was instituted for minors from 16 to 18 years of age. Pregnancy and maternity leaves for women were greatly increased. The network of public cafeterias and child-care centers was expanded. Boarding schools have been established and tuition fees have been abolished in the senior classes of secondary schools, and in secondary-level special and higher educational institutions.

The Communist Party and the Soviet government have manifested particular concern for the improvement of the living conditions of the laborer. Along with the government housing program, individual housing projects aided by State credits have been given wider scope.

The unending increase in the living standard of the working class, the kolkhoz peasantry, the national intelligentsia based on the overall development of the productive forces of the country and the multiplication of the social wealth, the creation of conditions for peaceful creative labor on the part of the entire people, all of this constitutes the higher goal of the Communist Party and the Soviet government. This noble aim flows from the nature of the Soviet system, a genuinely popular system.

The production of consumer goods is being systematically increased in the USSR. During the fifth Five-Year Plan, smelting of pig iron for consumers goods was increased by 60%, steel by 52%, coal mining by 37%, oil by 72%, development of electric power by 71%, production of cotton fabrics by 40%, of wool fabrics by 48%, sugar by 24%. But we are still trailing behind the leading capitalist countries in the level of consumer-goods production.

On the road of peaceful economic competition, the Soviet country has had to solve, in a historically extremely short period, the basic economic problem confronting the USSR, that of catching up to and overtaking the most highly developed capitalist countries in the production of consumer goods.

We have at our disposal everything we need for the solution of that problem: natural resources, an up-to-date heavy industry, and heavily mechanized agriculture. The socialist system provides the possibilities of bringing about a mighty leap forward in the productive forces of the country.

The Most Important Point for the Victory of Communism

In the undeviating rise of the productivity of labor, V.I.Lenin saw the basic prerequisite for the creation of a social system ranging above that of capitalism. The problem of raising the productivity of labor was advanced, as a historical necessity, to the plane of first importance, immediately following the conquest of power by the Proletariat. Taking the Communist "Voluntary Saturday Work" as an example of the heroic struggle of the working class for the raising of the productivity of labor, V.I.Lenin emphasized the fact that the rise in the productivity of labor, attained on voluntary saturdays, was the beginning of a turning point of world-wide historical significance.

The productivity of labor is an all-encompassing economic criterion. The growth of the productivity of labor depends on the level of technology and science, on the organization of production, and on the skills of the workers, on the concentration and specialization of production, on the harmonized work of adjacent branches of the national economy, on the degree of utilization of natural conditions, on the allocation of the productive forces.

Under capitalism, not all labor is considered productive, but only labor which yields profits to the employers.

At the same time, an increase in production is accompanied by a wasting of labor. Growing armies of unemployed, ruination of the peasantry, loss of skills on the part of the workers, destruction of material assets in time of crisis, obstacles placed in the way of the development and introduction of new productive techniques, the parasitism of the exploiting classes which themselves not only take no part in the productive labor but also draw off a mass of workers for the service of parasites, etc. - all of this constitutes varied manifestations of the wasting of labor and of its products in capitalist society.

In contrast to the capitalist system, in the socialist system socialist productive relations constitute the principal and decisive force assuring a continuous rise in the productivity of social labor. Socialism has engendered the deep-felt concern of the laborers in the unending development of the productive forces, in the expansion of production and its improvement, has conditioned the need and created the possibility for the continuous heightening of the results of social labor.

The undeviating growth of the productivity of social labor lies at the roots of the socialist method of productions, and is determined by the requirements of the basic economic law of socialism.

Whereas in Tsarist Russia, during the period from 1861 to 1917, i.e., for 56 years, the productivity of labor in industry rose by only approximately three times, the productivity of labor in Soviet industry has risen by over six-fold in the course of only the last 26 years. Great successes have been achieved in the postwar years in raising the productivity of labor. As a result, our country has caught up with the advanced capitalist countries of Western Europe as to the level of the productivity of labor.

The rise in productivity of labor under socialism brings with it an increase in the production achieved by individual workers and a heightening of the efficiency of

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labor of the entire society, taken as a whole.

Advanced Soviet plants are producing goods in ever increasing quantities, not so much because of the increase in the number of workers as because of the increase in the productivity of labor.

In the industry of the USSR, of the entire quantity of commodities produced, 51% was due to the increase in the productivity of labor during the first Five-Year Plan, 79% during the second, 69% during the war years and the fourth Five-Year Plan, and over two thirds of the entire growth in industrial production during the fifth Five-Year Plan.

Under conditions of continued improvements in production based on the latest techniques, the main portion of the entire growth in industrial production was achieved thanks to the rise in the productivity of labor. This factor of the growth of socialist production now acquires decisive meaning.

The growth in the productivity of labor makes it possible to economize on the enormous mass of available labor power. For example, had the productivity of labor in 1937 remained at the level of 1928, an additional 8 million workers or so would have been required for fulfillment of the State Plan for heavy industry in the USSR. If, in 1955, say, the productivity of labor had been at the same level as in 1940, then, toward the end of the fifth Five-Year Plan, it would have been necessary to draw on an additional 15 million workers or so in order to fulfill the program outlined for industrial production.

Thanks to improvements in the techniques used in our plants, each hour of time spent in industry at the present time yields six times as many commodities to society as it did 25 years ago.

The socialist system of production yields savings in working time as would have been unthinkable in pre-Socialist organizations, including capitalist society. Only socialism has brought available and realized labor to a true economy, to the rapid and unceasing growth of the social productivity of labor.

The average yearly productivity of labor on the part of the workers in industry in the USSR rose approximately eight-fold in 1955 (compared to 1913, and despite the shortening of the working day), and exceeded by a factor of 2 the level attained in prewar 1940.

Technical progress, improvement in the workers' skills, systematic planning, organization of production and labor under socialism, all reflect the new, socialist productive relations, fully corresponding to the character of the productive forces, and exert an immeasurably greater influence on the results of social labor than under capitalism.

The scientific grounding of the Plans and the timely adjustment of these Plans to the abilities of their executors, the unremitting control over fulfillment of the Plans and the swift removal of any discrepancies, the clear and effective recording of all economic activities comprise the art of planned guidance of production.

The growing creative activity of the laborers is reflected in the new forms of the socialist organization of labor, in the combining of skills, formation of complex brigades, shift and hour-work tasks, interdepartmental brigades, complex technology, etc.

Assembly-line production, work cycle, hour graphs or time studies, all of these progressive forms of production organization bring a rhythm to the operations of a plant, the best possible utilization of techniques, and the growth of labor productivity.

The conveyor belt and other forms of mass production are used in our industry without overstraining the workers' strength and with the indispensable precondition of the mechanization of auxiliary operations.

The productivity of labor in the mass-production system grows not only due to the fact that this system accelerates the productive process (by shortening the time between successive operations), but also due to the fact that it reduces the amount of work required per finished product.

Improvement of the assembly lines and incorporation of preparatory and auxiliary shop work into the system has an extremely important significance for the fuller utilization of working time in each plant.

An assembly-line process would be out of the question without a carefully thought-out mode of production, without the organization of production on the basis of time studies. The time graph determines the smoothness of the entire organization of production, harmonization of the basic and auxiliary labor processes (timely overhaul, power supply without outages, steam, water, raw materials, stock, fuel supply with downtime eliminated).

Soviet plants and factories, by improving their operation, proceed from the daily to the hourly schedule graph. This makes it possible for production management and for the working force to control the load on the equipment, to undertake operative measures for eliminating impairment in the course of the productive process. On the assembly and conveyor lines of the Moscow instruments factory, the transition to the hourly schedule brought about a 30% increase in the output of the workers.

Senior foreman Nikolai Korablin of the Kuibyshev "Avtotraktorodetal'" (automotive and tractor parts) plant rendered a valuable service. The working force in foreman Korablin's section took the initiative in a competition for increasing the productivity of labor by reducing loss of working time during shifts.

The working day of thirteen workers was fixed with the aid of norm specialists in the section. An analysis showed that each machine operator lost not less than 1 hour and 20 minutes during the shift in waiting for setup of the machine, delivery of forgings, etc. The nonproductive working time in the section amounted to 11.3%. An analysis of the work of the machine-tool operators was of help not only to the foreman, but to the entire crew in clearing up and removing the causes of the irregular output of finished products in the course of the shift.

Due to shortening of the losses in working time during the shift in Nikolai

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Korablin's section, the productivity of labor was increased by 17%. With the same number of workers and the same amount of equipment in use, the crew in that section began to produce one thousand more finished pieces during a shift than previously.

The rational utilization of the working time and of labor power would be unthinkable without a strengthening of the creative labor discipline in production. Without that, it is impossible to realize the complete and rational utilization of techniques, to organize production and labor correctly and sensibly.

Modern machine production cannot tolerate laxity and lack of rhythm in the work. The organization of rhythmic operations in the plant is one of the enormous reserves in the growth of the productivity of labor.

The greater the rhythm of work in the plant, the less downtime there will be on the machines, the less losses of working time, the less material scrapped. Rhythmizing of the work is a necessary prerequisite for the smooth increase in the productivity of the labor of the entire working force.

It is impossible to systematically preserve rhythm in the work without observing technological and Plan discipline. For even the slightest changes, made in opposition to the norms agreed upon in the Plan, may bring about a bottleneck in the production and output graph.

The productivity of labor of the entire plant force may be increased only under the condition that the work of an enormous number of people, working on the most varied types of machines and instruments, is brought into harmony. An inadequate degree of organization, not only on a plant-wide or factory-wide scale, but even in one or several shops, may hinder the growth of productivity in the plant as a whole.

One of the important prerequisites for even and rhythmic work in any plant is a correct organizational structure, the most convenient and feasible one for the given concrete production conditions, of the shops and their sections.

Rhythmicity, harmonious and smooth coordination, and a high productivity of labor of the entire working force are achieved with greatest ease in the assembly-

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line system of production organization. When the equipment is set up to conform to a sequence of operations, based on the flow of the technological manufacturing processes, the workers waste less energy and time in transporting parts and components. The assembly line shortens the distance traveled by the parts, eliminates reverse and repeat motions, speeds up the technological process, and economizes on production space. The machining and treating of parts without stops between operations shortens the cycle of working and assembly of the finished product. The transportation of parts is mechanized in the assembly-line organization of production. Assignment of a definite operation to each worker enables the worker to perfect his production habits, his approach to the work.

Even and rhythmic work in the plants is organically connected with the introduction of new techniques and advanced technology. The experience accumulated by factories operating on the graph method [the Leningrad plants "Elektrosila" (electric power), "Pnevmatika" (pneumatics), the Vitebsk Komintern machine-tool factory, the Gor'kov milling-machine factory, the Second Moscow State bearings factory, and many others] demonstrates that the struggle of the factory staff for smoothness and rhythmicity in production begins with the perfecting of techniques and technology and leads to complex mechanization and automation of the productive process.

With the growth of technical capabilities in our industry and in all branches of the national economy, the significance of techniques, as the most important source of growth in the productivity of labor, comes more and more into the forefront. New techniques yield the possibility of greater easing of labor of the workers and reducing the amount of work per production unit. A stable rhythm in the operation of factories and plants can be achieved only along the road of technical progress.

Assembly-line production and its further stage of development, automation, are the most effective forms of production organization, in which smoothness and rhythmicity of the entire work performed are achieved.

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The smooth and rhythmic operation of a plant is reflected favorably in its production and economic activity and contributes to the introduction of a higher culture of labor, to assimilating new techniques and a progressive technology.

The great economic significance of smooth and rhythmic operations is not limited to individual plants and factories. Rhythmic output of finished commodities ensures fulfillment of the obligations of the plants toward the State and consumers, enabling them to fulfill the same production schedule with a smaller amount of reserve means.

The July Plenum of the Central Committee of the Communist Party of the Soviet Union adopted a resolution in 1955 based on the report submitted by N.A.Bulganin, which placed upon ministers, managers of government agencies and enterprises, as well as Party and Soviet organizations, the obligation to undertake the necessary measures to ensure rhythmic work of plants and smooth output of production goods in accordance with the Plan involved, giving particular attention to the uninterrupted supply of materials, improvement of planning and of production organization.

In places where insufficient attention was paid to the neat organization of this important task, there accumulated in some enterprises large surplus of material goods above that called for by the Plan and not needed for production, with scarcities being felt in other places. At the same time, the planwise handling of material resources was hampered to a certain extent, which had a negative effect on the development of individual branches of the socialist economy.

A correctly organized supply of materials and products not only contributes to the rhythmic operation of enterprises, but also forestalls the formation of excess reserves of raw materials and finished materials, and corresponds to the law of planned, proportionate development of the national economy.

It is necessary to raise the quality of planning applied to production and to the flow of materials and finished goods, in order to enable productive enterprises to assess the production schedule for the following year. An orderly system should

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be established, under which production tasks might be altered only in exceptional cases, with every such alteration necessarily reflected in the supply schedule.

Nonrhythmic flow of work on the part of a plant, crash projects under which the production schedule is met by means of a feverishly accelerated pace of work at the end of the month, do great harm to social production.

Other managers and industrial administrators attempt to attribute the poor operation of a factory or plant to other causes, allegedly outside their control. Actually, a nonrhythmic flow of production is the inevitable consequence of poor plantwise planning, the absence of sufficient concern for the timely supply of raw and finished materials, a poorly thought-out organization of cooperative labor, especially between plants in different branches of the national economy.

The managers of a number of industrial ministries and enterprises have still failed to take real measures to ensure the rhythmic operation of the plants and factories entrusted to them, by way of liquidating losses in working time and improving the organizing of labor of unskilled workers. These are serious shortcomings which must definitely be eliminated.

In some branches of industry, the capabilities of the productive enterprises involved are not tapped to anywhere near capacity. Many enterprises assimilate their rated capacities at an extremely slow rate and permit considerable downtime of equipment.

According to the calculations of the State Planning Administration of the USSR, improved organization of production facilities and utilization of available productive capacities in 1960 could result in not less than 7 million tons of pig iron, 11 million tons of steel, 70 million tons of coal, about 100 thousand tractors, over 10 million tons of cement, 42 million pairs of leather shoes and footwear, and many other important commodities vital to the national economy.

If this entire quantity of commodities had to be obtained from newly built enterprises, the task would require the building of more than 10 blast furnaces and

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35 open-hearth furnaces, 200 new coal-working pits, 2 tractor factories, 17 cement manufacturing plants, and 8 leather shoe factories. Many billions of rubles would be required for the construction of these new enterprises.

The Five-Year Plan for the development of the USSR during 1951 – 1955 envisaged raising the productivity of labor in industry by approximately 50%. During the years of the fifth Five-Year Plan, from 1950 to 1955, the productivity of labor in industry rose by 44% in all. An insufficient rate of growth in the productivity of labor was registered in such leading branches of industry as the coal, metallurgical, construction, and lumber industries.

During the years of the preceding Five-Year Plans, the number of workers gainfully employed increased mainly as a result of freeing the working force tied down in agriculture, thanks to the mechanization of kolkhoz production. Now, when the Party has posed before the people the task of achieving a steep increase in agricultural production, we cannot expect to count on the possibility of expanding industrial production by means of an extensive drawing off of labor power from the countryside. Any further increase in industrial and agricultural production must come for the most part from an increase of the productivity of labor on all sides.

This, in turn, requires that the experience of innovators in production, the experience of teams of the best workers in the enterprises be widely propagated, become the property of all workers in industry. The whole question is that all possibilities and reserves be utilized to speed up the growth of the productivity of labor: by full utilization of the most ample supply of equipment, introduction of new techniques and advanced technology into production, and also by improving the organization of labor.

An extremely important reserve for raising the productivity of social labor is the further development of specialization in production, coordination of the work of plants and of different branches of industry. Our industry has before it the task of achieving a new turn toward the creation of specialized enterprises and expanding the

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degree of mutual coordination, limiting the assortment of commodities manufactured to individual enterprises, and enhancing uniformity of production by standardization of the finished goods.

Economy of material resources is also associated with the productivity of labor. The more materials are economized, the greater will be the social productivity of labor, other conditions being equal. At the same time, cutting down on the specific rate of flow of materials invariably contributes to savings in human labor power as well: As a result of savings in material resources, the expenditure of unskilled labor occupied in haulage, loading, unloading, and storage is reduced; the time used in handling the materials is also reduced, as a rule.

The growth in the productivity of labor under socialism is intimately associated with the economic law of distribution according to work done. The distribution of the social product between the members of society under socialism is achieved in accordance with the quantity and quality of the labor expended. Each working person has the right to receive that portion of the social product which corresponds to his share in the social labor. The one who produces more commodities or commodities of improved quality has the right to obtain higher pay for this labor.

Concern for the growth of the productivity of labor has become one of the most vital links in all of the practical work of the Party and of the government in the management of the national economy of the country. The Communist Party and the Soviet government, in working out their economic policy, take into account the requirements of the economic laws of socialism, including the law of the continuous growth of the productivity of labor.

The higher the productivity of labor and the greater the number of new machines which can be produced, the more rapid will be the growth and improvement in social production based on the latest production methods.

Technical progress presupposes a growth of the more advanced production means, and is one of the most important components in the growth of social wealth, in the multiplication of socialist property. Experience in socialist construction in our country has provided a striking demonstration of the fact that socialist property grows more rapidly, the more advanced productive techniques become.

Only with the constant and decisive introduction of new techniques and advanced technology into production, modernization of machines and equipment, thorough improvements in the production organization, can the urgent task of an overall heightening in productivity of labor be successfully accomplished.

The Twentieth Congress of the Communist Party of the Soviet Union, in the directives pertaining to the sixth Five-Year Plan, envisaged new tasks with respect to the growth of production and the further raising of the welfare of the people.

The productivity of labor and its significance in the production of commodities is on the increase. Whereas 67% of the increase in industrial commodities obtained in the USSR during the fifth Five-Year Plan may be ascribed to a heightening of the productivity of labor, 80% of the increase registered during the sixth Five-Year Plan may be so attributed. An increase by even one percent in the productivity of labor is equivalent to cutting labor power requirements by more than 165,000 workers. Each percent of increase in the productivity of labor in some given branch of industry signifies an increase in coal mined per year of several million tons, an increase of over a billion kilowatt-hours of electric power, of tens of millions of meters of textiles, etc.

The growing productivity of labor is a factor of first-ranking importance in the forward surge of society, expressing the development of the productive forces of society.

The success of the economic competition between the USSR and the leading capitalist nations, the further growth in the power of the Soviet State, depend primarily on a heightening of the productivity of labor.

Our Party sees, in the continued growth of the productivity of labor, the principal road toward a successful competition of socialism with capitalism.

CHAPTER II

THE CONCERN OF THE STATE WITH THE DEVELOPMENT OF THE PRODUCTIVE FORCES OF THE COUNTRY

Socialist Industrialization of the Nation

The process of improving production signifies developing the two aspects of production, namely the productive forces and production relationships.

The predominant role is assigned to the productive forces, since it is their development which elicits changes in the production relationships and economic relationships in human society. At the same time, production relationships between men have an effect on the status of the productive forces, accelerating them or holding back their development.

The level of the productive forces is characterized by the degree of perfection attained in the means and objects of labor (by which we mean the machines, mechanisms, raw materials, finished products, and other means of production), as well as in the production technology. Other decisive criteria for the level of the productive forces are the professional experience of the cadres, the degree to which they have mastered the techniques, the social character of labor, which is expressed in the concentration, specialization, coordination of production, in the growth of socialization of labor, in the allocation of the productive forces, etc.

The tempo of growth of socialist industry, the industrial capabilities, the new character of the productive enterprises, their ties with the national economy, all serve as clearly defined criteria of the high level attained by the productive forces in our country.

The Soviet Union has in less than 20 years traveled the distance in industrial development which took Britain, the oldest country in the capitalist world, over 100 years.

New techniques are penetrating in an uninterrupted flow into all branches of material production. During the first two Five-Year Plans, the cost of the basic production means per worker almost doubled in the metal-working industry, almost quadrupled in iron and steel metallurgy, more than tripled in the coal industry, and increased by 2.5 times in the chemical industry. Not only the basic branches of heavy industry, but many others as well, which earlier had been at the level of handicrafts (the meat, dairy, forestry, and fish-husbandry industries), have advanced to the same front rank as the most up-to-date branches of industry.

Figures showing the basic capital investments in industry yield a picture of the growth of the technical equipment in production facilities. The basic capital investments increased from 49.4 billion rubles in 1928 to 189.3 billions in 1937 (in 1933 prices). In 1955, the basic investments had increased more than double over the 1940 level. In the postwar years, industry, construction, transportation and communications were allotted machines, equipment, and accessories valued in the hundreds of billions of rubles.

The preferential growth in the production of the production means was an expression of the law governing the development of socialist economics, the basis of expanded socialist reproduction.

Our government is striving to promote a first-ranking and preferential development of the production means, coal mining, petroleum production, smelting of steel and pig iron, development of electric power, manufacture of machinery, transportation means, structural materials, chemicals.

Heavy industry must always take first place, since it is the basis on which rests the constant progress of the entire national economy, the satisfaction of the

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growing demands of society. It is possible to create new production branches or to overcome the lag in particular sectors of the national economy only on the basis of a preferential development of the heavy branches of industry.

The creation of a heavy industry in the USSR was a historical necessity; industrialization was necessary in order to technologically rearm all branches of the national economy, including agriculture, in order to promote the unswerving progress of techniques and, on that basis, the rapid and constant growth of the productivity of labor, to make our country a powerful, economically self-sustaining and independent entity.

The Communist Party and the Soviet government, basing themselves on the teachings of V.I.Lenin, determined the roads and the methods of socialist industrialization in the Soviet Union.

The Party was guided by the fact that the advantages of the socialist system of economy, such as social ownership of the production means and planned direction of the entire national economy, ensure a faster tempo of economic and cultural development than is possible in any capitalist nation. The history of the development of the productive forces of the Soviet government serves as an irrefutable proof of this statement.

The Plan for industrialization of the USSR furnishes the concrete pathways, methods, and means of solving these grandiose problems. The Plan pointed out the sources of socialist accumulation. In order to fulfill the Plan, cadres of builders of industry had to be created, the creative capabilities of the working class had to be developed, the union between the workers and the peasants had to be strengthened on the new economic basis.

The Fifteenth Conference of the All-Union Communist Party (b) underlined the fact, in its resolution, that ever newer possibilities for the subsequent increase in the rate of development of industry and agriculture are opened up, in pace with the degree of fulfillment of the Plan for industrial building, that wider perspec-

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tives are opened in the utilization of all the internal resources of the USSR.

Let us take as an example the development of the Ural region in the industrialization of the USSR. The history of the development of the productive forces of the Ural region is a characteristic example of the rapid rate of socialist construction.

The Urals are associated with the decree issued by the Central Committee of our Party on the work of the Uralmet (Ural Metallurgical Trust) starting with 15 May, 1930, a decree playing the most vital role in the development of Soviet industry. The industrialization of the country, as dealt with in that historical decree, cannot be based in the future solely on the single southern coal-metallurgical coalition. A vitally necessary condition for the rapid industrialization of the country is the creation in the East of a second basic coal-metallurgical center in the USSR, by way of putting to use the very rich coal and ore deposits in the Urals and in Siberia.

The Urals, a region with a rare and highly favorable combination of metal, chemical, mineral, nonmetal mineral, and timber raw materials, as well as huge power and fuel resources, increasingly unfolded its riches to the people.

Soviet geologists discovered that the Urals are capable of almost entirely satisfying their own fuel needs, with the sole exception of coking coals for metallurgical purposes (the latter is transported there from the Kuznetsk and Karaganda basins). In 1941, the amount of coal mined in the Urals was increased to a level 8 times that reached in pre-Revolution times. During the war years, the coal output almost tripled and continued to develop intensively, especially in the principal Ural coal basins of Chelyabinsk and Kizelovsk.

Mining of iron ores and nonferrous metals grew at a rapid rate. Magnetitities, brown hematites, red and chrome hematites, titanium hematites, and complex iron ores containing nickel, vanadium and other valuable minerals provided the basis for the accelerated development of ferrous metallurgy in the Urals, for the economic specialization of the region.

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Near the region's richest deposits of magnetic hematite, in the southern Urals, rose up the giant of domestic metallurgy, the Magnitogorsk combine. Here was discovered the Bakal'mine, famous for the quality of its ores, with almost no undesirable phosphorus or sulfur admixtures in its composition. In the central Ural region, near the oldest and richest deposits of magnetic hematite, the new metallurgical base of the Urals, the Novo-Tagil' giant plant has been erected in recent years.

The Urals produce, for the entire country, nonferrous rolled stock, tubing, wire, cable, nonferrous castings and alloys, machine parts and semifinished products for machine-building and other branches of industry from nonferrous metals.

The mighty aluminum plants use the Ural bauxites as their ore base. The Urals have become the most important region in the production of magnesium, a metal even lighter in weight than aluminum.

The well-earned fame of the Urals is based on the production of high-grade metal. A particular feature of the metallurgy of the present-day Urals is the fact that the Urals supply all kinds of alloyed steels for the use of machine-building plants in the Soviet Union.

Toward the beginning of the third Five-Year Plan, the Urals occupied fourth place in the Soviet Uion (trailing behind the Moscow, Leningrad, and Ukraine regions) in the volume of the metal-working industry.

Every new year saw an increase in the significance of the Urals for the Soviet machine-building program. Its growth was due, for the most part, to the production of equipment for the ferrous and nonferrous metallurgy, petroleum, chemical, mining and power industries, and many other branches of the national economy of the country.

The Urals become the most prolific supplier of various machines and equipment for other economic regions of the Soviet Union: These included tractors and transportation means, the latest construction and road-building machinery, means of mechanization for the mining industry, powerful excavators, and giant blooming mills.

The Ural heavy machinery-building factory at Sverdlovsk has rightly been named

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the "factory of factories".

In the assembly shop for large-size components, which is one of the largest such shops in the Uralmash, there are three huge bays of machinery; any one of them could easily accommodate a freight car of conventional length. Matching the size of the shop and its equipment are: powerful hoisting derricks, immense planing machines, and boring mills. The machines and machine parts produced here are astounding in their size.

This immense machine-building giant supplied, even in the prewar years, about 20 blast furnaces to metallurgical plants in different parts of the Soviet Union, built rolling mills and crushing and pulverizing machines, filled domestic orders for tubing for the Moscow subway, rigs for mine shaft drilling and giant earth-moving power shovels for ground breaking in various new construction areas in the country. Machinery, bearing the UZTM label, appeared in widely varying enterprises and construction sites.

As the most important economic region in the eastern part of the country, the Urals became one of the foremost industrial foci of the USSR. This naturally resulted in new needs for the development of its power network.

In the Ural industrial complex, principal attention was focused on forms of production consuming large quantities of thermal power (ferrous and nonferrous metallurgy, chemical industry, building-materials industry, etc.) as well as on large electric-power consumers (aluminum, magnesium, iron and steel alloy production, copper refining, etc.).

Large hydroelectric power stations were built in the Urals, and powerful thermal electric power stations, at Krasnogorsk, Sredneural'sk, Chelyabinsk, Magnitogorsk, Gubakhin, Bereznikov, etc. During the prewar Five-Year Plans, the power of the electric power stations in the Urals increased by more than 7 times, and the gross electric power output increased by 13 times.

Hardly anywhere, outside of the Urals, is there to be found such a fortunate combination of resources of chemical raw materials with the broadest possibilities of utilization for the chemical manufacture of various by-products of industry.

Nonferrous metallurgy in the Urals is becoming an ever more reliable raw materials base for the chemical industry (for the production of sulfuric acid and sulfur, obtained from pyrite ores, etc.). Enterprises yielding coking coal for iron and steel metallurgy have also become a base for the development of the nitrogen and fertilizer industry.

The Ural economic region encompasses a wide region extending from the far North to the southern steppes. The forest riches of that region are distinguished by the great variety of timber, from various pine woods to such valuable species as birch, oak, and others. The Urals have become one of the greatest suppliers of lumber and timber of the country.

Urals sawmills, lumber yards, and woodworking plants produce an enormous quantity of furniture, billions of match boxes. The home-building combines, erected after the Patriotic War, manufacture prefabricated housing units. Waste products of the sawmill industry are used to produce hydrolytic alcohol and other chemicals. Wood also serves as a metallurgical fuel for the production of high-quality brands of pig iron, and is used in the woodpulp chemical industry. A sizable portion of Ural timber goes to cellulose and paper-manufacturing plants in the country.

Industrial ties between branches and separate districts have united the Urals into a single economic complex, organized by the combination, specialization, and coordination of enterprises, drawing into the economic cycle sources of raw materials and fuel of local origin, and so-called "production wastes".

There still exist a wealth of possibilities in the national economy and in the industry of the Urals for the planned complex development of this economic district, inexhaustible in its resources.

Based on industrial assistance from the Urals, the Kuzbass (Kuznetsk Basin), during the years of socialist construction, was converted into a powerful economic district in the East of the country. Here, large mechanized mine pits and giant electric power stations were put into operation. The Kuznetsk metallurgical combine was built, daily delivering to the national economy thousands of tons of pig iron, steel, and rolled sheet. Other large-scale heavy industry enterprises have also been set up. The coal-mining output in the Basin increases from year to year, but the demands for Kuznetsk fuel supplies also grow.

The creation of the Ural-Kuznetsk combine exerted an enormous effect on the development of the economic life of the eastern districts. Two metallurgical giants, Magnitogorsk and Kuznetsk, separated 2200 km from each other, carry out interdistrict communications, exchanging Magnitogorsk ores for Kuznetsk fuel, drawing into the economic cycle not only the riches of the Urals and of Siberia, but also the natural riches of Kazakhstan.

The Communist Party devotes a great deal of attention to the accelerated, rounded development of the productive forces of previously retarded national border States.

In the past economically retarded districts, like the Lower Volga, Siberia, the Far East, the Republics of Central Asia, have become, under the Soviet power, large-scale centers of up-to-date industry. In Kazakhstan, Uzbekistan, Kirghiz, the Tadjikistan and Turkmenistan Republics, bases of ferrous and nonferrous metallurgy, machine-building, and chemical industry were set up, coal mining increased at a rapid rate, large-scale economic-territorial complexes were built up. Their social specialization was set at the proper level, intradistrict specialization was developed, coordination and combination of different branches and enterprises and interdistrict economic ties were cultivated and strengthened.

The setting up of a huge petroleum base in the district lying between the Volga and the Urals is one of the greatest achievements of the Soviet people in the struggle for the strengthening of the economic capabilities of our Homeland, in the cause of creating the conditions prerequisite to the planned development of the productive forces of the nation.

It is sufficient to note that at present Kazakhstan, together with the other Central Asia Republics, produces industrial products as much again as the entire industry of pre-Revolution Russia. The electric power requirement of one manufacturer is nearly 5 times greater than that of the entire nation in 1913.

A powerful modern industry was created in Belorussia, in Georgia, Armenia, and other Republics of the Union. The socialist government showed special concern for the accelerated development of previously retarded industries in Latvia, Lithuania, Estonia, in the western districts of the Ukraine, Moldavia (Bessarabia).

The great advantage of socialism, the possibility of developing the national economy on the basis of a single government Plan, enabled industrial centers to be built at places where the proper prerequisites existed at the start of construction works, in the form of basic raw materials and power sources.

The construction of a large number of large-scale and medium-scale electric power stations, heavy and light-industry enterprises, food and local industry enterprises, brought into being a new ramified structure of the national economy in different economic districts.

On the basis of concentration of production, Soviet ferrous metallurgy took first place in the world. In 1951, over half of the metallurgical factories in the country smelted more than a million tons of pig iron each. Before the Revolution, not a single one of the metallurgical plants could have reached even half that output.

In our times, the Magnitogorsk metallurgical combine alone has as much metal output as all of the metallurgical plants in Tsarist Russia put together.

A whole series of combines representing a very high degree of concentration of production have been established in the USSR. These include Magnitogorsk, Kuznetsk, and other metallurgical combines, copper combines in Kazakhstan and in the southern Urals, the Stalinogorsk combine in the chemical industry, the Balakhnin combine in

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the paper and pulp industry, the Tashkent combine in the cotton textile industry, and many others. Soviet combines, as a rule, take care of successive stages of the processing of raw materials, manufacture basic products, and make universal use of industrial by-products.

Combines have become the base of support for the development of other branches of production. A whole network of machine-building plants has grown up around the Magnitogorsk metallurgical combine, which processes the widest variety of types of metal. Magnitogorsk metal is used in tractor factories and other factories in Chelyabinsk, in the Miassky automotive works, etc.

The creation of all types of socialist transportation facilities, of the State unified transportation network, has been of great importance in the development of the productive forces of the USSR. Railroads are constantly engaged in extending their track system and develop on the principles of mass production. Hundreds of thousands of kilometers of waterways have been put into service. Automotive and trucking transportation facilities have long since replaced transportation by horse-drawn conveyances.

The victory of socialism, the industrialization of our country have radically altered the relationships between the basic branches of the national economy.

The unstable relations in social production, often susceptible to breakdown, which are an elementary factor in capitalism due to the influence of the economic laws inherent in that very system, have given way, under socialism, to consciously organized and sustained proportionality, corresponding to the laws of planned development.

In pre-Revolution Russia, the share of agriculture in the gross national product amounted to 58% and that of industry to no more than 42%. In 1937, over 70% of the gross national product of the USSR was due to industry.

As a result of the fulfillment of the first two Five-Year Plans, the Soviet Union moved ahead to second place in the world in the overall volume of industrial

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production. This laid down the conditions enabling the Eighteenth Congress of our Party in March 1939 to pose the task of catching up with and overtaking the most highly developed capitalist countries in economic relations, i.e., in the production of consumer goods.

The figures compiled in this area are the best evidence of how social production was expanded in our country. From 1913 to 1940, the volume of commodities produced by major industry in the USSR rose by almost 12 times. Already, toward the end of the second Five-Year Plan, the USSR occupied second place in the world in total volume of capital goods produced, and first place in Europe. The production of machinery in 1913 took up only 6% of the gross industrial product, but accounted for 30% in 1940. The specific weight of machines and capital goods production in the USSR was higher than in any other country in the world. Toward the beginning of the first Five-Year Plan, the USSR was importing about a third of all its machines from abroad. In 1932, imports in this area dropped to below 13%, and in 1937, imports of machines accounted for only 0.9% of the total machines.

These figures demonstrate rather strikingly how stormy the rate of growth was in the years of the prewar Five-Year Plans, with respect to the productive forces of the Soviet nation.

The attack of Hitlerite Germany on the Soviet Union, the arduous war forced upon us, resulted in enormous damage on our national economy and postponed for many years the fulfillment of the fundamental economic tasks confronting the USSR.

During the period of the Great Patriotic War, industry in the eastern regions of the country, in particular the Urals and Siberia, was reorganized and became a powerful base of supplies for the Soviet Army; during the fourth Five-Year Plan, this base rendered enormous assistance in the recovery of the economies of war-ravaged sections of the country.

After the Great Patriotic War was over, the Communist Party led our country forward on the road of a new economic upturn. Each year brought new increases in the

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production of pig iron, steel, coal and petroleum. The Party also assumed the responsibility for the recovery and development of light industry and food industry, transportation, building, construction, and agriculture, since it was obvious that a powerful rise in our economy required for its realization first of all the preferential development of the production means.

By the end of the fourth Five-Year Plan, the volume of manufacture of the production means reached 205% of prewar levels. The prewar levels in consumer commodities were attained in 1949, and were exceeded by 23% in 1950.

During the years of the fifth Five-Year Plan, capital investments in industry were increased by 94% over those in the fourth Five-Year Plan. This included a rise of 3.4 times in capital investments for the construction of electric power stations, a rise of 2.3 times in the petroleum industry, and 1.8 times in ferrous and non-ferrous metallurgy.

While over 1500 large-scale industrial enterprises were put into operation during the first Five-Year Plan, and 4500 during the second Plan, with about 3000 large-scale units being started in the first three and a half years of the third Five-Year Plan, the number of large-scale industrial enterprises restored, rebuilt and newly built during 1946 - 1954 came to about 8600.

Soviet industry is now represented by more than 200,000 enterprises in the fields of metallurgy, machine-building, the chemical, construction, textile, food, and other branches of industry.

It is important to note that the proportions prevailing within the same industry have been modified. While one third of the industrial product in 1913 was accounted for by manufacture and two thirds by consumer goods, the specific weight of the production means at the present time amounts to over two thirds (70%, to be exact) of the overall industrial product.

It is clear that this circumstance has substantially altered the role of industry and its relations with all other branches of the national economy.

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In 1955, our heavy industry achieved new successes. In one year, 33 million tons of pig iron and 45 million tons of steel were smelted; 391 million tons of coal were mined and 70 million tons of petroleum were produced; electric power stations of the country developed 170 billion kilowatt-hours of electric power.

In 1955, the industrial product of the USSR was 3.2 times higher than in 1940, with the production of capital goods increased by a factor of 3.9. The speedy development of heavy industry and the growth of the agricultural product enabled the production of consumer goods to more than double over prewar levels.

Specialization and Coordination of Industry

As their heritage from the Tsarist system, the Soviet people received not only a backward industry and agriculture, but also an extremely irregular allocation of the productive forces of the country. Over three fourths of the industrial product were produced in the Moscow, Ivanovo, St.Petersburg districts, and in the Ukraine. The factories of the Donets basin and the Dneprov area accounted for 73% of all the coal in 1913, while Baku accounted for as much as 83% of the petroleum.

As early as the time when the first Plan was drafted for the development of the national economy of our country, viz. the GOELRO Plan (in 1920), the ground was laid for the division of the country into economic districts, and the district tasks were defined.

The planned allocation of the socialist large-scale machine manufacture proceeds along the pathway of the versatile development of districts, bringing industry close to the sources of raw materials, fuel and power supplies, and also to regions consuming the products of industry; along the pathway of specialization of industrial production and of agriculture in individual districts for the utilization of favorable economic and natural conditions; along the pathway of strengthening the system of interdistrict ties, ensuring the highest productivity of social labor; along the pathway of the complex development of the economy of all of the districts

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for the satisfaction of the overall State and local needs.

Specialization in industry presupposes the overall development of one (or of two or three) leading branches of production in the territory of the economic district in question (depending on existing natural and economic conditions), which contributes to the greatest possible growth in production and yields the possibility of developing the fundamental type of commodities to be produced at minimized losses.

Specialization of the economy of the districts is determined in the final analysis by the overall interests of the development of the socialist economic structure. Specialization is conditioned primarily by the need to rely on especially favorable natural conditions and resources of a particular district, in order to ensure the economy and growth of the productivity of social labor, to develop technical progress in the most important branches of industry.

The clearest example in this respect is provided by the Urals. Between the Urals and other economic districts of the country, there exists a lively exchange of various commodities. The country dispatches to the Urals materials and commodities lacking there. The Urals in turn dispatch to other districts of the country different forms of their locally produced commodities. The Urals specialize in the production of metal, machines and other industrial goods, and send these to the eastern regions of the USSR. The East supplies the Urals with coking coals. At the same time, the local coal industry is being intensively developed in the Urals.

The powerful industrial development going on in the Urals provides the national economy of our country with the possibility of saving on large quantities of material means, since the need to transport metal and machines to the East from the Donets basin and the Dneprov area, and petroleum from Baku, is thus obviated.

Intimate economic ties were established between separate sections of the Urals, which were engaged in industrial and economic specialization. The Sverdlovsk and Chelyabinsk regions, with their rich deposits of iron ores and nonferrous metals, are distinguished by the powerful development of ferrous and nonferrous metallurgy,

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and of heavy industry. In the Molotov region and in the Bashkir region of the Autonomous Soviet Socialist Republics, light and medium machine-building predominates, since metal arrives there from the eastern districts of the Urals. The western districts of the Urals provide the eastern districts with petroleum and petroleum derivatives, potassium fertilizers, magnesium, etc. The Northwest of the Urals, rich in timber, supplies not only the entire Urals region, but also many other districts of the Soviet Union. Commodities required by the northern districts flow from south to north. In the South, with the discovery of rich deposits of iron ores and nonferrous metals in the Orsk-Khalilovo district, there has now grown up an industrial center in the Urals with numerous enterprises whose importance ranks high throughout the Union. The Ural economic complex is being supplemented, as we see, by still another important link.

Chemical industry correlates the coal industry with ferrous and nonferrous metallurgy. Coking gases are received for the production of nitrogen fertilizers, aniline dyestuffs, and other commodities. Machine construction provides the chemical industry with machinery and a variety of equipment.

The chemical industry furnishes the machine-building industry with pigments, plastics, rubber and uses the waste products of the woodworking industry for the production of alcohol. Dry distillation is used to prepare charcoal for the processing of high-grade metals, and also for the production of acetic acid, methyl alcohol, resin oils, and alcohol-derived fats, etc.

The continuous development of the productive forces of socialist society, technical progress, and the latest discoveries in science dictate the need for ever increasing specialization in production. Arising on a specified production and technical base, specialization exerts a powerful influence on production, advances technology, brings into life new tools of labor. Specialization makes it possible to use highly productive equipment, advanced technology and automation of production on a large scale. Specialization produces a total revolution in machine construction and in other branches of industry.

V.I.Lenin pointed to the direct relationship existing between specialization and the progress of technology, stating that specialization in its very essence is a never-ending process, just as is the case for the development of technology in itself. "In order to raise the productivity of human labor, directed, for example, toward the manufacture of some part of a commodity, it is necessary that the production of that part be specialized, become a special branch of production, having to deal with a mass commodity and therefore allowing (and calling for) the use of machines, etc." (Bibl.2).

Specialization results in an ever greater number of production branches and specialized enterprises; specialization of enterprises not infrequently becomes the point of departure for the creation of new branches.

During the years of the Five-Year Plans, a multiplicity of new branches developed in our machine-building industry: automotive, airplane, tractor industries, textile, chemical-machinery building, and many others as well. The development of science and technology led to the appearance, for example, of such branches as turbomachinery building, electronic manufacture, bearing production, and other branches of industry. In the chemical industry, the production of synthetic fibers, synthetic rubber, and plastics has developed into independent branches, not to mention a number of other branches. In recent times, the radio electronics industry has split off as an independent entity from the electrical equipment manufacturing industry. The manufacture of instruments has become one of the most powerful independent branches. The atomic industry has arisen as a new factor.

A new and higher stage of specialization is the specialization of enterprises engaged in the manufacture of a single specified commodity.

The Leningrad industry, having at its disposal highly skilled cadres and a powerful technical base, specializes mainly in the development of percision machine-tool building, and supplies the country with highly productive machinery. The

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Yaroslavsk and Minsk automotive works specialize in the production of heavy-duty trucks. The Ural and Kutai automotive factories specialize in the manufacture of automotive vehicles with medium load-carrying capacity. The machine-tool building industry has specialized factories for the manufacture of lathes, milling machines, drills and boring mills, gear hobbing machines, planers, automatic machine tools, power hammers, presses, and different tools.

The establishment of specialized enterprises manufacturing a small and restricted line of finished products is a great achievement in the cause of perfecting productive techniques.

The further development of technological progress requires, in line with objective necessity, the transition to a still higher stage of specialization. This involves the specialization of enterprises in the manufacture of individual subassemblies and parts, and also in the production of stock, i.e. castings, forgings, stampings.

Such a degree of specialization has already been accomplished in a number of branches of industry in the USSR. For example, in the automotive industry, there are particular enterprises for the manufacture of radiators, carburetors, pistons, piston rings, leaf springs, springs, starters, etc. In the machine-tool building industry, there are specialized plants for the manufacture of hydraulic-actuated instruments and devices, pumps, divider heads, and also plants specializing in the manufacture of rough castings for machine-tool construction.

The development of specialization of enterprises is one of the most important prerequisites for the penetration of automated equipment in all branches of industry. The productivity of labor in specialized plants is considerably higher than in non-specialized enterprises engaged in putting out the same line of commodities.

Along with specialization, the productivity of labor is also affected by the size of the enterprises and, in some branches, by the size of the in-plant units. For example, increasing the power of subunits in an electric power station may result in a 45% or greater reduction in capital outlay. In metallurgy, large-size blast furnaces yield a higher productivity of labor. During the sixth Five-Year Plan, new furnaces put into commission will have large dimensions: A considerable number of blast furnaces will have volumes ranging from 1500 to 2000 cubic meters, with the average effective volume for blast furnaces at the beginning of 1956 being about 748 cubic meters.

During the years of the Five-Year Plans, sizable shifts in the direction of specialization took place in our industry. However, many shortcomings were noted in that area. At the Plenum of the Central Committee of the Communist Party of the Soviet Union in July 1955, a fully developed criticism of those shortcomings was submitted, and measures were adopted for the expansion of specialization and of co-ordination of industry.

The directives of the Twentieth Congress of the Communist Party of the Soviet Union on the sixth Five-Year Plan make provisions for broad measures bearing on specialization of production. Primarily, order must be brought into the machine-building field.

It would be incorrect to give the impression that the division of labor and the expansion of specialization lead to isolation and autonomous behavior in individual branches and enterprises. On the contrary, such measures contribute to the growth of productive ties and to cooperation. It is in this that the continuously rein-forced social character of production finds its expression.

Under the conditions obtaining in Soviet society, specialization is organically linked to the cooperation of socialist enterprises.

Cooperation, consists of productive ties linking various enterprises and of reciprocal assistance, based on the division of labor, under which several enterprises participate collectively in the manufacture of an industrial commodity. The cooperation of socialist enterprises yields the possibility of a fuller utilization of the equipment and the total resources of each plant.

In socialist society, industrial cooperation has an entirely different character than does capitalist cooperation, which is continually jeopardized by the anarchy in production. Manufacturing ties among Soviet enterprises stand out as links in a single, planned economy.

Socialist cooperation, the mutual assistance between workers of different plants and factories, permits a rapid and broad-scale organization and proper development of manufacture of the most complicated machinery and other commodities.

The most widely favored types of cooperation in our industry are the cooperative manufacture of individual machine parts, and technological cooperation. Cooperative manufacture of machine parts involves industrial ties in which the enterprises manufacturing the finished product enter into cooperation with plants specializing in the manufacture of individual parts and subassemblies.

It suffices to say that, in the manufacture of a Soviet automobile, over 500 plants and factories take part, some of them manufacturing individual parts and subassemblies or various semifinished products, supplying rolled sheet steel shaped to specifications, etc., to the enterprises which manufacture the finished vehicles.

A typical example of technological cooperation is furnished by the productive relationships linking enterprises in the electric equipment manufacturing industry and the heavy machine-building industry. Plants building heavy machinery manufacture large castings and forgings and dispatch them to other plants within their industry for the manufacture of turbines or to plants serving the electric equipment industry for the manufacture of generators. This aspect of cooperation allows the fullest use of the productive capabilities of the enterprises.

The great advantages accruing from specialization and cooperation between branches of industry have already been proved in practice. They contribute to the development of technology, to the use of advanced technology and highly productive equipment, including automated facilities, and promote the smooth and rhythmic operation of industrial enterprises.

Progressive organization of production, based on intensifying specialization and on widespread cooperation in industry, is one of the solid reserves of socialist industry.

It must be admitted, however, that up to the present several ministries have been extremely slow in achieving specialization and cooperative production in their enterprises, or have been inconsistent. These require many industrial enterprises to manufacture products of large and varied nomenclature, often not corresponding to the profile of production. Along with this, the manufacture of identical and interchangeable mechanisms, subassemblies, and parts is spread out over many nonspecialized enterprises.

At the July (1955) Plenum of the Central Committee of the Communist Party of the Soviet Union, mention was made of the fact that, if the Moscow and Gorky automotive works were freed from the manufacture of products not suited to their production line, if they were to use only the most advanced production processes, and if they were to receive some new equipment, then the manufacture of automotive vehicles could be increased 1.5 times, with the existing floor space. At one of the meetings of the active members of the Leningrad Regional Party Organization, it was noted that the production of commodities could be stepped up 30 – 50% in Leningrad alone, solely by means of specialization in the machine-building enterprises, using the same production space.

Following the July Plenum, the Central Committee of the Communist Party of the Soviet Union and the Council of Ministers of the USSR carried out a number of practical measures aimed at a more detailed specialization of the ministries and at the concentration in particular ministries of the production of commodities of a particular type. This relates to the manufacture of diesel engines, instruments, and several other commodities.

Poor specialization in plants is not infrequently to be explained by an inadequate degree of cooperation in the production processes. Many machine-building and

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instrument-manufacturing plants were unfortunately organized on the basis of a closed production cycle, including a whole gamut of preparatory shops and ancillary production facilities in the make-up of the production cycle; and many plants in that field are still being built on that principle. For example, a plant for chemical equipment and a plant for manufacturing fittings in Kurgan were very recently designed with their own separate and independent casting shop, although both plants are located in the same area.

Especially serious shortcomings are found in the organization of specialization in the manufacture of machine tools and instruments, which not only results in poor utilization of plant capacity, but also impedes the creation of more advanced machine tools, accessories, instruments, and consequently holds back the growth of the productivity of labor in all branches of the national economy.

Greater coordination is required in the operations of the planning bodies. It is a known fact, for example, that the city of Novosibirsk has in the last 15 years emerged as a large industrial center in the eastern part of the country. Here, branches of industry were developed under the control of different ministries. Each of the ministries, in their functioning, started from the problems under their own jurisdiction, often without due regard to the interests of the industrial center as a whole. As a result, serious disproportions arose in the development of a number of the branches of the economy of the city.

There are over 35 foundries in the city, most of them poorly mechanized. Therefore, the unit output of castings per square meter of production space is negligible, and the net cost per unit ton of casting is very high. A part of the enterprises are without foundry units, and are forced to import their casting stock from the central regions of the country and from the Urals.

Considerable shortcomings exist in the enterprises of the city, as to organization of cooperation. The "Sibsel'mash" factory, for example, receives oil cans for use in agricultural machinery, from the Moscow district. At the same time, another

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Novosibirsk plant in the vicinity of the "Sibsel'mash" manufactures the same type of oil cans and dispatches them to Rostov-on-the-Don. The same "Sibsel'mash" factory ships castings of forged pig iron to Dnepropetrovsk and to the Urals, while local enterprises are forced to import castings from Rostov-on-the-Don and other cities. Or take still another example. The locomotive overhaul plant of the Ministry of Communication Routes of the USSR at Novosibirsk receives steel castings from Tashkent, Rostov-on-the-Don, and from Ulan-Uda, while the railroad switch plant of the same Ministry, located across the road from the locomotive overhaul works, ships steel castings to the Kurgan region.

Up-to-date highly productive techniques may be used to full advantage only in the mass production of a single line of commodities, under assembly-line conditions.

The specialized manufacture of standardized parts and instruments, hydraulic power equipment, press dies, machine-tool accessory electric equipment, jigs and fixtures for metal-cutting machine-tools and other equipment is far from adequately developed in our industry. A sizable number of these commodities, as well as castings and forgings, are produced in small-scale, insufficiently mechanized shops with equipment of low productivity.

A large quantity of the castings, forgings, standards, calibrating instruments, and other commodities of widespread use are produced by many enterprises with their own facilities, which results in excessive cost and does not ensure high quality of production. All of this takes place because of the continued existence of poorly specialized foundry, forging and press works, inadequately developed standards and instrumentation branches of industry, as well as inadequate specialization in the manufacture of electrodes, fittings, and dies.

The manufacture of a general-purpose instrument in specialized enterprises requires less labor and is several times cheaper than in nonspecialized plants.

The directives of the Twentieth Congress of the Communist Party of the Soviet Union provide for the organization of specialized plants and shops in various econom-

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ic districts of the country in the manufacture of castings, forgings and dies, standard instruments, spare parts, parts made of wood, plastics, fittings, and other items. Specialized plants will also be established in the manufacture of automatic communication and in the means of mechanization.

An important role in the decisions of the Party Congress was assigned to bringing order and rational organization into production, in the creation of specialized enterprises in different economic districts, in the achievement of cooperation between enterprises within the confines of economic regions, and of large-scale industrial centers.

In particular, to ensure the supply of pig iron and steel castings to industrial enterprises during the sixth Five-Year Plan, specialized foundry plants equipped with the latest techniques, and also specialized foundry shops, were built. In addition, during the coming three years, district base shops will be organized for the production of steel, pig iron and aluminum castings, as well as forging and pressing shops for the manufacture of forgings and stampings based on the latest technological advances.

During the sixth Five-Year Plan, practical solutions will be devised for questions on specialization of the production of standard instruments, spare parts for tractors and agricultural machinery, different subassemblies and parts used in large quantities in industry.

The organization of the specialized manufacture of machine parts and fittings in order to meet the requirements of all branches of the national economy, with the use of automated equipment, will permit savings of several billions of rubles annually throughout the country. Specialization in the production and overhaul of spare parts will result in shortening the downtime of machinery and equipment by approximately 5 - 6 times and thus in a sharp increase in the productivity of labor.

Specialization of production, cooperation between enterprises and between branches of industry, remarked N.S.Khrushchev at the All-Union Conference of Workers

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in Industry in May 1955, is of enormous importance for the further development of industry. "Each minister wants to carry out production in a closed cycle, within the limits of the enterprises under the jurisdiction of his own ministry. This is unreasonable, particularly under our socialist conditions. The problem consists in proceeding along the line of specialization and broad cooperation in production. Cooperation must take place not only within the ministry's jurisdiction, but also between ministries. The establishment of specialized plants makes it possible to organize the production of high-quality and cheaper industrial commodities on a mass basis and offers the possibility of rapidly passing from the handicraft stage in this field."

The expansion of the specialization of enterprises and their rational cooperation may take place, at the present time, in several directions.

It is important to define the need for the manufacture, in economic districts, of general-purpose products having a mass outlet such as: standards, instruments, castings, forgings and stampings, plastic and wooden articles.

In the organization of new enterprises, as a rule, it is economically favorable, instead of erecting general-purpose plants, to set up central assembly enterprises which assemble articles and manufacture basic parts. Narrowly specialized plants, engaged in the manufacture of parts and subassemblies for shipping to those major assembly plants, should be built around the assembly plants. It is expedient, in that respect, to carry out a broad-scale standardization and exchangeability program of parts and subassemblies, with the purpose of having a supply of parts and subassemblies suitable for a range of goods. This enables the manufacture of such parts and subassemblies to be organized on a mass-production basis, or by large-scale belt-line techniques, with the broad use of mechanization and automation of the production processes, and with the assimilation of new, more progressive technology.

The specialization and cooperation in production achieved in the Soviet Union

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are leading to an enormous saving in social labor, permit a considerable improvement in the utilization of equipment and in the use of the entire material and labor resources of the country, a broad development of assembly-line production with a high degree of mechanization and automation.

The directives of the Twentieth Congress of the Communist Party of the Soviet Union, relative to the sixth Five-Year Plan, provide for an even more extensive development of economic districts and industrial centers. In order to successfully carry out the directives of the Congress, the task of the Party, Soviet and economic municipal and district bodies, as well as Union and Republic ministries and planning bodies, will be to carry out serious work for a most complete and reasonable utilization of the possibilities available for tapping resources within the districts and industrial centers, in order to solve the many current problems and those looming on the horizon.

To gain a higher level of economic efficiency in production by means of specialization and cooperation, this means a rational reconstruction of the cooperation of enterprises falling within overlapping ministerial jurisdictions inside the confines of the economic districts, Republics, regions, zones, large cities, and industrial centers. Specialization and cooperation on the basis of existing specialized enterprises and shops and those now under construction, the expansion of cooperation within ministerial jurisdiction and between ministries, taking the perspectives of development into account, will permit a marked raising of the productivity level of social labor, curtailing production costs and increasing the quality of the product, thus ensuring continued technical progress.

The Planned Allocation of Productive Forces Under the Sixth Five-Year Plan

In order to speed up technical progress and promote a sharp rise in the productivity of labor, great importance resides in the advantages of the planned allocation of socialist production, the further intensification of the social division of labor by developing the specialization and cooperation of industrial branches and enterprises.

The scientifically grounded allocation of the productive forces leads to the creation of a rational system of division of labor over economic districts by a correct combination of specialization and complex development of the district economies. The fundamental economic districts in our country were established chiefly in the prewar years. From that time on, the level of economic development of the country was raised to a new height, and much was changed in the economic geography of our national economy as well. The truly scientific economic breakdown of the country into districts had to be oriented not only toward an up-to-date state of the economy, but also had to take into account the perspectives of development of the national economy for at least 10 - 15 years ahead.

In the choice of districts and sites of allocation of industry and individual enterprises, it was necessary to take an accurate account of the natural and economic conditions and features of the particular zones and districts of the country, allowing the greatest economy of labor in all stages of production, handling, and supply. Planning of production on the basis of the individual economic districts as well as on a nation-wide basis permits using to full advantage all of the possibilities of each given district.

The social character of the productive forces and socialist ownership of the production means govern the planned allocation of those factors over the entire country. This allocation determines the territorial division of labor and the specialization of economic districts.

The planned allocation and development of the productive forces guarantees the continued economic growth of all of the economic districts and of the Republics. These permit a rational utilization of the natural resources of the country and have become an important factor in the economy and in the growth of the productivity of social labor, as well as of the acceleration of the tempo of expanded socialist

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Under the Sixth Five-Year Plan, the Soviet peoples once again will demonstrate their ability to utilize the rich natural and labor resources of the economic districts of the nation.

The Soviet peoples will work to guide all branches of industry through the transition to large-scale machine production. At the same time, they will make a new historical step forward in the development of the social character of production.

The development of the productive forces is unthinkable without a continuous rise in the economy of all of the economic districts on the basis of the latest technical achievements. If the level of production of any given economic district begins to lag behind, this will inevitably retard the overall course of forward development. In this lies the profound economic meaning of the objective necessity for the development of the economy of all of the districts on the basis of the latest technical progress.

Economic districts will, in turn, develop in such a way that the requirements of industry and agriculture of the district as to fuel and electric power, metal, building materials, and chemical fertilizers will be satisfied. For the complex development of the economic districts, the reserves of each industrial center, city, and enterprise will be brought into account, and the local natural conditions and possibilities will be widely studied.

Previously, it was no rare occurrence for fuel, electric power, and several types of raw materials to be in short supply in particular economic zones of the USSR. This was felt mainly in the European sector of the country. Here were concentrated up to three fourths of the industrial production facilities, while the coal mined amounted to only a little more than half of the total quantity mined. This relationship between the development of industry and the output of coal mining led to irrational haulage of coal from the Kuznetsk basin and from Karaganda to the districts in the European sector of the country.

Fuel shortages in the European sector of the country were subsequently eliminated by two approaches to the problem: universal development of the fuel - power base of these districts and acceleration in the rate of construction of new enterprises in the eastern districts of the country, rich in raw materials, fuel, and hydroelectric power.

However, a radical solution of the fuel - power problem confronting the European sector of the country and the Urals district could be attained only by increasing the output of hydroelectric power, coal mining, petroleum, natural gas, and other forms of fuel. If heat- and power-consuming enterprises were to be continually allocated to those regions, this would nullify the efforts to eliminate fuel and electric-power shortages. In the directives of the Twentieth Congress of the Communist Party of the Soviet Union, emphasis was placed on the need to restrict the building of such enterprises in these districts, involving on a much broader scale the natural resources of the eastern part of the country in the economic cycle.

The first Five-Year Plans emphasized for the most part the development of industry in the European sector of our Homeland and in the Urals. During the days of the Great Patriotic War, the efforts of the people were concentrated on the development of production in the Urals, in western Siberia and in Central Asia. In unprecedented short periods, huge plants providing the armed forces with everything needed for victory over the enemy were brought into being in Novosibirsk and Omsk, Kemerovo and Stalinsk. In the Kemerovo district alone, over 350 industrial enterprises were placed into operation.

Now, the front of great operations has shifted even farther to the East. In the immense and vast stretches between the Urals and the shores of the Pacific Ocean, the Soviet peoples, under the leadership of the Party, are carrying on a great labor offensive.

The concern of our Party and government for a more rapid rate of development of the productive forces in the eastern regions is dictated by serious political and economic considerations. Gigantic natural resources and land riches in those districts guarantee a highly uniform allocation of production in the vast reaches of our country, strengthen the defense capabilities, and accelerate the building of communism in the USSR.

The role of the eastern districts in economic construction under the sixth Five-Year Plan is defined not only by the fact that enormous resources of coal, iron ore, nonferrous ores, and ores of rare metals, as well as inexhaustible hydroelectric power resources, are to be had there. Capital investments in the various branches of industry yield a particularly great economic effect there, the productivity of social labor is high and, compared to other districts of the country, the net cost and unit cost of commodities produced are lower. It should be taken into account that, by improving the allocation of productive forces in the USSR, by bringing industry closer to the sources of raw materials, fuel, and power resources, and to the consumer districts, the State manages to channel almost half of all capital investments into the development of the eastern districts. Capital investments are being significantly increased in the economies of Siberia and of Kazakhstan.

The policy of allocating the productive forces of the nation is directed toward achieving a universal development and a strengthening of the economy and culture of all of the Republics of the Union.

The Central Committee of our Party has carried out a number of important measures for enhancing the role of the Union Republics in the administration of the national economy. New ministries under the direct jurisdiction of the Union Republics have been set up. A vast number of enterprises in the coal, lumber, petroleum, metallurgical, cattle-raising, dairy, light, textile, and food industries, building-materials industry, automotive transport, and communications have been transferred from centralized Union jurisdiction to Republic administration.

Each branch of industry, transportation, communications, agriculture has its own peculiarities in development and allocation needs. In various parts of the country, more favorable conditions exist for certain branches of production than for other forms of industry. Taking these conditions and prerequisites as a point of departure, a territorial division of labor is being planned, economic districts are being formed and developed, complexes of entire groups of adjacent regions and Republics having their place in the national economy are being formed and developed in the spirit of the Leninist policy on nationalities, in the spirit of the constitutional rights of each Republic. Specialization yields the greatest effect in areas where the leading branches of a given economic district are correctly coordinated with adjacent branches, as well as with branches which produce widely used consumer goods.

In the decisions of the Twentieth Congress of the Communist Party of the Soviet Union, much space is allotted to the further prospering of the productive forces of the national Republics in our country. Here we give a concise survey of only a few of the Republics, to give a general picture of the directions to be taken by their development under the sixth Five-Year Plan.

The Russian Soviet Federated Socialist Republic under the new Five-Year Plan will carry out sweeping measures for the improvement of the allocation of productive forces.

In the economy of the Russian Federation, a conspicuous place is occupied by the Moscow industrial district. Here are concentrated large cadres of skilled and experienced industrial workers, engineers, technicians, and scientists.

The enterprises located in the Moscow industrial district produce almost one fifth of the entire gross national industrial product of the Soviet Union. Here we find the largest machine-building and instrument and tool manufacturing plants, up to 28% of the entire production of machine-tool and instrumentation manufacturing facilities of the entire country. The experience of Moscow, of the working force in the various enterprises, and of the staff of its scientific institutions is being carefully studied throughout the country, and in large part determines the fate of

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the introduction and assimilation of new techniques and technological advances.

The workers, engineers, and technicians in the Moscow plants and factories, in collaboration with the scientists, will master the production of highly productive oxygen-producing facilities having capacities of 10,000 - 30,000 cubic meters hourly, for ferrous metallurgy, locomotives, and gas-turbine-driven vehicles, for transportation and automatic conveyor lines, for machine-building enterprises. The Moscow machine builders manufacture the bulk of the 220 automated and semiautomated lines slated to become operative under the sixth Five-Year Plan.

The directives of the Twentieth Congress with respect to the sixth Five-Year Plan make provisions for the most rapid possible development of industry in the eastern districts of the country, improve the relationships in the volume of industrial product between economic districts. The specific weight of the Moscow industrial district must be reduced, despite the absolute growth of its production.

The face of the Leningrad industrial district determines that of the city of Leningrad in many ways. This district is a powerful production base and possesses a highly developed network of scientific research, design, and training institutes. In addition to the most important plants in machine-tool building, machine-building and instrument and tool-building industry, Leningrad also boasts ship-building enterprises, producing the tonnage of seagoing and river transport vessels so necessary to our country.

Metal for the Leningrad industry, until recently, was brought in from remote places. The northwestern sector of the USSR now has a metallurgical base of its own, the Cherepovets metallurgical combine. This greatly improves the geographical allocation of the metallurgical industry of the USSR and facilitates the supply of metal to Leningrad and other industrial centers which gravitate toward Leningrad. In the Vologod region, for example, new industrial enterprises have made their appearance in recent years, in the field of machine building, structural materials manufacture, and other branches of heavy industry. On the Kola Peninsula, the mining industry has

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been given a big boost and provides the new Cherepovets metallurgical combine with beneficiated ores. In the Komi Autonomous SSR, in the Pechora district, the coal-mining base of northwestern metallurgy is being developed. Under the sixth Five-Year Plan, construction will be completed not only on the Cherepovets metallurgical combine, but also on the Orsk-Khalilovo metallurgical combine. The builders are proceeding to the erection of still another Western Siberian metallurgical plant and of two other metallurgical plants in Siberia. In the Russian Federation, new enterprises are appearing in the field of machine building, iron-ore processing, nonferrous ore processing, petroleum and other branches of industry, and new pipelines have been put into service.

In the East, many new industrial enterprises, electric power generating plants will be put into operation, and the construction of new railroad lines is in progress.

The eastern districts of the country possess inexhaustible mineral resources. Here are concentrated up to three fourths of all of the natural coal reserves and up to four fifths of the hydroelectric power potential and timber riches, basic reserves of nonferrous and rare metals, enormous resources of chemical raw materials, iron ore bodies and structural materials. Here, we find vast stretches of virgin soils and deposit-bearing grounds, meadows, pastures, and grazing areas.

The Twentieth Congress of the Communist Party of the Soviet Union placed on the agenda a general plan for the development and allocation of ferrous metallurgy enterprises in Siberia, and plans for the broad development of geological exploration, scientific research, and other operations on Siberian soil.

The plan laid for the development of the productive forces of Siberia over the next few Five-Year Plans is striking not only in the grandeur and vast scope of the project outlined, but also in the scale of the natural riches themselves, which will be drawn into the sphere of the creative activities of the Soviet peoples.

During the next 10 years, the Soviet people will transform Siberia into the

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greatest base in the Soviet Union with respect to coal mining and the development of electric power, into the fundamental base for heat-consuming and power-consuming branches of industry, especially in the production of aluminum, magnesium, and titanium, as well as electrometallurgy, chemistry of coal and tar products, and electrochemistry.

With the aim of ensuring the complex development of the national economy in the eastern districts, the Twentieth Congress of the Party planned the setting up there of new large centers of machine building, capable of manufacturing all types of machines, mechanisms, instruments, basic and servicing equipment.

As experience demonstrates, coal mining and the production of electric power in the East is economically more efficient than in the European sector of the USSR. Costs per unit ton of increased coal output during the fifth Five-Year Plan in the coal mining basins of Eastern Siberia were 2.5 times lower than in the Donets Basin, and were 1.5 times lower in the Kuznetsk basin than in the Donets Basin. The net cost of one ton of coal in 1955, in the Kuznetsk basin, was almost 1.5 times less than in the Donets basin. In 1960, plans envisage the mining of 80 million tons of coal in the Kuznetsk basin. Those 80 million tons will cost the State 2.4 billion rubles less than the same quantity of coal mined in the Donets basin. The production of a single ton of pig iron at the Kuznetsk metallurgical combine costs about 230 rubles, while it costs 300 - 350 rubles at the metallurgical plants of the South.

The newly built railroad trunk lines connecting Magnitogorsk - Sterlitamak - Abdulino, Kurgan - Sinarskaya - Krasnoufimsk district, Barnaul - Omsk and other lines provide a stimulus to the further development of the productive forces of the Urals, Siberia, Kazakhstan, and other eastern districts of the country.

Scientists and staff workers in the higher technical training institutes and scientific research institutions of Siberia are working on the problems confronting the conversion of the eastern districts of the nation. Advance sections of the Academy of Sciences of the USSR, and its affiliated sections, Western Siberian,

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Eastern Siberian, and, farther out, at the edge of the continent, the Far Eastern Academy of Sciences, are probing deeply into the problems.

As a result of prospecting and exploration work in the Yakutsk Autonomous SSR, deposits of iron ores have been discovered and, in close proximity to them, deposits of coking coals. Valuable deposits of nonferrous and rare metals have also been discovered. The discovery of rich placer deposits and large diamond beds in recent years are also of particular importance for the national economy.

Geologists have also been carrying on investigations on a broad scale in other districts of Siberia and the Far East. In the Maritime and Khabarovsk regions, prospecting and exploration for tin ore bodies have been stepped up.

There are many deposits in Siberia, but they have not yet been explored and studied adequately. This is true not only of newly discovered deposits, but also of old ones known for a long time. For over 20 years, the ore base of the Gornaya Shoriya had not yielded to geologists. And only during the fifth Five-Year Plan, owing to the expansion of the front of prospecting as well as of explorative and scientific research operations, was this base which is the cornerstone of the Kuznetsk metallurgy successfully brought under an exhaustive study, and the way cleared for exploiting it on a broader scale.

Even the Kuznetsk basin, this coal-mining gem of the world with its immense variety of reserves of high-grade coals, has been studied only to a small extent, although a whole generation of researchers have devoted their entire lives to that project. There is no doubt that explorations in the Tungus coal-bearing basin or in such a large-yield brown-coal basin as the Chulymo-Yenisei Basin, where solid masses of coal seams run from outcroppings at the surface to dozens of meters into the depth of the earth, will yield new and remarkable findings.

The mineral riches of Siberia are even found in surface outcroppings. Kulunda and Khakassiya lakes are rich in salts. A large-capacity salt-processing industry will be founded there. Preliminary investigations show that possibilities exist

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there for the production of soda, sodium sulfate, sodium chloride, and other salts of practical importance in the national economy.

In addition of coal and gold, timber and furs, the Angara Basins and the shores of Lakes Baikal and Sayana are rich in iron and manganese ores, mica, and bauxites. There are deposits of talc and magnesites, gypsum and limestone, quartzites, refractory clays, marl, granite and marble, graphite and many other pay minerals. There is no doubt about the fact that geologists will discover deposits of oil and natural gas there.

Eastern Siberia is akin to the Urals with respect to its natural resources and the exceptional variety of mineral wealth.

In the territory of the Irkutsk region, in the district of the construction site of the Bratsk hydroelectric power plant, a new economic district is in the making. The scheme for the allocation of industrial enterprises in that district must be carefully thought out and drawn up with the most rational arrangement of the plants, factories and combines, as well as of the cities and workers settlements, communication routes, power networks, and many other factors taken into due account. All of the construction projects and communications in the Bratsk industrial district must form part of a single, integrated complex. This will constitute a new and most important industrial district in the East of the nation, with highly developed mining, aluminum and chemical industries - a country producing many rare metals (titanium, tungsten, molybdenum, and others).

<u>The Ukrainian Soviet Socialist Republic</u> is increasing the gross output of all industry by approximately 1.7 times, and that of the Republic's industry by 1.6 times. The miners of the Republic are effecting a pronounced increase in the amount of coal mined, due to the development of the Donets Basin and the assimilation of new coal deposits in the Greater Donets Basin, at Pridneprov'ye, and also in the western regions of the Ukraine. The capacities for mining and beneficiating ores in the Krivor Rog iron-ore basin and in the Kerchensk ore fields will be expanded.

The erection of the Kakhovsk hydroelectric power network will be completed, the Kremenchug and Dneprodzerzhinsk hydroelectric power plants will be built, large thermal electric power stations will be built, and construction work will begin on the Kanevsk hydroelectric power dams spanning the Dneper.

Construction workers are finishing up on the project of the canal linking the North Donets and the Donets Basin, which will permit supplies to be shipped by water in increasing quantities to the cities and enterprises of the Donets Basin. The canal will soon be operative.

Construction will begin in the Republic on a petroleum-processing plant, a new ferroalloy plant will be built and put on stream, the production output of local structural materials, particularly wall units of natural stone, will be expanded.

Large-scale industrial enterprises manufacturing consumer goods are being readied for operation, such enterprises as the Chernigov worsted and cotton goods combine, the Khersonets cotton combine. Construction is scheduled for a new cotton textile combine, synthetic fiber plants in Chernigov and Cherkassy, sugar works, and a new industrial combine for processing corn into molasses and starch.

Ukrainian geologists are engaged in extended geological exploration and prospecting operations, to expand the raw materials base of the ferrous metallurgical industry of the South, in prospecting for new mercury deposits in the Transcarpathian mountain area and in the Donets Basin, and are conducting detailed prospecting and exploration work on titanium and zirconium.

In the Byelorussian Soviet Socialist Republic, along with the Minsk automotive and tractor works, a plant for automated lines and special machine-tool assemblies, a clockworks factory, a plant for tractor spare parts, and a worsted fabrics plant are being erected. The special "Stankolit" foundry, which will be built at Vitebsk, will provide pig-iron castings for the entire machine-tool building industry of the Republic.

There are rich reserves of peat in the Byelorussian SSR. Its specific weight in

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the entire fuel budget of the Republic amounts to 53%, and in the fuel budget of the electric power stations, to about 80%. The universal development of the peat industry is a most vital condition for the growth of power capabilities and of industrial production as a whole. Under the sixth Five-Year Plan, the yield from peat mining will be increased by not less than 6 million tons. The manufacture of peat briquets will also be increased, five briquetting plants being slated for construction for that purpose. The output of milled peat will be doubled. Plans have been drawn up for building a pilot plant for manufacturing wax from peat, and enterprises in Gomel' for processing peat tars.

New peat-processing enterprises will be built in Byelorussia, as well as two petroleum refineries, a plant manufacturing agricultural machines, plants and shops for pretreatment of flax and hemp, sugar works. Existing enterprises, including tractor, automotive and machine-tool building plants, will be expanded and remodeled.

The manufacture of building materials will be expanded during the new Five-Year Plan; this applies to prefabricated reinforced concrete construction, large brick, plaster fiberboard partitions.

As a result of the fulfillment of the fifth Five-Year Plan, the industrial capacities of the Baltic Republics have greatly increased, the kolkhoz system has been strengthened, and the standard of living of the laborers has been raised.

Under the sixth Five-Year Plan, provisions are being made for the further development of the economies and culture of the fraternal Republics of the Soviet Baltic Coast.

The Latvian Soviet Socialist Republic will increase the gross output of its production by 1.6 times during the Five-Year Plan.

The greatest development, in terms of rate of growth of production, will be attained by such branches of industry as diesel-engine building, electric machinery manufacture, and agricultural machinery manufacture.

Plans have been drawn for the erection of the Pliavins hydropower plant having a capacity of 120,000 kilowatts, a second series of Riga-process thermal and space-heat power stations will be put on the line, and the capacity of the Liepais central electric station will be increased, with construction work to be started on the maritime fishing-port facilities at Ventspils.

Subsequently, after connecting the Latvian power net with the Estonian and the Byelorussian systems, the power output of the Pliavins hydroelectric power station may be increased.

A significant increase in the yearly fish catch will confront Latvian fishermen with a great task. Construction of the Ventspils fishing harbor, making available up-to-date fishing vessels to the fishing fleet, as well as up-to-date fishing equipment, will create favorable conditions for the development of active fishing operations in the Atlantic and Baltic.

The Lithuanian Soviet Socialist Republic, under the sixth Five-Year Plan, will participate in the Plan with greater material resources and more highly skilled cadres at its disposal than ever before. In accord with the directives of the Twentieth Congress of the Communist Party of the Soviet Union, the gross industrial product will be increased by roughly 1.8 times. A good deal of attention will be devoted to the development of machine building, building materials manufacture, light and food industry, and other branches of the economy of the Republic. The fuel and power base will be strengthened.

Large-scale power enterprises are growing up in the Republic. Not far from Kaunas, in Nieman, the Kaunas hydroelectric power plant, which will furnish cheap power to industry and agriculture, will be erected. When it is put on the line, the production of electric power in Lithuania will be almost doubled.

At Vilnius, plants manufacturing television equipment, drills, lathe and machine-tool jigs and fixtures and accessories, and office equipment will be built. Construction work will be completed on the huge specialized factory "Elektrotekhshirpotreb" (for manufacture of industrial and household electric equipment). New equipment will be assigned to existing factories, enabling them to effect significant increases in output. The yield of peat worked will increase 1.6 times, and cement manufacturing will triple in output. A development project on the harbor facilities of the Klaipeda fishing port is also contemplated.

Great improvement projects will be carried out in the agriculture of the Republic. Plans are afoot for drying out 298,000 hectares of earth for the construction of new soil-improvement systems, and 332,000 hectares for the maintenance of existing systems.

The fraternal Soviet Republics will render considerable assistance to the Lithuanian SSR in helping the latter fulfill its tasks under the sixth Five-Year Plan. In 1956 alone, agriculture in Lithuania was supported by thousands of tractors, ploughs, cultivators, and quite a few other types of agricultural machinery. Much equipment arrived at plants of the Republic, at the port of Klaipeda, at the construction site of the Kaunas hydropower station. Lithuania will in turn send machine tools, bacon, cement and oils, building equipment, leather and leathergoods, telephone equipment, radio receiver sets, electric equipment, bicycles, clothing, fish and fish products to its sister Republics, under the new Five-Year Plan.

The Estonian Soviet Socialist Republic has bituminous shales as its fundamental mineral wealth, its reserves being sufficient to last many centuries. New mines, cities, and settlements are being developed in the shale basin. Among them may be counted the city of Kohtla-Jarve, a large industrial center. Gas pipelines will start here, carrying natural gas to a host of enterprises and dwellings in Leningrad, Tallinn, Kohtla-Jarve. Narva will soon also be supplied with gas.

Shale is not just a fuel; it can be refined to yield gasoline, fuel oils, different grades of oils, hyposulfite, sulfur in lumps, and dozens of chemical products. Even shale ash may serve as a good-quality raw material in the manufacture of building materials.

Under the new Five-Year Plan, the Republic will significantly increase its out-

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put of shale, yield of gas, and other products.

Scientists in the Republic are working to achieve full utilization of organic materials contained in shale. They will perfect the progressive methods used to enrich this valuable form of fuel, including underground gasification.

The Republic will obtain electric power from shale-fired power stations, at a power level almost triple that previously attained. This will make it possible not only to satisfy the needs of the Republic, but also to transfer a portion of the electric power to Leningrad.

Highways and a factory and polygon of reinforced concrete works are being built in the Republic.

Agriculture in Estonia is increasing the production of commodities derived from increasing the livestock, raising the crop yield of farms, and establishing a firm and reliable fodder base.

The Uzbek Soviet Socialist Republic, during the years of Soviet power, has seen the erection of more than 1000 enterprises, and ferrous and nonferrous metallurgy have been established in the country. Coal mining and exploitation of oil fields have taken on a broad scope, on the basis of which machine building, chemical, and other branches of industry have risen up.

In the Tashkent area, the production sheds of a new machine-building plant have gone up. This plant will manufacture excavating dredges, power shovels, and other earth-moving equipment.

The working force of the enterprise has also produced more than one batch of earth-moving dredges of the "4PZU-2" model. This equipment is designed for work on large trunk canal waterways and on small irrigation systems between kolkhozes. The small size of the units makes it possible to haul them with ease, loaded on a single truck. The earth dredges have a high capacity, dumping up to 4500 cubic meters of pulp per day onto the banks.

Soviet Uzbekistan has been transformed into one of the more advanced industrial

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and kolkhoz Soviet Republics. The electric power developed in Uzbekistan exceeds by several times that produced in all of pre-Revolution Russia.

Breath-taking perspectives are opening up before the national economies of the Republic. The Republic's industry will increase its output of commodities significantly during the sixth Five-Year Plan.

In the Angren-Almalyk mining and industrial district, new coal mining enterprises are to be set up and the existing ones remodeled. Semimetal ores are available in this district for expansion and industrial use. A large nitrogenous fertilizer plant will be built. Power construction projects will be widely developed. Hundreds of large enterprises will be erected in different places in the Uzbek Republic.

The Republic's agriculture has become the richest base of Soviet cotton growing. The Uzbek Republic is one of the principal producers of silk, astrakhan furs, jute, kenaff hemp, and rice in our country.

In the course of the next two years, the complex mechanization of cotton field cultivation will be completed, and progressive techniques in agronomy, along with the latest agricultural machinery, will be in universal use.

Extensive work is being done to bring new lands under cultivation. The volume of construction of water irrigation systems in the Republic will be increased about 4 times over that of the fifth Five-Year Plan. The new irrigation network will bring to life 325,000 hectares of land, and the reclaimed irrigated land will extend further over 6.8 million hectares of arid and semi-arid pasture land.

From now on, the campaign to recover the arid desert lands of Central Asia will take on even greater scope. In accordance with the directives of the Twentieth Congress of the Communist Party of the Soviet Union, the Central Committee of the Party and the Council of Ministers of the USSR adopted a resolution in August 1956 entitled "Irrigation and Reclamation of Virgin Lands of the Barren Steppes in the Uzbek SSR and the Kazakh SSR, for Increasing Cotton Production".

The Central Committee of the Communist Party of the Soviet Union and the Council of Ministers of the USSR confronted the laborers of Uzbekistan and Kazakhstan with an important State project: to establish a very broad cotton-raising district in the barren steppe, by means of reclaiming virgin lands, for a further increase in the production of cotton. On the basis of the decision of the Party and the government, it was planned to reclaim 300,000 hectares of new land, including 200,000 hectares of land in the Uzbek Republic and 100,000 hectares in the Kazakh Republic. In the period from 1956 to 1962, the Central Golodnostep Canal and the Southern Golodnostep Canal will be built, and the Kirov Canal will be reconstructed. The time has arrived for new sovkhozes, vehicle and road stations, cotton gins and serviceable automobile highways to make their appearance on the Barren Steppe.

The Soviet people will render the Barren Steppe habitable, and it will no longer be barren since, along with the cotton, it will yield fruit, meat, milk, and various agricultural products. The new sovkhozes will be given broad opportunities for the development of all branches of agricultural production.

On the basis of the decision of the Party and the government, the new cotton-growing district will receive a capable technical base. The Soviet peoples have at their disposal a rich experience in the field of reclaiming new lands. The heroic working class of our Homeland will supply the virgin lands with powerful tractors, combines, plows, drills, and other equipment.

The Kazakh Soviet Socialist Republic has never before experienced such a sweeping stride in its economic development as that provided for in the sixth Five-Year Plan.

The natural riches of Kazakhstan are inexhaustible. The Republic occupies one of the foremost places in the country with respect to reserves of iron ore, coal, petroleum, bauxite, lead, zinc, copper, rare metals, phosphate rock. Under the sixth Five-Year Plan, this wealth must be used to the best possible advantage.

The new Five-Year Plan will alter the face of many districts, cities, even

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whole regions.

The vast chernozem expanses (Black Earth Area) of the Kustanai Steppe have been brought under cultivation, and will yield hundreds of millions of pouds of marketable grain and other varieties of agricultural produce. Together with the extensive work for the reclamation of the virgin and fallow soil in the region, extensive work must be done and far-reaching planning must be initiated to mine the pay ores discovered recently.

The Kustanai region will become one of the richest granaries of the Soviet Union. At the same time, the Kustanai region is becoming transformed into a large-scale base for ferrous metallurgy.

Here, where the Urals and Kazakhstan come together, everything needed to establish a new powerful base for heavy industry in a short period is at hand. The mineral wealth of the Kustanai region, or of the area known as the Turgai Depression, includes reserves of iron ores many times in excess of the coal fields in the Urals, and coal reserves many times in excess of the reserves of the Karaganda Basin.

Large deposits of nonferrous and rare metals, and asbestos, have also been discovered in this area. All of these may be worked in open pits.

An iron-ore processing industry with a productive capacity of 10 million tons of ore annually is scheduled for erection, based on the Kustanai deposits, and plans have been laid for the construction of a large bauxite mine, an aluminum refining plant, and also for the mining of coals for power production on a large scale. The new Five-Year Plan contains projects for the construction of an ore-dressing combine and other large enterprises.

Pavlodar has been almost totally deprived of industry. It will now become one of the most important centers of machine building and metallurgy.

New industrial enterprises are springing up in other cities as well: Petropavlovsk, Kokchetav, Chimkent, Dzhambul, Semipalatinsk, Alma-Ata. New construction sites require huge supplies of structural materials. Plans have therefore been outlined for the erection of cement plants in Semipalatinsk and Chimkent, for slate producing plants, for plants manufacturing glass, ceramics, asbestos, prefabricated reinforced concrete, and dry plaster.

Hundreds of kilometers of wide-gage railroad track will be laid in the Republic during the sixth Five-Year Plan.

Kazahstan has available enormous possibilities for effecting a steep rise in all branches of agriculture. The Five-Year Plan envisages a fivefold extension of grain production. This growth is ensured first of all by the cultivation of limitless stretches of fertile virgin lands. The cultivated areas in 1956 were increased to triple that in 1953. In 1956, Kazakhstan delivered 1 billion pouds of grain to the State, overfulfilling the State Plan by 402 million pouds. This means that in one year more grain was turned in than was produced in Kazakhstan over a total of 11 years before the virgin lands were taken under cultivation. Kazakhstan is becoming one of the foremost grain-producing districts of the nation, particularly with regard to high-quality wheat of the hard-grain or durum varieties.

Operations conducted by Soviet geologists on the territory of Kazakhstan have resulted in the discovery of a multiplicity of new deposits of iron and manganese, coal and petroleum, titanium and bauxite, different nonferrous and rare metals and nonmetal minerals. New centers of industry will be established, based on such deposits.

One of the primary problems to be tackled in a sharp intensification of exploration and prospecting work in the Dzhezkazgan district, which is the richest. Exploration work will be extended to other copper deposits in Central Kazakhstan.

The next most important problem to be resolved by geologists in Kazakhstan is a forced campaign of exploration of known lead and zinc deposits and prospecting for unknown deposits.

Kazakhstan will be able to expand the raw materials base with respect to titanium and such rare metals as beryllium, tantalum, and columbium.

The directives of the Twentieth Congress of the Communist Party of the Soviet Union envisage a much further growth and strengthening of the entire minerals and raw materials base of our country.

The mineral deposits of the USSR contain inexhaustible hidden treasure troves of the most varied kinds of pay ores and minerals. The study and industrial mining of those minerals will keep more than one generation of Soviet geologists and miners fully occupied.

Geological exploration work has led to the discovery of new large coal and oil fields, and ore deposits of ferrous, nonferrous and rare metals and other minerals, on the basis of which large enterprises are being established for our heavy industry.

Many important, and sometimes difficult, problems remain to be resolved in the area of expanding the raw materials base supporting our industry.

In the first instance, exploration for new oil and gas fields must be intensified, and also prospecting for deposits of nonferrous and rare metals, titanium and manganese ores in the eastern districts of the country, as well as geological exploratory work in the preparation of new mining fields of coking coals in the Donets, Pechora, Kuznetsk, and South Yakutsk Basins, coals with low ash content and coking coals in Kazakhstan, and coals for the firing of power installations, in the European sector of the Union, in the Urals, and in Central Asia.

Several copper-smelting plants in the Central Urals are experiencing shortages of copper concentrates, which are partially brought in from Dzhezkazgan and mines in the Southern Urals. Geologists in the Urals will intensify their prospecting for copper deposits within the range of the principal and eastern greenstone belts of the Central Urals, during the sixth Five-Year Plan. At the same time, prospecting and exploration work will be developed further in the districts of the Southern Urals.

In the Caucasus and Transcaucasian areas, favorable geological prerequisites have been discovered, justifying a further expansion of the raw materials base in molybdenum and copper. In Georgia and Northern Osetia, prospecting will be intensified for new finds of lead and zinc, and several other useful minerals.

The sixth Five-Year Plan is a great step forward in the rational allocation of the productive forces of the nation, the optimum division of social labor based on specialization and cooperation in production and on the total development of the economic districts and Union Republics.

The Working People - Our Basic Production Asset

The entire history of the development of production under conditions of capitalism serves as convincing proof of the fact that a system based on private-property relationships chains creative initiative, the energy of the working people.

Under capitalism, the working class raises the degree of its skills while remaining in the position of an appendage to the machine.

Under conditions of socialism, the machines are not an opporessive factor, but on the contrary liberate the creative forces of the working people. For the first time in history, the laborer becomes the complete master of production, raising on all sides the productivity of collective labor.

Basing itself on the objective laws of development of Soviet society, on the revolutionary and labor experience of broad masses of laborers, Leninism teaches that in order to build communism, the productive forces of society must be developed in the first instance: These productive forces are the machine tools of labor and the basic productive force - the laborers themselves, their creative capacities and creative talents.

After the Great October Socialist Revolution, the road was cleared for the establishment and development of new labor and social relationships, a new psychology, new habits, and morality. If we remember how the Party of the Bolsheviks began to wake the consciousness of the working people, if we remember how the pre-Revolution worker, peasant, intellectual appeared in the mass, we can readily see how grandiose have been the shifts produced in the consciousness of the multimillion masses, how great have been the victories achieved by the socialist ideology.

As a result of the long, universal educational work of our Communist Party, the spiritual face of the working class of our country has changed, the working class becoming the leading force of Soviet society.

The new working people, workers and peasants, women and men, peoples of different nationalities, all of these are the wards of our Party. Ahead lies long and diverse work in the further communist education of the working man. However, what has already been accomplished in a historically short period in the way of reshaping the consciousness of millions of laborers for the development and enrichment of their spiritual world, for the strengthening of their new psychology and new morals, bears witness to the strength, greatness and wisdom of our Party, the leader and educator of the people.

In all stages of socialist construction, the Communist Party and the Soviet government will expend much energy and time in the effort of preparing and drawing into socialist production new cadres of workers, educating and training the growing generation of builders of communism, raising their skills and cultural and technical level in all aspects.

From its very first steps, the Soviet government has been organizing the productive training of the workers, helping them to overcome their technical illiteracy.

The Soviet government has prepared the working class cadres in the process of production itself.

Hundreds of thousands of experienced workers have been training millions of new workers. This method of mass training of cadres can attain full development only under the conditions of the Soviet system of economy, where the worker is not threatened by unemployment, where he has nothing to fear from revealing the "secrets" of his workmanship, where the spirit prevailing is one of comradely mutual aid and cooperation in labor for the benefit of all of Soviet society. This concern

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for each new addition to the labor force may be manifested only by the working class of a country of socialism, which carefully sustains and actively multiplies its best revolutionary and labor traditions, love for work, patriotism, loyalty to the general cause, ability to apply all of one's strength in the name of the goal of the entire people, striving to manifest in all activity a creative beginning, to support what is new and progressive.

Our Party devotes particular attention to the working youth, which has the task of carrying forward the great banner of communism. The Party has and still is educating the youth not with the aid of ready-made moral precepts, but directly in labor, in the struggle for the building of communism. The Party is educating a new generation in the spirit of the glorious revolutionary traditions of the older generation of the working class, is teaching them audacity and fearlessness, steadfastness and courage.

The problems of the youth, said V.I.Lenin on 2 October 1920, at the Third Congress of the Komsomol (Communist Union of Youth), may perhaps be expressed in the following words: "the problem is to study and learn". V.I.Lenin called upon the youth to study communism, to master all of the achievements of modern science, engineering, and culture, to enrich their memories with the knowledge of all of the wealth developed by humanity, and to put these acquisitions to the service of the building of the new society.

In mastering knowledge, the youth is obliged to associate each forward step in his or her ability, education, and training with the general struggle of the laborers, to coordinate this with the labor of the workers and peasants, since only in labor together with the workers and peasants could he become a true communist. It is necessary, taught V.I.Lenin, that youth solve some practical problem of the general labor, be it the smallest or simplest problem, each day in some village, in some city. In this lies the foundation of the success of the communist education of youth.

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In order to prepare the youth to take its part in the production in our country, a network of vocational and technical courses was established which embraced almost all of the more or less significant enterprises in the country. The instructions of the Party, relating to the subordination of the labor of the working youth to the aims of aspiring to and acquiring skills, relating to the organization of schools which combine practical training with theoretical education and sociopolitical education, form the basis of the socialist system of the vocational and technical preparation of the new additions to the working class.

As early as December 1922, at the Tenth All-Russian Congress of Soviets, note was taken of the "growth of plant - factory apprentice schools, as the unique type of school serving the working youth occupied in productive labor". The Congress went on record in favor of a decisive expansion of the network of such apprentice schools, to a number capable of accommodating all of the adolescent working generation. The Congress of Soviets emphasized the special significance of such schools for the training of healthy, cultured, and politically active reserves of the working class.

Under the historical conditions prevailing in the early Twenties, in the first stages of socialist construction, the Communist Party and the Soviet government laid out the future channels of development of the mass training of skilled workers. A new type of Soviet vocational school was established, factory - plant apprentice schools, in which productive on-the-job training was combined with a general and technical education, with the communist education of the working youth. The factory - plant apprentice schools played a vital role in the training of skilled workers for all branches of the national economy.

To ensure the further development of socialist industrialization based on the priority and accelerated development of heavy industry and based on the electrification of the country, the Communist Party pointed out that a necessary prerequisite for solving the problem at hand was the development of cadres, the decisive and sharp expansion and qualitative improvement of practical work in the field of training and increasing the skills of the cadres of industry. The Sixteenth Congress of the Party recognized the factory - plant apprentice schools as the fundamental form of training of skilled workers from the youth level, and called for a considerable extension of the existing network of both contingents of such schools and of schools of wholesale on-the-job training and in-service training in industry.

Factory - plant apprentice schools not only prepared new cadres of highly skilled workers (set-up men, repair and maintenance men, tool and die makers etc.), but also cadres of workers equipped to carry out specific operations in mass production. During the years of the first and second Five-Year Plans, one of the first buildings to go up on any construction project of a newly constructed plant, factory, or mining facility was the factory-plant apprentice schools, where training of cadres of young workers would be in progress right during construction of the plant. For example, over the period of 1930 - 1933 alone, about a thousand factory - plant apprentice schools were built.

The students of the factory - plant apprentice schools were dispatched to the first blast furnaces, open-hearth furnaces, and steel rolling mills of Magnitogorsk and Stalinsk, to the new mine pits in the Kuznetsk Basin and at Karaganda, took their places at the lathes and machine tools of the Gorky and Moscow automotive works, the giant tractor combines of Stalingrad and Chelyabinsk, at the machinery of the Stalinogorsk and Chernorechensk chemical combines. While before the first Five-Year Plan, factory - plant apprentice schools accounted for 80,000 skilled workers, these schools trained as many as 450,000 skilled workers during the course of the first Five-Year Plan. During the second Five-Year Plan, these apprentice-schools trained 1,400,000 workers, and during the 20 years of their existence, they have given the nation about 2,500,000 skilled workers.

The impetously developing industry of the Soviet land has imposed such demands on the rate of growth of the working class that the factory - plant apprentice

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schools alone were unable to satisfy the requirements of the labor market. The Sixteenth Congress of the Party therefore placed on the agenda for the coming years, along with the requirements for extending the factory - plant apprentice schools as the basic form of training skilled workers from the ranks of the youth, the problem of a broad development of short-term training and pretraining of labor power. This necessarily entails the obligatory subsequent raising of the productive and technical, as well as cultural and polytechnical, level of the workers.

This was the only right road to take in solving the problem of adding to the cadres of the working class and in solving the problem of the socialist reproduction of labor power. In all of the most remote districts of the country, plants were built, mine pits and mines were opened, oil wells were drilled, and new cities arose. The new life resuscitated older enterprises, which were expanded and rebuilt on the basis of advanced technical achievements. Everywhere, together with factory - plant apprentice schools, a network of technical clubs was set up, mass measures for the assimilation of the new techniques were carried out.

The establishment of skilled cadres of workers in the production process itself was a historical necessity in view of the rapid rate of socialist industrialization, growth of the needs for labor power and a shortage, in the early periods, of technically literate people. Under such conditions, no prolonged delay in production and in the mass exploitation of machines could be tolerated, there could be no waiting until the schools trained technically equipped cadres. The country had to proceed immediately to the building of machines and to the development of their mass utilization in the national economy, at the same time training people in the techniques, setting up skilled cadres.

The Soviet plants became, for millions of people, a school of socialist labor. Young men and girls entered the factories and plants without any kind of training and had to master work on the latest machinery in a short time, to become skilled workers. New cadres of workers were formed in the process of mastering the new

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techniques, assimilating and using them in their work. In answer to the call of the Communist Party to master production techniques, technical instruction was broadly developed throughout the nation.

The broadest masses of workers aspired to training in skills and techniques. Different production and technical courses and schools were set up in all of our factories and plants. As early as 1932, the State technical minimum was introduced for workers in the leading qualifications. Technical training began to assume an ever wider scope.

On the basis of the growth in skills and technical training, socialist competition was raised to a higher level. A movement of production innovators, breaking the old norms in production and overfulfilling their productive tasks by many times, took root in the country. Modifying and perfecting existing productive processes, these innovators achieved a sharp increase in their output with the same expenditure of labor and materials. The basis of that movement lay in the fact that the best representatives of the working class, who had not only mastered the technical minimum, but had even gone beyond, approaching and reaching the level of the engineering and technical personnel and often surpassing the latter, originated in the medium of the working class itself.

As early as 1935, the December Plenum of the Central Committee of the Communist Party advanced the following requirement: The training and improving of skilled workers, the overall training of workers to qualify for the technical minimum (obligatory for all workers), is to be subordinated to the task of raising the cultural and technical level of the working class to the level of workers engaged in engineering and technical labor.

The cultural and technical rise of the working class is manifested in the gradual elimination of the essential difference between intellectual and physical labor, and clears the way for achieving the higher productivity of labor necessary for the transition from socialism to communism.

During the years of the prewar Five-Year Plans, the Soviet working class grew in size and strength. It developed its own production and technical intelligentsia. Hundreds of thousands of workers became engineers, directors of enterprises and institutions.

During those same years, considerable changes took place in the composition by nationalities of the working class of the USSR. Cadres of workers of the principal nationalities grew up in the industrial enterprises of all of the Union and Autonomous Republics. The swift growth of national cadres of skilled workers was an exemplary demonstration of the triumph of the Leninist policy on nationalities, which made possible an unheard-of prospering of the productive forces in the previously economically backward and most oppressed national border areas of pre-Revolution Russia.

The successful accomplishment of the organized selection of labor power on the kolkhozes contributed to the fulfillment of the plans laid down under the prewar Five-Year Plans. Quite a few pioneer workers and innovators, outstanding foremen and masters in industry, construction and transportation came from the ranks of kolkhoz workers who entered the working class during those years.

State Labor Reserves

A new page in the development of the Soviet Union, namely the epoch of completion of the building of a socialist society and the gradual transition from socialism to communism, was heralded by furthergoing and ever broader development of industry, in the first instance of the leading branches of heavy industry. In 1940, under the incessant development of socialist industry, it became obvious that the ever increasing needs for labor power could not be satisfied either by the organized recruiting of workers from the kolkhozes or by the factory - plant apprentice schools. The new enterprises, equipment and construction projects, working with increasingly complicated techniques, required workers who were even more highly skilled; the kolkhoz workers channeled into industry either had no professional skills at all, or had some skills but at a level entirely inadequate for the purpose. The newcomers therefore had to be shunted off to secondary occupations or to work sectors where no special skills or experience were required for the work. This in turn led to the situation where a sizable portion of the newcomers lost interest in production and drifted back to village and countryside. The enterprises were again obliged to recruit workers and to again make efforts toward training them.

The factory - plant apprentice schools, set up as adjuncts to large enterprises had no standardized methodical administration, stable curricula or textbooks; each enterprise trained its cadres solely for its own needs, without taking into account the needs and requirements of the national economy as a whole. These schools were reluctant to take on the difficult job of training workers in the leading professional skills, which in essence would decide the success of the effort in heavy industry, i.e., in the metallurgical, fuel, and power industries.

The upshot of all this was that industry, transportation, and construction experienced a sharp shortage in skilled workers. At the same time, the socialist mode of production presupposes appropriate conditions for the reproduction of labor power. One of the basic underlying conditions for expanded socialist reproduction is the planned channeling of labor power to the productive enterprises. The labor reserves of a socialist society must be distributed according to plan between the branches of the national economy and specific enterprises. A constant rise in the level of the skills and culture acquired by the entire mass of workers is a characteristic feature of the reproduction of the cadres in a socialist society.

The planned socialist economy lets the Soviet government have at its disposal not only material resources and financial means and distribute these in accordance with the requirements of the national economy, but also to exert control over the planned training, distribution, and utilization of labor power. The training of skilled labor power, the distribution and redistribution of the labor reserves between the branches and spheres of the national economy in a socialist economy is a most important task confronting the State. This is one of the principal functions of a socialist government.

The government ensures the expanded socialist reproduction of labor power, a systematic inflow of the needed labor power into our rapidly developing industry. In contrast to capitalism, socialism knows no such disastrous phenomena as a constant surplus labor market, a multimillion army of unemployed, which has become one of the chief characteristics of large-scale capitalist industry.

The socialist State has at its disposal powerful, constantly replenished State-controlled labor reserves, without which socialist industry cannot develop and which are distributed in accordance with the requirements of the plan for development of the national economy. The mass training of skilled cadres for socialist production is one of the decisive conditions for raising the productivity of labor, for the ultimate development of the national economy on the basis of advanced techniques, for the growth of the material welfare, and the increase in the cultural level of the Soviet people.

As early as 1919, V.I.Lenin emphasized the fact that one of the basic principles of the communist unification of labor is the fact that the State authorities allocate the available labor power to the various branches of the economy and the different enterprises. This Leninist concept has found its embodiment precisely in the establishment of a State-controlled labor pool, trained and distributed by the State according to the needs of socialist production branches.

The State labor reserve of the Union of Soviet Socialist Republics was created in accordance with the decree of the Presidium of the Supreme Soviet of the USSR dated 2 October 1940. The text of the decree clearly formulated the basic fundamental positions determining the organization of the system of State-controlled labor reserves:

"The problem of the further expansion of our industry requires a constant

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supply of fresh labor to the pits, mines, transportation sector, factories, and plants. Without a continuous replenishment of the make-up of the working class, the successful development of our industry is impossible.

"Unemployment has been completely wiped out in our country, poverty and want in country and city have been done away with forever; in view of this fact, we have no people forced to knock on the doors of factories and plants begging for work, thus forming, in an elemental fashion, a constant labor pool for industry.

"Under these conditions, the State has the task of an organized training of new workers from the city and kolkhoz youth, and the establishment of the necessary labor pool for industry."

It is well to remember at this point that it is extremely difficult for young people in a capitalist society to acquire productive skills: training there is high in cost, is achieved at the expense of the worker himself and his family, and is far from accessible to all or within everyone's means. The socialist State completely takes over the material expense associated with professional training. The youth are taught free of charge in the system of labor reserves and are supplied with food, clothing, living quarters, teachers, and textbooks.

The organization of the productive training of city and kolkhoz youth was still another manifestation of the concern of our Party for the communist education of the younger generation, for incorporating them into the ranks of highly productive socialist labor.

The system of labor reserves gives the Soviet government the opportunity to train young workers on the basis of a single plan for the national economy, and to place them in various enterprises, with due account taken of the needs of different branches of the national economy and of the different economic districts of the nation. The training institutions and the labor-reserve schools have become one of the principal sources for the replenishment of the working class in socialist society.

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The Soviet youth fervently followed the appeal of the Party and the government to learn factory skills. There is no better testimony to their burning desire to enter the new schools, to their eagerness to take active part in socialist construction, and to expend their forces in the service of the Homeland than the unending flow of applications.

The system of State labor reserves required directors of training institutions, thousands of foremen for on-the-job training, instructors, auxiliary personnel. The Party and the government supplied the training centers with about 45,000 persons having some experience in Party, economic, and production-pedagogic work, including over 20,000 foremen with experience in on-the-job training.

In large cities, in industrial enterprises, railroad junctions, construction sites, maritime and river ports all over the Soviet nation, over 600 trade schools and over 120 railroad training schools were set up inside of a short period. Over 800 factory - plant apprentice schools began operation, and together with the schools opened later for training workers for the lumber industry, building-materials industry, and railroad construction work, over 1300 factory - plant apprentice schools were started. About 900 straight schools and apprentice schools were organized around the base of factory - plant apprentice schools taken from the corresponding departments. Special attention was paid to the training of workers in such schools for the coal, metallurgical, and defense industries, and also for construction work.

On the basis of production training in trade schools and factory - plant apprentice schools, the principle was to master a skill while performing socially useful labor, under conditions approximating actual production. The trade schools and apprentice schools became enterprises of a sort, where on-the-job training of the students was combined with productive work; from the very first days of work in the school, the student came in contact with actual industrial raw materials and finished goods, and learned how to manufacture useful, even if simple at first, commodities on the school machine tools.

This principle excludes any kind of arbitrariness in the training process. The student sees from the very beginning that his labor is of use to himself and at the same time necessary to the State, for which the trade school or apprentice school for labor reserves is producing valuable and necessary items.

The same principle lay at the basis of the training programs, which in fact constituted the difference between these and the programs of the factory - plant apprentice schools. In the latter, most of the training time was given over to a study of the theoretical foundations of the productive process. At the same time, going overboard in the general disciplines not infrequently resulted in the inability of graduates of such schools to perform the simplest operations familiar to any worker with practical experience, when these students arrived on the production line or bench. In the trade and railroad schools, almost five sevenths of the training time was given over to on-the-job training, and almost all of the training time was devoted to actual job training in the factory - mill training schools.

Theoretical training in the trade and railroad schools, from the very beginning of the creation of the labor reserves, had the aim to not merely "break-in" the young workers but to have them master the techniques involved and acquire a clear concept on the course of the entire productive process, become able to read drafts, get a grounding in the technology, and become familiar with the technical literature in their specialty.

The trade and railroad schools and the factory - mill training schools became a reliable base for the training of medium-skill workers in the mass job categories needed by industry, transportation, and construction. Detachments of young workers arrived at the same level as industrial worker cadres. The trade and railroad schools, in which on-the-job type training was combined with the study of the theoretical background and technology, successfully accomplished the training of the necessary cadres.

With the first graduate class of the labor-pool schools, a new and remarkable page in the history of the planned training of worker cadres in our country was started. Socialist production immediately incorporated over 250,000 young men and women who had mastered the skills of miners, construction workers, metal workers, oil field workers, metallurgists, railroad workers. A quarter of a million of able-bodied, energetic, and alert young patriots began to render our people assistance in the fulfillment of the grandiose plan of development of the national economy.

The Soviet working youth demonstrated their high moral and political standards during the period of the severe trials faced by the Homeland during the years of the Great Patriotic War. The unprecedented labor exploits of our glorious youth in the factories and mills, on kolkhozes and sovkhozes, were entered forever into the pages of the history of Soviet society. Soviet young men and women, demonstrating their valor and herosim on the labor front, proved to be worthy of their fathers and older brothers who were defending the Homeland against the Hitlerite aggressors.

Representatives of the new generation of the working class - trade school instructors and labor-reserve school instructors, were in the front ranks of the heroic fighters on the labor front. During the war years alone, 2.5 million young workers, trained in the system of State labor reserves, poured into industry. They were dispatched in large solid detachments to sectors of the national economy most important from the standpoint of defense, to the mills producing ordnance and ammunition, to ferrous and nonferrous metallurgy enterprises, to the coal, machine-building, and power industries, to the railroad-transportation network, to construction projects.

Let us remember, for instance, how aircraft factories had to be built under war conditions in the eastern districts of the country, primarily engine-manufacturing plants. By dint of the heroic efforts of the working class, those plants were built in the shortest time possible. But, in order to get the lines rolling, skilled workers were needed, especially engine builders. The chief administration of the

State labor reserves was commissioned to recruit, within a two-week period, 15,000 young workers from those in training - lathe hands, machinists, milling-machine operators - and to direct them to such airplane plants. This military mission of the Party and government was successfully accomplished.

Young skilled workers with unbounded devotion to the Homeland, with a single endeavor - that of helping the armed forces of our country - forged the victory over the enemy, with entire disregard of hours worked, sometimes without even leaving the shops for days at a time. With their deeds they justified the confidence placed in them by the Party, the government, and the fighting forces of the valiant Soviet Army. By the end of 1943, the new aircraft factories in the east of our country were already working at peak capacity.

The make-up of the workers in that branch of industry was sharply replenished. The number of young workers in the aircraft factories, predominantly those trained in the labor reserves, reached 80 - 90% of the total number of all workers. After some time, of the hundreds of thousands of workers trained in the labor reserves and sent into the aircraft, tank, artillery, and mortar plants, as well as into munitions factories, over 10,000 brigade leaders of youth front-line brigades and assembly-line foremen were brought forward. With their labor exploits, they demonstrated what Soviet youth is capable of, in full mastery of advanced techniques.

At the end of the war, the Party and government adopted a decision to send 20,000 young workers trained in the trade schools and labor-reserve schools of Moscow, Tashkent, Tbilisi, Kemerovo, Chelyabinsk, Sverdlovsk, Kuznetsk, Gorky, Chkalov, and other cities, into the liberated Donets Basin. After adoption of the resolution, only two weeks elapsed before 8000 construction workers had been selected, including carpenters, joiners, bricklayers, concrete workers, riggers, welders, and 12,000 metal workers, including machinists, lathe hands, milling-machine operators, blacksmiths, and other specialists were chosen. Detachments were formed of those workers, headed by foremen and by directors of trade and labor-reserve schools.

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These detachments were equipped with portable machine shops with the necessary machine tools, electric welding equipment, transportable furnaces, anvils, measuring, cutting, and lathe-setting tools.

The significance of these detachments of young workers in the reconstruction of the mine pits, metallurgical works, and power plants of the Donets Basin was very great. Together with the students graduated from the trade schools and labor-reserve schools, they constituted from one fourth to one half of the entire working force engaged in the rebuilding of such enterprises as the Stalin, Yenakiyevski, and Makeyevski metallurgical works and the Zuyev electric power station.

An enterprise so vitally important for metallurgy in the Donets Basin as the Chasov-Yarskii refractories plant was three-fourths restored by the efforts of the youth detachment of the labor reserves. Three thousand young men and women were sent to the ruins of the Zuyev, Shterov, and other electric power stations, which had to be rebuilt in order to get industrial enterprises back into operation. Six thousand workers were dispatched to build up the Yanekiev and Stalin metallurgical works, 8000 to restore the mine pits and 3000 to rebuild the plants at Kramatorsk, Slavyansk, Drukhovka, and Konstantinovka.

Most of the work in the reconstitution of transportation facilities, light industry enterprises, and other branches of industry was carried out by young workers and students enrolled in the system of labor reserves.

In 1945, the Party and government posed in all sharpness the problem of a universal improvement in the quality of the training given the young workers, and demanded a steep rise in the level of the training and educational work performed in the trade schools and labor-reserve schools. A broad program for the reconstitution and expansion of the network of labor-reserve training institutions was drawn up and carried into action. In 1946, the government promulgated an extended program of measures for the further improvement of the training given the labor reserves, and for increasing the number of workers being trained in trade schools, railroad training schools and factory - mill training schools. The Party and government manifested unflagging concern for the development of the system of labor reserves, and systematically rendered assistance to the trade schools and labor-reserve schools, with the aim of raising the quality of their training programs in all respects.

In the interests of the development of the national economy of the country, the graduates of the labor-reserves system were channeled into the most important branches of production and into the economic districts of the country which were most important in terms of the overall national economy. During 15 years of existence of the labor reserves (1940 - 1955), countless detachments of young workers were poured into the ranks of the working force in the leading branches of industry, with priority given heavy industry enterprises. Of 8 million graduates from trade schools and labor-reserve schools, the bulk was employed in coal, metallurgical, machine-building enterprises, on construction projects, and in the transportation system. For example, the machine-building industry absorbed 1,700,000 young workers in that time, the coal industry 1,200,000, the railroad transportation system over 800,000, industrial construction developments employed 770,000, metallurgical plants and mills absorbed 650,000, etc. It was precisely in those sectors of socialist production that the need for new workers cadres was the most pressing.

The network of training institutions under the system of State-controlled labor reserves grew from year to year. Their number rose to over 3000 as early as 1955. Entirely new schools have been set up for skills training and labor-reserve training in all Republics of the Soviet Union.

In the Ukraine alone, there are 658 different labor-reserve training institutions. In the 15 years of existence of the system of labor reserves, about 1,500,000 workers who had completed trade and labor-reserve training were absorbed in industrial enterprises, in transportation and construction work, and in the agricultural work force of the Ukraine.

In the Kazakh SSR, during the past two years alone (1954 - 1955), the number of

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labor-reserve training institutions has been increased from 61 to 122. The number of workers trained in such institutions rose from 9800 in 1953 to 26,000 in 1955. Since 1940, the rapidly growing industrial enterprises appearing in all the districts of Kazakhstan, the innumerable construction projects, the new railroad lines of the Republic have absorbed over 300,000 young workers who received their training in the labor-reserve training institutions.

Many new enterprises have started operation during those years in the Uzbek SSR, and graduates of the labor-reserve system are at work everywhere in those enterprises. They are mining coal in the mine pits and mine galleries of Angren, melting steel in the Begovatsk metallurgical works, building the young and growing industrial center of Almalyk, laying new railroad track. During the years of their existence, the trade schools and labor-reserve schools of Uzbekistan have prepared over 140,000 young workers, and are now considerably expanding their network and the curriculum of skills taught.

In Tadzhikistan, during the first five years (1940 - 1945) of the existence of the labor reserves, 8000 skilled workers in the mass job categories were trained and sent into production, while in 1955 there were already over 20,000 graduates of the trade schools alone, young coal miners, oil field workers, railroad men, communications technicians, agricultural mechanics, etc. working in the enterprises, transportation facilities, and construction facilities of the Republic. In the district and industrial centers of the Tadzhik SSR, new and still newer schools are being set up. In 1955, schools were started in Pakhtaabad, in Kurgan-Tyuba, in the oil field settlement of Kim, at Kanibadam, Ura-Tyuba; in Sharkhinau, a school was opened for teaching courses in the mechanization of agriculture, directed specifically at young women who will be the future tractor operators.

The network of labor-reserve training institutions is undergoing a rapid development in the young Soviet Republics on the Baltic Coast. During the postwar years, roughly 31,000 skilled workers were trained in the Estonian SSR for the dif-

STAT

ferent branches of the national economy: over 10,000 construction workers, over 7000 metal workers, over 3000 shale field workers, about 5500 agricultural mechanics, etc. The labor-reserve training institutions of the Lithuanian SSR have trained and sent into production over 30,000 skilled workers.

With each coming year, the training and production base of the trade schools and labor-reserve schools is strengthened further. These schools receive new supplies of equipment, the latest machine-tool prototypes and mechanisms, sets of modern instrumentation, and various accessories. The number of textbooks and training manuals published is being increased, new buildings are being built for the trade schools and labor-reserve training schools. Machine shop trainers, laboratories, metal-working cabinets, workshops for special technology and other disciplines are being built and re-equipped. Thousands of highly skilled workers are sent in from industry to function as experts for in-service training.

New Techniques and the Problems Involved in Training Workers

The training of skilled cadres increasingly depends today on the development of total mechanization and automation of production. Control of the most varied productive processes is becoming more widely automatic in nature. The automatic system of machines will further replace manual labor, open new possibilities for the growth of the productivity of labor and at the same time for a rise in the cultural and technical level of the working class, freeing man from a number of fatiguing operations, and facilitating the labor process. The maintenance of automated labor processes requires higher skills on the part of the worker, technician, and engineer. The question of training specialists in automation and remote control, in automation of production and instrument manufacture, recruited from the ranks of students in secondary and higher training institutions, acquires an extremely vital importance in this connection.

Working with the new machinery and mechanisms requires of the worker, in addi-

STAT

tion to professional skill in his trade, a knowledge of the fundamentals of mathematics, mechanics, or electricity and requires the ability of achieving continuous operation of the machinery and devices without stoppage. Without the acquisition of thorough knowledge, the worker is incapable of mastering the complex techniques now being continually introduced into Soviet industry, construction, agriculture, and transportation.

The widespread popularization of the use of high-speed and power cutting tools, multiple machine operation, introduction of machine tools producing whole subassemblies, total mechanization of basic and auxiliary operations, automation of control and transition to assembly - line arrangements of automatically controlled machine tools - all of this introduces decisive changes in the character of the labor performed by the workers.

The Soviet machine-building industry, for example, needs workers who are thoroughly familiar with the equipment of various shops for cold-working metals, adjusted to an assembly-line type organization of production. In assembly-line production, the worker operating the machine tool cannot be limited to merely starting and stopping the machine tool. During operation, he adjusts the mechanisms, and must make secondary fine adjustments in the machine setup as the cutting tools wear out and become dull. The worker must be acquainted with the design and interaction of the component mechanisms, the conditions under which the components will perform correctly, the causes of possible malfunction, and the methods effective in preventing shutdowns and eliminating bugs. In this respect, it is impossible to get along without a knowledge of the kinematics of modern machine tools, hydraulic and pneumatic devices, electronic control, automatic communications, methods for tooling up and setting up machine tools. Multi-index position and multiple-tool automatic transfer machines and semiautomatic machine tools not only require maintenance adjustments in the course of operation, but also require periodic changes in setup, which must be performed by a specialist in setting-up operations. This specialist is usually called upon to service 6 to 10 different types of machine tools forming a section of an assembly line. The skill of a set-up man is entering the mass job category. In addition to workers for the basic machine-building shops, highly skilled lathe operators, milling-machine operators, polishers and grinders, and machinists for tool and die shops, maintenance and overhaul shops, and experimental work are needed. They will perform general-purpose work of special complexity, which is demanding the highest skill levels.

The worker in the Soviet machine-building plants - the highly skilled machine tool operator of the not too distant future - will be called upon to operate and manage a group of different machine tools, of the lathe and screw cutting type, jig borers and drilling machines, and also machine tools combining different functions. The worker of another category will have to assimilate the operation of milling, broaching, boring mill and gear hobbing machines; a third worker will have to be able to operate grinding and lapping machines, etc.

New types of metal-cutting machine tools, special and combined machine tools, semiautomatic and automatic transfer machines, automatic press forging units, machines for die-casting and centrifugal casting impose new demands on the workers engaged in the operation of such machine tools.

For operating modern mechanized blast furnaces, open-hearth furnaces, and steel rolling mills, a mastery of the scientific fundamentals of production, of the chemical and physical processes involved, will be required.

Significant changes are being introduced by technical progress in the character of the labor and the professional training of construction workers. Changes in the techniques used in construction work entail further changes in the make-up of construction workers, in the relationship between the number of workers involved in mechanized labor and those engaged in manual labor.

Thus, in earth-moving, loading and unloading, and transportation operations and projects, the skills most in demand will be those of power-shovel operators, bulldozer drivers, dragline operators, hydraulic-excavator operators and earth-dredger operators, truck drivers and tractor and caterpillar drivers, drivers of dump trucks and operators of self-powered cranes. These occupations will come to replace the unskilled digger, now on the way out.

In the erection of buildings, prefabricated foundations placed in position by crane operators or operators of tower cranes and riggers, are coming into ever wider use.

The old, laborious processes involving erection of walls and roofing made of materials assembled in small units (brick, stone, small concrete slabs) are being crowded out by new, progressive methods involving the use of larger-size units (large wall units, wall panels, roofing panels, room partitions, etc.). The manual working methods of the bricklayer, which are not amenable to mechanization, will give way to less laborious, more readily mechanizable methods of work, which are reduced in the final analysis to the assembly and erection of units and panels with the aid of hoisting devices and cranes. In 8 hours, two bricklayers can lay a brick wall 3.5 m^3 in volume. In the same time, two riggers can assemble a wall of large-size prefabricated units measuring 25 m^3 in volume. In the assembly of buildings, installations and facilities with the use of large-size prefab units, the prime skills on the construction project became those of tower-crane operator, rigger, and electric welder.

The most far-reaching changes take place on construction sites and in finishing operations. In connection with the more widespread use of dry methods of finishing the internal surfaces of buildings, and the replacement of decorative plastering by façades covered with plasterboard materials, most of the time in advanced construction projects is not so much spent in applying plaster by the old "wet" method, but in doing the facing work on the inside surfaces using sheets and slabs of plasterboard. In this connection, the profession of plasterer has been combined in a number of cases with that of plasterboard, tile-mosaic, and marble-slab layer.

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The electrification of railroad transportation exerts its effects on the labor of transport-system workers, and creates better conditions for work, freeing a sizable proportion of the workers. In electric and engine-driven trains, the engineer works in a covered, warm, well-equipped cab. It is far simpler and more convenient to run an electric train than a train with a steam locomotive.

The content and form of the training of young workers under the system of State labor reserves will meet to an increasing degree the new requirements of the national economy, and the requirements of technical progress in socialist production and in the cultural and technical growth of the workers of the nation. It is along this line that the development of the State labor reserves is being directed in the post-war years.

The youths are being trained to an increasing extent, under the system of labor reserves, to handle those skills whose specific weight in production will inevitably increase as technical progress advances. Among the graduates of the trade schools and the labor-reserve schools, we may find representatives of hundreds of the most different skill categories.

The training of workers for machine building has been greatly expanded under the system of labor reserves.

Together with skilled machinists, lathe operators, milling-machine operators, and other metal workers, the machine-building and metal-working industries are now obtaining, from the labor pool, set-up men for polishing and grinding automatic and semiautomatic machines, etc. Together with machine-tool operators for assembly lines, the system of labor reserves will furnish trained set-up men for highly productive equipment operated on an assembly-line basis. New cadres will be made available to work in such complex branches of industry as the radio and electronics industry, electric power, and appliances manufacture. Along with miners, the coal industry will absorb machinists for operating stationary compressors, winches, screening machines, jaw crushers, and conveyor belts. Representatives of over 20 skill categories are being trained in the trade schools and labor-reserve schools solely for the field of shipbuilding and waterways transportation. Future helpers for locomotive and electric train engineers, train personnel, etc. are undergoing training for the railroad transport system.

Special factory - plant apprentice schools were organized in the postwar years in order to train cadres of mechanics for construction work, using a 12-month period rather than the usual six-month preparatory course. The training of highly skilled building and construction workers to handle especially complex tasks in construction, rigging and finishing, was carried out in construction trade schools on the basis of a two-year training period. Under the sixth Five-Year Plan, the network of such trade schools and labor reserves training schools will be greatly extended, and in some skill categories (in finishing work) building-trade training schools with a three-year training period will be instituted.

Under the conditions of acceleration of technical progress, one of the leading types of training institutions in use under the system of labor reserves has been the technical school, where young people with a secondary educational background are eligible.

In a comparatively short training period, covering one to two years, the technical schools have graduated highly skilled workers and young technical personnel in over 170 distinct specialties; workers in particularly complex skill categories undergo a training course lasting two years. Inside the walls of such schools, the youths are trained in the most responsible specialties, associated with the control and operation of complex devices, machinery, and assemblies.

For the metallurgical industry, the technical schools are training machinists for the drive motors of rolling mills and machinist-operators for such mills, as well as laboratory technicians for research on metallurgical and coal-tar derivative chemical processes; for the coal industry: machinists and machinist's helpers for coal combines and cutting machines, mine-pit electricians, mine foremen; for the

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petroleum and chemical industries: rigging and drilling crews and machinists for self-powered well-drilling units, operator's helpers in petroleum refineries, laboratory technicians in petroleum research and testing laboratories.

The power-generating and the electric manufacturing industry both now get machinists for operating steam and hydraulic turbines, electricians for servicing automatic telephone dial stations and radio-television equipment, with one or two years of training behind them. The technical schools make available to agriculture electricians for electrification and setting up of radio facilities, laboratory technicians for kolkhoz laboratories, radio technicians for machine and tractor stations, and sovkhoz mechanics. A good deal of attention is devoted to the training of designers and draftsmen, planning personnel, inspectors for technical inspection and control, and dispatchers.

The training course in the technical schools consists of theoretical and practical work, carried out in well-equipped laboratories, shops, and in actual plants. The students receive a good share of theoretical training. For example, future set-up men for automatic and semiautomatic machines study the general technology of metals, the fundamentals of metal cutting theory, the design and performance of machine tools, applied mechanics, electric equipment and automatic control of production, organization of labor and production, and a number of other disciplines. However, the paramount place in the work of the schools is taken up by productive on-the-job type training, to which over two thirds of the entire training time is devoted.

In the technical schools, particularly favorable conditions conducive to the study of complex skills are created. These schools immediately won for themselves wide popularity among the Soviet youth. They have a great future before them: To the extent that the number of youths with a secondary educational background increases, the training of workers in most job categories will become concentrated in the technical schools. In the years of the immediate future, there will be a much

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greater proportion of students with ten-years' schooling entering the training institutions of the labor reserves than there will be with seven years' schooling.

At the September (1953) Plenum of the Central Committee of the Communist Party of the Soviet Union, N.S.Khrushchev pointed out that the need had matured for introducing a change in the system of training tractor operators, combine operators, and workers in other mass-skill categories engaged in agricultural production. In order to conduct the training of agricultural cadres as it should be conducted, it was necessary to reorganize the existing schools of mechanization into training institutions for mechanization, to standardize the length of the training course, to apply a system of training such as used in the trade schools and in the factory - mill training schools, and to greatly extend the entire range of training agricultural mechanics.

A resolution adopted by the September Plenum of the Central Committee of the Communist Party of the Soviet Union placed the training of the immense number of cadres of mechanical personnel in agriculture under the jurisdiction of the system of State labor reserves. This provided the opportunity for correctly proportioning the training school network, improving methodical management, systematically studying, generalizing, and making available to broad circles the positive experience acquired in the training of mechanics cadres.

In accordance with the rapidly increasing extent to which socialist agricultural production is being geared to technical equipment, the training of mechanical workers for machine and tractor stations and sovkhozes was shifted into new channels.

Previously, mechanical cadres in agriculture were trained in training institutions and in the training network of the Ministry of Agriculture and the Ministry of Sovkhozes. Under that system a dissipation of forces and available means was inevitable, there was no management of training curricula and methods in the training institutions under a single authority, and arrangements existed for constant study, generalization, and transmission of the positive experience acquired.

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Many schools were simultaneously training cadres in over 30 different specialties, with training periods ranging from 2 to 18 months. The upshot was that, over a number of years, particular specialists were being trained to handle each their own type of agricultural machinery, and as a rule being unable to service and handle other agricultural machinery. The training of mechanical cadres for agriculture was tailored to routine agricultural tasks: tractor drivers were assigned to the start of sowing operations, combine and harvester operators to the beginning of the harvesting of grains, operators of flax-threshing machines to the beginning of flax threshing, etc. As a result, the training of mechanics was not carried through to the end, they did not work in the field during the period of training on the machines, and therefore failed to fulfill the shift output norms, after release from the schools.

In the agricultural mechanization training schools, mechanics and operators with a broad range of skills are now being trained, instead of workers engaged in different narrow specialties. The tractor mechanic and operator now gets the training which enables him to work independently and productively on tractors of all makes, on grain, trailer and automotive combines, on special complicated agricultural machinery, such as flax threshers, flax combines, beet combines, corn harvester combines, self-powered mowing machines, etc., as well as to carry out work on overhaul and maintenance of tractors and agricultural machinery.

In that fashion, the tractor operator - mechanic is able to consistently perform work which previously had to be carried out by several workers, each in his own narrow speciality. The young combine operator - mechanic, after completing a training course in an agricultural mechanization training school, is capable of operating not only self-powered, but also tractor-trailer grain combines, and is also able to do machine shop and maintenance-overhaul work on the mechanization of labor-consuming operations in animal husbandry. This helps toward a constant replenishing of mechanical cadres, ensuring around-the-clock work of mechanical personnel in

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machine and tractor stations and in sovkhozes.

The entire system of labor reserves throughout the nation was operating over 900 agricultural mechanization training schools, in October 1955. In less than two years of their existence (1953 - 1955), these mechanization training schools had trained and directed into machine and tractor stations and into sovkhozes more than 500,000 tractor operators, combine operators, tractor brigade teams and other skilled mechanical personnel. These new agricultural cadres know modern techniques and how to use them. They have been trained by specialists and experts in their field and by instructors using new training plans and curricula, as basis, in which the main emphasis is placed on practical activities; during the training period, they have been engaged in serious practical productive work right under field conditions.

The training of agricultural cadres under the system of labor reserves is being extended and perfected. The mechanization training schools are being shifted to the training of mechanical personnel having higher skill qualifications. Tractor operators and mechanics with a broad range of abilities are now being turned out by the training schools after completion of a one-year course. In 1955, these schools registered for the first time an appreciable influx of young men and women who had finished secondary school education. The material and technical base of the agricultural mechanization training schools is being reinforced. The training schools have been given access to a considerable number of the most varied types of machinery, making it possible to organize the training process on the level of up-to-date mechanization of agriculture.

The pedagogical process in the mechanization training schools must be continually and every more broadly enriched by the experience of innovators in agriculture, of prominent tractor drivers, combine operators, and drivers and operators of other machinery, opening inexhaustible reserves for a further upswing in agriculture. Such a constant enrichment of the training process by practical experience makes it possible to prepare mechanical cadres on a higher level, in correspondence with the requirements stipulated by the historic decisions of the Central Committee of the Communist Party relating to the further sweeping development of agriculture.

Under the sixth Five-Year Plan, the productive range of job skills mastered by agricultural mechanical personnel will be broadened, the volume of their knowledge in the field of machine work, maintenance and overhaul work will be increased, which is also true of the categories of electrician, blacksmith, and the automatic machine operation. Such workers will also be trained in one of the construction skill specialties.

The State labor reserves have the task of developing the training of workers in a wide range of skills associated with the electrification of agriculture: workers engaged in the assembly and operation of agricultural electric power plants and power switchgear, electricians for layout of power and illumination networks, and also for the installation and operation of electric machinery and appliances, etc. The grounds have been broken also in this cause.

Another question on the agenda is the setting up of professional skills and technical training schools in which students with a seven-year educational background and with some job skills will simultaneously be able to complete their secondary school education.

Under the sixth Five-Year Plan, plans have been laid for the universal improvement of the quality of training given to the youth in all of the schools and training schools of the State labor reserves and directly in on-the-job training, as well as in the higher and secondary technical training institutions.

In a whole number of branches of industry, a new appraisal must be made of the methods used in training workers in the enterprises and under the system of State labor reserves, with due account taken of the requirements of technical progress and with proper use of the experience of practical innovators. It is especially important to organize skilled cadres in the coal and lumber industries, and in the construction industry.

The Communist Youth and the entire Soviet youth, inspired by the Communist Party, are focusing their efforts and attention on the most important sectors of the national economy. The youth warmly responded to the decision of the Party and of the government to bring the virgin lands and fallow lands under cultivation. Hundreds of thousands of young men and women went out into the districts where virgin lands were being cultivated, and in self-sacrificing labor made their contribution to the successful realization of the tasks of the Party and government. In the ranks of that youth army are the conquerors of the new lands, including over 100,000 young mechanical workers trained in the labor-reserve schools.

In answer to the decision of the Party and of the government regarding the further industrialization of construction work, as to mass production in reinforced-concrete construction projects and parts, over 17,000 young men and women, carrying Komsomol passes, arrived during 1955 and 1956 on construction sites for new plants, using prefabricated reinforced-concrete techniques. Many thousands of delegates of the Komsomol, the best representatives of the working Soviet youth, were channeled into the fundamental operations in the mining galleries of the Donets Basin, Kuznetsk Basin, at Karaganda, and took part in the erection of hydroelectric power stations, in the building of railroads, etc.

The Communist Party and the Soviet government turned to all of the Komsomol organizations, to the boys and girls forming their membership, to all of Soviet youth, with an appeal to send their best comrades to take part in the building of electric power stations, metallurgical, chemical, and machine-building plants and oil refineries, mines, coal pits, railroads, cement and reinforced-concrete plants in the eastern and northern districts of the country and in the Donets Basin. During 1956 - 1957, hundreds of thousands of young boys and girls were sent to those regions of the country, to participate in the building of a third powerful metallurgical base in Siberia, to build the most powerful hydroelectric power plants in

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STAT

the world on the banks of mighty rivers, to construct over 100 machine-building plants, to lay out thousands of kilometers of railroad track, to put up dozens of new cities and settlements.

The Party and the government called on the Soviet youth on more than one occasion, sending the young people to handle great historical tasks. In the years of the Thirties, young enthusiasts built a large industrial center on the banks of the Amur, and the center was named "Komsomol'sk" in their honor. Thousands of strong and daring young people went down into the mine pits of the Donets Basin, to bring up millions of tons of coal. With their own hands, the youths built a tractor factory in the steppes near Stalingrad, and assembled thousands of powerful machines with those same hands. Our youth built huge metallurgical combines at Mt.Magnitnaya and at Ala-Tau in the Kuznetsk Basin, and were the first to stand shoulder to shoulder with their fathers and older brothers before the hot ovens and furnaces. And it is not so long ago that young men and women workers reclaimed the virgin lands of Kazakhstan, Siberia, and Altai.

Young Soviet people have achieved a lot in often unpopulated and barren areas, but there still remains a large amount of work to be done in fulfilling the program of great advances, promulgated by the Twentieth Congress of the Communist Party of the Soviet Union. The confidence of the Communist Party has inspired the young men and women and instilled in them new strength for creative undertakings.

The Growth of Culture and of Creative Activity on the Part of Industrial Workers

While placing new tasks before the Soviet peoples, the Communist Party is concerned for their intellectual and cultural-technical growth, since only the conscious, creative activity of the masses can bring success to our great cause - the cause of building a communist society.

Only cadres which have completely mastered the available techniques are capable of advancing production along the road of technical progress, of creating more advanced techniques. The most sophisticated machine requires from the worker an extensive background of technical knowledge, a raising of his overall cultural level. The latest advances in techniques constrain the worker not only to deepen his mastery of his particular specialty, but also to become aware of the general laws governing the entire productive process.

In recent years, the trend manifested by our workers toward the continual improvement of their skills has led to the appearance of a new type of worker with a broad professional educational background, conscious and active go-getters in production, in command of complicated techniques related to different productive processes.

The technical progress in socialist production, the enormous sweep in the development of the overall level of education and professional training, determined a rise in the cultural level and skills of the workers never before witnessed in history. The cultural and technical level of the workers in the Soviet Union is constantly on the rise. From year to year, the number of workers in our industrial establishments having not only a seven-year, but even a ten-year secondary educational background, is on the increase. The large-scale socialist enterprises are actual training combines, where thousands of people are trained with no interruption in their work.

In each Soviet plant, in each productive sector, the results of this gigantic labor conducted by the Soviet State with the aim of fulfilling the historical task of making all of the workers and peasants cultured and educated people, have made themselves felt to a large degree.

The learning of the Soviet people has taken on an unheard-of broad scope, unknown in any other country of the world: The total number of people undergoing training or study courses in the USSR comprises over 50 million.

At the Kuibyshev locomotive works at Kolomensk, each single worker is undergoing training. The Party, trade union, and Komsomol organizations in the plant and

STAT

in its shops are devoting a good deal of attention to raising the technical and general educational level of the workers.

When the working day is over, thousands of lathe hands, milling-machine operators, steel foundry workers, molders, foremen, and technologists make their way to evening schools, technicums, to the machine-building institute.

An enormous network of schools for advanced training, attached to our enterprises, contribute to a versatile increase in the skills of the workers, a transmittal of the experience acquired by leading workers, who have achieved a high productivity of labor, to the entire mass of workers in the leading skills.

In the schools for advanced training, the students learn from practical innovators how to produce high-speed melts, how to work at high speeds and at high rates of output, how to better organize the work and the working area.

At the I.A.Likhachev automotive works in Moscow, the workers in basic shops of the plant have in the main graduated from secondary school. At the "Krasnyi Proletarii" (Red Proletarian) machine-tool factory in Moscow, 90% of the workers employed in the basic shops of the plant have undergone special productive training in recent years in factory - mill training schools, in trade schools, in courses and schools for raising skills. Many skilled workers in that plant, without losing time from their regular work, have completed technical courses, study courses in technicums and higher training institutions, and have been transferred to responsibilities on the engineering and technician level.

At the Dzerzhinskii metallurgical works in Dneprodzerzhinsk, almost all of the workers and the engineering and technical workers are engaged in improving their store of technical knowledge. Hundreds of the workers have completed training courses in schools of advanced methods of labor, in training courses for foremen. Many furnace hands and gasworks employees, without losing time from work, continue their studies in night-school metallurgical institutes, in the technicum, in the schools for working youth.

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At the Magnitogorsk metallurgical combine, half of the workers in the combine are studying in night schools and technicums, taking the correspondence courses of higher training institutions or various other courses. During the last 10 years, the number of workers with a seven-year or secondary school background in the combine labor force increased from 12% to 40%.

Millions of Soviet workers, peasants, and salaried workers are furthering their education and pursuing studies, without interrupting their work, in schools for general education, or in courses for increasing skills.

Night schools for the working youth, courses and schools in advanced labor techniques are found in almost all industrial enterprises. The largest enterprises accommodate night-school branches of institutes and technicums.

Go into the technical library of any factory you choose, you will see in the reading room, sitting at the same table, an old engineer, a cadre worker, some technician still younger in age, and some extremely youthful worker recently included in the labor force at the plant. All of them are imbued with striving to keep pace with the rapid development of modern techniques.

The entire range of forms of training in progress at the K.Liebknecht metallurgical works at Dnepropetrovsk embraces several thousand workers: foremen and engineers included. One out of every two workers employed at the plant is taking some course of study.

The senior foreman of the rolling mill "750" at the "Serp i Molot" (Hammer and Sickle) factory, I.I.Turtanov, was right in maintaining that the shop has become his university. As is the case for many of his comrades, he studied in the school for foremen, in political clubs and seminars, attended many lectures on different questions, and associated constantly with engineers, scientists, and persons active in the arts.

During his 25 years of work in the shop, he did not pass a single day without learning something new in the work, without reading some article or attending some

STAT

meeting, lecture, or seminar. His political education in the plant began in a discussion circle on current events in politics. He is now studying, on his own, the works of the classical writers of Marxism-Leninism.

At the G.Ordzhonikidze tractor works in Kharkov, "plant Saturdays" are in effect, devoted to providing opportunities for leading workers in socialist competition to deliver lectures and reports, to share the experience gained in their work. The milling-machine operator N.Lupandin submitted a report at one of those Saturday meetings on his methods of work. The leading worker made very careful preparations for his talk. He read through a great deal of technical literature, attempted to illuminate in detail the question of how his experience might be turned to advantage in other shops, to what extent the experience might prove useful not only to other milling-machine operators, but also to workers of other skills. N.Lupandin was able to generalize his own experience and that of other milling-machine operators.

In raising their own theoretical standards, the workers penetrate still more profoundly into the productive processes, develop the capacity for serious research. They not infrequently come forward with reports on the results of their investigations before the technical council of the enterprise.

The experience of leading plants and factories provides convincing evidence of the truly inexhaustible possibilities latent in Soviet enterprises, for continually raising the cultural and technical level of their cadres, and evidence of how wide open to every Soviet worker are the paths to knowledge.

There are now many young people in the nation who go directly to a production job on completing their ten years of education. This has become an entirely normal and natural phenomenon. Courses are organized for the working youth, they are assisted in learning skills, new cadres of specialists of medium and even high rank are recruited from their midst.

The higher and secondary educational institutions, or their branches assigned

STAT

to large plants, also train highly skilled cadres of specialists. The worker, having received an engineer's or technicians diploma without ever taking time off from production work, is not only in possession of theoretical but also of practical knowledge and practices, all of which distinguishes him to advantage from people who have received a higher or secondary technical education without any actual labor experience.

The number of highly skilled specialists is on the increase. While, during the 1927/28 school year, only 160,000 students were taught in all of the higher educational institutions of the country, the number reached 1,867,000 in 1955. Toward the end of the first Five-Year Plan, there were only 90,000 specialists with a higher education and 56,000 with a secondary-school education available to the national economy. At the present time, there are in excess of 5,500,000 specialists having higher and special secondary-school education at work in the country. Under the sixth Five-Year Plan, the plan is to increase the number of specialists graduating with a secondary-school and higher educational background by approximately 1.5 times, and to double the number over that available under the fifth Five-Year Plan, for heavy industry, construction, transportation, and agriculture.

It is to be noted that the cultural and technical growth of the Soviet workers exerts an effect not only on their production achievements, but is also felt in the demands and, as it were, in the whole life of the Soviet people. And this is as it should be. Just as it is impossible to separate labor from living conditions or productive discipline from all ethical norms, so is it impossible to regard the cultural and technical growth of man outside of the relationship to his entire individual development and growth. Studying and upbringing are an integral process reflecting the overall relationship and mutual interdependence of all aspects of social development.

Labor and education have become fused into one entity in the life of the Soviet people. It is in this that the new, socialist character of labor in our country and

STAT

the new role of labor and education, as the very first vital need of man, are strikingly expressed. It is precisely in the continuous combination of the urge to labor with the urge for the conquest of knowledge that we find the sources of all of the accomplishments of the working class.

The fundamental creative force in Soviet society - the working people - are the masters of our country, of all of its riches. And they value that wealth highly, seeking to multiply it and to use it for the benefit of all of the Soviet peoples. The lathe operator saves time in machining parts. The miner attempts to bring a higher yield of coal up to the surface. The textile worker remembers that the country needs each additional meter length of cloth or fabric which he produces. The tractor driver, combine operator, simple kolkhoz worker are all aware of the fact that each poud of wheat, potatoes,or corn added to the harvest as a result of their efforts gives the nation millions of pouds of additional agricultural produce.

In our country, no antagonism exists between the interests of the State and the interests of the individual. Highly productive labor, creative initiative, the idea of the innovator, all contribute simultaneously to the welfare of the society as a whole and to the welfare of the worker himself.

The Soviet peoples perform with enthusiasm the work which is most required for the socialist State. Even if that be difficult work, the workers and kolkhoz workers are not afraid of facing difficulties, they overcome them with their self-sacrificing labor. To give one's creative energies and capacities to the advancement and flowering of the Homeland is the greatest patriotic endeavor of all Soviet peoples.

The working class of the Soviet Union has always been the spearhead in the historical creativity of the popular masses.

Year in and year out, the creative capacities and talents inherent in the working class have been revealed more completely and brilliantly, our enterprises witness the manifestation of workers' talents, which master with a high skill the build-

STAT

ing of modern complicated machinery, devices and equipments, show an unusual skill in assembly work and in controlling a wide spectrum of production processes.

Leading workers, innovators, rationalizers of production have become the real masters of production, the real activists in the socialist national economy. They have proved over and over their ability to rise to the level of new tasks placed before them in connection with the growth of new techniques. Educated workers, as a rule, become the active standard-bearers of technical progress.

The struggle for technical progress is in the first place a struggle for the culture of production, for a higher degree of technical outfitting of the enterprise, for improved organization of production, for the strictest observation of technological discipline. The real struggle for culture in production develops at the point where industrial workers acquire technical knowledge in the true sense, where they perfect their labor practices.

Leading production workers and innovators have a creative relationship to their labor, alter the methods of work, improve upon manufacturing processes, elaborate new production techniques to make the labor of the worker easier and more productive. Soviet workers are solving the most complex organizational and technical problems. Putting forward and carrying into life their own rationalizing suggestions, innovator workers are in essence performing functions that are usually relegated to workers on the engineer and technician level.

Technical creativity, inventiveness on a mass scale, the movement of rationalizers of production, became, under the conditions of socialist activity, inexhaustible sources and constant promoters of technical progress. The working class of our country is rich in experienced resourceful people, full of initiative, whose technical inventiveness finds again and again new opportunities for improving upon techniques and production processes. There are quite a few enterprises in our country where almost every worker is a rationalizer of production or an inventor.

The course taken by the Party to speed up technical progress must find its expression in the further increase in labor productivity. Every person who suggests some kind of technical improvement, in order to bring about an improvement in labor productivity, to save metal stock, fuel, electric power, and other material means, contributes to the cause of universal expansion and acceleration of the growth of social production. This is particularly true of workers in heavy industry, since the specific weight of heavy industry in production is especially great, in view of the fact that it has available such a background of techniques and such extensive material values as no other branch of the national economy.

Leading workers raise the level of consciousness, awaken the creative activity of all of their comrades in their sector, shop, or plant and, by their example, induce the entire mass of workers to noteworthy efforts and make all production workers labor with eagerness and true zeal.

Leading workers are not reconciled to shortcomings, they pool their efforts to eliminate malfunctions and bottlenecks, so that the plant where they work will continue undeviatingly along the path of a rise in the productivity of labor, will register ever newer successes. To go forward and to entrain others, that is the law of the working life of the workers who are leading progressive production workers. This means the unflagging mastery of new techniques, progressive technology, a merciless struggle against sluggishness, routinism, sloppiness.

The goal of socialist production - man and his needs - deeply affects all of the workers in fully mastering techniques and using those techniques to full advantage. Socialism gives birth to new relationships with the new techniques, since the techniques are introduced with the aim of making the labor of any and all easier and of improving the life of the entire people.

The new relationship of the people in socialist society with techniques is sharply manifested in the development of socialist competition. This took on a mass character as a result of the growth of the cultural and technical level of the working class. Only socialism makes room for the creative initiative of the popular

STAT

masses in the cause of improving the production processes. Everything new and useful in production meets with widespread favor throughout the socialist economy.

Mass socialist competition has become the constant operating force behind the acceleration of the development of techniques, creates the best forms of organization of production, and confirms progressive norms of labor productivity. The organizers of socialist competition must strengthen their control over fulfillment of the obligations agreed upon, must sustain an overall initiative of the leading progressive workers and of innovators in production, must make their experience the property of entire enterprises and branches.

The innovators in socialist production are the sons and daughters of the working class educated in the spirit of daring searches, of an untiring perfection of techniques, of the organization of production and advanced methods of labor. The concern for improving any and every socially useful task, the striving to do one's bit in the whole people's effort has become a permanent hallmark of the Soviet worker. Finding something new, making his own discovery on the job, no matter how small, he strives to share his findings with his comrades. There is no greater joy for the Soviet innovator than the knowledge that he has helped toward the success of thousands of workers, that he has enriched the storehouse of the people's experience. Under the conditions of socialism, a good example is contagious. Thus, after the achievement of the foreman's helper, Aleksandr Chutkikh, at the Krasnokholm worsted fabrics combine became known, 35,300 brigades of outstanding quality appeared within a year in the enterprises of the textile industry.

And also in this striving to offer the fruits of one's creative findings to society, we see evidence of a new striking feature unknown to exploiting systems, where the worker conceals from others the secret of his skills.

A particular feature of workers' innovations, rationalization of production and inventiveness in our country is its mass character, the noble character of the stimuli galvanizing people into action. The creative thinking of the Soviet people is rich!

During the years of the fourth and fifth Five-Year Plans, over 5 million inventions and technical improvements, resulting in savings of billions of rubles to the country, penetrated into job practices in the mills, mines, mine pits, construction sites, and railroads. Concern for increasing labor productivity, for raising manufacturing output and improving its quality, for curtailing expenditures in raw materials, all this guides the consciousness of the workers, who further technical progress with their collective experience in socialist production.

A remarkable example of the social conscience and truly socialist relationship with the interests of society is the mass-scale discussion of the production plans of enterprises scheduled for realization under the sixth Five-Year Plan. How profound and sincere was the interest in judging production, in social welfare as reflected in the speeches of the workers! And, what is particularly important, the plans of the new Five-Year Plan were discussed by the masses with animation and excitement. In each of thousands and thousands of speeches resounded the "concern of the rank-and-file workers for increasing the productivity of labor", in which V.I.Lenin saw the distinguishing feature of communism.

"... If we are to be content with the plan as outlined", stated the Donets miner F.Slobodchikov at one of the meetings, "then our mine will be marking time for two years in succession. But we are not satisfied with it. The country expects from us more coal, and we have no right not to make use of our great reserves in the growth of fuel output. It is apparent that the economic directors of the mines want to live the quiet life, but our conscience and miners' sense of duty cannot remain content with that..."

The growth into the technical and cultural level of the workers, the rise in their skills, have become basic conditions for the birth of continually newer forms of socialist competition, innovation, and invention.

Entering into competition for ever greater and more significant increases in labor productivity, the people of our industry are invariably also achieving savings of materials as well as conservation and multiplication of material values. From competition in the savings of particular materials, the production collective bodies are undergoing a transition to a more complex economy and savings of all forms of material resources.

In solving problems of the economizing of material resources, the Soviet peoples use the fundamental advantages inherent in the socialist mode of production as basis. These advantages are expressed in the rational distribution of material resources among enterprises, in the broad-scale and planwise introduction of new progressive materials and top-quality substitute materials. The high rate of technical progress is also counted among those advantages.

Millions of workers in industry are opening and putting to use the vast reserves of savings in realized labor, are developing on a broader scale than ever the socialist competition for economic expenditures of raw and finished materials, for universal curtailing of production losses, for raising the productivity of social labor. They discover new and effective forms of competition: struggle for the overfulfillment of State tasks without additional expenditures of raw materials, finished products, and fuel supplies; savings in production and introduction of personal records of savings in materials and tools; maximum economies in the use of raw and finished materials with maintenance of a high quality of manufacture, lowering of the net cost of commodities produced at each operation; cutting expenditure of metal stock per each item produced.

The results of competition are clearly evident in the fact that the amount of material going into each item is exactly as much as is required for the most protracted and productive service of that item. The results also determine the useful expenditure of material resources in terms of the amount of waste produced in the process of manufacturing a piece of goods, the degree to which the waste products are utilized, the savings achieved in particularly valuable materials, the methods

STAT

used to replace them by less valuable and more abundantly available materials, etc.

Leading progressive workers and engineers have found that millions of tons of metal have been piled up in the slag heaps near metallurgical and machine-building enterprises. Workers and engineers in the southern metallurgical works have estimated that the cost for one ton of metal recovered from the slag and scrap heap is about 20 - 25% less than the price of scrap brought in from outside the plant. They put themselves to work to salvage scrap from the slag heaps in an economic manner, as a result of which our metallurgical works each year receive hundreds of thousands of tons of metal at lower prices.

The reconditioning of used and worn tools, which involves a smaller expenditure of labor than the fabrication of new tools, has been introduced on a broad scale in many machine-building plants. The possibilities latent in this practice may be judged from the fact that, according to tentative estimates, work on the reconstitution of used and worn tools in the national economy of the USSR might result in savings of 40,000 tons annually of different tools, including high-speed metal cutters and their substitutes.

In all branches of industry, the workers, being competent masters of production, are engaged in the rationalization of power savings and in introducing progressive measures for saving of power resources.

The joint efforts of workers, technologists, mechanical and electronic engineers and technicians succeed in opening and putting to use particularly large reserves in the economy, specifically in improvements and in the introduction of the latest technological processes.

By mastering the most varied and versatile techniques of advanced technology, innovators in production develop on an ever broader scale socialist competition aimed at bringing to light all latent production reserves. In their activities, they strive to improve the entire social production, wherever they are working, whether in a conventional smithy or in an automated plant provided with the most

STAT

advanced techniques.

In achieving high indices in their work, leading production workers seek out new paths of their own, as a rule, Evgenii Shershnev, foreman of the Vladimir Il'ich plant in Moscow, is one of those who discovered a new path of his own. He proposed a competition for technical progress in each production sector. The exploits of the innovator were followed by foremen and section managers in Moscow factories and plants, in a general movement for technical progress and improvement of production, embracing the foremen of industrial enterprises in other cities.

When Shershnev was entrusted with the supervision of a shop section, he became the youngest foreman in the plant. Previously, most of the production space had been occupied by motors subjected to a burnishing process. The young foreman began with the most rational utilization of the production space. Everything now looks different on the plant floor. The burnishing stand for the motors occupies much less space than previously: it is laid out lengthwise along the shop section. Two lines of working positions are arranged parallel to it. The number of such positions has been more than doubled. Consequently, the number of motors simultaneously being assembled has been increased by the same amount. And the assembly is performed by half the number of people. This has become possible because of the fact that they were chosen not by quantity but by ability, initiative, and experience.

During the fifth Five-Year Plan, labor productivity in the section under foreman Shershnev's supervision was increased 7 times. Motors are now being assembled there at a rate 3.5 times faster than in 1950. Less than half the number of workers is involved.

Similar occurrences have become common and everyday experiences in our country. Their strength and significance lies precisely in this everyday and mass character. They bear witness to the depth to which the socialist conscience has pervaded the mind of the majority of our people.

In the directives of the Twentieth Congress of the Communist Party of the

STAT

Soviet Union, it is stated that, under the sixth Five-Year Plan, large reserves for increasing labor productivity and stepping up the output of commodities are to be achieved by modernization of the available equipment. The staff of the Moscow "Frezer" (milling) plant is making widespread use of such reserves. In that plant, practical experience has already been accumulated in the modernization of machines and machine tools to demonstrate that, with a comparatively small capital outlay, the volume of production may be significantly increased with the same production space and equipment, and the output per worker can be increased at lowered unit cost per item.

The experience of the plant staff attests to the fact that the use of four-spindle heads for drilling chipping orifices in large-size chunks results in an increase in labor productivity by 70%. An attachment with a pneumatic clamp for milling keyways in the same parts makes it possible for the worker to perform three operations instead of one, i.e., to service three machine tools. Accordingly, two workers are freed. In exactly the same manner, after setting up the pneumatic heads for milling broaches, milling cutters and other tools, the milling-machine operator can now handle two, and sometimes three, machine tools.

In the drill milling shop, there is a group of drilling and milling machines with a manual work cycle. After completion of the work cycle, the worker has to move the carriage 400 - 500 mm manually, each time. The auxiliary time spent on that machine tool amounted to roughly 30%. The plant engineers developed a head of less rigid design and a mechanism for accelerated displacement of the machine carriage. And here are the results: the auxiliary operating time was cut to half and milling conditions were improved. After the remodeling of all such machine tools, the labor productivity for the section as a whole was increased by approximately 10 - 15%.

Improvement of the rigging and subassembling of the machine tools is one of the many ways in which an appreciable production and economic effect may be brought to

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bear. But the highest degree of modernization of equipment is to be obtained by automation.

A rather complicated device was manufactured as an attachment to a machine designed for butt-welding of the working and tail sections of a number of tools in use in the plant. As a result, the welding equipment became semi-automated. Use of the semi-automated assembly sharply improved the quality of the welding jobs. The labor productivity of the welder was heightened by 30 - 40%.

Workers also suggested automation of the centerless grinding, knurling and stamping machines, and replacement of the grinding and gear-milling machines by automated machines. The loading machines, which were designed and fabricated to service the centerless grinders, made it possible to increase the productivity of the grinders by 2.5 times. One such machine now puts out during one shift all of the articles which were produced by several automated lathes in two shifts. The introduction of automatic loading machines on the third, fourth, fifth, and sixth lines resulted in a tripling of the labor productivity.

This type of automation of equipment holds much promise. In the future, it may be possible to hook up automated conveying facilities, thus obtaining an automated production line.

As in each Soviet enterprise, innovators in the Kirov plant made a small contribution to the cause of improving techniques during the fifth Five-Year Plan. The technical creativity of the workers and specialists resulted in many tens of millions of rubles saved during the Five-Year Plan.

However, inventiveness, innovation, and rationalizing activity is of greatest use only when the various obstacles which, up to the present, have impeded the development of created initiative have been cleared out of the way.

The creative initiative of the masses, which constantly gives rise to new developments, is in need of responsive management and support. But it is often the case that much fuss is made about some innovation exploit, and then the contribution is forgotten. To cite only one example: in a competition for increasing the degree of overfulfillment of the norms by each worker, initiated on the suggestion of the Leningrad lathe operator, comrade Lepilin, there was plenty of talk about getting started on the new road, but then the excitement subsided almost completely.

A well-known foreman in high-speed brick firing, P.A.Duvanov, arrived in the capital of the Kirgiz SSR. He demonstrated his method of working at one of the brick plants in the city of Frunze. In five days, the output of brick in the enterprise was more than doubled, and the fuel costs were cut by 30%. It was shown, and should have become obvious to all, that the introduction of the innovations demonstrated by comrade Duvanov into production practices would have been of especially vital importance just when the Soviet peoples were proceeding to completion of a broad program of capital goods production, as laid down in the directives of the Twentieth Congress of the Communist Party.

However, the widespread use of the Duvanov techniques ran afoul of inertia and indifference on the part of the local leading workers. The Minister of the Building Materials Industry of the Kirgiz SSR, comrade Sadygaliev, instead of breaking through the resistance of the conservative elements, insistently suggested to the innovator that he share his experience not inside the shops, but in auditoriums, giving lectures or talks. He even tried to convince Duvanov that it was somehow impossible to fully introduce the latter's methods in Kirgizia.

This case demonstrates that there are still people among us who want to just drift along, without bothering with problems. For such people, it is easier to welcome and entertain a guest than to take up the organizing work in a plant.

But the workers, engineers and technicians fully appreciated the experience of comrade Duvanov. The staff of the Belovod brick factory rearranged its work plans to conform to the new method. The young furnace chargers Lunina and Ibragimova, the brick firers Gordienko, Degtyarenko, and the unloader Koldybayev were particularly quick in assimilating the new process. As a rule, they overfulfilled their job

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tasks by 2 - 2.5 times. But the working personnel did not remain content with that, they undertook to introduce still another suggestion of Duvanov, the firing of brick with high moisture content.

The socialist system opens the broadest possibilities for the constant improvement of labor and production. But in order for those possibilities to become translated into reality, an intense struggle must be waged against sluggishness and for the introduction of new work methods, for the full utilization of the resources of the enterprise.

In order to speed up the development of production, the Central Committee of the Party and the Soviet government require from each Party and economic worker the able and efficient exploitation of all economic levers available to the socialist State for the undeviating realization in life of the principle of the material concern of the workers with the results of their labor, for the removal of shortcomings in the organization and remuneration of labor, in planning for the growth of labor productivity, etc.

A serious precondition for increasing labor efficiency in our industry is the improvement of the organization of labor and of pay scales. The Twentieth Congress of the Party laid down far-reaching measures for improving work standardization, elimination of important shortcomings in the system of wage scales, in the remuneration of the labor of skilled and unskilled workers, in the universal intensification of the personal material concern of the workers with raising their skills and their productivity of labor.

The all-peoples' socialist competition for fulfillment before the stipulated time of the tasks assigned under the sixth Five-Year Plan shows the richness of our people in organizing talents and the great importance of progressive experience in the cause of developing socialist economy, in creating an abundance of consumer goods in our country, in the great cause of building communism.

The working class and the kolkhoz peasantry understand well that the tasks posed by the Twentieth Congress of the Communist Party under the sixth Five-Year Plan require great efforts and intensified labor, they know that many difficulties will be encountered in fulfilling the plan. But they are firmly convinced that they will be capable of surmounting all difficulties and acquitting themselves with honor of the assigned tasks.

CHAPTER III

TECHNICAL PROGRESS - THE PATH TO A NEW RISE IN THE NATIONAL ECONOMY OF THE USSR

The continuous addition of ever new production techniques to our productive effort is, under socialism, the basic source of increase in productive output, of the growth of labor productivity in all branches of the national economy.

The development of techniques involves more than a quantitative growth in the means of production. The ownership of the means of production by the people as a whole opens the possibility and calls forth the need to consistently and rapidly replace old techniques by new techniques, and new techniques by still newer techniques, to introduce new machines, to renovate existing machines and equipment.

The techniques available to socialism must be the most advanced techniques in large machine production, yielding the greatest possible savings in social labor.

The newest techniques available to socialism are characterized first of all by high-power and high-speed machines, which make possible a significant increase in the productivity of labor and the fulfillment of work projects on a gigantic scale.

For the newest techniques available under socialism, what is typical is not single machines, but rather a system of machines, a combination of different machines performing several operations or all of the consecutive processes in the manufacture of some type of commodity. A system of machines in each branch of production makes possible the replacement on a broadening scale of manual labor processes by machine techniques, and automation of production.

The struggle to achieve a continuous rise in manufacturing techniques is a most important task for all branches of industry. To insistently improve on techniques, means to design the most highly productive, economic and reliable machine tools and machines, to extend electrification to broader levels, to develop further complex mechanization and automation of manufacturing processes, to use to full advantage the achievements of science in the area of the utilization of atomic energy for peaceful purposes.

The overall raising of the technical level of production has now become the most important task facing us. The fundamental condition for the solution of the problem must be a sharp acceleration of the rate of improvement in techniques in all branches of industry, on the basis of electrification, complex mechanization and automation of manufacturing processes, the introduction of the latest models in highly productive machine tools, machines and equipment, constant perfecting of production technology, the use of atomic energy for peaceful purposes.

Machine-Building

Technical progress is first and foremost, and best, registered in machine-building where, as at a focus, all or almost all new scientific and technical concepts become concentrated. Soviet machine-building has been termed, and not casually, the core of heavy industry.

Machine-building contributes to the development of techniques by the fact that it creates new machines and raises labor productivity in the machine-building enterprises themselves, and largely by the fact that it produces up-to-date machines, machine tools, instruments, equipment, tools, and accessories which open the way for technical progress in all branches of industry, transportation, and agriculture.

Soviet machine builders are at the present time capable of building any machine type needed by the country.

During the last years of the fifth Five-Year Plan alone, over 2500 new models and types of machines and mechanisms were put into production.

While increasing the output of machines, machine-building workers constantly improve upon the design of the machines, increase their productivity and capacity, and achieve accuracy and rhythmicity in the operation of the machines. They equip the machines with up-to-date attachments, equipment, and control and measuring devices.

In order to manufacture new complex machines and equipment, workers, engineers and technicians are bringing into operation new plants and shops, they are improving existing equipment, and applying advanced technology and all kinds of newly developed materials.

Over 500 different grades of steel, cast iron and alloys of nonferrous metals are at the disposal of Soviet machine designers. They also make broad use of plastics, special qualities of glass, lumber, rubber, and other nonmetallics.

The operation of a machine depends not only on the materials of which it is made, but also on the methods employed in manufacturing and machining separate machine parts and assemblies.

Technical progress in machine building depends directly on the development of the design and construction of metal-cutting machine tools. Mass production facilities are being expanded for new types of machines and devices performing turning, drilling, slotting, planing, milling, grinding, tapping, lapping, finishing operations, in a word, all of the operations involved in the manufacture of up-to-date complicated machinery are well accounted for.

Machine building enterprises have at their disposal an enormous and widely varied stockpile of metal-cutting machine tools to special design, semiautomatic and automatic machines, automatic transfer machines, automatic forging and pressing machines, machines for die-casting and centrifugal casting.

Machining of metal with cutting tools was, in the early stages of machine manufacture, the basic method for manufacturing parts. Many things have changed since

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that time, new and more advanced techniques for machining metals have appeared on the scene. At the present time, production space and equipment in machine shops take up most of the space in machine-building plants. But during the most recent years, appreciable shifts have been registered in the technology of the laborious and expensive process of metal cutting.

Not only the increase in output of machine tools and machinery, but also the quality, reduction in unit costs and the possibility of utilizing the same amount of stock to achieve a higher commodity output, depend on the level of technology attained in the machine-building industry itself.

Great results may be achieved by the introduction on a really mass scale of advanced technology and new methods in metal machining. High-speed methods for machining parts may be employed in turning, tapping and threading, in planing and shaping, grinding and in other operations.

The most vitally important thing for us is to install the accomplishments of leading workers, work brigades and shops at a more rapid rate in ever wider circles. What is needed is not new records set by individual pacesetters, but the mass-scale assimilation of progressive methods. Even a thousand high-speed workers with their most outstanding successes cannot give the country as much as would be achieved by a one-percent rise in the productivity of labor of each and everyone machine-building worker.

Advanced methods in metal working must be put to use not only by individual workers, but high-speed metal-working sections and shops must be organized. Such experience is already at hand.

The achievement of the "Krasnyy Proletariy" ("Red Proletarian") plant, one of the initiators in the mass-scale assimilation of high-speed metal-cutting techniques, is highly interesting in this respect. Even previously, there were a good number of high-speed workers, e.g. the lathe operators Markov, Ugol'kov, Shumilin, Sel'tsov, and others, employed in the plant. They achieved a significant increase in the speed of cutting. However, they were operating as individual star performers.

Senior foreman I.Belov of the first machine shop of the plant and the second in command of the shop, A.Bolotin, suggested proceeding to collective operations using high-speed techniques, organizing the first section in the industry using high-speed metal-working methods. A plan envisaging the reorganization of the work, and modernization of all lathes and multiple-cutting-tool machines was worked out, collectively discussed and carried into life. A time-study graph-plan was compiled for the section covering loading of the equipment, taking into account not the time norms for each operation, but the data for the mean labor productivity of the workers (naturally, taking overfulfillment of the norms into consideration). Each worker knows beforehand what he is to do and when to do it. The assignment of a certain operation to each worker operating a machine tool contributed to raising the productivity of labor. All of the machinists working in the section stepped up the rate of metal cutting by 3 - 5 times. The output of commodities rose by more than 1.5 times. Scrap was reduced to a minimum, and the efficiency of the equipment in use rose sharply.

All of the machine shops in the plant now have sections where all of the workers have made the transition to high-speed metal-cutting operations.

The "Krasnyy Proletariy" plant produced so many machine tools above the norms set by the Plan, during the years of the fifth Five-Year Plan, that the output could serve to outfit several large-scale machine-building plants. During the Five-Year Plan, the time spent per machine-tool station dropped, on the average, from 534 to 330 norm-hours. The unit costs of a manufactured machine tool also dropped 30% below 1950 levels. This is the result of the introduction of new techniques and increase in skills and workmanship of the plant cadres.

Engine lathes, turret lathes, multiple-spindle cutters, boring mills, grinders, planers and drill presses in the plant are being operated at high speeds. The number of high-speed machine operators ranges into the hundreds. "Krasnyy Proletariy"

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has for a long time had the capacity, and should have, to enable all workers in the plant to master highly productive approaches to the work. However, the experience acquired by the leading section has still to penetrate into all sections of the plant.

One of the progressive methods considered in machine-building has been an increase in the precision of stock, and improvement of stock quality. This phenomenon has taken on an overall and general character, and has elicited changes in the distribution of social labor and in the structure of social production.

Note was taken, at the July Plenum of the Central Committee of the Communist Party of the Soviet Union, of the fact that the introduction of new techniques and advanced technology in forging units and in foundries creates vast possibilities for increasing the output of commodities and lowering unit costs. Precision casting, shell-mold casting, pressure die-casting will be the main trends in the revamping of foundries in machine-building plants.

It is widely known that foundry production occupies an important place in machine building. In particular, up to 85 - 90% of the weight of machine tools is contributed by casting stock in machine-tool building, and up to 60 - 80% of the weight in general machine-building (e.g., manufacture of pumps, compressors), etc. As a consequence of the liberal allowances, the machining of castings often proves to be very laborious. For that reason, foundry workers are now striving to produce casting stock approximating as closely as possible the ultimate shape and dimensioning of the finished part, in order to reduce the subsequent machining work to a minimum. The solution of that problem is being attained by casting in metal molds (chill-casting), centrifugal casting, pressure die-casting and other advanced techniques in foundry production.

Investment casting is winning an ever larger place for itself in the machine- and tool-building industry.

The technique of precision investment casting of parts has alleviated the need

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for subsequent machining to such a degree that it unquestionably justifies the as yet rather high initial cost of this casting.

The mass-scale introduction of shell-mold casting and the use of combined mold types is also a progressive method. It greatly simplifies the task of obtaining precision-dimensioned and high-surface-finish small steel and pig iron castings.

Soviet foundry workers have evolved improved methods for producing cast iron of high strength. In some plants, the manufacture of pig iron castings, suitable for replacing steel castings, has been organized.

Machine-building workers in the Karl Marx works at Cheremkhovo are constantly engaged in improving manufacturing processes. The workers in the pig iron foundry have successfully mastered the machine molding of parts, chill-casting and centrifugal casting.

In the plant machine shops, over half of the machine-tool equipment has been readjusted to high-cutting-speed operation. Conveyor assembly lines have been organized for machining operations on a number of items. The path of travel of the body of a mine-shaft pump in the machining process was shortened from 185 to 28 meters. The plant almost doubled the output over that achieved in the first year of the fifth Five-Year Plan, with the use of the same floor space.

Some workers in Ministries and directors of enterprises did not look upon the foundry shops as first-rank links in the process of machine manufacture, but regarded them merely as suppliers of blanks to be worked. Repeatedly, directors of enterprises engaged in machine-building gave priority to machine and assembly shops, assigning to the preparatory metal-working shops, including the foundries, the status of stepchildren. Foundry workers were thus left to their own devices, and naturally the quality of their work suffered and had a negative effect on machine-building. Sufficient evidence of this may be seen in the fact that scrap amounted to 8 - 10% of the materials worked in many foundries.

Pressure working of materials is one of the most efficient manufacturing techniques. Hot-forging and cold-pressing have a number of important advantages over other techniques in metal working.

Stampings and forgings are of high quality and usually require no further machining of the blanks in metal-cutting machine tools; further, stamping itself is a highly productive manufacturing process.

A smith at the Leningrad machine plant, A.Potekhin, was the first in the plant to switch over from free mechanical forging of the metal to hot-pressing; he proved by his experience the economic advantages inherent in hot-pressing, under small-scale mass production conditions.

The change-over of a plant to the manufacture of metal blanks and stock, preformed to the closest feasible tolerance to the finished parts, is a means of achieving a steep increase in labor productivity. The take-up of metal per single square meter of work space rose to 9.2 tons at the Leningrad machine plant, and the yearly output per single production worker rose to 164 tons.

The advantages of drop-hammer forging compared with smith-forging are widely known. But drop-forging has not yet been developed to perfection. The more progressive and more economical press-forging yields, even when compared to drop-hammer forging, considerable savings in metal and reduces by 2 - 3 times the time spent in machining, since it makes possible reductions in roughing allowances, and the production of blanks more closely approximating the finished shape of the part.

A machine forging press in automotive and tractor industry plants makes it possible to increase by 1.5 - 2 times the output of forgings, with the use of the same floor space, and to reduce the amount of metal used. It is necessary to utilize the accumulated experience and to manufacture, at a faster pace, new forging and embossing presses, to broadly expand the most advantageous manufacturing technology available in the production of blanks and stock material in our enterprises.

In 1955, about 220 models of forging and pressing machines were produced in the country, many of them put to use for the first time. Hot-forging presses designed

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for and delivering 630 to 6300 tons of impact strength are in use, which are in no way inferior to their foreign counterparts and in some cases are even superior.

However, the rate of growth and the status of our manufacturing facilities for forges and presses are still lagging sharply behind the demands of the national economy. Our industry is producing very few forging machine presses, upright forging machines, automatic forges and presses, drop hammers and other up-to-date forging and pressing equipment.

No less than 29% of the growth in the output of manufactures of forges and presses, scheduled in the Directives of the Twentieth Congress, will be obtained through the improved use of existing production capabilities and a more rational organization of production.

The realization of that task will depend in large part on the correct specialization of design offices and of plants. The growth in the scale of machine building, the concentration and introduction of the assembly-line method of production, invoke the need for combining anew questions in technology and economy. The task of the designer is not only to design a machine, but also to ensure the technical feasibility and economic soundness of its manufacture and economic efficiency of its operation. Machine-builders must see to it that each machine part is manufactured with the least expenditure of labor and, with the smallest expenditure of materials, consistent with a high quality for the machine as a whole.

All of the necessary prerequisites are available in the USSR to introduce radical improvements in the organization of design and drafting work. Experience has been accumulated in the manufacture of machines of first-class design, and skilled engineering cadres have been graduated and are continuing to be trained.

In order to constantly improve on techniques, designers study existing machinery from all aspects, ascertaining in just which operational functions a given mechanism has ceased to perform satisfactorily. This opens the way for determining, more accurately and effectively, the promsing trends in designing concepts. However, a

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truly scientific approach to the study of machinery is often impaired by the absence of standardization in the methods used, the norms and testing requirements, in theoretically grounded principles underlying performance of tests. This often deprives scientists and designers of the opportunity of reaching some kind of definitive conclusions on the quality of a particular piece of machinery.

Designers must be equipped with a procedure in developing new types and forms of machinery which will enable them beforehand to grasp the correct concept of the performance of each machine under all possible operating conditions, taking into account all circumstances affecting its operation.

The productivity of labor in a machine-building plant depends in large part on the technical preparation of manufacture, on the quality of design of the machinery, and on the development of the technological manufacturing processes. The degree of harmonious adjustment of the operations depends largely on the degree to which production has been supplied with the needed tooling and accessories, on how the experimental prototype of the machinery was manufactured, on the degree to which the data culled from experimental tests were assessed.

In the course of the technical preparation, it is important to provide for methods of progressive technology which increase the reproducibility of manufacturing processes of identical (and similar) parts and subassemblies and enhance the degree of mass-reproducibility; care must be taken to ensure the design interchangeability of machines as a whole and of their individual parts (subassemblies, details); parts and specifications reduced to standards accepted throughout the Soviet Union must be used in machine design, and an effort must be made for standardization of manufacturing processes.

The principle of design interchangeability is carried out in different ways. In one case, it aids in incorporating into a new machine design components which had been part of a piece of machinery already in use; in another case, it makes possible the use of identical design parts in several different machines; in a third case, it

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allows for the incorporation of improved components, produced in the process of designing new models, into machinery which the plant has already been manufacturing, and at the same time allows the quality of the machine performance to be improved. This principle is also observed in the working out of designs for each new machine in particular, where design interchangeability assumes the form of multiple repeatability, in a single machine, of identical parts and subassemblies.

Smooth control over production contributes in large measure to achieving interchangeability of blanks, machine parts, and subassemblies. This acquires particular importance in the conveyor-belt line type of machine assembly. The rhythm of the final assembly line is impaired when separate parts and whole subassemblies are of inadequate interchangeability, and call for various types of finishing and alignment work, which often becomes the cause for an interruption in the output graph of finished pieces and products.

When manufacturing processes are reduced to standard forms, parts which are similar in shape and configuration are manufactured on the basis of a single technological process, using standardized equipment and tooling, which also enhances the repeatability of the processes involved. Standardization enhances the extent to which the manufacturing process can be mechanized and tooled up, reduces the labor-consuming aspects of the operations, effects a sharp reduction in tool change-over time and shortens the length of the manufacturing cycle for the product.

Major contributions to enhancing the mass reproducibility of items in machine design are made by standard specifications, accepted throughout the Soviet Union, applying to fasteners (bolts, nuts, pins, etc.), as well as all-Union jurisdictional (industrial-branch) and plant-wide standards for individual parts of simple dimensioning. Standardization of this type of parts makes it possible to manufacture them simultaneously in large batch lots on adjustable conveyor-belt lines, for several different machines.

Advanced technological processes and the creative experience of innovators in

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machine-tool building have resulted in improvements in the methods of materials handling and working, which in turn has led to the realization of new machine-tool designs. Progressive manufacturing processes have been made possible thanks to the mastering of multi-tool-indexing and multiposition machining techniques, permitting a variety of simultaneous operations on the same machine tool. The use of the principle of multiposition indexing has led to a broad development of special-purpose machine tools which are extremely efficient in the mass production of parts.

However, when the shape of parts is altered, special-purpose machine tools often become unusable or require extensive retooling and change-over. To meet this problem, transfer machines have been designed, consisting of modular subassemblies and parts allowing a variety of combinations, and making possible rapid change-over and retooling in case the contours of the parts to be machined are modified.

The advantages inherent in a planned system make it possible to set up a fully elaborated system of standardized and normalized subassemblies and combinations of machines, for subsequent introduction into machinery design, to be worked out by plant design personnel. The concentration of production of that type of subassemblies and combinations in specialized plants serves as a powerful factor in the lowering of unit cost of machinery and in raising the productivity of labor in the machine-building industry.

The preceding discussion clearly indicates the importance of elaborating the scientific fundamentals of organizing the entire area of technological preparations for production. A swift rise in the technological culture in machine construction is possible only when based on broad standardization of parts and modular interchangeability of subassemblies and machines, i.e., when based on the standardization of the manufacturing processes involved.

The typization of technological processes, together with the unification of subassemblies and standardization of parts, result in an increase in the productivity of labor and in a 30 - 40% time reduction in preparing the workpieces.

The technological preparation for production, as we know, embraces the following: preparation and proper verification of draftings, elaboration, introduction and standardization of the manufacturing processes, designing and testing of attachments, accessories, and tools. In a number of plants engaged in large-scale and medium-scale machine-building, the system and procedure followed in developing manufacturing processes have become obsolete, and have long been lagging behind the level of modern problems and requirements.

In plants engaged in single-part manufacture and in small-lot manufacture, the approach by technologists to designing technological processes is in most cases a subjective one, leaning solely on one's personal experience and knowledge, while what is actually required is the approach in which the design of the processes is based on the generalized and verified experience acquired by the particular plant and on the experience of outside enterprises. As a result, technologists often approach the problem of working out the methods for manufacturing each particular part design or subassembly design as if they were the first person to confront the problem, whereas it is a fact that manufacturing processes previously worked out and verified in practice are generally available for use in the production of parts and subassemblies.

In a number of Ministries and local government agencies, work aimed at the assessment, study, and dissemination of accumulated experience has been neglected. This results in the fact that technologists and designers in local plants waste much unnecessary time and effort.

Until recently, the machine-building industry Ministries and planning bodies often assigned production quotas to machine-building enterprises solely in terms of tonnage. This led to a sharp contradiction with the technical progress dictated by the problem of machine weight reduction and design improvement, and in no way stimulated concern on the part of the enterprises for showing savings in raw materials and production materials.

It is necessary to instill all workers engaged in machine construction with an interest in economical technology, in the continuous improvement of manufacturing techniques. The time has come to fully overcome inadequacies in the technological preparation of production, in the roles played by technologists, the time has come to smooth the path for regular exchange of experiences between technologists in different plants and in scientific research institutes for machine design. In designing and elaborating manufacturing processes, efforts should be made to have various processes intermesh timewise, so that the time spent in operations in the manufacture of parts for subassemblies will be as closely compatible as possible. This may be achieved by subdividing the operations or, conversely, by concentrating the operations; by using special tooling and accessories; by changing the type of equipment used in performing the operation; by introducing new technological procedures.

In this respect, the method of high-quality surface zone quenching of the working parts of machinery and tool components is of interest. Heating by high-frequency currents may be used to case-harden large parts, several meters in length and weighing several tons, and small parts, several millimeters in length and weighing as little as a fraction of a gram.

Case-hardening or surface-hardening enhances the performance factor of the goods manufactured, lengthens the service life of automobiles, trucks, tractors, various machines and combinations of machinery widely used in many branches of the national economy.

Of several enterprises where the techniques of induction-heating and surface-hardening have been most widely and most successfully introduced, first importance must be given the automotive and tractor industry. Foremost among these in turn is the Likhachev Automotive Works in Moscow. In that plant, the staff of the section responsible for high-frequency currents, with the cooperation of workers in the laboratory and corresponding member V.P.Vologdin of the Academy of Sciences of the

USSR, a number of devices for high-frequency induction heating and for quenching of mass-production items have been designed and successfully applied. The most interesting production facility developed is an automated machine tool for quenching, to a depth of from 3 to 5 mm, crankshaft journals for six-cylinder automotive engines.

The facility quenches 32 shafts per hour and exceeds in productivity similar production facilities available in the USA. For example, the tunnel facility of the American firm, "Tocco" designed for the case-hardening of crankshafts to be used in six-cylinder engines, extends 18 m in length and is operated by a team of five workers. The facility at the Moscow Automotive Works has the same productivity, but is only 4 m in length and is operated by a single worker, whose labor is considerably eased by mechanization of all loading and unloading operations.

Other methods are also being used in machine construction to increase the strength of machine parts, e.g., impregnation of the surface layer with carbon (carburizing), with nitrogen (nitriding), with aluminum (aluminizing), or with chromium (chroming).

Shot-blasting of a spring made of ordinary steel greatly increases the service life of the spring.

Long service life and reliability of machinery depend not only on the strength of the surface layer in the working parts, but also on the quality and the type of treatment. The designers and builders of modern high-speed high-productivity machinery often use methods of surface microfinishing, with the aid of lapping materials compounded with lubricants, grinding, and surface-finishing with abrasives.

It is important to be tireless in forging ahead in the area of improving the technology underlying various production processes. We have rather wide experience in the study of different types of metal-working: cutting, electric-spark and anodizing treatment, induction heating, and welding techniques. However, insufficient study has been devoted as yet to methods for obtaining the most favorable combination of different types of treatment, the most favorable sequence of operations, the appropriate design of the entire manufacturing process of a part.

Machine-builders may save enormous amounts of metal by reducing the weight and size of machinery, through the use of low-carbon alloy steels and of new production materials which increase the productivity and lengthen the service life of the machinery and equipment.

Workers, engineers, and technicians have done much to raise the labor productivity in the machine-building industry. At the same time, it is no secret to anyone that advanced technology has as yet a poor foundation in machine-building. New progressive techniques and processes worked out in a leading enterprise, which result in a manyfold increase in labor productivity, reduction in expenditure of metal and materials, and significantly greater production with the same floor space, are often not used to advantage by plants engaged in similar work.

As pointed out by the July Plenum of the Central Committee of the Communist Party of the Soviet Union, the most important achievements in science and technology are still being introduced at a very slow rate in production practices in the machine-building industry, and enormous reserves available for production are being poorly utilized. Work on the design and mastery of new machinery, mechanisms, devices, new forms of materials and progressive technology is often poorly carried out. In scientific research institutes, work on the design of new high-productivity machinery and devices is inefficient. This paper has made an attempt to point out the main trends in the work of machine-builders, the main pathways to be followed in order to achieve a new rise in our machine-building efforts.

<u>Mechanization and Automation of Production</u>

V.I.Lenin, in the very first years of Soviet power, emphasized the need for the mechanization of production on a broad scale, as a means for easing the labor of the Soviet people and raising the labor productivity. V.I.Lenin stated: "It is necessary to introduce machinery everywhere, to convert to machine techniques on as wide a scale as possible" (Bibl.3).

The potential work of machinery and mechanisms is being harnessed to ever greater extents, in an effort to mechanize the physical labor of the worker. Below, we give a few well-known examples of mechanization: introduction of excavators in earth-moving projects, cutting and loading machines in the coal mining industry, grain harvesters, potato harvesters, beet harvesting combines, and other agricultural machinery.

At present, transition is in progress from mechanization of particular processes in industry on an expanding scale to complex mechanization of production, to mechanization of technological process control, to the design of improved forms of organization of production as a whole. To the extent that specialization in production is enhanced and cooperation between enterprises is improved, part of the work now being done in subsidiary shops will be fulfilled by specialized enterprises, with incomparably greater productivity.

The July Plenum of the Central Committee of the Communist Party of the Soviet Union poses industry the task of complex mechanization of all production processes. It has become necessary to mechanize all operations, starting with the loading of raw materials and ending with the finished product.

A number of basic operations in industry and agriculture have undergone complete mechanization. But the process of mechanization is still far from completed. Further growth in mechanization is decisive for speeding up the rate of development of socialist production.

In several branches of industry, boasting of wide-scale and almost complete mechanization of the basic processes and of production in general, many auxiliary operations have been poorly mechanized, up to the present. As a result, a serious disproportion has resulted between labor productivity in the basic and in the subsidiary operations, thus lowering the overall level of labor productivity in the

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enterprises and in entire branches of industry. In each branch of industry, there exist sectors where labor must primarily be mechanized.

Complex Mechanization, i.e., mechanization not only of the basic production process, but also of all links comprising the process, is of the most vital importance for the growth of labor productivity. In complex-mechanized coal and peat enterprises, labor productivity of the workers has been doubled and tripled and further increased over that achieved in the remaining enterprises in the same branches of industry.

The economic effectiveness of mechanization may be appraised from the following example. If part of the obsolete metal-cutting machine tools in the Moscow Automotive Works were to be replaced, the forging and stamping shops and foundries were to be refitted, complex mechanization and automation of production were to be carried out, then the output of vehicles could be doubled with the use of the same production space, and without increasing the working force.

In the lumber industry, felling of trees, haulage and removal of timber have been extensively mechanized, and such laborious operations as trimming brushwood, clearing felled timber, loading, etc. are done by hand even though the labor spent in those operations takes up 55% of the total volume of work.

Each enterprise and each branch of industry, in carrying out complex mechanization projects, has at its disposal extensive capabilities for eliminating the disproportion between the basic production processes and auxiliary and subsidiary operations. However, subsidiary operations often, including the present time, account for most of the savings achieved by mechanization of the basic manufacturing processes.

Complex mechanization permits the most productive use of new techniques, as well as a removal of disproportions between productivity of the equipment in preceding and succeeding steps of operations.

As already mentioned, modern techniques are distinguished by the fact that several actuating mechanisms, carrying out operations which in the past were performed independently by individual machines, are combined in a single new machine of the same type. This technique is known as the technique of automatic transfer machines.

Automatic transfer machines necessitate an automation of production, since it is in practice impossible to exercise manual control over a machine tool which is simultaneously performing dozens of operations.

The manufacture of automatic transfer machines combining the functions of drill presses, boring mills, automatic screw machines and milling machines has already been mastered in our enterprises. Machine shops are using hundreds of different types of transfer machines, in which all working and idle strokes of the tools are completely automated and which were fabricated in machine-tool plants in Moscow, Kiev, Leningrad, Yegor'ev. Multioperation automatic transfer machines perform all technological and checking operations, where the workpiece is moved from position to position in continuous sequence. The machines themselves feed and withdraw the tool, clamp the work, and turn the power on and off: billet stock is fed, turned, drilled, threaded, and the finished part is separated from the stock, after which new stock is fed.

The machine-tool building industry now is confronted the task of rapidly developing and assimilating the manufacture of automatic lathes, automatic grinders and other types of automatic multi-tooling machines, on a mass-production basis.

The latest Soviet machine tools, for example electric profiling machines, can perform by following contours on drawings and blueprints.

Research and development work is in progress at present on lathes which will be controlled by predetermined programming. Assume, for instance, that a highly skilled lathe operator is turning the first part. The entire process will be taken down on magnetic tape by means of equipment similar to a tape recorder. The tape is then run off in a device which will control the lathe in subsequent operations,

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replacing the machinist. The tape is reproducible and thus not one, but many machine tools manufacturing the same particular part, may be automated.

Transfer machines first appeared in the machine-tool building industry. In some particular cases, such machine tools could readily be equated to an automatic assembly line, with respect to completeness of the production cycle.

The first series of automatic and semi-automatic transfer machines in the world, for the machining of caterpillar roller bushings, was proposed in 1939 by I.P.Inochkin, a worker at the Stalingrad Tractor Works. From that time on, transfer machines have taken firm foothold in different production branches. Soviet scientists and engineers, in collaboration with innovators, have combined into a single unit a group of machines capable of carrying out an entire cycle of operations in the machining of different articles. These groups of machines are connected by automatic materials-handling and transfer lines and by a single automatic control setup.

Dozens of automatic lines are in operation in plants in the Soviet automotive, tractor, and agricultural-machinery building program. They have been set up in the "Stankoinstrument" plant, in the "Ordzhonikidze" plant, and in the "Krasnyy Proletariy" plant.

A calculation of the productivity of automatic transfer machines manufactured by the "Stankokonstruktsiya" plant shows that 150 such combination machine tools are replacing 1348 general-purpose machine tools, lathes, boring mills, and other machine-tool types, and have cut down the required working force by 2400 men over two shifts.

The development of forging and stamping presses, of automatic and semi-automatic high-productivity metal-cutting machine tools, the output of specialized automatic and semi-automatic prototypes in machine-tool building was and remains the decisive factor for the further progress of the entire industry.

During the fifth Five-Year Plan, the staff of the First State Roller-Bearing

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Works raised production output and expanded the list of manufactured items to include high-precision and large-size bearings, i.e., the most difficult ones to manufacture.

The plant staff achieved notable results thanks to the fact that it absorbed many technical suggestions of interest, which enabled the personnel to significantly increase the productivity of the available machinery. Main emphasis was placed on modernization of the forging and stamping equipment, to increase the strength of the basic subassemblies of that equipment. Hot rolling of parts on special-purpose rolling-mill beds improved the quality and increased the output of forged blanks for bearing raceways. But the plant technologists did not stop at that point. They suggested assimilating the technique of hot calibration of races, as an improvement over the method of hot-rolling. This method permitted a reduction in machining allowances, sharply lessened surface flaws, and improved precision of the finished parts.

Semi-automatic lathes are the basic form of turning equipment in the plant. In order to raise labor productivity on turning and grinding equipment even higher, the staff of the plant is modernizing obsolescent machine tools of low productivity, retooling them with the necessary attachments, and thus preparing the way for transition from partial to complete automation.

The duties of the worker operating a semi-automated machine tool are reduced to placing and removing the work. This is very difficult and tiring: the operator handles anywhere from 500 to 1000 kg of forgings during a shift.

Designers spent long hours pondering the problem of how to automate the machining of bearing raceways. Finally, a solution was found. One of the engineers suggested a design plan for an automated line in the four-spindle automatic lathe section. The line was set up with the participation of in-plant designers and leading workers of the plant. It involved 40 lathes in the automatic lathe section, and provided the possibility of simultaneously turning out several different types of bearing raceways. All of the operations associated with machining raceways on that line are fully automated. The workers no longer set up or remove parts and work-pieces on the lathes, but simply monitor the progress of the operations.

Proceeding from semi-automated to fully automated setups, and from automated assembly lines to fully automated shops and plants, the Soviet people are accomplishing the automation of production.

Automation in machine-building plants yields extensive savings in the national economy: Modern assembly lines permit a considerable reduction (by a factor of several times) of the working force employed and a reduction in working time spent in the manufacture of the products.

Four multispindle automated machine tools being operated by two workers occupy, for example, a floor space not in excess of 60 m^2. These replace 30 lathes, which were serviced by 30 operators and required 250 m^2 floor space. An automated line of machine tools designed to machine the engine block of a four-cylinder passenger automobile engine cuts the labor involved in the operations by 18 times, compared to the labor spent in the same operations using general-purpose machine tools.

Using the old technological methods, the engine block had to be machined by 56 machine tools, occupying 500 m^2 of space. A total of 180 men worked in the section, in three shifts. The automated line for machining the engine block of the ZIS-150 truck consists of 16 machine tools and materials-handling devices. This assembly line takes up 200 m^2; three men are required to service it. In the course of a single shift, it fully satisfies the requirements of the plant in engine blocks.

Automation of production processes provides for enormous savings in raw materials and means of production, with a concomitant increase in production output. Automation expenses are amortized within a short period of time.

Automated lines in plants manufacturing agricultural machinery, for the production of rake teeth, released a total of 200 workers, resulted in a 30% reduction in unit cost of product, and yielded annual savings of several millions of rubles. The

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Gorky automotive builders put into operation a series of automated transfer lines for the manufacture and assembly of water-tube radiators.

During the past two years, other enterprises in the field of automobile, truck, tractor, and agricultural-machinery manufacturing have achieved renowned successes in the area of mechanization and automation. Using their own forces, they designed and manufactured several original automated lines, automatic transfer machines and machine-tool combinations for the mass production of several machine parts. By the beginning of 1956, 90 automated and semi-automated lines were operative in those enterprises. They produced 30 different engine parts on a mass-production basis.

During the coming 4 - 5 years, plants in the automotive, tractor, and agricultural-machinery manufacturing fields will require dozens of automated and semi-automated lines. The Ministry of Machine-Tool Building and Tool Industries alone is called upon to deliver about 150 such production lines. On the average, the Ministry will be responsible for 25 - 30 lines per year, and 8 - 10 times increase over the previous commitments.

Automated lines will be needed not only by the automotive industry, and by tractor and agricultural machinery manufacturing facilities. In order to satisfy the demands of various branches of industry, machine-building enterprises must expand their volume of work and speed up the production of automated lines.

A prerequisite for the introduction of automated production lines on an even broader scale is the machining of standard parts, differing solely in dimensions, on the same line. To meet this requirement, standardization of mass-production machine parts will be organized and carried out, leading to machining based on a mass-production cycle schedule, and standardization of designs and manufacturing conditions is also on the program. The standardization of machine parts will provide a basis for working out an inventory of automatic equipment, suitable for both independent use and for insertion into the makeup of other automated production lines.

The upgrading of quality specifications for various products requires intensi-

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fying of technical control: in many machine-building plants, the number of inspectors comprise from 10% to 20% of the total number of production workers. Unitl fairly recently, there were about a million inspectors in the machine-building industry alone, including workers, foremen, and engineers. The introduction of automatic monitoring and inspection techniques made it possible to cut the number of inspection personnel in half, in the initial periods alone.

Automatic inspection and testing devices capable of operating without direct intervention by inspector-workers have been developed in the USSR. The parts are fed automatically into the materials-handling line of the automatic setup. Their dimensions are checked at that point, and they are sorted into groups.

Automatic inspection monitors the accuracy of the work and informs the operators of defects in the workpiece, with respect to location character of flaws. Upon reception of the flaw-detection signal, skilled workers restore the desired mode of operation.

Automatic shielding devices emit alarm signals, indicating possible deviation from the normal course of the manufacturing process, stop the process or part of it, switch out the facility involved (protection against faults in electric power stations), or else undertake other measures to eliminate the hazard (e.g., release of steam, in the case of excessive pressure build-up in a boiler).

The power rating of the first series of the new automated plant has been fully achieved by the staff of the Ul'yanov plant, manufacturing low-power engines. Only machines are at work in that plant. After passing down a line of machine tools and automatic transfer machines, and being subjected to various operations, the metal stock becomes converted into a finished piece (in this case a piston).

The production of pistons for automotive and tractor engines has become an object of automation owing to the fact that the piston is a typical engine part which has to meet an annual demand of many millions of pieces.

All of the manufacturing and materials-handling operations are completely

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automated in that particular machine-building enterprise. Machines control the behavior of each technological operation. The machines themselves carry out the casting process, machining and chemical processing, and themselves control all of the production, convey the finished pistons, and remove chips. Over 1500 switches, contactors, relays, and other electric devices comprise the control elements, which bring all operations of the machines into harmony and accurate sequencing.

Rather simple electromagnetic relays are employed in the plant. Some relays operate with predetermined time lags, while others are actuated after counting off the number of operations performed by an adjacent mechanism, and still others go into action only when the piston brushes against the relay contacts.

The packing machine is then brought into action. A gang of contacts controls the motion and positioning of a paper strip for packing.

Only seven skilled setup and layout men and three operators are employed in the automated plant. Previously, there were four other workers there. The labor involved in the manufacturing processes has been cut by over 5 times. The duration of the production cycle has been shortened to half.

Workers, engineers and technicians, under the supervision of scientists, are developing new automated enterprises for the manufacture of different kinds of parts. The day is not far off when plants, manufacturing several types of agricultural machines, will be automated.

A comparatively high level of automation has been achieved in certain areas of process control in the chemical industry, and also in some branches of light industry and food processing.

In light industry, production units are being automated, air-conditioning facilities are being introduced on a broad scale for the creation of an artificial climate best for certain technological processes, allowing the improvement of product quality and heighten the productivity of weaving, spinning, and other textile mills.

In the food-processing industry, automated and semi-automated units are being

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introduced for the packing, sorting, and canning of foodstuffs. The amount of automated and semi-automated facilities in use in 1953 exceeded by over ten times the total supply of automatic equipment available in 1940.

In railroad transportation, automatic switching of railroad cars and the organization of rolling stock is being introduced. Wayside railroad switches are being operated automatically. This measurably speeds up the turnover of rolling stock and facilitates the work of railroad personnel.

The transition to complex automation of production processes is particularly progressive. It is a well-known fact that, in the transition to automatically controlled complexes of machines, labor productivity experiences a manifold increase.

The achievements of Soviet science and engineering in combination with a wealth of practical experience in the development and operation of automated production lines have made it possible to arrive at a solution to the problem of complex automation of enterprises in various branches of production.

The introduction of automation on a broad scale in our country has become possible as a result of the stormy development and the overall rise of all branches of the national economy, and the successful assimilation by our industry of a large number of new types of machinery, machine tools, and devices. However, it should be kept in mind that automation is not a simple attachment of automatically controlled equipment to machine tools and machinery. In many cases, it will yield the desirable effect only when significant modifications of the technological process itself are brought to bear.

Modern industrial production comprises a series of complex technological processes. These processes are carried out at high speeds, and take place, in many shops, at very high or very low temperatures. Machines process certain raw materials, direct contact with which must be either avoided altogether or reduced to a minimum.

Automation and remote control make possible the control of production processes as functions of heat, light, electrical, chemical, mechanical, or other conditions.

A special feature of modern techniques in metallurgy, chemical processing and a number of other branches of industry is the continuous operation of the basic production units. This requires that the various technological processes run in step with each other.

The electric basis of machinery and the principle of continuous operation of the actuating mechanism create the technical prerequisites for an automation of machinery. Automation of widely diverse processes became possible owing to the fact that operating machines now incorporate hydraulic, pneumatic, electric, and electronic devices. Those devices are capable of fully reproducing the functions previously carried out by human operators. The actuators follow the behavior of the processes, sensing each and any deviation of the controlled variables, comparing their values with the predetermined desired values, determining the nature of the changes taking place in the process, and exerting the required control effort.

Automatic control devices exercise control over production processes and assure that the normal operating conditions for which the process is preset are maintained. Automatic control fixes the speed, temperature, pressure, electric circuit voltage, etc. necessary for the process.

Increments in power, speed and other performance variables of the machinery or any increase in the number of tools and subunits in a single machine, necessarily lead to automatic control of the actuating mechanisms.

Control operations acquire a decisive importance in production processes. Improper or inaccurate control efforts lead not only to the production of items of poor quality, but may also result in damage to the equipment used.

Automation of control processes is based on a scientifically developed system of accurate, timely and high-quality performance of a multiplicity of operations.

Thanks to automation, one or several operators may control a large number of machines and mechanisms. Under automation, the labor of the operator undergoes a change and, in time, more and more resembles the work performed by a technician or engineer.

Automation ensures faultlessly accurate and neat work on the part of production units and materials-handling equipment, eliminates possible damage to the machinery, and speeds up the production process, economizes on fuel, power and production materials, and reduces wear on equipment and machinery.

The development of production automation and improvement of automation itself constitute some of the most important reserves in the further heightening of labor productivity. The far-reaching improvements in techniques in general, and of automatic systems of machines in particular, will result in a still greater growth in labor productivity. Automation frees the production process from its limitations, imposed upon it by the limits of the physical capacities of the human body; the range of possible growth of labor productivity is extended to unheard-of limits.

Still, automated control processes are far from having penetrated into production practice on the scale which is entirely possible under the conditions of a planned economy.

In most branches of industry, an automatic system of machines embraces, for the time being, separate stages of production or separate basic ensembles and several subsidiary sections. Only a few enterprises here and there are fully or almost fully automated. This applies mainly to the machine-building industry, where a significant number of automatic compound machine tools, automatic gangs of machine tools, and some individual automated plants are in operation.

It must be acknowledged that we are lagging behind our needs in this matter, as well as behind technical achievements abroad.

Under the sixth Five-Year Plan, a transition will be effected to more effective complex automation.

The development of automation in production requires a rise in the overall technical level of industry and raises a number of new technical problems, posing with particular and complete sharpness the question of perfecting automated devices and expanding the basis of their production.

The national economy has particular stringent needs for devices and controllers used in measuring and controlling nonelectric variables, devices for measuring large rates of flow of gases and liquids, high temperatures and high pressures, large stresses in the testing of machinery and reinforced concrete structures, electronic devices for proportional control and other more advanced forms of control, ultrasonic and electromagnetic flow meters.

Provision is made in the Directives of the Twentieth Congress for increasing, by a factor of four, the output of control devices and automatic process control devices, making it possible to speed up the automation of production processes and to create the conditions for a transition from partial automation to complex automation.

The electrical manufacturing industry is to increase the production of standard equipment and testing equipment (magnetic starters, contactors, terminal switches, all kinds of relays and other devices for interlocking in automatic machine systems), as well as a variety of devices and mechanisms for the automation of existing equipment.

The development of automatic production lines under the sixth Five-Year Plan is being projected on a large scale; not less than 220 automated and semi-automated lines and shops are scheduled to be put into operation in machine building.

Under the new Five-Year Plan, provision is made for performing the transition from automation of separate units and operations to automation of shops, technological processes, and the creation of fully automated enterprises. A much more extensive introduction of remote-control equipment, automatic inspection and control in power systems, in oil refineries, and in other branches of industry is being planned.

Under the sixth Five-Year Plan, an especially rapid growth in the manufacture of machinery and equipment for complex mechanization and automation of production is planned. For example, while the output of machinery for metal-working will increase by roughly 80% under the Five-Year Plan, the manufacture of automated and semi-automatic lines and equipment for automatic shops and plants will increase by about 5 times, and the manufacture of control devices and of the means of automation will increase by about 3.5 times.

The posing of that problem is fully justified and not out of place. Its actuality is due to the successes of socialist industry, to the achievements of science and engineering, to the creation of skilled cadres capable of solving complicated technical problems, in our country.

Electric Power Development

The matter of the electrification of our country has become an inseparable part of the building of communism in the USSR.

As early as 1920, V.I.Lenin promulgated the famous dictum: "Communism is the Soviet power plus electrification of the entire country".

Developing that thought further, V.I.Lenin pointed out that only when the country became fully electrified, only when industry, agriculture and transportation could be backed by a technical base of modern large-scale industry, would we have completely triumphed.

By electrification of the country, V.I.Lenin meant not simply the building of individual power stations, but the gradual transfer of the entire economy, including agriculture, onto a technical base of modern machine production, associated with the matter of electrification. The leader and teacher of the working class said that only by way of bringing all branches of the national economy to a higher technical basis, associated with electrification, would it be possible to achieve a sharp rise in the productivity of the entire national labor.

The Communist Party and our entire people are working, without slacking, to make Lenin's testament come to life.

In pre-Revolution Russia, the power developed by the entire network of electric power stations amounted to only 1,100,000 kw, and the electric power output came to 1.9 billion kilowatt-hours. Tsarist Russia stood close to last place in the generation of electric power, lagging behind even such a small country as Switzerland.

The Leninist plan for the electrification of Russia (GOELRO) envisaged the building, over a 10 - 15 year period, of 30 electric power stations with a total capacity of 1.5 million kilowatts and a reconstruction of old power plants, raising their power ratings to 250,000 kw. On the basis of the initial indices, the GOELRO plan was fulfilled in 1931, and by 1935 it had been overfulfilled by almost 3 times.

Based on the power network established as a result of the realization of the GOELRO plan, the Party promoted further work in the electrification of the country. During the years of the prewar Five-Year Plans, the construction of electric power stations developed on a broad plane. In 1940, the installed generating capacity of power stations in the USSR reached 10,700,000 kw, and the electric power output amounted to about 50 billion kilowatt-hours, in other words 25 times in excess of the 1913 level.

The construction of electric power stations continued even under the trying conditions of the Great Patriotic War. During the war years, the installed generating capacity of power stations in the Urals more than doubled, that in the Kuznetsk basin increased by 1.7, that at Karaganda by 4.1 times, and that in Uzbekistan by 1.9 times.

In the postwar period, much work was done in the development of hydroelectric power engineering projects and in the installation of giant hydroelectric stations. The power stations, destroyed in the zone of military operations, were modernized in the process of restoration and were outfitted with advanced and highly efficient equipment. As an example, we may point to the Dneprov hydroelectric power station. After restoration, the power of the Dneprov station was stepped up by 15%. The head on the dam was raised by almost one meter, which increased the output of electric power. Control and startup of units became fully automated.

During the fifth Five-Year Plan, ten electric power plants were put on stream, equipped with the latest word in advanced techniques, in Siberia and in the Ukraine, in the Far East and in Georgia, in the Urals and in the North Caucasus, in the coal basins of the Kuznetsk and Donets, and in other regions of the country: Ust'-Kamenogorsk, Tsimlyanski, Gyumush, Verkhne-Svir', Mingechaur. Hydropower stations at Kamskoye, Kakhovka, Gorky, Dubossary, Narva and other sites, large heat power plants or thermal electric power stations at Mironovo, Slavyansk, Nizhne-Tura, Yuzho-Ural'ski, etc., were commissioned.

During the years of Soviet power, over 300 large- and medium-capacity electric power stations have been built and put on stream, including 90 hydroelectric power stations. The output of electric power in the USSR in 1955 exceeded by 86 times the pre-Revolution level. We are now producing daily almost the same amount of electric power as was generated by all of the power plants in the nation in 1920.

The vigorous growth in power facilities made it possible to vastly expand coal mining, oil production, steelmaking, rolling of ferrous and nonferrous metals, high-productivity machinery, machine tools and equipment, and permitted the equipping of new enterprises, railroad lines, sovkhozes and machine-tractor stations, to supply dwellings, schools, and hospitals. Electrification speeds up the rate of development of all branches of our national economy and primarily heavy industry, the backbone of the economy of a socialist State.

Electric power continually penetrates further into all branches of production. It plays a decisive role in the development of the technical progress experience by our industry.

Mechanization of laborious and difficult operations and automation of techniques in all branches of production are uhthinkable without electric power and electrification of the manufacturing process. This is best defined in the metallurgical and chemical process industries.

Electrical machinery and devices mechanized all branches of the national economy and automated almost all production processes. Without electrically actuated controls, it would be impossible to operate modern large rolling mills and other highly complex units. Electrification improves technology and raises labor productivity. Electrical processes are readily amenable to control and permit an improvement of the production of high-grade light and nonferrous metals, alloy steels, and chemicals, placing production of aluminum, zinc, magnesium, electrolytic copper, ferroalloys, and other highly important products on a mass-production basis. The broad development of electrosmelting, electrolysis, high-frequency induction tempering of metals, and other forms of electrotechnology in our industry demonstrate the great effect exerted by electricity on increases in labor productivity.

Electronic engineering, radar, and the use of atomic energy for peaceful purposes open immense possibilities for the growth of the productivity of labor.

The mechanization and automation of production, the expediting of conveyor-belt production methods, high-speed cutting of metals, electrolysis and heat treatment of metals by electricity, high-frequency induction hardening, electrification and development of railroad transportation, new electric-arc welding techniques and many other advanced methods associated with new techniques, together with a rise in the level of culture in production, impose increased demands on electric power. A continually expanding growth in electric power is therefore a necessity. This is a decisive prerequisite for the further development of new power-consuming enterprises and for the introduction of more advanced manufacturing processes in all branches of the national economy.

The power base in our country is being expanded primarily in terms of stations with high and with superhigh power capacities.

Over a hundred hydraulic and fuel-fired power stations, providing a total power of several tens of millions of kilowatts, are being erected in our nation.

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In spite of the great success attained in hydroelectric power engineering, thermal electric power stations remain, under the sixth Five-Year Plan, the main sources of power supplies for the country's needs. Their total power will be increased by 2.2 times. The technical level of thermal electric power stations will be raised further.

Speaking of the development of the electric power base, it is important to note that the advantages of a socialist economy, planned guidance of the economy, high forms of socialization of labor, make it possible to carry through electrification successfully and on a broad scale, resting on the basis of the most advanced techniques.

The power network of the Soviet Union is growing not only quantitatively, but is also developing qualitatively. Enterprises engaged in the manufacture of power-generating machinery are putting out first-class boilers, hydraulic turbines, and generators of all types and sizes. Turbines and steam boilers with high steam parameters are being installed in fuel-fired electric power stations, automatic units are being introduced to control combustion and ash-removal processes. Providing automatic controls for only a portion of the existing boilers would economize up to 1,500,000 tons of fuel annually.

Plants operating in the Soviet Union have made possible the manufacture of powerful power units: turbines and generators for the turbines (turbogenerators) rated at 50,000 - 150,000 kw. Our plants have produced the most powerful hydroelectric power installations in the world for the Kuibyshev hydroelectric power station. Improvements incorporated into the power equipment permit a successive reduction in fuel costs and capital investments for electric power stations, a lowering of the unit cost of electric power, and to an increase in the productivity of the power generating units.

Particularly great success has been achieved by the Leningrad Metal-Working Plant and by the "Elektrosila" plant. The hydraulic turbines designed and manu-

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factured at the Leningrad Metal-Working Plant have an overall power of several millions of kilowatts, and are distinguished by their high performance characteristics.

The sixth Five-Year Plan opened new horizons for the plant staff. The plant must develop and fabricate more powerful, more advanced, and more economical machines. The plant is being prepared, in particular, to deliver a super generator rated at 200,000 kw, with an improved cooling system, which will make it possible to greatly reduce the operating cost of the generator.

One of the leading trends in technical progress in modern power engineering is the use of steam of superhigh parameters, the advantage of which lies in the fact that economic operation of the installation is enhanced by increased temperature and pressure levels.

During the postwar years, the turbine manufacturing industry mastered the production of new power equipment, including powerful and economic steam turbines and hydraulic turbines, pumps, blowers, and other machinery for electric power plants. The total installed generating power of large turbines in our country was counted in the millions of kilowatts, by the end of the fifth Five-Year Plan.

Such plants as "Uralelektroapparat", the Ural Hydroturbine Works, the Ural Turbine Works, and other enterprises are constantly working on mastering the manufacture of machinery and equipment embodying new designs. Such new machinery, available in great numbers, brings up-to-date techniques to the electric powerhouses. At "Uralelektroapparat", one of the largest plants manufacturing machinery, electromechanical tests were completed in February 1956 on a new powerful oil circuit breaker. Hydrogenerators for Bulgaria, engines for China, electric motors for mines and mills in the Urals, Kuznetsk and Donets basins and Central Asia are also being fabricated there.

A great deal of interesting work has been accomplished by machine designers in the plant in the design of transformers, circuit breakers and other electrical equip-

STAT

ment for the metallurgical combine being erected by the Soviet Union in India.

High-speed steam turbines rated at 100,000 kw power with a steam pressure of 90 atm, and turbines of 150,000 kw power, with a superhigh steam pressure of 170 atm.

As an example, we may also cite the machinery at the construction site of the Volga-Don canal, and that at the Volga hydroelectric power plants, steam turbines rated at 150,000 kw, operating at 3000 rpm, etc.

Machine-builders at Podol'sk (the Ordzhonikidze factory) have produced a once-through boiler with superhigh steam parameters. This required machining 120 km of tubing from high-alloy, refractory steel, and over 20,000 weld joints.

Fabrication of a boiler of that type is a step forward on the road to technical progress in power projects. This is the first industrial unit to make the grade in the transition to the manufacture of boilers designed for superhigh temperatures and pressures. The boiler stands 32 m in height and weighs over 1000 tons, being strikingly different in its technical specifications from other heat-generating equipment. The working steam pressure in the boiler is raised as high as 215 atm, and the temperature goes as high as 575°C. The throughput of the unit comes to 300 tons of steam per hour.

In one day, the boiler consumes 1500 tons of coal in pulverized form. In medium-pressure boilers of the same throughput, 300 tons more coal would have to be burned. The installation of these new boilers in fuel-fired electric power stations will save the country tens of millions of tons of coal.

While increasing the output of power-generating equipment, leading machine-builders are perfecting the technology involved in the manufacture of such equipment, reducing the labor involved and saving on metal stock. For example, the labor involved in producing a steam turbine of 50,000 kw rating was cut by 37.5% over the past five years. Thanks to the use of welded-cast and welded-pressworked designs in the manufacture of hydraulic turbines for the Kuibyshev hydroelectric power station, over 6 million rubles were saved.

Soviet turbine builders are now increasing the power ratings of steam turbines and water-wheel generators from 100 - 150,000 kw to 250 - 300,000 kw. Under the sixth Five-Year Plan, they must produce a turbine rated at 300,000 kw, for a steam pressure of 300 atm at a temperature of 650°C. This is equivalent to five Volkhov hydroelectric power stations in a single turbine!

The Twentieth Congress of the Communist Party noted the fact that the enormous program scheduled in the construction of fuel-fired and hydroelectric power stations faces the workers of the power machinery building industry with new and great problems.

It is recognized as necessary to organize a specialized, centralized base in the manufacture of turbine bucket billets for all turbine manufacturing works. After standardization is achieved, centralized machining facilities for the stock will be organized. This will permit widespread use of the methods of precision stamping, precision casting, cold-rolling to specifications, to ensure appreciable savings in stainless steel. The machining of turbine buckets will possibly be transferred from general-purpose machine tools to specialized equipment, thus accelerating the production process and slashing costs.

Even more serious questions arise in the fabrication of hydraulic turbines of superhigh capacity for the hydroelectric power stations in Siberia. Those machines will exceed the power ratings of their predecessors by 2 - 3 times. For example, we are faced with the task of building a hydraulic turbine of radial-flow, axial-flow design for a head of 100 m, 200 - 300,000 kw power ratings, in one integral unit. The greatest power yet achieved by us for a turbine of that type in a single unit is 85,000 kw. Outside the USSR, the most powerful turbine to date is rated at 120,000 kw.

A most important feature of the development of electrification in the USSR is the widespread utilization of hydroelectric power resources. The development of

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hydroelectric power is being systematically increased in the USSR.

The development of hydroelectric power is technically correct and a justified item, since hydroelectric power stations have considerable advantages over coal-fired and oil-fired power plants. The basic advantage of hydroelectric stations resides in the fact that they operate not on solid or liquid fuel, but rather employ the energy yielded by water streams.

The water-power resources of our Motherland are extraordinarily great. For example, the total number of rivers in the USSR is in excess of 200,000, with an overall length of about 2.5 million kilometers of waterways; the lakes are estimated at over 250,000.

The power of hydroelectric stations which could be erected on our rivers exceeds 300,000,000 kw. This is almost three times as much as the hydroelectric power resources in the USA and over five times that of Canada.

The Soviet Union occupies first place in the world in reserves of water power, and is still making insufficiently complete use of them. We have still to catch up with the United States of America in the number of hydroelectric power stations, in the overall balance of electric power output, with over one fourth of the total electric power output in the USA being obtained from hydroelectric power plants.

The growth in the number of hydroelectric power stations and the increase in their installed generating capacity has made it imperative that all units operate without faults and outages and that uninterrupted transmission of power to cities and villages is ensured. This is being taken care of by automation of the control facilities.

The first semi-automatic hydroelectric power plant was started up in 1935 near Erevan, and the shift to automatic control of all power units in hydroelectric stations was completed by the end of 1952. This involved the introduction of remote control into hydroelectric power plants, developing over half of the total power of the hydropower plants in the USSR. During the following years, work was continued

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in bringing hydroelectric power plant facilities under remote control.

In the status of automation of hydroelectric power stations, the Soviet Union occupies first place in the world. In 1952, automation of all of the large hydropower stations of the USSR was completed. Many of them are already remote-controlled from central dispatcher points in the power network.

Whereas the change-over of power plants to automatic control previously only reduced the number of personnel in the plants (and reduced operating costs), automation is now capable of also providing reliability and accuracy in the operation of the units.

The economic advantages of automated hydroelectric power stations have also found their reflection in lowered net costs for energy generated.

It requires no more than a few minutes to start up the most powerful hydropower installations and to bring them to peak-load operation. But the startup and adjustment to peak load in the case of a fuel-fired unit, comprising a once-through boiler and turbine, requires not less than 4 hours (and much more, in the case of drum boilers).

In automated electric powerhouses, not only is the time required for starting up the power units shortened by 5 - 6 times, but water losses are also reduced and current frequency and voltage are advantageously maintained at constant level. Rapid switching on of the units, reliability in power supply, accurate control of power, frequency, and voltage aid in readjusting operations and in linking stations with large power networks.

Automatic equipment, including contactors, relays, circuit breakers, float switches, forming part of all complex and domestic hydrotechnical installations, ensure reliability and accuracy of operation of the units.

Control of installed units in hydroelectric and pumped-storage hydro plants is carried out from the dispatching point of the power network. The dispatcher knows at any given moment the state of each unit and other equipment. Signals from the hydroelectric and pumping stations inform the dispatcher on the flow of the production process.

Observation of the equipment in automatic hydroelectric power stations is also carried out by means of systematic inspections. In the case of outages and power breakdowns, an alarm signal is received at the station manned by a technician or engineer. On arriving at the powerhouse, the man on duty either takes care of minor faults himself or else calls in the maintenance crew of the power grid.

At the Kuibyshev hydroelectric power station, the basic mechanisms employed and the ancillary and monitoring equipment are controlled automatically by remote control. The units are switched on and off automatically. Special devices, floating relays, indicate the level of the Volga in the penstock and tailrace of the plant. A special signal gives the alarm to the man on duty on the shift, in case of leakage of lubricant or faults in the cooling system. The operator on duty then switches the necessary unit or transformer on or off by remote control. An engineer attached to the pooled dispatcher control office of the Ministry of Electric Power Stations of the USSR may monitor the operation of units in hydroelectric power plants from Moscow. The entire complex equipment of hydroelectric stations will be controlled by 92 men. The number of personnel employed per 1000 kw of installed capacity will be three times less than that number employed at the Dneprov station.

As already stated, the automation of units in hydroelectric power stations is practically completed; these are now being changed over to remote control and remote switching and signaling arrangements.

Remote control completely displaces operating personnel at the power stations. The Uzbek power network is fully automated and remote-controlled. Each group of four or five power stations is controlled from a single dispatching control point, manned by two workers.

Automated and remote-controlled hydroelectric power plants are the prototype of the technique of communist society, with respect to the level of their technical instrumentation and the nature and productivity of their labor.

Workers in electric power plants are faced with a serious job: to complete, in the course of the next two or three years, the installation of complex automation and remote control of hydroelectric power stations, effecting the change-over to remote control of the basic power networks and remote control of all large sub-stations. Coal-fired and oil-fired electric power plants must be changed over from automation of discrete operations or automation of single units to the complex automation of entire power production processes.

The construction of large installations, complex in nature, for hydroelectric power stations has become possible only as a result of the high level of mechanization attained.

Construction projects in our country have been placed on a completely new basis. Over a thousand machines of different types have been brought into play for the mechanization of construction.

Modern hydroelectric power plants have been built and erected in the most varied geological and topographical settings; have experienced heads differing greatly in strength and in quantity of water throughput; differ from each other in design and size of installation and equipment, which in turn are made of different materials. Each of the hydroelectric power stations, even on one and the same riverway, has its own peculiar features.

Soviet hydraulic and civil engineers must solve a number of questions covering a broad area in the erection of new hydroelectric power plants under a variety of conditions. Such hydroelectric power stations not infrequently comprise a whole complex of engineering installations.

One of these complex hydroelectric power stations is the Narva hydroelectric power plant.

The power available from the Narva has for a long time intrigued engineering thought. A project for an electric power plant on that river was worked out in 1899.

However, the realization of that task proved to be beyond the capabilities of the Tsarist regime, and of bourgeois Estonia as well. Only the Soviets proved capable of harnessing the Narva.

The Narva river has its source in Lake Peipus (Chudskoye Ozero) and drains into the Gulf of Finland. Near the city of Narva, the quiescent flatlands river converts into a torrential stream. Crashing through a stony ridge, it plunges almost directly downward, with the tremendous force, from a height of ten meters, to form the well-known Narva waterfalls.

The complexity involved in building the Narva hydroelectric plant resides in the fact that it is, in its own peculiar way, an off-the-river power station. Water is brought to the station along a man-made canal waterway. This station comprises a complex of hydraulic engineering installations covering a relatively large territory, and consists of the main station, branch station points, and forebay. The Narva power station is entirely automated. The personnel required to service the station is ten times less than the personnel in coal-fired and oil-fired stations.

In installed power ratings, the station exceeds by many times that of all of the hydropower works existing at the Narva waterfalls in 1940, and surpasses the first of all Soviet hydroelectric power plants, the Volkhov installation.

The startup of the Narva hydroelectric power station meant a significant increase in the amount of electric power generated in the Leningrad and Estonian power networks. The Narva hydroelectric station opens vast perspectives for the further industrialization of the Estonian SSR.

Soviet scientists and engineers have worked out dam projects involving the use of concrete, reinforced concrete, lumber, stone, and earth, more economical than those built outside the USSR, on similar geological sites.

On the Volga, Kama, and on many other rivers, power installations are being erected on sand foundations. To ensure their full reliability, their dimensions are being enlarged, and steel reinforcements are being provided in increased number.

A total of 6,500,000 m^3 of concrete and 3,200,000 tons of metal reinforcements were incorporated into the foundations of the Stalingrad hydroelectric power station.

Scientists and engineers of our country must find a way of treating soft-soil foundations with special binders and cementing materials, in order to transform sand into firm rock foundation. It will then be possible to sharply reduce the size of the installations, to simplify similar devices, to protect dams from erosion, to discontinue the driving of metal sheetpiles below installations to block water seepage. It is even now difficult to conceive of the savings in forces and means which might be made available to the national economy by the successful tackling of that problem.

We must design and build hydraulic engineering works better, faster, and more economically.

In order to use hydroelectric power resources available in the country to full advantage, three basic principles are observed in the construction of hydroelectric power stations.

The first principle consists in the tandem arrangement of all hydroelectric power plants on a given river. In this way, the river "works" for man to the limits of its capacity.

Five power stations, the V.I.Lenin Dneprov Station, the Kakhovskoye, Kremenchug, Dneprodzerzhinsk, and the Kanev stations, comprise the single system forming the Dneprov power complex.

Two hydroelectric stations have already been built on the Dneper. The V.I.Lenin Dneprov hydroelectric station has been furnishing the national economy with electric power for about 25 years now. During the last year of the fifth Five-Year Plan, the first units of the Kakhorskoye hydroelectric power plant went on stream before the scheduled date. The Kremenchug hydroelectric station will be erected under the sixth Five-Year Plan.

Near Dneprodzerzhinsk, ground has been broken for the construction of a new hydroelectric power station, the fourth on the banks of the Dneper.

The Dneprodzerzhinsk hydroelectric power plant, with 250,000 kw installed generating capacity, will supply the industrial and agricultural districts of the Donets and Dneprov basins with electric power. A railroad line and an automotive highway will pass over the dam causeway.

Not everyone realizes what enormous work is being carried out there. A total of 40 - 60 million cubic meters of earth have to be excavated and moved, and 1,250,000 m^3 of concrete have to be placed, backed up by tens of thousands of tons of metal reinforcements. The 670-meter span of the concrete dam, belonging to the Dneprodzerzhinsk electric power station, intercepts the river, raising the water level by 30 m. In order to afford reliable protection to the lower-lying portion of the left bank of the river against floods, construction workers will erect a levee extending 50 km.

Under the sixth Five-Year Plan, gigantic labors were continued on the complex exploitation of Europe's largest river, the Volga.

The first three stations built on the Upper Volga were the Ivan'kov, Uglich, and Shcherbakov stations. Under the fifth Five-Year Plan, construction projects were started on three further stages in the Volga power series: Gorky, Kuibyshev, and Stalingrad hydroelectric plants. Under the sixth Five-Year Plan, all 20 turbines of the Kuibyshev hydropower plant will be placed on stream, with an overall power rating of 2.1 million kilowatts, followed by the Stalingrad plant with an overall power rating of 2.3 million and the Gorky hydropower plant. Construction is planned on two more powerful hydroelectric centers, to be incorporated in the greater Volga complex: the Saratov and the Cheboksary hydroelectric power stations. After these power stations have been put into operation, the entire Volga stretching from Kalinin to Stalingrad will be yielding its stored energy to our hydroelectric power plants.

The Volga's largest tributary, the Kama, has already seen the first hydroelectric power plant go up on its banks. The river is now spanned from shore to shore by the Kama hydroelectric station dam, built of reinforced concrete. The Votkinsk hydroelectric power station is being erected on the Kama. The storage reservoir of this second hydroelectric power station will extend for 370 km. Construction workers still have a big job ahead. The Votkinsk hydroelectric power plant will surpass the Kama hydroelectric power plant in installed capacity. Plans are underway for the erection of a still more powerful hydroelectric plant on the Lower Kama.

On the Syr-Dar'ya, Naryn, and Vakhsh rivers in Central Asia, on the Rioni in Georgia, on the Kura in Azerbaijan, on the Razdan in Armenia, hydroelectric plant construction projects are scheduled, in tandem with existing hydroelectric power stations or those now under construction. A train of 12 hydroelectric power stations could be set up on the Rioni river; at the moment only one is in operation, the Rioni hydroelectric power plant, and one station is under construction. When this is started up, the water power of the Rioni will be roughly one-tenth harnessed. Large and medium-scale hydroelectric power plants will be built on the Dnestr, Neman, Western Dvina, and on other rivers.

A great shift in hydroelectric power projects toward the East was initiated under the sixth Five-Year Plan. Vast reserves of water power latent in the Siberian rivers will be harnessed to serve the nation.

The rivers of the "land of the great future", as Siberia is justly known, contain within themselves 90% of the water power reserves of our entire country.

The enormous power resources of the rivers of Siberia have been exploited to only a small extent. On the Ob', for example, the largest river in Siberia, eight hydroelectric power stations could be accommodated; so far only one hydroelectric power station is being built, at Novosibirsk. This station will supply abundant and cheap power to industrial enterprises, machine and tractor stations, kolkhozes and sovkhozes, and will provide electric power for the Trans-Siberian railway line. Waterways will be improved in the upper reaches of the Ob', where a reservoir is

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being formed 240 km in length and 20 km in width. The Bukhtarma hydroelectric power plant on the Irtysh will supply power to industrial enterprises and agriculture at Altai.

Construction of the Krasnoyarsk hydroelectric power plant on the Yenisei is being planned, with an installed generating capacity of 3,200,000 kw.

A site has been found for the hydroelectric station 40 km from Krasnoyarsk, near the village of Shumikh. All of the installations of the station will be built on granite foundations. A total of seven million cubic meters of concrete and reinforced concrete have to be placed. The length of the reservoir will extend to 500 km, and its volume will be 107 billion cubic meters of water.

The work lying ahead for the builders of hydroelectric power facilities will be all-encompassing in scope. Before proceeding directly to the erection of hydroelectric power plants, extensive preliminary work has to be carried out. Railroad branches and spurs of 105 km track length have to be laid and two automobile and truck roads stretching 75 km have to be built. Passable roads will be laid over sharply broken terrain. The overall volume of earth- and rock-moving and filling work, for the building of passable roads alone, will involve about five million cubic meters of material.

A tandem complex of large hydroelectric power stations will be built along the Angara. These will provide cheap electric power to industrial enterprises and construction projects in Eastern Siberia.

Much remains to be said about the marvelous Siberian river Angara, a tributary of the Yenisei. In hydropower resources, this river takes one of the leading places not only in the Soviet Union, but in the entire world. It is estimated that the river is capable of generating up to 65 billion kilowatt-hours of electric power annually, i.e., more than the Volga combined with the Kama, Oka, and its other tributaries.

All of the rivers usually have their source in tiny streamlets, but the Angara

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is an exception. A total of 330 rivers and small streams drain into Lake Baikal, the deepest fresh-water lake on the face of the globe, and only the Angara, cutting its way through a rocky mountain chain, discharges from that lake. It is not without reason that Siberians refer to the Angara as the favorite daughter of Lake Baikal.

Under the conditions prevailing during the Tsarist regime, leading Russian scientists, explorers, and experimenters were unable to study the power riches of the Angara to any extent. Only after the Great October Socialist Revolution was an omnilateral study undertaken of the unexploited riches of Eastern Siberia. It was the Soviet power that placed these riches at the service of the people. As early as 1920, specialists were working out the first plans for harnessing the power of the Angara.

The huge water masses of the Angara, the possibility of controlling its water volume over a time span of years owing to the magnificent natural reservoir available in Lake Baikal, has always intrigued the imagination of electric engineers. Angara does not require the building of special artificial reservoirs and pondage, to serve the hydroelectric facilities. The water storage is provided in this case by Nature itself. And it will be an inexhaustible source of power to the hydroelectric utility complex along the Angara.

Construction work on the Irkutsk hydroelectric power station was initiated in 1950. In March 1950, an excavator dug up the first cubic meter of earth in the village of Kuz'mikh. The first two power units placed on stream, as early as 1956, in that hydroelectric power plant were delivering industrial current. The installed generating capacity of those units is 660,000 kw. Ten hydroelectric stations of the Volkhov type would have to be built to equal the power ratings of this first hydroelectric power station on the Angara. The dam servicing the hydropower facility raises the level of the Angara and of Lake Baikal. The "renowned sea" (Slavnoye More) extends as far as Irkutsk.

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A second hydroelectric plant on the Angara, the Bratsk hydroelectric station, is the largest hydraulic engineering facility in the world. It will generate as much electric power, roughly, as the Kuibyshev and Stalingrad hydroelectric stations on the Volga combined. The Bratsk hydroelectric station will be erected in the area of the Padun rapids. The river cuts through a heavy mountainous ridge at this point. Its banks reach 80 - 90 m in height and form an escarpment dropping almost straight downward. The river flows freely and broadly up to the heel of the future dam. The river's breadth reaches 4 km across at some points and funnels to 800 m at the dam site. The dam will be erected at that location. The storage reservoir will be several times larger than the Kuibyshev Sea. This "Angara Sea" will provide, in combination with Lake Baikal, the prerequisites for smooth year-round operation of the power station.

It is difficult to overestimate the significance of the Bratsk hydroelectric power station, the most powerful power station in the world. By reason of its design data - installed generating capacity, electric power delivered, and net cost - it has a right to the name of the "pearl of the power network of the Soviet Union".

When tamed by high dam works, the Angara, now full of rapids, will be transformed into a convenient navigable waterway.

The harnessing of the Angara will make this district of Siberia, rich in resources of raw materials and fuels, the largest center of the aluminum, chemical, mining, and other industries.

The energy from the Irkutsk and Bratsk hydroelectric power stations will enable the railroad network in that region to obtain electricity. At the same time, electricity from the Bratsk hydroelectric plant will be transmitted to neighboring industrial districts, to Irkutsk - Cheremkhovo to the southeast and to Krasnoyarsk in the west. The Bratsk - Irkutsk - Cheremkhovo power network will be formed. In subsequent years, this network will be incorporated into a unified power net covering all of Eastern Siberia, to be later linked with the power network serving the

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European sector of the USSR.

Power from hydroelectric plants on the Angara will feed the powerful electrified express trains of the Trans-Siberian main railway line, and also those running on local regional railroads. The dams of the hydroelectric power facilities will raise the level of the river, drown the rapids in the Bratsk district, and open up a through route from the Mongolian Peoples Republic, via the Selenga, Lake Baikal, the Angara and the Yenisei, terminating in the Arctic Ocean.

The Soviet people, equipped with the most advanced techniques, are not only controlling the run-off of individual rivers, but are rearranging entire river basins (e.g., the Volga basin). The transfer of waters from one basin into another has now become entirely practicable. The problem of a radical space redistribution of the water resources over an extensive area taking up three great plains of the country, the Western Siberian Plain, the Turana Plain, and the Caspian Sea Plain, will assume full importance in the future.

With the future construction of the chains of electric power stations on the banks of the mighty Siberian rivers, it will become possible to alter the entire climate of the region: enormous bodies of water, up to now draining into the Arctic Ocean, may be partially diverted to the South, where they are needed by the arid lands of Central Asia.

The second principle applied in Soviet hydraulic engineering is the complex nature of the equipment and installations. The building and putting into operation of hydroelectric power stations exert an influence on various sectors of the national economy, for which reason construction projects for hydroelectric power stations involve not only power questions, but transportation and irrigation problems as well. Such problems, along with the power problems, are basic components of complex hydraulic engineering construction work.

The third principle requires, in the building of hydroelectric power facilities, wherever technically possible and feasible, the development of water storage reservoirs for the proper and fullest utilization of the run-off of the rivers, to create sizable winter water reserves.

Sluices are built and the river is dredged to a navigable depth, to solve the transportation problems.

The storage reservoir associated with the Dneprov hydroelectric power station drowned the famous Dneprov rapids, with the result that the river became navigable over its entire extent.

Navigation is hampered on the Volga in the summertime, owing to the fact that shoals appear in the river. The river will acquire a stable depth after all of the Volga hydroelectric power stations have been put on stream.

The Angara river is not navigable at the present time. In the district of the city of Bratsk, the rapids known as the Padun Rapids are especially troublesome. When the hydroelectric power station has been completed, the rapids will be flooded over and the river will become navigable to shipping.

The navigation locks on many of our waterways are the largest in the world. The locks on the White Sea - Baltic Sea Canal are made of timber, with rhombic sluice gates. On the Svir'stroye, on the Moskva Canal, on the Volga, the Volga - Don and other waterways, the locks are made of reinforced concrete. Devices designed to discharge water from the sluice chambers while bypassing the headwaters are in use at the Shcherbakov water works. At the Ust'-Kamernogorsk works, a single-chamber pressure lock of prestressed reinforced concrete was built first. Filling and emptying of the lock chambers is performed by hydraulic power.

The building of hydroelectric power stations will make it possible to solve, at one stroke, problems of flooding and of land irrigation.

After the Farkhad hydroelectric power station and the associated irrigation canal had been built, it became possible to irrigate 150,000 hectares of the Barren Steppe in Uzbekistan. Nourished by their water, the fertile lands now yield rich harvests of cotton and other produce. After start-up, the second hydroelectric power station, at Kairak-Kumsk, will furnish electric power to the cities, making it possible to irrigate the virgin lands in the Republics of Central Asia, 500,000 hectares of fertile lands on the Barren Steppe. After the Kairak-Kum reservoir is filled, the future "Tadjik Sea" will spread out to 80 km in length and 20 km in breadth. An irrigational system will be developed over many thousands of hectares of newly reclaimed land. Four hydroelectric power stations, at Kuibyshev, Stalingrad, Kakhovka and Tsimlyanski, will comprise an irrigation system servicing 4,750,000 hectares and will further irrigate 9,700,000 hectares of land.

The Directives of the Twentieth Congress provide for further development in the amelioration and irrigation of farmlands. Plans worked out for the Five-Year Plan envisage an increase in the area of irrigated land of roughly 2,100,000 hectares, reclamation of 3,100,000 hectares of arid land, and irrigation of about 80,000,000 hectares for pasture and grazing.

The task of the hydraulic engineers reduces to redirecting the natural flow of rivers to conform to the needs of the national economy, to make the elemental phenomena of nature bow to man's will. This requires a profound study of the conditions of water flow and of the regularities in force, in order to foresee hydrological events ten years ahead.

In our country, the solution of hydraulic engineering problems is based on careful studies and research into natural conditions. Various scientific organizations, not only hydrotechnical ones, are drawn into the work; these including geological, geotechnical institutes, institutes of mechanics, physics, ichthyology.

In the design of installations and their complexes, Soviet hydraulic engineering seeks the best and most economical solution for each given case. In choosing the site for a waterworks project, in setting up the installations, scientists and engineers compare a number of variants and choose the most feasible one.

Scientific projects and the construction work itself are produced by the needs of the socialist national economy, by the plans for its development. The planned character of the socialist state make it possible to take care of the complexity of the solutions to water resources problems and hydraulic engineering problems, guaranteeing the most complete utilization of the water resources.

The building of large-capacity electric power stations, of enormous canals and irrigation systems, signifies an unheard-of upward sweep in social production, a new higher stage in the socialization of labor and in the concentration of production, unknown to and inaccessible to capitalism.

During the past 25 years, a large fund of experience has been accumulated in our nation on the construction of hydroelectric power stations, canals, and irrigation systems. It is understandable that, without the prerequisites in the field of development of techniques, we would have been unable to proceed toward fulfillment of the grandiose program of hydraulic engineering construction.

Power and hydraulic works construction provide a shining example of the intimate correlation between progress in techniques and growth of the production scale in our country.

Alongside the giants of power engineering, contractors are engaged in erecting small hydroelectric power stations, which will electrify interior and more remote sections of the nation. The harnessing of small rivers and the construction of agricultural hydroelectric power plants is moving ahead in full swing. Hundreds and thousands of new kolkhozes will be supplied with electric current and will be enabled to raise their economy to a technical level, based on the extensive use of electric power.

The problem of uninterrupted supply of electric power to all branches of the national economy is being solved not only by the introduction of new power capacities, but also by a fuller utilization of the equipment in existing electric power plants, and in savings of electric power by consumers.

One of the most pressing problems in the area of space and process heating facilities is the problem of fullest utilization of the power ratings of coal-fired

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and oil-fired electric central stations. Our fuel resources may be greatly increased by making use of the reserves of the economy.

Full utilization of the power capacities of thermal electric power stations would mean yearly savings of 850,000 tons of basic fossil fuels.

Great savings in fuel at electric power plants may also be achieved by the further introduction of equipment operating on high-pressure and superheated steam. For example, fuel-fired electric power stations operating at a steam pressure of 30 atm yield fuel savings 25 - 30% greater than that achieved in steam power plants where a steam pressure of 15 atm is employed.

In industrial enterprises, fuel losses in boiler houses are 20 - 25% higher than in the boiler units or large modern electric power stations.

The reduction in electric power consumption in the manufacture of compressed air is a very pressing problem not only in coal mining but also in other branches of industry, since the field of application of compressed air is exceptionally broad.

In the oil industry, expenditures of electric power are being reduced not only by improving the operation of the power economy, but also as a result of the introduction of the most rational methods in the exploration for oil.

In machine-building, power savings may be realized to a greater extent than in any other branch of industry. Savings are achieved in this branch by a careful technical preparation of production, by selection of the most efficient method for machining parts, by the use of elaborate tools and devices, by the most economical technological mode of production scheduling, ensuring reductions in the labor and power going into finished parts, by increasing labor productivity, reducing scrap and losses in the form of chips and waste.

Great savings in electric power may be achieved in the metal-working industry by reducing allowances for the machining of parts. At the First State Bearing Factory, the metal scrap lost in the form of chips in the manufacture of a single bearing was reduced by 40 grams. This measure resulted in savings to the factory of about 30,000 kw-hr of electric power monthly.

As already stated, the generation of hydroelectric power depends on the run-off of the river waters. In different seasons of the year, and in different years, the run-off varies. In large-rainfall years, a significant portion of the river run-off fails to arrive at the turbines of the hydroelectric power stations and consequently does not contribute to the generation of electric power. Electric power is usually in greater demand during the daytime and evening hours than during the night. In most cases, the summer load is smaller than the winter load. If a hydroelectric utility were to operate in isolation, furnishing electric power to some given region, then the installed generating capacity would be ruled by the minimum rate of water flow. To satisfy wintertime electric power needs, a special standby capacity would have to be planned, in coal-fired as well as in oil-fired electric power plants. The standby capacity would be needed to balance the drop in power and in electric power generation during low-rainfall years. The situation could be greatly improved by linking the hydroelectric power stations with the overall power network. At the same time, the hydroelectric station would join forces with the fuel-fired power station. This would enable fuel-fired stations of the entire power network to operate around the clock on an almost steady schedule, and would improve the operating conditions of fuel-fired electric power stations, raise plant efficiency, and also economize on fuel. The incorporation of the Dneprov hydroelectric power station, together with the coal-fired electric power stations in the Donets basin, into the Southern Power System made possible power savings of 250,000 kw in the installation of coal-fired stations. This may be explained by the fact that the Dneprov hydroelectric power station generates more power in the springtime (in the spring-thaw flood season) than in winter. This power arrives in the Donets basin via transmission lines. Power engineers make use of this circumstance by shutting down the coal-fired Donets basin stations for overhaul. If the Dneprov hydroelectric power plant were not incorporated into the Southern network, a reserve of power of about

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250,000 kw for shutdown standby would have to be arranged in the coal-fired stations in the Donets basin.

The greater flexibility of units in hydroelectric power plants is especially valuable for large power networks. A sharp increase in load in such power networks, associated with sudden shutdowns or trip-outs of certain units, must be immediately made up for by standby units.

The organization of power nets was envisaged as far back as in the GOELRO plan. The basic form of the development of the Soviet power projects has been the organization of power networks, uniting into one whole the power economy of entire districts. During the years of the first Five-Year Plan, power systems were equal, in their installed capacity, to one third of the overall installed generating capacity of all the electric power plants in the country.

Before the war, large networks of electric power facilities were organized at Leningrad, Moscow, in the Urals, in the Donets basin, and in the Dneprov basin.

During the war years and postwar years, dozens of large-capacity power systems were built in the Urals, in the central portion, and in the southern part of the nation.

The organization of power networks in the Republics is one of the most magnificent achievements of the Leninist policy on nationalities. Power networks speed up the liquidating of backwardness of particular districts and help creating all conditions necessary for the development of the national economy of the Republics along the industrial road.

The most important advantage inherent in the organization of power systems and in the development of power nets resides in the fact that the site selection of electric power stations is not dependent on the location of the consumers. This opens the possibility of building electric power stations closer to fuel production sites or to sources of water power, since the electric power is delivered to the consumers from an integrated chain of electric power networks.

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The growth in the productive capacities of the electric power base in the USSR and the success achieved in long-distance transmission of current set up favorable conditions for the creation of one single power system encompassing the entire nation.

The successful solution of the problem of an all-encompassing electrification program for the country is possible only by way of organizing power systems and power system combines.

The installation of hydroelectric power stations with extra-high capabilities in Eastern Siberia makes it possible to build a single power network for Central Siberia, extending from Novosibirsk to Irkutsk. It will embrace the Angara-Yenisei and the Ob' hydroelectric power facilities.

The building of a single high-voltage network in the European sector of the USSR, in turn hooked up to the Trans-Caucasian power network and to the power network of Central Siberia, will bring the historic task closer to achievement, namely the creation of a single power network for the entire Soviet Union.

This requires the solution of complicated scientific and engineering problems. At the Power Engineering Institute of the Academy of Sciences of the USSR, the fundamentals of the power balance and the structure of a single power system for the Soviet Union have been worked out, and the different stages of its development are being determined.

The single power network for the European sector of the USSR will integrate the Kuibyshev, and the Stalingrad hydroelectric power stations with the Central, Southern, and Ural power networks. In addition, the Georgian, Azerbaijani, and Armenian power nets will also be connected into the system.

In a single power network servicing the European sector of the USSR, the main load will be carried by the complexes of hydroelectric power plants on the Volga, Kama, and Dneper, the electric central plants operated on anthracite and brown coals, on the tailings of coal dressing processes in the Donets, Moscow, Ural, and other mining districts, as well as thermal electric power centrals burning peat as fuel.

In addition to the electric transmission lines of 400,000 volts, connecting the Kuibyshev - Moscow and the Stalingrad - Central Black-Earth Region - Moscow hookup, transmission lines between the Kuibyshev - Urals and Stalingrad - Donets Basin will be set up under the sixth Five-Year Plan. Transmission of electric power from the Stalingrad hydroelectric power station to the Donets Basin will be on DC lines. The construction of an electric transmission line trunk linking Moscow - Cheboksary hydroelectric plant - Votkinsk hydroelectric plant - Sverdlovsk is being planned. The Saratov hydroelectric power station will be linked with the Central Black-Earth Region and with the Kuibyshev hydroelectric station.

Owing to the fact that a single power net will unite districts which are remote from each other, especially in the East-West direction, the difference in time zones will be put to use. For example, in the Urals twilight sets in two hours earlier than in the central regions, as a result of which late-hour electric power requirements will be felt with a lead of two hours. For that reason, the same units may be used, first to turn on illumination facilities in Sverdlovsk and later in Moscow.

Electric power stations unified into a single power net in the European sector of our country will yield about half of the total electric power produced in the USSR, in 1960.

In the future, a single power system in the European sector of the USSR will also include the Northwestern complex of networks.

The Siberian power network and the single power system for the European sector of the USSR will be later combined, by means of a powerful transmission line setup linking the Lower Yenisei hydroelectric power stations with the Urals. The extent of that electric transmission line network will be about 2000 km, and its transmitted power will be several millions of kilowatts.

A number of power centers in Kazakhstan will be connected with the single high-voltage network servicing Siberia and the European sector of the USSR. At the same

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time, the Central Asia complex of power networks will be organized.

The unification of power systems via powerful high-voltage electric transmission lines, i.e., the creation of a single power network, will be the highest stage in the development of the power base of the nation.

A single power network will make it possible to combine and put to use different forms of power resources and power equipment, including nuclear electric power stations, will ensure highest flexibility and greatest savings for the power base of the national economy.

The Soviet nuclear power station, the first of its kind in the world, has already been in operation for over two years. It amply confirms the possibility of employing the energy of nuclear reactions for stationary power installations. The experience accumulated has enabled Soviet specialists to set up a project involving powerful local nuclear power stations.

These will operate as part of a single power system, in unison with coal-fired and hydroelectric power stations of various types. There still remains the problem of the most feasible allocation of nuclear power stations, in the light of the decisions of the Twentieth Congress. Nuclear stations will be built, in the first instance, in districts which lack their own fuel base. This will make it possible to relieve transportation facilities from the necessity of hauling an enormous quantity of fuel supplies.

During the course of the sixth Five-Year Plan, nuclear power stations operating at high power ratings will be built. The use of the energy of atomic fission, and in the future of atomic fusion as well, opens practically unlimited opportunities for supplying the power requirements of the national economy.

V.I.Lenin's prophetic words have now already been justified: "...If Russia is covered by a dense network of electric power stations and powerful technical facilities, then our communist economic construction will become an example for the socialist Europe and Asia of the future" (Bibl.3).

The level attained in the development of the electric industry raises the question of a sharp increase in the annual increment in installed generating capacity of electric stations, increasing the yield of electric power to a level that would fully satisfy the needs of the national economy and of the population.

The generating capacities of the power stations will increase at a faster pace than the generation of electric power. This will afford the possibility of creating the necessary power reserves in the networks, which are determined as not less than 10% in the basic power systems.

The increase in the production of electric power will keep ahead of the increase in the gross industrial product, will ensure the required intensification of production, the development of power-consuming production areas, and also the growing need for electric power in railroad transportation, agriculture and consumers needs.

In the Directives of the Twentieth Congress of the Soviet Union with respect to the sixth Five-Year Plan, in the area of electrification, plans are laid for enhancing the rate of development and improving the quality of the construction of power stations, bringing about further improvement in the technical level of fuel-fired electric power stations, hydroelectric power stations, and electrical and heat power networks.

This attests to the fact that the Party is evincing the deepest concern for the development of heavy industry and its power base. In line with this, the present rate of development in electrification make it possible to introduce electric power on the broadest scale into all branches of the economy, and to furnish more electric power for home and consumer needs.

Metallurgy

Our metallurgical industry is for the most part coping successfully with all of the demands imposed upon it by the rapid advances. The great merit of metallurgy is that it provides high-strength special grades of steel to the builders of steam boilers and turbines, automobiles, trucks and tractors, excavators, textile machinery, and many other machines. The significance of metallurgy has increased particularly in the production of hard alloys, from which metal-working tools are shaped.

The metal parts, going into industrial facilities and the latest machinery, locomotives, excavators, scrapers, automobiles, trucks, tractors, usually work in the open air and are subject to wind effects and to the deposition of fouling substances. The long service life of such parts and machinery is increased through the use of higher-grade metals capable of resisting corrosive attack, retaining all of their mechanical properties in cold and hot environments.

The higher the quality of the metal, the stronger and the more reliable will be the part in which it is used, and the more productive will be the machinery. High-grade metal may be used to make parts of lighter weight having the same margin of safety. Less downtime is required for overhauling the machinery and for removal of worn parts; the machinery also gives much longer service.

In order to obtain steel of higher quality, a small quantity of alloying elements is added to the iron, such as chromium, nickel, titanium, manganese, tungsten, molybdenum, vanadium.

Metallurgy has mastered the production of steels of special grades and is producing such steel in increasing quantities for the most varied needs. Among those grades of steel are refractory, acid- and alkali-corrosion resistant, nonmagnetic steels, as well as steels with magnetic properties.

The growth of Soviet metallurgy is intimately connected with technical progress. In the Directives of the Twentieth Congress of the Party relating to the sixth Five-Year Plan, space is allotted to considerable improvement in the use of existing metallurgical facilities.

In the postwar years, Soviet metallurgists rebuilt many enterprises and set up new units. They achieved production of special-purpose metals for the manufacture of new types of machinery and instruments, intensified the mechanization and automation of manufacturing processes, without ceasing to improve the use of the entire fund of available facilities.

Soviet metallurgy has markedly exceeded the pre-war technical and economic norms in the use of blast furnaces, open-hearth furnaces, and rolling mills. This was achieved because of the fact that not only the basic production processes have been mechanized and automated in all metallurgical enterprises, but that this also has been done for labor-consuming subsidiary operations. The use of such measures is particularly and strikingly evident in such plants as the Chelyabinsk metallurgical works where, together with mechanization and automation of the metallurgical shops, mechanization is carried out in subsidiary, auxiliary, and overhaul shops. Up to recently, over half of the working force of the plant was occupied in those areas.

Complex mechanization of heavy loading and unloading transfer operations is especially important in iron and steel metallurgy. Owing to the complex mechanization carried through at the Kuznetsk metallurgical combine, the productivity of the labor of the workers employed at those operations increased 2.5 times, and the net operating cost for these work stations were more than cut in half.

Automatic control of complex devices and of heat-treating processes is of enormous significance for the metallurgical industry. Automation of blast furnaces and open hearths, steel mills and other basic equipment in ferrous metallurgy yields significant technical and economical results.

A large blast furnace consumes over 5000 tons of materials daily. The process of charging such a blast furnace has been completely mechanized. The charging operation is controlled by a single operator.

In 1948, the Soviet Union built the world's first automated rolling mill. Complex automation of the rolling mill at the Magnitogorsk metallurgical combine made it possible to achieve, within the very first year of use, an increase in output of 15%, and savings of 1.5 million kw-hr of electric power annually.

A high level of automated process control is characteristic of modern rolling mills. Soviet rolling mill designs are distinguished by their complete automatic control.

The introduction of automation, mechanization of laborious processes involving hauling and processing tremendous masses of raw materials, fuel and finished products, into the metallurgical industry, and the change-over to new technological processes have changed the face of the labor of Soviet metallurgical workers. At the present time, about 95% of the cast iron and 87% of the steel is produced in automated furnaces.

The installation of automated lines in metallurgical plants for the continuous annealing of hot-rolled strip, the continuous tinning of tinplate roll, the electrorefining and electropolishing of sheet steel, etc. has made it possible to reduce the processing time by 5 - 6 times, to lower the number of workers involved in the processes by 4 times, and to reduce the amount of floor space needed to accommodate the equipment by roughly 3 times.

The shortening of downtime needed for furnace maintenance and the introduction into the entire industry of advanced techniques in the organization of overhaul and maintenance work have by now become a rather important way of increasing the metal production.

Until very recently, blast furnaces had been shut down for up to two months for general overhaul, and up to three months or longer for general overhaul and repair. Large overhaul and repair operations on open-hearth furnaces lasted 1.5 to 2 months. The timely efforts by workers of the "Uraldomnaremont" plant (Ural Blast-Furnace Maintenance), of metallurgical works, and of design organizations in the Urals, have resulted in the elaboration and assimilation of high-speed methods for overhauling blast furnaces and open hearths.

By increasing the size of the units to be assembled and perfecting the technology involved in the operations, workers of that trust, in unison with the Novo-Tagil'skoye metallurgical plant and the "Gipromez", carried out the overhaul of a large blast furnace by shifting a huge subassembly unit weighing about 2500 tons. Directly adjacent to the operating furnace, previously assembled on a special stand into a large unit, metal structural elements of a new blast furnace, together with castings and equipment, were kept ready. After the old furnace had been dismantled, the new furnace was hoisted onto the plinth by means of hydraulic jacks and electric-power winches.

The removal and replacement of the blast furnace took 12 hours. The furnace was installed to such precision that adjustment operations proved unnecessary.

The same method was also used in the repair and overhaul of the blast furnace No.2 at the Kuibyshev Works in Novo-Tagil'skoye. Here, all of the metal structural elements, castings, and equipment of the furnace were assembled into a large unit weighing over 700 tons, and firebrick lining was placed in an annular tube and in shielding segments. The shifting of the unit took a total of 3.5 hours.

An indispensable condition for the growth of ferrous and nonferrous metallurgy is the expansion of existing enterprises and the building of new ones. Metallurgical workers are putting new shops and plants into operation.

Workers, technicians, and engineers of the Chelyabinsk Metallurgical Works have put a new blast furnace unit on stream. The entire unit consists of: blast furnace with pouring bed, skip-hoist trestle, ore trench, steam and air blast station, and other equipment. The builders used the most advanced methods, thanks to which the basic operations were completed in less than eight months.

Wherever it proved necessary, pre-cast reinforced concrete was brought into play. Comparative figures will be of interest in this respect. In comparison with a previous blast furnace completed in 1952, the amount of pre-cast reinforced concrete used in the installation of the new blast furnace was increased by 11.5 times.

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Three (out of four) sections of the skip-hoist trestle were assembled from large reinforced-concrete bays. These bays, weighing 45 tons each, were assembled with the aid of a special-purpose gantry crane.

It took 300 men five months to set up the trestle for the previous blast furnace. In all, 40 men finished the assembling of the new trestle in one month. They assembled on the ground huge structural elements of metal construction, and used powerful hoisting cranes to assemble them in that form. The electricians organized their work in a different manner, since the number of workmen needed to assemble the blast furnace was one third less than the number needed on the previous job.

The use of new techniques and technology on blast furnaces of the Magnitogorsk Metallurgical Works made it possible to step up the throughput of the furnaces by one fourth, and yielded hundreds of millions of rubles in savings. The blast furnaces of the Magnitogorsk Metallurgical Combine produce the cheapest pig iron in the country. The highest output per worker has been achieved in that combine. This high output per worker raises the average level of pig-iron production in all ferrous metallurgy enterprises by more than 3.5 times. The Magnitogorsk workers attained such high efficiencies per blast-furnace volume, such low rates of coke consumption, such durability of furnaces and ancillary equipment as have never been achieved by any metallurgical plant in the South.

Others are inclined to think that nature itself furnished the necessary prerequisites to enable the Magnitogorsk workers to take their place in the front ranks.

However, that is not entirely the case. It is sufficient to remember that winter in Magnitogorsk is longer and colder than in the South, and this very often renders operation of the blast furnaces more complicated. Ores from Mt.Magnitnaya are much less consistent in iron and sulfur content and in the composition of the gangue than ores from the Krivoi Rog ore fields.

The secret of their success boils down in this case to the fact that all of the

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ores mined in Mt.Magnitnaya are crushed, dressed, carefully neutralized, and agglomerated. Agglomeration (the process of sintering a mixture of ore fines and fuel) takes care of ores of constant chemical and physical make-up with the necessary and sufficiently stable iron content, with the agglomerate being completely fluxed in the process.

The highly complicated and expensive system resorted to for dressing the ores from Mt.Magnitnaya is extremely beneficial from an economy viewpoint. The Mt.Magnitnaya ore concentrates, the agglomerate and the pig iron are the cheapest to be had in the Soviet Union. Furthermore, the Magnitogorsk workers are capable of burning coke which is consistent in its physical and chemical properties, firm, and not amenable to breaking up into fines.

Another comparison will also prove very important and edifying. The techniques and the magnitude of the volume of production of the Magnitogorsk Metallurgical Combine and of the Novo-Tagil'skoye Metallurgical Works are approximately the same. These enterprises burn similar fuel hauled from a distance and use raw materials of identical grade, which are local in origin. Nevertheless, the production and quality figures attained by the Magnitogorsk workers are markedly superior to those of the Tagil workers.

The July Plenum of the Central Committee of the Communist Party of the Soviet Union pointed out the necessity of making public the experience accumulated in advanced enterprises relating to the intensification of production processes, the use of neutralized ores, fluxing of agglomerate, the use of highly refractory components, and oxygen blasting. The introduction of such progressive techniques will improve metallurgical production. However, such measures are still being translated into actuality at a very slow pace.

Metallurgical workers have resorted for hundreds of years to the dressing of ores, to reduce the content of gangue in the ores. They thereby increased the capacity of the metallurgical ovens and furnaces, cut down on use of fuel, and im-

STAT

proved the quality of the metal.

No more than half a century has elapsed since the first time that "oxygen-enriched" air blasts and pure oxygen were first put into practice. At first pure oxygen was used for oxyacetylene welding jobs. Later oxygen-enriched air and oxygen came to be used in metallurgy and in the petroleum, natural-gas, and chemical industries. A special oxygen industry even came into being. This latter is developing at a very rapid pace. For example, while the average capacity of a turbine has been increased 125 times over the past 40 years, the capacity of installations used to produce oxygen from the air has been increased about a thousand times during the same time. Today this young industry has available such a large number of facilities as to provide a yield of several tens of thousands of cubic meters of oxygen hourly. The production of oxygen increased with particular sharpness in the postwar years, when the average capacity of oxygen-producing facilities increased by 7 - 8 times. Techniques of oxygen production were improved at the same time, and the power needed to produce oxygen was reduced.

What advantages accrue from the use of oxygen in metallurgy?

It is a familiar fact that the air needed for the technological process to go to completion is blown into blast furnaces. If the blast is enriched by the addition of oxygen, this results in a significant improvement in the blast-furnace process.

Pure oxygen makes it possible to obtain high-grade pig iron in furnaces, known as low-stack furnaces. In this case, blast-furnace gas, which is useful only for combustion, is replaced by technological gas, i.e., a gas which may serve as chemical feed stock and which, after being processed, yields synthetic ammonia and other valuable end products. Oxygen used in low-stack furnaces enables metallurgists to employ low-grade peat, coal mined in the Moscow region, and other forms of cheap fuels.

The advantages of the enriched air blast in blast-furnace practice reveal the

STAT

meaning of several lines in the directives of the Twentieth Congress of the Communist Party of the Soviet Union on the sixth Five-Year Plan, which referred to the goal to obtain, by 1960, under the responsibility of the Ministry of Ferrous Metallurgy of the USSR, the smelting of all blast-furnace ferrous alloys with the use of oxygen-enriched air blasts.

Oxygen is also employed in the Siemens-Martin or open-hearth process in metallurgical plants. As a result, the productive capacity of the furnaces increased by 20 - 30%, with 15 - 20% savings in fuel consumed.

It is stated, in the directives of the Twentieth Congress of the Party, that approximately 40% of all of the steel made by the end of the sixth Five-Year Plan must be obtained by means of oxygen-enriched blasts, this including all of the steel made in Bessemer converters.

The essence of the converter technique, in its general features, is as follows: air is blown through the melt of pig iron, poured into a special vessel, known as a converter. Harmful impurities and carbon are burned off in the process, with the pig iron being converted into steel.

This transitory process was previously carried out using ordinary air, for which reason it yielded steel of not too high a quality. An oxygen-enriched blow speeds up the conversion of pig iron to steel and at the same time enhances the quality of the steel to such a degree that it is now in no wise inferior to open-hearth steel.

In the directives of the Twentieth Congress of the Communist Party of the Soviet Union, another and no less important task is placed before Soviet metallurgists: that of organizing the production of electric-furnace steel by a duplex-process using converters and electric furnaces in tandem. Open-hearth steel is obtained, superior in quality to Bessemer steel. The open-hearth technique successfully rids the metal of harmful impurities, especially phosphorus and sulfur impurities. However, the heat takes not 10 - 20 minutes, as in a Bessemer converter,

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but 6 - 8 hours.

The aim of the duplex process is to remove the shortcomings of the Bessemer converter and open-hearth furnace while at the same time taking full advantage of their strong points.

The duplex process permits great savings in materials and doubles the productive capacity of electric furnaces. Electric-furnace steel is cheaper, approaching open-hearth steel in price. And this point is particularly important, since electric-furnace steel is, in turn, of much better quality than open-hearth steel.

It is important to note that the oxygen in the open-hearth shop of the "Zaporozhstal'" plant made it possible to increase steelmaking by 20% over a two-year period, without introducing new open-hearth furnaces. In the "Azovstal'" plant, the change-over of the open hearths to operations involving the use of oxygen also increased the amount of steel output considerably. Therefore, in order to overcome the lag in that area, a large-capacity oxygen-production shop has been set up in the Novo-Tagil'skoye Metallurgical Works. One of the units in that shop recently commenced operations, and the first batch of oxygen was dispatched to the open hearths. The intensification of the steelmaking process in the ninth and tenth furnaces of the first open-hearth shop greatly increased the output of metal. Owing to the acceleration of the steelmaking process so achieved, an appreciable amount of time was saved per heat.

At the present time, several large-capacity oxygen-producing facilities are in operation at the metallurgical works. But this is far from adequate for the industrial volume of steel production. The introduction of oxygen in the converter production process is particularly lagging.

High-speed melts achieved by innovating metallurgists have been called upon to fulfill a great role in the cause of improving production. Saving time by means of the high-speed melts, the innovators are succeeding in making tens of thousands of additional tons of steel annually.

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A new technique for cooling open-hearth furnaces bears striking testimony to the technical progress being achieved in metallurgical practice. As we know, melting of steel takes place when the temperature reaches $1600^{\circ}C$. In order to lighten the load on the steelworkers and at the same time increase the durability of the furnace, the separate checkers are cooled by different techniques. They were originally cooled using cold water. But this approach had a negative effect on the wear resistance of the furnace. A tremendous amount of water had to be used; in addition, in order to cool the furnace, special devices were needed, such as cooling towers, spray ponds, and pump stations.

At first glance, the suggestion of one Soviet engineer to bring about a radical improvement in the open-hearth steelmaking process seems very simple. The furnaces were to be cooled with boiling water. The new method is known as flash-cooling. It lengthens by 4 - 5 times the service life of the caissons, frames, and other parts of the steelmaking units and greatly reduces overhaul costs. And, a highly essential point, the new method reduces the rate of water flow by 50 - 60 times: the need for special cooling facilities was eliminated.

A new method of furnace checker overhaul is a great achievement in open-hearth steelmaking.

This method of overhauling open-hearth furnaces has been put into practice at the Magnitogorsk Metallurgical Combine. While the furnace is still in operation, right next to it, in the pouring bay, a new metal furnace shell is put up, all parts of the assembly are put in place, right up to the tubes used for admitting the cooling water. Since only the furnace is being overhauled, it is quickly dismantled. The finished stand-by furnace body is immediately installed in place, the assembly is completed and the refractory firebrick lining is set. The time required for major overhaul of an open-hearth furnace has been reduced to three days, providing an additional 2000 tons of steel, roughly speaking.

The technical level of steel mill production is on the increase, thanks to an

STAT

all-encompassing drive in improving the technology and organization of production. Roller grooving has been revised in a number of mills. High-power and high-speed electric motors have been installed in many rolling mills, making possible an increase in the throughput of metal in each roughing pass through the rollers. This has an immediate effect on the productive capacity of the mills.

In addition, two and even three sheets per pass have begun to be rolled on the rail and girder mills of some plants; section mills have been adjusted to handle five or more sheets simultaneously. Now a single thick-sheet rolling mill or medium section mill yields three times as much steel sheet per shift as it did before the war. The production processes in most rolling mill shops have been mechanized, and automation is being carried through. We have some mills capable of continuous rolling operation. A high-capacity mill for the continuous rolling of railroad rails and of girders has been installed in one of the plants.

During recent years, the working staff of progressive plants has devoted a good deal of attention to the automation of blooming mills, which are highly productive powerful roughing mills designed to shape steel ingots 9 - 10 tons in weight into blooms (steel stock of square cross section).

No less concern is manifested by metallurgists regarding automated rolling mills. The small section mill "280" at the Kazakh Metallurgical Works may be rightly called an automated mill.

All laborious operations are automated in this unit. The labor productivity of the millmen has increased by one third.

Metallurgists in the plants are turning readily to the experiences of metallurgists in the peoples democracies. They have set up an automated finishing mill, according to blueprints of the Czechoslovak rationalizer Bohumil Sladek, from the town of Kladno. The automation of the finishing line of the "280" mill made it possible to transfer 20 rollermen to other sections and to more than double the power ratings of the unit. Automated rolling units have now been set up in adjacent

STAT

mills.

Workers and engineers in the plants have a good understanding of the significance of modernization of old and obsolescent equipment. Many of the creative undertakings of millmen and mechanical technicians in the Izhor plant have been incorporated into the treasurehouse of advanced experience. Some rolling mills have been in service for over ten years here. By dint of the efforts of the workers, engineers, and technicians of the plant, those mills have acquired the qualities of up-to-date equipment. Now all of the old rolling mills have been equipped with edger rolls. The screwdown gears are no longer driven by steam engines but by electric motors. A great improvement was obtained in the replacement of bronze and babbitted bearings on live rollers of rolling mills by roll neck textolite bearings. The durability of the new bearings was 10 - 12 times greater and considerable savings in nonferrous metals were achieved in the process.

Improvement in techniques is also a material base for a regime of economy.

In steelmaking and rolling-mill shops, from 16% to 22% of the ingots go into scrap as the billets rolled from the ingots are shaped. Metal is also lost in the removal of surface flaws, as the ingots and billets are rough-ground and polished. In blast furnaces, in particular, large losses of ore, coke, and flux are allowed for (exhausted to stack in the form of flue dust).

Innovators find great opportunities for a varied range of approaches to cut down on losses of raw materials and worked materials in blast furnace, steelmaking, and steel-rolling work.

The percentage of high-grade metal is increased by cropping the ingots (after they are cast). Metallurgists are striving to obtain ingots better rationalized in shape and weight.

Experience in the struggle to cope with ore losses, due to ore particles being entrained in the dust exhausted up the flue, has been gathered at the Magnitogorsk Metallurgical Combine. The intensification of the gas pressure at the throat of the

STAT

blast furnace from 0.7 - 0.8 atm (gage), as done in this plant, not only increases the throughput of the blast furnaces but also reduces stack losses of ore by roughly 1.5 times.

A basic measure taken to reduce ore losses in blast-furnace practice is the careful preparation of the ore for use in production processes. Painstaking preparation of raw materials, process materials, and fuel in all branches of the metallurgical industry, for that matter, is one of the basic economy factors.

Great possibilities for economy in fuel resources are offered by a combination of the metallurgical industry with other branches of production.

To obtain a ton of metal, metallurgical workers have to heat 100 m^3 of water, which yields only a portion of its heat and does not have time to cool off in the process. The water is drained into nearby rivers or is passed through a cooling tower. It suffices to point to the enormous volume of metallurgical production in our country to understand that we are dealing with billions of cubic meters of water, whose liberated heat might be of tremendous value. Heat can be gained not only in the process water, but also in the slag, blast-furnace gas, etc. Two thirds of the thermal energy in the metallurgical industry could be used in the form of supplementary energy resources.

Powder metallurgy has been placed at the service of the national economy. Powders are fabricated from the waste metal and are pressed and sintered to specifications, into desired end products.

The economic efficiency of powder metallurgy is determined by the fact that it provides industry with high-precision parts derived from waste and scrap metal, parts which require no further machining.

Economy reserves are also inherent in the use of fuel wastes, and this applies to blast-furnace gases and coke gases in the first instance. Those gases, particularly blast-furnace gas, are piped to heat open-hearth furnaces and the heating ovens of rolling-mill shops, at the same time freeing part of the coke gas. In pass-

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ing, we may note that other reserves lie in the use of coke gas, which may be rightly considered a valuable chemical raw material and a high-quality process fuel.

Blast-furnace slags have served up to the present time solely as the raw material stock for valuable structural materials and parts. And remember that the stockpiles of slags accumulated at metallurgical works are counted in the tens of millions of tons annually.

A multiplicity of tests have demonstrated that blast-furnace slags are also excellent in the role of soil fertilizers and are not only not inferior to lime fertilizers, but are even superior. Steel-derived slags are also useful as fertilizer, in particular slags with high phosphorus impurities or slags derived from the Thomas and Siemens-Martin processes.

The metallurgical industry is a huge consumer of fuels. Metallurgical ovens and furnaces require about as much fuel as the boiler houses of all of the central coal-fired and oil-fired electric power stations. One of the basic approaches to fuel economy in steel metallurgy is the intensification of production processes.

Much of the fuel is economized in high-speed melts. The proper operation of the heating cycle of furnace checkers is of great significance. In rolling mill shops, a very effective approach is the shortening of furnace downtime, careful monitoring of the temperature cycle, and feeding of ingots to the rolling mill at a predetermined heat temperature.

It is a generally accepted fact that the development of Soviet metallurgy is proceeding ahead in full swing, at an accelerated pace. However, the nation is still experiencing a metal shortage. This is to be explained by the fact that the demand for metal is increasing at a much faster rate, and also that metallurgists are slowly assimilating the production of shapes and grades of metal which are economical and in highest demand in the national economy. Up to the present time, we are still lagging behind quite a bit in the production of electric-furnace steel, as well as in the development of iron production by direct reduction. The produc-

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tion of light metals and alloys is lagging behind the needs of industry.

The directives of the Twentieth Congress of the Communist Party of the Soviet Union relating to the sixth Five-Year Plan schedule for the iron and steel metallurgy, especially with respect to improved organization of production and utilization of existing capabilities, increases of 47% in steel, 35% in pig and cast iron, 40% in rolled sheet steel and rails, during the current Five-Year Plan.

Among the large enterprises in domestic metallurgy, the Kuznetsk Combine has enormous internal reserves at its disposal. Metallurgists at the Kuznetsk Combine, in seeking out new possibilities, have plans for appreciably increasing their yield during the Five-Year Plan. The amount of pig iron and steel melted will be increased by more than 50%. Production of pig iron will be stepped up by 52%. Most of the increase will be obtained as a result of modernization and improved exploitation of existing furnace units. An increase in blast temperature, excellent preparation of ore raw materials and other measures must increase the volume efficiency of the furnaces by 9.2%. The specific weight of the agglomerate in the burden, charged in the blast furnace, must be increased. Melting of steel will be increased by 52.9%. In this case, the increased steel production will be obtained for the most part by improved utilization of existing furnaces (reduction of open-hearth downtime, shift to the use of larger melting stock, use of oxygen blast, enhanced durability of the furnace roofing).

Modernization and automation of equipment in rolling mill shops will increase the production of rolled sheet. Rolling mill downtime will be shortened by increasing the durability of the rollers, through quenching and deposition of hard alloys. Iron-ore mining will be stepped up considerably, and the production of agglomerate will be expanded.

But metallurgists are far from capable of doing everything by their own efforts. One of the untapped reserves for increasing the amount of steel melted is, for example, reducing the time required for charging burden into an open-hearth furnace.

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This can be done by feeding the scrap metal into the furnace, with the scrap pressed into thick bales. The bales may be prepared by huge baling presses. But there are no such baling presses available at the combine, and the scrap is pressed into shape in the old way, by semimanual methods.

One of the features characteristic of technical progress in metallurgy, especially in foundry practice, is the transition to semicontinuous casting. Previously, the technology of pouring ingots at the Leningrad works for working nonferrous metals was somewhat primitive. The process was piecemeal, laborious, and primarily manual in character. The transition to semicontinuous casting is a great step forward. The plant has fabricated the machines required for this operation with its own resources. And the metallurgists are even now obtaining large castings of higher improved quality.

New techniques are inseparable from progressive technology. A constant improvement in manufacturing processes is one of the very first concerns of metallurgists. Resources are to be found everywhere in an economizing, creative attitude toward the task at hand.

One of the most significant conquests by the plant staff is the introduction of rhythmic operations. The plant has achieved a regular output of production not only for each day, but for each shift. A correct and even rate of production sets up favorable conditions for highly productive work.

The introduction of new techniques, a rational and economizing attitude toward the work, will accelerate the turnover of the basic funds and reduce the capital expenditure per unit product. At the same time, improvements in the technical production base are sometimes reflected in an increase in capital outlay per unit product. For example, in mechanizing the ore stockyard serving the blast furnace shop of the metallurgical works at Kosaya Gora, the amount of capital invested per unit product almost doubled. But this was economically feasible, since the productivity of labor increased and a large group of workers was freed for other work. All of

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this resulted in a reduction of net production costs by 24%.

Outfitting the enterprises with the latest techniques, of course, requires large capital expenditures, but on the other hand ensures a high productivity of social labor and sharply reduces net production costs. Our government therefore readily resorts to large investments in order to see to it that metallurgical enterprises are equipped with the most up-to-date techniques.

The most progressive strides of our metallurgy along the road of technical progress are continually associated with the assimilation of new and advanced technology, and with the introduction of new techniques.

Mechanization of all production processes and subsidiary processes, conversion to complex mechanization and to full automatic control, i.e., to a continuous flow process of production, remain to be accomplished. Up to very recently, flow production methods had been adjusted to the operation of the first and the third links in the metallurgical cycle, i.e., blast-furnace production and steel rolling; the middle link, i.e., the melting of steels and, the main item, the pouring of steel, was still carried out batchwise.

Metallurgists have made great efforts in developing and mastering the new technology of steelmaking and in organizing a continuous process for pouring steel ingots. The molten steel, instead of being teemed into a mold to produce ingots, is poured into a special device which, on accepting the molten metal, produces a solidified continuous steel strip for rolling and shaping. This stock is then fed to the rolling mill and emerges from the mill in the form of the finished product, shaped steel or sheet.

Metal losses incurred in continuous pouring are cut down by several times, and the labor of the working force is much alleviated, the need for expensive equipment is eliminated, and the complicated blooming mill stage is left entirely out of the process.

An industrial facility for continuous pouring of steel has been built as a result of the creative collaboration of coworkers from the Central Scientific Research Institute for Ferrous Metallurgy and workers of the Gorky "Krasnoye Sormovo" plant.

At the new open hearths of the "Krasnoye Sormovo" imeni Zhdanov plant in Gorky, there are neither tap troughs nor conventional chill molds for pig iron. The complex process of teeming and solidification of the steel takes place in closed drop-bottom molds. Most of the equipment is placed underground, out of sight. A senior operator stands at the master control console, hooks up a microphone, and gives orders to another ten control desks located underground. The shift foreman gives the command to start the pouring process.

Metal from the open-hearth furnace is poured into an enormous skip car and carried up a skipway to a higher platform. Both pour machines are started up. The man on duty drops the skipcar bottom, and the molten steel streams down into the receptacles of two special tetrahedral molds known as crystallizers.

Within a quarter of an hour, two melts of metal are seen moving upward on conveyor belts, to the left and right of the pouring platforms.

Hardly has the molten stream begun to enter the molds when the water cooling system quickly chills the metal. A skin appears on the surface of the metal and gradually thickens there. But the core of the pour is still molten. The process proceeds further, into the zone of secondary cooling. At the instant when the continually moving steel ingot reaches a predetermined degree of solidification, the operator switches on the trimming equipment. In one or two minutes, the ingot is trimmed to the required specifications for the rolling mills. It is then fed automatically on an inclined transfer device and is carried up to the shop for further treatment.

The new method of pouring ingots eliminates the possibility of piping. The polished copper walls of the mold make the surfaces of the ingot smooth. This increases the yield of useful metal.

Monitoring instruments subject even those processes, which previously success-

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fully resisted any kind of precision control, to the will of man.

At the same time, the culture involved in the production process is enhanced and the labor of the working crew is diminished. All of the 800 units and mechanisms are powered by 49 motors controlled from remote-control desks. The air in this section is fresh and pure, with the usual dust and soot absent. All of the units are fenced off by shields and steel-wire grids.

The new techniques in steel pouring yield great savings. A total of 8 million rubles was spent in setting up the facilities involved. However, in the course of a single year, the plant achieved about 14 million rubles in savings. Thus, the cost in equipment required for continuous pouring of steel was amortized in less than a single year.

Technical progress in metallurgy leads to further improvement in machine manufacturing and makes possible a broader utilization of the enormous resources of our industry.

<u>The Coal Industry</u>

In order to satisfy the fuel and raw materials demands of the national economy, Soviet geologists are conducting intensive operations in prospecting for natural mineral deposits, and are uncovering reserves of useful minerals, including in the first instance coking coals, nonferrous and rare metals, aluminum ores, petroleum, and iron ores.

Soviet geologists and prospectors are equipped with the most up-to-date techniques. They are probing the depths of the earth with the aid of seismic waves from shot blasts. The most delicate instruments enable them to sense the "breathing" of ore deposits. They use airborne camera equipment and magnetic dip needles to locate and investigate, in unheard-of short periods of time, enormous expanses of the earth's surface. In order to uncover useful minerals, they are making continually broader use of techniques based on the use of radioactive radiations.

Carrying out the suggestions of the Party and of the government, they have discovered and are continuing to discover new coal beds and coal provinces, and are filling in the data on known reserves of natural resources in our country.

Our minable coal deposits meet any requirements of industry in their chemical composition and physical properties. The largest coal fields are to be found in the Donets Basin, the Kuznetsk Basin, at Karaganda, the Pechora fields, etc., all of them rich in coal which is suitable for burning metallurgical coke.

In supplying the nation with fuel, the Donets coal fields will play, as in the past, a most important role.

The rapid development of the coal industry in the Donets Basin will make it possible to sharply reduce coal freightage from the eastern districts to the European sector of the country. The versatile, rounded exploitation of new coal fields in the Ukraine, the Aleksandrii fields near Krovograd, the L'vov-Volyno fields, and also other coal deposits on the right bank of the Dneper and in western provinces of the Ukraine, will contribute to a marked extent to the realization of this goal.

It has been established by complex geological exploration expeditions, based on geophysical methods of prospecting, that the coal seams extend far to the West from the Dneper and to the East in the direction of the city of Novomoskovsk in Dnepropetrov Province, and to Kharkov, to the North of Voroshilovgrad, beyond the Don.

The Greater Donets Basin is more than double the area of the Donets Basin in its old geological range, already assimilated in the industrial sense. Coal has been discovered in the vicinity of large industrial centers, such as Dnepropetrovsk, Kharkov, etc.

Carboniferous provinces extend 200 km to the West of the former boundaries of the Donets Basin and 30 km to the North. The boundaries are shifting to the South and to the East. Geologists predict an extension of the Donets Basin boundaries

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further in the direction of Poltava, Voronezh, and Stalingrad.

The coal in those new regions is found at shallow and at medium depths, and is suitable for coking. Coke is particularly needed by the Ukraine, which has vast resources in iron and manganese ores, and also other materials needed for metallurgical production.

In the western provinces of the Ukraine, a new fuel base is growing from day to day.

Along the banks of the Western Bug, to the South of Volyno Province and to the North of L'vov Province, mine shafts are being sunk in the new L'vov-Volyno coal fields.

The government has furnished the mine builders with powerful techniques: a large number of excavators, bulldozers, scrapers, and hoisting cranes. Highly productive machinery for underground working is being shipped in from Moscow, from the Urals, and from the Donets Basin.

The coal industry has been furnished with a large amount of new equipment during the postwar years.

Cutting and loading combines have taken on great importance for the coal-mining industry. They take over the basic operations in coal mining, beginning with breaking the coal off from massive seams and ending with loading the coal on conveyor belts. Cutting machines break up the rock in the mining face. Drilling is carried out by electric-powered drills, pneumatic drill hammers (air hammers), and automatic drilling rigs.

A pool of the most varied types of machinery has been set up for loading operations. Conveyors, including flight or scraper conveyors, shaking conveyors, and belt conveyors, are used to transport the broken coal from the working face. Electric-powered trains of shuttle cars haul the coal to the mine shaft. Here the coal is mechanically dumped into underground dumpcars and hoisted to the surface. Loading onto railroad gondolas is also mechanized.

New types of coal cutting and loading combines create the conditions for realizing the complex mechanization of coal-mining operations. With their aid, even such a labor-consuming process as cutting into the coal face and loading the broken coal onto conveyors can be mechanized.

Loading machines, which make possible a growth in the productivity of the labor of seam cutters and shaft sinkers, are being more and more widely used in blocked-out stopes. In the skilled hands of leading production workers, this technique yields excellent results.

In coal mining, complex mechanization in the new organization of production (converting work on faces to the graph schedule of cyclic operations) becomes a means for obtaining an intense growth in coal mining output.

Acceleration in the rate of technical progress will depend not only on new machinery and mechanisms, but also on how successfully these devices are improved upon, how effectively they are used, and how their efficiency is increased. Despite the fact that there are great numbers of cutting machines available in the coal-mining industry, as well as combines and other machinery, the productivity of labor in many mine pits remains low, and the net cost of coal mined remains too high. This is to a great extent a result of the poor utilization of techniques, and of inadequate concern shown for the complex mechanization of the mining operations.

In the Donets Basin, a great deal of the wasted labor is due to manual operations (counting under this heading manual labor in servicing the machinery). Under conditions of intensive mechanization of some production processes, predominantly the most basic ones, mechanization of other processes is lagging behind in the Donets mine pits. Building of roof timbering and supports manually cannot keep pace with a cutting and loading combine: the combine can mine up to 100 tons of coal hourly, and the hauling operations manage to handle no more than 60 tons. The combines in many pits are therefore operating at a speed calculated in only tenths of a meter per minute, whereas they are designed for cutting speeds of over a meter per minute.

In the Karaganda fields, there is a large mine pit known as the Zhdanov pit which is equipped with cutting and loading combines. But in many sections of the mine, the combines work at only partial load over a long period; up to two thirds of the gross amount of coal mined is broken loose and loaded on the conveyor belt by hand. Entirely too many workers are engaged in breaking the coal loose and loading it onto the conveyors, and shovels are to be seen everywhere at work alongside the cutter. When complex mechanization and a cyclic organization of operations were first introduced in the second section of this mine in the spring of 1955, the output of coal mined by the cutting and loading combine increased by almost 2.5 times as against the average monthly productive capacity of the cutting combines of the "Donbass" type in the Karaganda fields.

It has been estimated that, in the work carried out by hand in moving conveyors, building-up timber roofing and in roofing control, 100 - 150 workers were involved per each thousand tons of coal mined, and sometimes even more workers. This amounts to over half of the total work force of miners in coal faces being worked by cutting combines. It is clear from this picture how enormous are the reserves inherent in the further mechanization of the processes in coal mining, in improved utilization of mining techniques. At coal faces where the "Donbass" coal cutting combines are being used, the output of coal mined increased 25% on the average, and the productivity of labor went up almost 1.5 times. When the workings were pushed forward with the use of rock-loading machinery, the rates of level driving were accelerated 1.5 times on the average, and the productivity of the labor of the drift gang increased by 35%.

At the same time, we may point out the fact that, although miners have been furnished with several types of coal combines, their range of application is relatively limited. Such types of combines are not designed for seams with splint coals and tough coals, or for seams with embedded dirt bands. Such veins are encountered

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frequently in the coal beds of the Donets Basin. It is necessary to design coal combines capable of working different varieties of coal seams.

At the center of the Donets fields, at the town of Stalino, there are large scientific institutions serving the coal industry. The staff members in these institutes are working on designing newer and improved machinery and devices for mine work. Tests conducted in 1955 on a developmental coal cutting combine known as the Donbass-2 yielded promising results. The new machine appreciably broadens the range of application of mechanized loading of broken coal, first of coal at the faces where splint coals and tough coals are being worked. A cutting combine type KN-2 has also been developed, and an extended belt-conveyor loader for a rock-loading machine, which yields a possibility of relieving the work of drift crews and accelerating the forward progress of mine workings.

Soviet designers are also at work on replacing timber supports and roofing by metal and reinforced-concrete propping. They are busy developing various forms of metallic roofing support. Our factories are putting out steel props up to three meters in length. By this time, metal supports are being used to prop up hundreds of mine stopes.

In addition to separate props in timber roofing of mine stopes, cog timbering or "chocks" or "organ walls" (breaker rows) are set up. Those forms of special support work are also made of metal. Steel organ walls are a safeguard against mine hazards and provide savings of about 4 - 6 m^3 of timber per thousand tons of coal. In the process, up to half of the work force engaged in roof control is released for other duties. The net cost of coal is reduced by approximately 2.5 rubles per ton. There is also much interest displayed in the shield for steeply pitching seams. This type of shield increases coal mining at the face to 6000 - 7000 tons per month, whereas the previous output was 2000 - 3000 tons. No less interest is shown in the "Kuzbass" type mechanized hydraulic shield-like roofing. This roofing, in combination with a coal stripper, makes it possible to completely mechanize the

STAT

cutting, loading, and hauling of coal, as well as setting up supports and carrying out roof control.

Pre-cast reinforced concrete presents enormous advantages in the building of support work for mine shafts. Reinforced-concrete pipes and shaftworks made it possible to completely mechanize this most labor-consuming operation - the placing of permanent roofing and support. Shaft-sinking workers are now released from the need to set up provisional support work in the mine shaft. The productivity of labor has risen sharply, since all of the work involved in laying supports for the shaft is reduced to the laying and pouring of concrete casings.

An entry-driving and shaft-sinking gang headed by N.Dubenko at the "Samsonovskaya No.1" new mine workings cut through 102 meters of mine shaft depth in a month, and laid in reinforced-concrete casing at a norm of 35 m. Such high rate of work in sinking and building up vertical mine shafts 7 m in diameter, with the aid of reinforced-concrete tube lining, were achieved for the first time.

By carrying out complex mechanization of coal mining in conformity with the decisions promulgated by the Twentieth Congress of the Communist Party of the Soviet Union, and introducing mechanization of roof control and mechanization of conveyor travel at the working faces, miners, engineers, and technicians in mine pit No.2 of the town of Shakhtersk became the first in the Donets coal fields to use mechanisms of new design.

Previously, recourse was had to the complicated and expensive combined timbering of the working stope, in the west wing of pit No.2. At the same time, 12 wooden props were placed one after the other, spaced almost a meter apart, with the stope roofing. Along with those "groups", square cells of wooden props and rail sections ("chocks") were placed. About 1000 m of rails and over 2000 wooden props went into each hundred meters of stope. This system of timbering could be dismantled by hand as the face advanced, and set up again in a new location.

The stope now has an entirely different appearance. It forms an excellent

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gangway: The top of the face is completely covered with firm roofing, and the working space is walled off from the gob by an even wall of massive props.

The new mechanized movable support work replaces all of the props, "groups" and "cogs" and makes it possible to completely mechanize roof control. And, what is particularly important, this roofing is used in the working of stopes in unison with other machines. The complex includes, in addition to the roofing and supports, the following: a "Donbass" cutting and loading combine, a curve-going flight scraper conveyor of new design, and a machine for advancing the conveyor and roofing as the stope advances. Roofmen, cutters and loaders, timbermen, conveyor placing crews, and conveyor runway men are replaced by the combine operating crew and the machinist in charge of the conveyor advancing mechanism and his helper. This mining machine advances on its four movable idler-sliders over the conveyor runway along the entire length of the longwall stope. The operator and his assistant then freely and rapidly pan up the face section of the conveyor to the new spot. They then move massive sections of timbering forward.

The previous technique was to dismantle the conveyor, move it ahead to the new face in sections, and there reassemble it. Pan-up crews spent a whole shift doing this work. An extensible conveyor may be moved during work on the face, without having to be dismantled. A preparatory shift is not necessary. Coal mining goes on continuously.

In addition to underground coal mining, strip mining or opencast mining is also being developed in our country. This method of coal winning was considered superior, in the past, only when the thickness of the layer of overburden to be stripped did not exceed the thickness of the coal seam. Open-pit mining of coal is now acknowledged to be profitable even when the depth of cover is some 9 - 10 times as thick as the coal stratum. Comprehensive mechanization of stripping operations has extended the field of such operations in extraordinary fashion.

The most economical and convenient form of strip mining is assumed to be the non-conveyor method of working. Stripped overburden picked up by excavators or a dump bridge is dumped directly onto spoil heaps. In large open pits, where there is nothing to hinder the machine in its motions, gigantic excavators with dippers of 15 m^3 capacity and walking draglines with buckets of 14 - 20 m^3 capacity and a boom of 65 - 75 m length replace the labor of hundreds of thousands of stripping miners.

Nature has been generous in bestowing the richest reserves in anthracite coal on the Kuznetsk Basin. Favorable conditions exist in a number of districts of the Basin for mining by opencast methods. This method of coal extraction has been introduced fairly recently in the Kuznetsk fields, but has already proven its economic competitiveness and promise. The productivity of labor in the pits is several times higher than in underground working. The net cost of coal tonnage mined at those pits is 2 - 3 times lower than coal mined in underground drifts. This is without taking into account the timbering cost, since there is no need for roofing and support in strip mining.

Strip mining of coal fields in Eastern Siberia has won well-deserved fame for itself as the most highly productive method. Strip-mined coal increased 20 times in output over the 1940 level. The advantages inherent in this method of working are confirmed by the fact that the net price of a ton of coal is 2.5 times lower, when mined in open pits in the Cheremkhovo coal fields, and 4 times lower, when mined in pits in the Krasnoyarsk district, than the cost of coal mined underground.

In addition to mining of many occurrences by direct dumping of spoil without the use of overland conveyors, local conditions in a number of cases require the use of open-pit haulage using machines with less horsepower.

Under the fifth Five-Year Plan, walking dragline-excavators were manufactured having bucket capacities of 14 m^3. These machines could pull out and move 800 m^3 of earth per hour. The coal industry will be provided with new machinery. Under the new Five-Year Plan, manufacturers of machinery will furnish coalmen with even more powerful excavators having an earth-moving capacity of 1200 m^3/hr. These excavators

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will be serviced by dump trucks loading up to 40 - 50 tons of spoil per run. The automobile and truck industry will manufacture that type of high-powered off-highway dump trucks under the sixth Five-Year Plan.

Goliath mechanical moles working in tandem with three-cubic-meter units, manufactured by the Uralmashzavod machinery plant alone, are capable of replacing, according to approximate data, over a million workers in coal mining, ore mining, and in hydroelectric plant construction projects.

In the directives of the Twentieth Congress of the Communist Party of the Soviet Union, relating to the sixth Five-Year Plan, special emphasis is placed on the need to manufacture excavators and draglines with dippers capable of picking up 25 m^3 of earth at a bite, with 100-meter-long booms. A new high-power mechanical mole will be vastly different from its precursors. The layout of the walking mechanism will be modified, for instance. The new fluid control layout eliminates the complicated system of tubes and piping, resulting in reduced weight.

Engine horsepower in the new excavator will be doubled. Over 50 generators and engines will actuate its mechanisms and winches. The superstructure of the excavator will be of hollow parts. This will also reduce the weight of the machine. The electric control arrangement is simplified.

Designers have concerned themselves with the comfort of the operators and the entire operating crew. The proper temperature will be maintained in the cab in summer and winter.

The goliath excavator is designed mainly for open-pit workings, for opencast mining of coal. The earth-moving giant will pack twice as much power as the excavator manufactured by the British firm "Ransom-Rapier Ltd." which is considered to be the biggest excavator in the world. While the stripped overburden was previously hauled by railroad on dumpcars pulled by an electric locomotive, the ESh-25/100 walking dragline now frees working crews and transportation and haulage facilities from that tedious work. In the course of a day, the goliath can dig up about as much earth as 2000 railroad flat-bottom cars are capable of hauling. In one year, the ESh-25/100 can move six million cubic meters of spoil. If the entire gang operating the excavator were put to work with shovels, it would take them a full thousand years to do the work the goliath does in one year.

With its extended boom, the new excavator can pick up muck and dump it 200 m away from the working face (a dumping radius of 100 m). This operation requires only 75 sec. A dipper carrying a 40-ton load travels at the speed of an express train. An excavator with 25 m^3 buckets can scoop up earth from a depth of 50 m below the level on which it is standing and, if need be, can pile the muck up to a height of 40 m.

The introduction of comprehensive mechanization of production processes is all the more vital to the coal industry for the reason that it provides the possibility of mining, with the variety of properties of different coals taken into account.

Only the "Donbass" and "Gornyak" cutting and loading combines are used for extracting coal in the Volyno mines. High-power conveyor belts are used to haul the coal. The coal travels in a continuous stream, untouched by human hands, all the way from the working stope to the mine tipple. A unique drilling rig developed at the Uralmashzavod is used for sinking mine shafts. Instead of the usual headframe, a metal platform stands raised high over the ground. It supports a control console unit with a rotor actuating a drill 6.2 m in diameter. The string of thick steel tubes ends in a cutting head. The head penetrates into the ground to a depth exceeding 300 m.

This rig embodies the same principle as that used in oil-well drilling, with the difference, however, that an oil well has a diameter of 200 mm, while a coal mine shaft measures 6.2 m across. A gang of only four men operates this complex unit.

With the aid of the shaft-boring drill, it took less than a month to sink the cage shaft of one of the mines to a depth of 224 m, and the skip shaft to a depth of 332 m. The drill rig developed the unprecedented speed of 20.5 m per day.

The old method resulted in only 50 m being sunk per month.

The technique of hydraulic-jet mining or water flooding has been applied successfully in the Kuznetsk Basin. Hydraulic mining embraces the cutting and hauling of the coal. Water from a powerful pumping station at the mine surface is pumped through pipeline to the working face. The jet of water, directed by the operator of the monitor (giant), undercuts the seam with tremendous force and breaks falling lumps of coal into fine pieces.

The jet of water retains its full force over a length of 2 - 14 m. This allows mining and face-driving to be carried out from a safe shelter. The flow of water carries off the pulverized coal in metal chutes to a special tank. The coal is then sent to the cleaning plant. Compared to a conventional mine, a mine built hydraulically is twice as cheap.

The experience of the first hydraulic mines in the Kuznetsk Basin, the "Tyrgan declivity" and others, bear witness to the great promise opened up by this new coal-mining tool.

The hydraulic mining method is primarily scheduled for use in the Donets, Kuznetsk, Karaganda, and Chelyabinsk Basins and in coal fields of Central Asia, with up to 12 million tons of coal annually slated for production starting with 1960.

The prospectors of natural riches, the geologists, are discovering new reserves of coal in the unbounded expanses of our homeland. Mine builders follow right behind them. And before long miners are being let down into the mines to work the faces. They know that only with the aid of new tools and the latest tools, by using the best and most progressive techniques of labor, will they be able to mine all of the coal needed by the Fatherland.

Petroleum and Gas

The petroleum industry is also developing at a rapid pace, along with all other branches of Soviet production.

Our oil industry has at its disposal sophisticated devices and equipment of domestic manufacture, for use in exploration work. Alongside gravimeters, airborne magnetometers, and electrical exploration stations, seismic stations are operating to obtain a more accurate picture than hitherto available of the structure of the bowels of the earth and obtain the most reliable orientation of exploratory drilling. The discovery of large oil fields, basically new concepts in oil-field exploitation based on the rational use of the energy stored in the oil pools, and artificial maintenance of bottom-hole pressure at a constant level made it possible to more than triple the yield of crude oil in 1955 over the 1946 yield.

Exploratory operations have resulted in the discovery of new and rich oil deposits, and an appreciable increment in prospected industrial reserves. The geography of the petroleum industry of the Soviet Union has been radically altered. Bashkiria and Tatariya have become the fundamental oil base of the USSR. They now provide over half of the crude produced in the USSR. This has brought the oil considerably closer to the main consumer regions located in the European sector of the USSR, and has greatly facilitated the job of supplying those districts with oil. Oil was first discovered in the Urals in 1919, in the Molotov region, in the district of Chusovskiye Gorodki. Geological prospecting for oil was then initiated in other districts of the Urals, leading to the exploitation of oil fields in Bashkir ASSR, the Krasnokamsk fields in Molotov Province and the Buguruslan fields in Chkalov Province. In recent years, new large oil fields and oil refineries have been built there. In 1960, plans call for the production of 75% of the country's crude in those districts.

The nation will find it feasible to develop the oil industry in the Urals and along the Volga. Net cost of crude in those districts is 3 - 4 times lower than in the old petroliferous regions.

Over the course of the last ten years, new large oil and gas occurrences were also discovered in Kuibyshev, Stalingrad, and Saratov Provinces. Industrial reserves of petroleum in the country have been increased roughly 5 times over the 1946 level.

The petroleum industry is developing by leaps and bounds in the Kuibyshev region. In 1955, Kuibyshev oilmen furnished the country with over twice as much petroleum crudes as in 1950. Hundreds of thousands of tons of crudes and light fractions were produced over the plan norms.

The newly developed fields, with their high-grade petroleum, are situated in well-populated localities rich in electric power, close to railroad lines and to the Volga river. Under such favorable conditions, it is possible to achieve, in a short period of time, not only a sharp increase in petroleum production, but also a considerable lowering of cost.

The Kinel'-Cherkassy district alone surpasses the largest Bashkiriya-Tuimazy oil field in its reserves. Toward the end of 1955, a powerful gusher was brought in on what is known as the Krasnoyarsk area.

Drilling men of the "Kuibyshevneft" Trust, following the example of oilmen in Tatariya, transfer oil-well derricks onto foundations made in enlarged units, in order to haul the derricks together with the accessory equipment, thus at the same time raising the efficiency of their techniques and considerably improving on the speed of well drilling.

But drilling rates cannot be speeded up without broad-scale industrialization of the building of new drilling rigs. The time has come to progress from the building of rigs under field conditions. The need to centralize the production of large prefab units in a large machine-building plant has become acute.

Industrial methods in the building of rigs, enlarged-unit prefab assembling of drilling equipment, introduction of multistring completions, all these techniques will raise drilling practice to a new technical high.

In addition to the immense oil fields to be found on land, our country also possesses large offshore oil reserves under the Caspian Sea.

Deep-water offshore oil extraction facilities have been organized, at points

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removed from the shoreline, by means of the latest techniques.

Petroleum production has been technically modernized in the past few years. The basic form of power used in working oil fields has been electric power. Electric power greatly increased the speed of drilling.

Turbodrilling and vibration drilling, as the most progressive and sophisticated methods, are an indispensable condition for the rapid and uninterrupted development of oil field exploitation. Soviet oilmen are faced with the task of considerably speeding up drilling operations, during the sixth Five-Year Plan. The Twentieth Congress of the Communist Party of the Soviet Union, in its directives relating to the sixth Five-Year Plan, scheduled an increase in the average speeds for drilling oil and gas wells of not less than 85% in production drilling and not less than 95% in prospecting drilling.

Machinery manufacturers will help the oilmen in accomplishing those tasks. They are designing and producing turbodrills, vibrating drills, pumps, compressors, and other machinery embodying new designs. Each year, the equipment becomes more sophisticated and more productive.

The highly productive vibration drill is a prime achievement of the staff of the Moscow "Borets" Machine-Building Works. The first two vibrating drills in use have already shown that their service life is 2 - 3 times longer than that of conventional drills. The vibrating drill is an example of the latest advanced techniques achieved by scientific and research organizations serving the petroleum industry. A new ampule-type rig has been developed for drilling boreholes. In increases the productivity of labor at the oil fields by 3 - 4 times. An improved V-angle compressor has been manufactured. The specific metal expenditure per one cubic meter of supplied air in this compressor is reduced by a fourth, and its efficiency has been increased by 4 - 5% over existing machines. New lines of wear-resistant electric pumps have been fabricated.

Manufacturers of machinery are putting out new compressors capable of handling

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700 atm pressure and high-speed plunger-rod pumps for pumping oil. Truck-mounted pumps designed for the hydraulic fracturing of oil-bearing seams will be manufactured. Turbocouplings (mechanisms coupling engines to pumps and other drilling machinery) are also effective in greatly increasing the productivity of labor in oil fields.

The new tools being made available yield great possibilities for sharply increasing the labor productivity, stepping up the production of petroleum derivatives, and achieving savings in material resources. An example of this may be seen in the introduction of the newest method in oil reservoir exploitation, peripheral water injection. This method, when used in the Tuimazy oil fields, made it possible to increase the labor productivity 3.5 times over the average productivity level in other oil fields, and resulted in annual savings of over 3 billion rubles in capital investment. Owing to the application of this advanced technique on a broad scale, the country obtained millions of tons of petroleum by secondary recovery.

Another method, slant drilling, makes it possible to drill boreholes without undermining living and industrial installations (where petroleum deposits are struck underneath them), and also makes it possible to drill two or more boreholes from the same drilling rig. This became possible because the power ratings on drilling rigs now amounts to 1200 - 1500 hp, while previously they did not exceed 200 - 400 hp.

New tools and techniques are enabling oilmen to drill down to new depths. At the Baku oil fields, a turbodrill for the first time in our country sank an offshore prospecting borehole to a depth of 4090 m. The turbine method of drilling is opening brilliant perspectives for the expansion of the front of drilling operations.

The turbodrill, an outstanding achievement of Soviet engineering, has also won acclaim abroad.

The oil industry in our country is switching resolutely to advanced technology, based on modern scientific principles. It has become a huge consumer of instruments and devices. During the past five years alone, the industry was furnished with many process control and regulating devices for use in geophysical exploration, drilling, petroleum recovery, and refining.

The new equipment has made it possible to start up large-scale refineries, and to automate part of the technological operations involved in the production and refining of crudes.

During the coming years, the need for devices and instruments used in drilling, producing, and refining petroleum will at least double, in connection with progressing automation.

The instrument-manufacturing industry will play an important role in the automation of petroleum recovery and refining. First of all, instruments are needed for quality control. Most of the existing equipment has become obsolescent in design. Instruments from the "Tizpribor" plant are heavy, bulky, and require large amounts of mercury. Electronic potentiometers also suffer from design defects.

Automation and remote control must be given a wide scope of expansion in oil fields and refineries, and automatic devices, facilities and plants must be designed. Scientific research and drafting organizations serving the petroleum industry are concentrating all their efforts on the solution of the basic technical and economic problems. One of the most pressing of those problems is automation of production processes (automatic process control).

There are many interesting and important problems which require immediate solution. Oil fields, refineries, and petroleum bases maintain large tank farms for oil storage. Thousands of workers are engaged in level gaging, filling storage tanks, and draining oil from tanks. At oil refineries alone, the staff of workers engaged in measurements, scheduling and operating the tank farm comprises almost one fifth of the total work force. Nevertheless, petroleum supplies still get lost in the rated inventories, due to negligence and errors. Control of tank scheduling by automated procedures would possibly free many thousands of workers and avoid the loss of valuable petroleum stocks.

STAT

All-rounded development of pipeline transport of petroleum crude and petroleum derivatives is required to keep pace with the growth in the production of crude. The network of mainline pipeline carriers for crudes and end products is the most economical and the most technically sophisticated approach. Pipeline transportation of petroleum is twice as cheap as railroad hauling. The main thing is that the petroleum arrives at the refineries from the oil field without losses.

In order to provide the oil industry with sufficient pipeline facilities, Soviet machinery manufacturers have designed mills for rolling big-inch steel pipe measuring over 1.5 m across and up to 18 m in length, with wall thicknesses ranging from 4 to 7 mm. The train of rolling mills is operated automatically. The pipes are made from sheet steel up to 1500 mm in width. The sheet steel stock, arriving in rolls, is unrolled. Units of sheet are then butt-welded, rolled along a spiral into pipe, and welded together along a spiral seam.

Stringing of main pipeline trunks differs in procedure from conventional industrial construction work in the great variety of problems encountered. The right-of-way of the pipeline approximates a straight line, and the pipeline is laid across rivers, mountains, swamp, ravines, cutting through highways and railroads.

Special semiautomatic and automatic facilities are used to weld sections of piping. An electric resistance welding technique has been developed whereby the pipe junctions are welded together in a short time without using electrodes and flux.

Designers have developed welding units for petroleum and gas pipeline laying crews. This unit is being built at the Leningrad plant of the Ministry for the Construction of Petroleum Industry Enterprises, in line with a project of the Electric Welding Institute imeni Academician E.O.Paton of the Academy of Sciences of the Ukrainian SSR.

The unit is mounted on a S-80 tractor. The cantilevered welding unit has a side-mounted clamping device reminiscent of large forging tongs. The tractor pulls a trailer with a diesel electric generator plant powering an engine of up to 300 hp.

A control console is mounted on the cantilever beam, together with the welding unit. After switching on the current, the welding unit first mechanically approaches the pipe sections one against the other and then clamps them in position. The welding process takes not longer than two minutes. The tractor then pulls the trailer along the pipeline ditch to the next job. The welding operation is then repeated. The unit performs 100 operations in a single shift. This is 3 - 4 times more productive than other methods for welding pipeline.

The welding junctions are inspected with radioactive cobalt isotopes. The scientific research institute for petroleum industry construction work has also developed a magnetic recording method for nondestructive weld inspection.

Pipeline cleaning, coating and wrapping, and laying the pipe in the trench are all carried out by complex mechanized columns. Backfilling of the trench is done by bulldozers.

All of these techniques were used in installing the Tuimaza-Omsk main oil pipeline. The length of this big-inch pipeline extends over 1332 km.

While covering huge areas, pipelayers dug out and filled back over four million cubic meters of earth, and laid tens of thousands of tons of steel pipe. Multidipper rotary excavators replaced many thousands of ditchdiggers. Excavators of this type produced up to one kilometer of prepared trench in a day of work.

Pipelaying crews overcame all difficulties in forcing rivers such as the Belaya, Ufimki, Sim, Tobol, Ishim, and Irtysh. High-power pumping stations were installed along the pipeway. Crude is piped from the Bashkiriya fields to the oil refineries at Omsk.

Under the sixth Five-Year Plan, schedules call for building a number of big oil refineries in Siberia and Kazakhstan, as well as in the central and western districts of the European sector of the country. Petroleum crudes from Tatariya and Bashkiriya will flow through the pipeline mains, crossing all of Siberia and

STAT

Kazakhstan. The crude will be carried by the pipeline from the Ural - Volga region to the center of the country, to the Ukraine and to Byelorussia.

Production of natural gases, as well as of gas occluded within petroleum is also on the increase. Natural gas is the most convenient and economically competitive form of fuel. It is three times as cheap to produce and deliver gas than the same amount of coal (in specific value). Gas is piped to Moscow, Leningrad, Kiev, Baku, Ufa, Tallin, Saratov, Stalingrad, and other cities. The government has adopted a decision to increase the delivery of natural gas to almost 5 times the present level by 1960, and to double the production of manufactured gas.

Hundreds of big mills and plants are switching to gas fuel. In addition, natural and manufactured gas will be used to produce carbon black, synthetic alcohol, acetylene, formalin, and other chemicals.

In developing the gas industry, pipelayers are stringing thousands of kilometers of new gas pipelines, including such mainlines as Shebelinka - Kharkov, Dashava - Minsk - Leningrad, and others.

Under the sixth Five-Year Plan, the petroleum industry will be faced with problems of enormous significance. The need for petroleum and petroleum derivatives is growing daily: The number of automobiles and trucks in the country will be increased by 46% under the Five-Year Plan, and the number of tractors will almost double. Jet propulsion is developing by leaps and bounds in aviation, and also requires fuel. There will be more and more diesel engines used by the railroads, and these also consume liquid fuel. The growth in freight and hauling operations, as well as the basic changes in techniques applied by different consumers of petrochemicals require, as we may see from the directives of the Twentieth Congress of the Communist Party of the Soviet Union, doubling of the production of petroleum end products (gasoline, kerosene, diesel fuel), and increase in lubricating-oil production by 1.8 times.

The growth of heavy industry, mechanization of agriculture, and development of all forms of transportation require an increase in the petroleum production to 135 million tons by 1960. During the five previous Five-Year Plans, the annual yield of petroleum throughout the nation was raised to 70 million tons, and increased by 65 million tons during one Five-Year Plan alone.

The fulfillment of these gigantic tasks require great efforts on the part of builders and oilmen.

Chemical Processing

Our country has at its disposal extremely rich reserves in raw materials which are processed in chemical combines. It is enough to name just a few of the basic types of chemicals, to give an idea of the multiplicity and sweep of the chemical processing industry in our country. Chemical plants, mills, and combines provide our industrial facilities with oxygen and hydrogen, nitrogen, acids, alkalies, and salts.

Chemical processing has also developed methods capable of bringing the latest forms of raw materials into large-scale production, producing synthetic goods and commodities which are not inferior, and are sometimes even superior, in their important properties to commodities of natural origin. At the same time, chemical processing is expanding the number of natural materials going into industrial processing, and provides the possibility of making more complete use of natural resources, immeasurably enhancing the productivity of social labor.

Our chemical processing industry has become a powerful factor in the further rise of the entire national economy, and has come to constitute an integral link in the socialist industry of the nation. There is now not a single branch of production which is not associated in some way with chemical processing.

Chemical processing facilitates the comprehensive exploitation of many forms of raw materials and power and creates favorable conditions for the planned development of new branches of production. As we know, the planned construction of large-

STAT

scale combines (including chemical processing combines) has been achieved as the main form of composite utilization of raw materials and finished goods and of power in industry.

Technical progress has found a powerful tool in the methods of chemical processing. Such methods accelerate the flow of production processes and bring about new forms of materials.

The intensification of manufacturing processes in industry is determined by the level of chemical science and technology. We have already made mention of the use of oxygen in metallurgy. Actual practice provides dozens and hundreds of examples wherein chemical techniques in production have sped up and increased to the maximum the output of various commodities.

Chemical processing in production is achieved on the basis of and in intimate association with the development of automation. Chemical processes, as a rule, combine well with automatic control. Underground gasification, a chemical technique for recovering fuels from the interior of the earth, is achieved by means of automatically controlled means of labor.

Continuity and automatic scheduling of all manufacturing processes is achieved in the organization of the modern chemical plant or combine by means of special equipment. Continuous processes are also being introduced into the new chemical plants and combines. Batch processes are being more and more relegated to the past.

Technical progress in chemical production is expressed in the rapid development of catalytic processes, in the application of high and superhigh pressures, high temperatures, deep-freezing, electric heat treatment, electrolysis, and many other chemical-engineering techniques.

The organization of the manufacture of chemicals is being improved with the aid of complex automation of continuous processes, radically altering the character of labor in the chemical industry. The latest techniques developed in chemical technology and the achievements in machine-building and electrification serve as a powerful technical base for chemical enterprises.

Electric power is needed to produce metals and alloys, many chemicals, such as calcium carbide, phosphorus, electrocorundum, acetylene, synthetic materials, and semifinished products such as synthetic ammonia, synthetic rubber, acetate fiber, and cellophane, and for refining petroleum.

Chemical processing in manufacturing, as one of the most important tools in technical progress, has now entered a stage of still deeper penetration of chemical processes and chemical materials in all branches of the national economy.

Versatile chemical servicing of production is based on the application of the laws of science to processes involving the recovery and processing of raw materials, and to the creation of synthetic products and materials.

A new branch of Soviet power engineering, gasification, contributes to the rational and most advantageous solution of enormous power and chemical engineering problems. We were the first in the world to achieve underground gasification of coal. All of the processes taking place at the underground firing face are regulated by automatic process control instruments. D.I.Mendeleyev's dream has been made a reality: He wrote in 1888 that the time would come, eventually, when coals in the ground would not be brought to the surface, but would rather be transformed in situ, inside the ground, into hot gases which would be piped out and distributed over great distances.

The highest techniques have created especially favorable conditions for the mass-scale industrial production of new materials, whose range is increasing rapidly, in pace with the introduction of the achievements of chemistry into production.

Most of the chemical products which are vitally necessary to modern society are not found in nature in pure form. We need high-quality motor fuel, special grades of rubber, and a wide variety of plastics.

Electric engineering places new and increasingly higher demands on plastics. Plastics must be able, for example, to resist temperatures above 200° – $250^{\circ}C$. Sev-

STAT

eral young branches of industry are intensely interested in plastics with constant mechanical properties, being inert to the action of acids, alkalies, and other chemicals. Machinery requires especially stable lubricating oils.

New synthetic materials are being manufactured by the aniline-dye industry and the synthetic rubber industry, synthetic fibers, synthetic ammonia, plastics, motor fuel and lube oils, medicinal preparations, vitamins, etc.

Complex processing of raw materials (particularly in the petroleum and petrochemicals industry) utilizes hydrocarbon gases which were previously released "into the air," and high-sulfur "sour" oils, which were previously fed into furnaces.

There are possibilities everywhere for effecting complex processing of raw materials. Natural gas, containing for the most part methane, is used predominantly as a fuel, while it is capable of yielding derivatives valuable to the national economy, such as acetylene, stocks for the synthesis of rubber, acetic acid, plastics, etc.

The extraction of residues of metal and ore from blast-furnace slag will yield important results. This technique may be used to recover highly valuable metals such as titanium, vanadium, columbium, tantalum, and cobalt.

Sulfur dioxide and other vapors are given off in the smelting of sulfide ores for copper, zinc and lead, in nonferrous metallurgical mills. These gases are also of no value, but they do contain raw materials for the manufacture of sulfuric acid and sulfur, needed by many branches of industry.

Economical procedures must be put to work to take advantage of the possibility of comprehensive chemical reprocessing of natural products and using the so-called industrial waste products to create new means of production and useful commodities. We must remember that the technical reconstruction of all forms of transportation is directly dependent on the level of development of the chemical processing industry, and in particular on the production of new materials. New grades of motor fuel and lubricating oils, lightweight high-strength chemical byproducts (plastics, aluminum,

STAT

magnesium, varnishes, paints, and many others) constitute the basis for the building of transportation means and their use.

The widespread use of plastics is now a fact familiar to everyone. Plastics are several times lighter than metals, yet many of them are not inferior to metals in strength. Even aluminum is heavier than several forms of plastics. In replacing metal parts, plastics reduce the weight of the parts, a result especially welcome in shipbuilding and airplane design. Special plastic materials are even immune to attack by sea water. Plastics are used in the manufacture of pulleys, noiseless gears, bolts, nuts, and are effective in insulating electric wiring. Those plastics have the same tensile strength as steel, but are 5 - 6 times lighter than steel in weight. Radomes, cockpit lights, windows in aircraft, etc. are made from Fiber Glas. The ordinary automobile has about 200 parts made of plastic.

Workers in the chemical industry are expanding the raw materials base at the disposal of the industry. Products useful as raw materials for foods, which were previously used for technical purposes, are now being replaced by synthetic chemicals. Food resources are being conserved in the process.

An important raw material stock for industry - ethyl alcohol - had been until recently obtained from processing grains and potatoes. The alcohol is now produced from sawdust and wastes of paper and pulp mills, and also from petroleum, for technical purposes. Achieving savings in animal fats, chemists organized the manufacture of soap and other detergents from less valuable organic substances such as coal, petroleum, and other raw materials which are available in abundance.

Thanks to the work of Academician S.V.Lebedev, industry is producing synthetic rubber from synthetic alcohol and acetylene from calcium carbide or from petrochemicals.

Modern chemistry and machine-building are producing an increasingly wider range of substitute materials useful for technical purposes. In a number of cases, the new materials possess even more valuable properties than the natural products, while

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they simultaneously expand the resources available for the production of consumers goods.

During the past ten years alone, hundreds of new materials have been devised, to replace metal, wood, wool, and silk.

Chemistry has an important role cut out for it in raising and preserving harvests, in the struggle for an abundance of agricultural and animal husbandry products. Compounds of rare elements are used as microfertilizers in agriculture. These microfertilizer compounds include such elements as boron, copper, manganese, zinc, and others. Many of them are used in animal raising, as fodder for cattle. Like vitamins, trace amounts of the microelements are capable of exerting a powerful effect on the growth, development and other vital functions of the animals.

The chemical processing industry faces the task of assimilating the production, on a broad scale, of highly concentrated mineral fertilizers, as well as chemical poisons for coping with pests and with diseases affecting plants of agricultural value.

Chemical production exerts a great effect on the growth of production of consumer goods and on the improvement in the cultural and living standards of the population.

Rational cooperation between the chemical and the petroleum and petrochemical industries enhances the profitability of many processes in petroleum refining. The expansion in chemical processing of petroleum gases permits maximum reduction in the use of food materials as raw materials for technical purposes.

All trends in the complex processing of different types of fuels are of particular interest to a socialist economy. Those trends yield the possibility of utilizing local fuels for satisfying the needs of individual economic districts in high-grade forms of power and in the production of chemicals. Trucking and hauling over long distances is at the same time reduced, or even completely eliminated.

The further development of chemical production in the national economy of the

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USSR requires the solution of a number of important practical questions. These questions include the following: how to achieve the greatest possible elimination of losses in raw materials, fuel, electric power, how to scale up the processing of local natural resources, improve the organization of industrial production of synthetic chemical materials on a big scale, with a concomitant increase in the volume of consumer goods production. The directives of the Twentieth Congress of the Communist Party of the Soviet Union envisage a stepping up the rate of development of the chemical industry, in particular in the production of chemicals needed for technical progress in different branches of the national economy. Under the sixth Five-Year Plan, increased utilization of petroleum natural gases and of petrochemicals for the production of synthetic rubber, alcohol, detergents and other chemicals is expected to displace fully the quantity of foodstuffs used for technical purposes, in favor of synthetic raw materials.

Transportation and Communications

The USSR has a highly developed railroad system. The progress made by manufacturers of machinery used in transportation and the growth in the production of electric power have prepared the conditions for a radical technical reconstruction of transportation and for the construction of new main transportation lines under the sixth Five-Year Plan.

Transportation facilities are being steadily furthered by technical advances. Two new types of traction have been put to use on railroads, electric traction and diesel and gas-turbine power. Automatic block systems, centralized control, and the latest forms of signaling and communications have been put into operation on the tracks. Waterway transportation is being supplemented with vessels of greater cargo capacity, and powerful cargo-handling facilities. The technical base of automotive and airborne transportation undergoes constant modernization.

Steam engines have been the most widely used type of engines since the inception of railroads, all over the world. Although steam locomotives have been constantly improved, the time came when further improvements in the technical and economic performance in railroad transportation would be impossible without introducing radical changes in the power base.

A steam-driven locomotive has need of a water-supply network while it is in operation. The economic performance of steam locomotives is therefore put through severe trials in arid and drought-stricken regions of the country. In addition, fuel stockpiles and special facilities for loading the fuel into the locomotive tender are required. The greatest drawback is that the efficiency of a steam locomotive is very low, amounting to barely 5 - 7%. All of those points led scientists and engineers to consider the need to replace the steam locomotive by more powerful and, at the same time, more economical locomotives.

It is a known fact that our country has become the homeland of the building of locomotives powered by internal-combustion engines. The locomotives powered by internal-combustion engines, designed and built by Soviet designers, engineers, and workers boast of important advantages over steam locomotives. It suffices to recall that the efficiency of an internal-combustion locomotive is 24 - 28% and that it burns much less fuel than a steam locomotive delivering the same power.

However, for a long period diesel and gas-turbine locomotives failed to receive widespread application in our nation's transportation system: only during the fourth Five-Year Plan was a start made in the mass production of internal-combustion locomotives. TE-1 internal-combustion locomotives, delivering 1000 hp, were first put in mass production in 1947, at the rebuilt Kharkov internal-combustion locomotive works. The plant staff then designed a new internal-combustion locomotive, the TE-5. This engine was designed for operation in the northern regions of the country.

The year 1954 saw the birth of a new type of internal-combustion locomotives. The TE-3 locomotive is articulated, like its relative, the TE-2 and consists of two sections, each generating 2000 hp.

Redesigning of a number of components in the locomotive, and especially in its diesel power plant, resulted in reducing the weight of the diesel locomotive and in increasing its power, credit going to the untiring work of designers and builders.

The TE-3 model diesel locomotive, mass-produced at the Kharkov Works, hauled a 5315-ton trainload over a difficult stretch of road with ease, during its trial runs. The length of the train, composed of 247 railroad cars, extended over 2.5 km. The diesel then hauled another trainload of 7300 tons on 100 four-axle cars. It would have required two high-power steam freight locomotives to move the same amount of rolling stock.

Diesel locomotives can haul even heavier trainloads at speeds up to 100 km/hr. The diesel can run in waterless desert areas: Diesel engines, as the saying goes, "never know thirst". The diesel uses up less water over a thousand-kilometer run than a single passenger would in traveling from Moscow to Vladivostok. No refueling was needed after traveling a thousand kilometers. The cost of diesel locomotive operation is 2.5 times lower than that of operating steam locomotives. Diesel efficiency is close to 28%.

Control of internal-combustion locomotives is automated to the limit. The engineer drives the locomotive with controls consisting of two levers and a push-button panel system, while monitoring various instruments that indicate the operation of individual units.

The fertile minds of designers have already come up with new plans. The staff of the Kharkov Works is working on designing a new diesel power plant generating 2500 hp. This will be a 12-cylinder job, two cylinders more than its predecessor.

The locomotive works are also designing a developmental passenger diesel locomotive capable of a maximum speed of 160 km/hr. Let us remember that not too long ago even airplanes were flying at that speed.

The replacement of steam locomotives by diesels has an enormous economical impact. Each internal-combustion locomotive put on the tracks to replace a steam-driven locomotive brings the government savings of 850 - 900 thousand rubles annually.

In September 1955, the Central Committee of the Communist Party of the Soviet Union and the Council of Ministers of the USSR adopted a decision on switching a number of factories producing transportation machinery to the manufacture of internal-combustion engine locomotives.

The Ministry of Transportation Machine Builders has built up a powerful production base for the manufacture of internal-combustion locomotives. Up to that time, internal-combustion locomotives had been manufactured by only one enterprise, the Kharkov transportation machinery plant. Other large-capacity manufacturing plants, such as those at Voroshilovgrad, Kolomna, and Bryansk, have been changed over to the manufacture of diesels.

Diesel locomotive manufacturing is being organized on the basis of extensive cooperation between enterprises. The Kharkov works, in addition to the mass production of diesel locomotives, will deliver diesel power plants to the manufacturing plant at Voroshilovgrad. At Kharkov, the centralized production of fuel equipment and regulators for diesel power plants is being set up.

The Voroshilovgrad Works serve as a large-scale base for diesel-locomotive building. This plant has begun the production of new locomotives. In addition, specialized mass-production of engineer's cabs has been inaugurated, to serve the plants at Kharkov and Kolomna.

Many of the shops at the Kolomna works will be renovated to accommodate the construction of diesel power plants. The Bryansk Works will also be converted to the manufacture of diesel locomotives. This plant will get the diesel engines delivered from other enterprises. Another plant is being built to handle the manufacture of diesel power plants.

This versatile cooperation and specialization between different plants, engaged in the manufacture of diesel locomotives, does much to increase the output and im-

STAT

prove the quality of the locomotives, and to lower net cost of engine construction and of the entire product, leaving the door open for advances in technology.

Institutes and the best engineers of the manufacturers of transportation machinery are being drawn into the technical reconstruction of existing plants which are being converted to the manufacture of diesel locomotives. Conveyor belts and assembly lines, embossing presses, shell-mold casting, facilities for heat treating parts by means of high-frequency currents, special-purpose machine tools and transfer machines, automated production lines, all of these are installed in all of the enterprises.

Costs incurred in the building of diesel locomotives are amortized in about three years, from fuel savings alone.

The electric locomotive, like the locomotive powered by internal-combustion engines, is a fully up-to-date locomotive, with broad possibilities of further sophisticated development. At the same time, it must be mentioned that the electric locomotive is beset with recognized shortcomings of its own.

Experience has demonstrated that, owing to increasing weight of trains and of the traffic-handling capacity of railroad sections, electric locomotives haul loads 2 to 2.5 times larger than those pulled by steam locomotives.

Conversion to electric traction roughly doubles the freight-carrying capacity, and reduces fuel consumption by 3 - 4 times, with great reductions in freightage cost. On electrified railroad lines, the technical travel speed of passenger trains is being sharply increased. In 1960, speeds will average 80 km/hr on the most important railroad lines.

Electric traction is particularly suitable when the supply of power is a hydroelectric power station. Under those conditions, efficiency is even greater. In addition, electric traction has a very unique feature, namely so-called regenerative braking. When the train is coasting downhill, the engines convert to generator operation. They exert a braking action on the rolling stock and deliver power to the network. Due to regenerative braking, a fourth of the power consumed on some railroad lines may be saved.

One further advantage inherent in electric traction broadens the opportunities arising when railroads are electrified. Transmission lines installed for serving railroads may be used to link electric stations. Hooked up into a cooperating network, the electric generating stations reduce standby equipment power, are capable of mutual assistance in emergencies, and distribute power not only to the electric locomotives, but also to towns and settlements situated near the railroad lines.

All of the preceding points constitute the basic advantages obtainable from electric traction and electric locomotives.

Electrification of railroads is going ahead full blast under the sixth Five-Year Plan. In the course of 10 - 15 years, the more important freight lines and lines serving mountainous areas, main railway lines with heavy passenger traffic, and suburban sections of large industrial centers will be converted to electric traction. The total length of track in electrified lines will increase to 8100 km under the sixth Five-Year Plan, i.e., will be 3.6 times higher than under the fifth Five-Year Plan.

The Novocherkassy factory is producing a new mainline electric locomotive, the VL-23-001. This electric locomotive is far superior to the mass-produced VL-22m machine. The new locomotive will pull freight trains over level-terrain and mountainous areas at speeds reaching 100 km/hr. The electric locomotive will develop 4300 hp, and will weigh 138 tons. The tractive force developed at speeds of 65 - 75 km/hr is 3 times as high as that developed in the VL-22m locomotive, and 2.5 times higher as that developed by the "L"-series steam locomotives.

The manufacture of new electric locomotives and internal-combustion locomotives, improvements in track economies, automatic signaling, and interlocking control of traffic and other measures will greatly increase the traffic-handling capacity of railroads.

Workers in the manufacture of transportation machinery face great problems, as stated N.A.Bulganin in his report at the July Plenum of the Central Committee of the Communist Party of the Soviet Union. "Steam locomotives, with their poor economical performance, must be replaced by diesel locomotives and electric locomotives. We have available designs worked out for internal-combustion locomotives and electric locomotives, but the production of such items is proceeding slowly. In this matter, we must take a number of serious measures, and in addition proceed to the construction of gas-turbine locomotives.

The gas-turbine locomotive is a locomotive with a novel type engine, which has a higher efficiency than that of the diesel locomotive, and delivers over twice as much power. We are now capable of building a gas-turbine locomotive with power ratings in excess of 8000 hp.

There are no gear trains, instruments, or steam boilers in the gas-turbine engine, as there are in the steam engine, nor any of the mechanical transmissions required by internal-combustion engines. After the fuel is burned, the gas is admitted under pressure through the engine nozzles, where the potential energy of the gas is transformed into kinetic energy. Acting on the turbine blades, the gas rotates the turbine impeller. The small number of intermediate links in the turbine assembly makes for high efficiency in converting one form of energy into another. The efficiency of a gas-turbine locomotive is 33%, and the gas-turbine locomotive burns only half the amount of fuel required by a steam locomotive.

Gas-turbine locomotives, burning solid fuel, are not fussy and consume fuel of practically any grade, including pulverized fuels (under similar operating conditions, the efficiency of a steam locomotive would be reduced even a few percent further). Replacing steam locomotives by gas-turbine locomotives would mean fuel savings equivalent to the fuel burned by all of the electric power stations burning fossil fuels in the country. Those are the bright promises held out by new techniques in railway transportation, in addition to the economies possible in other

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resources, such as ferrous and nonferrous metals, electric power, lubricating oils, and other materials.

The design of new and more economical models of internal-combustion engine locomotives, electric locomotives, and railway cars, and the modernization of existing types are already yielding annual savings reckoned in millions of tons of fuel, as well as reductions in freight costs.

The directives of the Twentieth Congress of the Communist Party of the Soviet Union propose replacing steam locomotives by electric locomotives and internal-combustion locomotives. Industry will discontinue the production of mainline steam locomotives, and will push production of diesel and electric locomotives. While 85% of all railroad haulage fell to the lot of steam locomotives until very recently, it is expected in 1960 that 40 - 45% of the haulage will be assigned to electric locomotives and internal-combustion locomotives.

Technical redesigning of traction in railway transportation poses a number of serious and complex problems to machine-builders. They are called upon, under the Five-Year Plan, to deliver thousands of electric locomotives and internal-combustion locomotives to the railroads. As early as 1956 - 1957, the need arose to design new high-power freight and passenger electric locomotives and diesel locomotives, as well as gas-turbine locomotives.

The Central Committee of the Communist Party of the Soviet Union and the Council of Ministers of the USSR adopted a resolution entitled "On the Overall Plan for Electrification of the Railroads", which is spread over 15 years.

The first phase of the broad program in technical revamping of the railway transportation system will be put into effect under the sixth Five-Year Plan.

Part of the railways in the Urals, Kuznetsk Basin, Caucasus, Kola Peninsula, and further thousands of kilometers of the great Trans-Siberian railway trunk line (Dëma - Chelyabinsk, Omsk - Novosibirsk) have already been electrified. Work on electrification will be completed on the most important railway trunk of the nation,

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the Moscow - Kuibyshev - Chelyabinsk - Omsk - Novosibirsk - Irkutsk line. In addition, the railway linking Moscow - Kharkov - Donets Basin will be converted to electric traction, as will a number of other railway lines.

Electrification will be carried out on railroads going in the direction Chelyabinsk - Kinel' - Ruzayevka - Ryazan' - Moscow, with second tracks being laid on the railway stretches from Ruzayevka to Ryazan' and from Syzran' to Inza. In the coming years, the largest electric railway line in the world, the Moscow - - Vladivostok line, will go into operation.

It is interesting to note that the conversion of the Moscow - Vladivostok line to electric traction will make it possible to save no less than 18 million tons of coal annually, and to reduce operating costs by 2.7 billion rubles annually, by comparison with operating cost of steam traction.

Plans call for the construction and putting into service of thousands of kilometers of new railroad track. The following important lines are to be put into operation:

Magnitogorsk - Sterlitamak - Abdulino, a direct outlet from the South-Siberian mainline into the European sector of the country (bypassing the more heavily loaded Chelyabinsk - Ufa railway line).

Stalinsk - Abakan, an important segment of the South-Siberian trunkline, which enables ores to be transported to the Kuznetsk metallurgical combine and anthracite to be hauled in from the Tom'-Ust'e coal fields.

Barnaul - Omsk, the new outlet to the Urals from the Kuznetsk Basin (bypassing the overloaded Novosibirsk - Omsk railway line).

The Gurev - Astrakhan' branch line will connect the Orenburg railway with the Ordjonikidze line, and provide a 500-km shortcut for freight going from the Urals to the Caucasus.

For communication with the western districts of China, the building of a railroad leading from Alma-Ata to the State border is being planned along the new shortest direction. This will constitute the third railway artery connecting our nation with the Chinese Peoples Republic.

The building of new lines, increases in the weight and speed of trains, acceleration of railway car turnover and utilization of other technical means of transportation, and a steady struggle to achieve savings in materials, fuel, electric power, reduction in net freight costs, such are the principal problems to be solved by railway transportation in the course of the sixth Five-Year Plan.

No less important is the question of the development and modernization of industrial transportation.

Industrial enterprises have at their disposal about 40% of all of the railway trackage and almost a third of all of the locomotives of the nation. Over 70% of all loading operations, involving rolling stock, take place on intra-industry transportation lines. If we also take into account intraplant freight haulage, then the tonnage of loading operations on railroad tracks of industries exceeds by 6 times the load tonnage of the network of general-purpose railroads. The length of the railway trackage belonging to industrial enterprises alone in the Soviet Union is greater than that of the entire railroad network of Britain and France combined.

Industrial transportation in our nation is making increasingly wider use of electric locomotive traction. This proves particularly feasible in open-pit mining operations. At the Korkino coal pits, for example, the traffic density is now already at the level of 300 trains daily. Such a heavy loading schedule is possible because of the highly efficient means of traction and automatic control of operations.

However, on the scale of the entire industry-wide transportation problem, preparation for the introduction of new forms of traction is going ahead in a hesitant manner and at a slow pace. The steam locomotive for the time being remains the principal form of locomotive used, and what is more important is that there is no unified plan for modernizing the ways. Each Ministry is carrying out modernization

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according to its own lights. This is why there are now over 15 different makes of industrial electric locomotives, whereas 3 or 4 makes would suffice for operations under any set of conditions. In order to adjust the mechanization of loading operations in the shortest possible period of time and in order to accelerate turnover of rolling stock, it is necessary to make use of experience abroad, in particular in the building of different dumpcars and special intraplant containers.

Engineers, technicians, inventors and workers in the field of automation of transportation and remote control are doing extensive work on the further development and improvement of this relatively young branch of industry.

Automation and remote control in transportation service contribute to safety in railroad traffic, maximum utilization of the traffic-handling capacity of land-based and airborne lines, reduction in the number of workers required to service the trains ships, and aircraft.

Automatic block signaling systems are being introduced on the most heavily loaded railway lines, and on innumerable stretches of railroad where the flow of passenger trains is especially heavy.

Automatic block systems are supplemented by automatic locomotive signaling, incorporating automatic stops. These devices eliminate errors in directing railway traffic.

The role of general-purpose highway trucking in carrying freight is on the increase. Centralized truck hauling systems are being given further development. Trucking transportation has made poor use of its reserves, up to the present time. This is to be explained by the fact that its network is so far-flung. As a result, about half of the loading trucks are idle, while the working section of the truck pool carries out half of its runs with an empty load. It is necessary to concentrate and enlarge the volume of truck transportation economy, to get it to provide the colossal assistance it is capable of.

Under the sixth Five-Year Plan, the emphasis on trucking transportation for general-purpose use will be significantly increased. The overall development of centralized trucking will be promoted, and the use of truck trailers will be greatly improved. Transportation of passengers by automobiles will also be increased.

Airline passenger service will be stepped up about one fourth under the sixth Five-Year Plan. High-speed passenger aircraft, making a fairly large number of local landings, will be put into service on the main airlines.

Helicopters will be put into service wherever possible in the national economy, since this type of vehicle requires neither roads nor airports.

Helicopters will be of even greater use to prospectors discovering new deposits of useful minerals in remote and inaccessible regions.

The ubiquitous aircraft greatly facilitates postal communications with the new mountainous regions and patrol service for fighting forest fires. Helicopters will provide fishing crews with information on the appearance of schools of fish and other sea fauna.

Designers are blueprinting new and cheaper prototypes of helicopters. Freight costs for helicopter trips in the near future will be no greater than freight costs using any other means of transportation. For passengers, helicopters provide special conveniences, and flights aboard the craft will be even cheaper than automobile transportation.

Communications are of extremely great significance, not only in transportation but in production as well. Different forms of communication are of aid in carrying out social-political, economic, administrative, and educational activities.

Thanks to the rapid industrialization of our country, the large industrial base serving the technical means of communication has been practically remodeled from start to finish. New research institutes and laboratories have been established, where much work is in progress on improving technical means of communication and designing modern types of equipment and new forms of communication.

Modern means of communication are based on the latest achievements in elec-

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tronics, physics, chemistry, and radio engineering. A mere enumeration of such basic forms of communication as the telephone, telegraph, facsimile, radio-broadcasting, and television suffices to give a picture of the complexity of the techniques involved.

From the primitive needle telegraph apparatus used in the dawn of the present age, communications has progressed to the printer teletype, telephone, and to the transmission of images over wires and by radio, over practically any distance. From storage batteries and the use of DC current for point-to-point communication by wire, communications has moved ahead to multiplexed AC transmissions of many hundreds and even thousands of telephone and telegraph communications channels using wire or radio.

Outlines are given in the decisions of the Twentieth Congress of the Communist Party of the Soviet Union for a program of activities in the communications field under the sixth Five-Year Plan, the program being entitled "Build a Broad Network of Microwave Relay Communications Links and Put into Service No Less Than 10,000 km of Those Relay Lines Under the Five-Year Plan".

We shall set up even more powerful microwave radio links operating on several thousand channels, and small relay links operating on several hundreds of channels.

A general idea on the changes which may be introduced into communications technique may be had from the following example.

A modern high-power radio relay line is capable of simultaneously handling 3600 telephone conversations, telegram transmissions, transmissions of radio and television programs. Suppose that two microwave relay stations are operating, one in Moscow and the other in Vladivostok. The network of intermediary stations, including automatically operated links, intercept the signals, amplify them, and transmit them further down the network. The signals arrive with instantaneous speed.

From Moscow, we can contact telephone stations, with automatic dialing, in

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Vladivostok or in any city served by the network, over radio channels. Then, by dialing the number of the subscriber, we can place our call with him. Audibility will always be excellent: it will not be subject to atmospheric or other variety of noise. Where necessary, standby equipment will be switched on in the intermediary link stations. If there is an outage in the current supplies, the local standby electric power station will go into action.

A switchboard in such a communications system could handle not only telephone conversations, but also telegrams, phototelegrams, even television programs. A citizen in Moscow, with his television set tuned to the broadcast of a Moscow concert hall, could switch to the transmission of a TV studio in Vladivostok, or view events taking place in other cities, on other programs.

The first microwave relay networks will connect Moscow with other cities in the European sector of the country. Some relay links will be set up in Central Asian and other Republics. In addition to the microwave relay networks set up under the Ministry of Communications of the USSR, branch relay lines will also be set up in the coming years. Railwaymen , for instance, are establishing connections between Moscow and Ryazan', and their line will be simultaneously used for television broadcast transmission from Moscow. Gas-pipeline stringing crews are switching from wire telephone systems to microwave relay links, and will use the latter for further observations on the behavior of the pipeline. Electricians and linemen are also setting up microwave relay links alongside high-voltage power transmission lines.

Under the sixth Five-Year Plan, the radio-equipment manufacturing industry will undertake the production of multichannel microwave relay systems, facsimile equipment, and microwave transmitters for radio broadcasting.

Construction

Thanks to the technical progress achieved by industry in our nation, the Soviet people are carrying out industrial, transportation, agricultural and domestic con-

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struction on an unequalled scale. In less than 30 years, 2019 new cities and workers settlements have sprung up in our country. During the postwar years, over 8000 large industrial enterprises have been restored and built. During the years of the fifth Five-Year Plan alone, cities and workers settlements obtained 150 million cubic meters of new dwelling space, and about 4.5 million homes went up in the countryside.

The tremendous volume of construction in our country poses many problems for building workers. The most important of those problems are those on improvement in design of buildings and installations and the strictest economies obtainable in building materials.

To solve those problems, standardized housing planning has been instituted. This type of planning offers great technical and economic advantages over construction work based on individual projects. Standard projects allow the possibility of reducing design and equipment to unified norms, and of reducing the standard dimensions of structural elements incorporated into mills and plants. Standard specifications on massive structural designs, members, and equipment contribute to improvements in quality and at the same time facilitate production of the items.

A construction industry has been established in our country and is in the process of rapid expansion, enabling us to build rapid and economically, using the most advanced methods, drawing on the use of pre-cast reinforced concrete parts and other new materials.

Pre-cast reinforced concrete members and designs signify a rise to a new technical level on the part of our building industry. The development of the production of pre-cast reinforced concrete members and the introduction of its use on a broad scale in construction work have become a matter of great import from the viewpoint of the State.

Following the decree promulgated by the Central Committee of the Communist Party of the Soviet Union and the Council of Ministers of the USSR, "On the Develop-

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ment of the Production of Pre-Cast Reinforced Concrete Structural Parts and Members in Construction Work", the manufacture of reinforced concrete foundation blocks, wall panels, columns, spans, girders, joists and flooring, for wall panels and ceilings was stepped up.

A lot of work has been done on the design and manufacture of structural members made of pre-cast reinforced concrete. Soviet construction workers have introduced welded-in frameworks, wiremesh and high-strength wire constructions into practice.

Soviet construction engineers have developed a method of continuous reinforcing of structures involving simultaneous automatic prestressing of the reinforcement, by means of which it has become possible to proceed to the mass production of prestressed reinforced concrete.

Soviet construction workers have greatly surpassed the level of the most highly developed countries in Europe and America in the use of pre-cast reinforced concrete. However, we are still seriously lagging in the application of prestressed reinforced concrete (pre-cast reinforced concrete with the steel reinforcement prestressed), which is more economical in all respects.

The manufacture of pre-cast reinforced concrete under factory conditions presents a number of advantages. Reinforced concrete greatly shortens construction job time, cuts costs of materials and lumber, enhances the productivity of labor, and accelerates the working tempo. The development of the manufacture of pre-cast reinforced concrete and its incorporation into construction work results in considerable savings in metal, lumber, and cement. Parts made of reinforced concrete constitute a sturdy and rugged fireproof framework, and are capable of replacing steel-frame work in industrial and civil constructions.

The industrialization of construction projects consists in the widespread use of reinforced pre-cast concrete, and in the mechanization of processes for erecting

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monolithic structures.

The construction and overhaul of heating units used in ferrous and nonferrous metallurgy, in the chemical and paper and pulp industries, require a very large amount of highly expensive firebrick lining. Scientists and engineers have recommended a new refractory concrete which is highly interesting in its properties.

The first experimental furnace using this lining has demonstrated the thoroughly reliable character of the design of wall and arch structures made of this refractory reinforced concrete, incorporating sodium silicate glass, at sulfur dioxide gas temperatures of up to 900°C. The new furnace operated with any expensive shaped refractory ceramic lining or steel jacketing.

Pre-cast reinforced concrete is of great significance.

Such concrete is used to make foundations, tunnels, roofing in buildings, highway and airport runway tops, silo towers, dairy farm buildings, reservoirs (oil storage tanks), walls, bridges, columns, masts, high factory stacks, cooling towers, and kiln towers.

In dwellings, almost all of the structural members are made of pre-cast reinforced concrete: foundations, walls, ceilings, staircase wells and landings, window and door frames, balconies, cornices, and parapets.

Industrial mass production of reinforced concrete members based on machine production is possible only where those members are actually of standard specifications. Specialization and cooperation between enterprises is therefore essential in construction, manufacturing, and work.

Pre-cast reinforced concrete structures and elements transform construction project sites into points of assembly and erection of buildings and installations. Structural members manufactured at plants serving the construction industry are assembled and erected at the construction sites with the aid of cranes and hoists on a mass-production scale, based on a production schedule for different forms of time-coordinated work.

Pre-cast structural members not only lead to a significant reduction in the time required for operations on the job site, but also diminish the size of the work project area and the number of temporary constructions and scaffolding required. Assembly and finishing work can be carried on all year round.

In the erection of enterprises in metallurgy, blast-furnace shops, open-hearth shops and rolling mills, builders coordinate construction and assembly operations with respect to time.

Steel-frame constructions, technological equipment, and refractory brickwork are mounted in place while the construction work is in progress. Proper organization of the work, thought through to the last detail, coordinated with all subordinate and related work crews, and smoothly and neatly carried out, is characteristic of quick construction jobs.

Assembly-line techniques are also widely used in structural projects. With the assembly-line method, permanent crews carry out the same operations day after day. This method is most suitable for construction on standard work projects, with blocks of homes incorporated in the flow system. Operations proceed according to the operational graph, which schedules the completion of each aspect of the work in pre-assigned time intervals. Each type of operation is repeated after a certain interval, known as the "flow pitch". Ditchdiggers, bricklayers, carpenters, plasterers, riggers, and painters execute only one specified type of work in each home. Many forms of work are fitted into the same time interval.

This type of construction work, based on technological rules, is similar to correctly organized industrial production, where everything corresponds strictly to technological procedure.

This has become possible as a result of the fact that the production of assembling and rigging work has been mechanized. Column-jib cranes and tower gantry cranes, with up to 40 tons earth-lifting capacity, are used in mounting the steel-frame members. The height and span length of the booms on those cranes make it possible to assemble the structural members in large units. Mechanization curtails the dangerous and laborious "piggyback" jobs.

For rigging work in construction of loading and unloading operations, plants are manufacturing tower hoisting cranes and cranes moving on rails or on crawler tracks.

In the Soviet Union, over a thousand makes (types, sizes, forms) of machines are used in construction work. Machines are used to move earth, dig ditches, prepare and place concrete, crush rock, weld steel members, plaster walls and ceilings, deliver brick and staircases to construction projects, transport grout and all necessary parts and materials.

Under the sixth Five-Year Plan, much work has to be performed in building for heavy industry.

Construction work on the Cherepovets and Orsk-Khalilovo metallurgical enterprises will be completed during the sixth Five-Year Plan, installation of the West-Siberia metallurgical works will be pushed forward, construction will begin on new metallurgical enterprises in Siberia. The Sokolovsk-Sarbai ore dressing combine and other large-capacity enterprises will be put into service in Kazakhstan, and the Kochkanar ore-dressing combine in the Urals, along with new mines at the occurrences in the Kursk - Belgorod district, will be put into service. Dozens of foundries, forging and pressing shops and other specialized mills, plants and shops will be built throughout the country. The construction of major electric power stations is being given full priority.

New and large seams in coal mines will be worked during the Five-Year Plan, and enterprises for the primary refining of petroleum will be commissioned. Thousands of kilometers of big-inch gas pipeline will be laid and put into service.

The volume of dwelling unit construction will be increased during the sixth Five-Year Plan. It is proposed to build, at State expense, a total area of hundreds of millions of square meters of housing projects in cities, workers settlements, and countryside localities. The rate of housing construction will increase with each coming year. The volume of construction work of municipal and rural schools will be about doubled over that of the fifth Five-Year Plan.

The construction industry will be boosted even more under the new Five-Year Plan. Manufacture of the widest variety of modern construction tools and equipment will be considerably expanded. The number of excavators for construction work will be tripled. The production of materials and easy-to-assemble parts, improvements in quality and lowering of construction costs will be sharply accentuated in the enterprises.

In construction, cooperation between enterprises in the building materials industry and enterprises in the construction industry will be geared to high pitch.

Cement is for construction work what metal is for machine-building.

It is a known fact that, without an uninterrupted and significant growth in the capacities of the cement industry, it will be impossible to expand the power, metallurgical, and other important branches of heavy industry, or to develop housing and cultural construction in town and countryside. The erection of new cement plants and the remodeling of old ones will make it possible to satisfy the demands of the national economy with regard to cement.

The elaboration of plans for new cement plants and the expansion of existing facilities will be carried out with the latest achievements of science and technology taken into account, in addition to the technical and economical performance achieved by the best enterprises in the country and by firms abroad.

The Party and the government have undertaken active measures to eliminate redundancies in planning and construction, to improve the entire field of architecture and construction.

It is a matter of honor for our builders and architects to create a socialist architectural style which will embody in itself all of the best that has been accumulated by the architectural thinking of mankind in the past, and at the same

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time relying on the most advanced creations of Soviet creativity. There must be a maximum of conveniences for the service of people in the buildings going up, and the buildings must be rugged, economical, and beautiful.

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Advances in Agriculture

The task of the new, socialist society is to bring closer together and to integrate industry and agriculture.

The principle of combining industry with agriculture has found its expression in the fact that, while developing heavy industry in all aspects, the Communist Party has posed before the Soviet people the task of achieving a sharp rise in agriculture, of raising harvest crops to 11 billion pouds, and increasing the output of consumer goods.

Achieving a sharp rise in all branches of agriculture is possible only through the combined efforts of workers in town and countryside. Socialist agriculture is based on modern technical advances and on the achievements of science. All of the basic tools of production for agriculture are being shaped by industry.

Until the advent of the Great October Socialist Revolution, the role of the working class in the production of agricultural goods was not large, and the role of the industrial working class was especially insignificant. The industrial worker fashioned simple tools (iron tools, harrows, winnowers, harvesters, and mowers) in capitalist enterprises, those tools ending up predominantly in the homesteads of landowners and kulaks (rich farmers). Agricultural workers also worked for the most part on the properties of landowners and kulaks. The landowners and kulaks multiplied their properties at the expense of the labor of the workers. The masses of the peasantry were forced to use the simplest tools of production.

The Soviet working class is actively participating in the production of agricultural goods. It has built up first-class tools to serve agriculture, furnishes fuel, and manufactures millions of tons of fertilizers. The working class is developing sovkhoz (State farm) agricultural production, and is carrying out the basic operations in kolkhozes (collective farms) with the aid of MTS (machine and tractor stations attached to kolkhozes). Now, in each hundredweight of grain produced in the kolkhozes, the fraction attributable to the labor of the working class amounts to over half of the work done. The share of the labor of the workers in the production of technical and grain products, and in the output of dairy products is also on the increase. The role of the working class in multiplying State and cooperative property in agriculture increases all the time.

V.I.Lenin indicated that the sole material basis of socialism was the heavy machine industry, capable of reorganizing agriculture.

Our agriculture is large-scale production, consisting of kolkhozes, machine and tractor stations, and sovkhozes. The material and technical base of the kolkhoz system and, at the same time, the points of support of the Socialist State in rural districts are constituted by the machine and tractor stations (MTS).

The MTS comprise large State enterprises assuring a productive relationship between town and country. In a modern machine and tractor station, there may be approximately 100 - 120 tractors, 30 - 40 combines, and 20 - 30 trucks. The MTS embrace entire kolkhozes in their activities and mechanize almost all agricultural operations. The interrelations between the MTS and the kolkhozes are in fact the socialist productive relations between the working class and the peasantry.

At the beginning of their activities, machine and tractor stations mainly serviced wheat growers and also undertook tractor cultivation of the soil and, partially, reaping of harvests with combines. Later, they more and more mechanized the production of technical agricultural products, and to some extent fodder production, potato growing, truck farming and also, to some degree, animal husbandry.

The working class is intensely engaged in supplying agriculture with new equipment. Industry is putting out new types of agricultural machines and tools. Every year, agriculture throughout the country receives thousands of tractors, trucks, grain combines, tractor-mounted and self-propelled mowers, potato-harvesting combines, and also mechanized cotton pickers, beet combines, flax combines, grain cleaners, and other agricultural machinery. The kolkhoz village receives an enor-

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mous quantity of different machine tools and equipment for outfitting MTS machine shops and maintenance and overhaul enterprises. The Communist Party and the Soviet government are transforming the MTS into genuine centers of technical, agronomic, and organizational assistance to the kolkhozes in the cause of their economic development.

The introduction of machinery is radically altering the structure of the power resources at the disposal of agriculture. Whereas, for example, the working stock of cattle amounted to 99.2%, and mechanical engines to only 0.8%, of the total power resources in agriculture in 1916, at the present time only a small percentage of the labor falls on draft animals, with mechanical engines accounting for 94%. Tilling with wooden plows and reaping grain with sickles are irrevocably a thing of the past. Mechanized plowing, mechanized sowing of vegetable and potato seeds, mechanized harvesting of agricultural produce are being assimilated on an ever broader scale in our agriculture.

Machine and tractor stations are now carrying out over 190 forms of different agricultural operations on the collective farms.

The specific weight of the power resources of the machine and tractor stations in kolkhoz production increases from year to year.

The transformation of the MTS into an all-encompassing material, technical, and scientific base for the development of collective farms, and the rounded enhancement of their role and responsibility for the welfare of kolkhoz economy signify a new phase in the assistance rendered by the working class to the kolkhoz peasantry.

The development and strengthening of the MTS as a form of productive contact between town and countryside and as a most important lever for State control of collective farms, is an indispensable condition for the further strengthening of the bond between the working class and the peasantry under the leadership of the working class.

In its decisions, the Central Committee of the Communist Party of the Soviet Union revealed discrepancies between the rate of growth of socialist industry and the level of our agricultural production. During the period from 1940 to 1956, the industrial product of the USSR increased by 3.2 times, while the gross agricultural product showed only a 10% increase. The total population rose by more than 20%, while the urban population during that period rose by nearly 45%. The demand for agricultural produce has increased considerably.

However, the level of production of agricultural produce is not such as to fully satisfy the growing needs of the population for foodstuffs or the demands of light industry and of the food industry for raw materials, and also does not correspond to the technical equipment of agriculture, nor to the possibilities lodged in the kolkhoz system.

Wheat production is the basis of all agriculture. It is the most highly mechanized branch of agriculture. However, even in wheat production, the cleaning, drying, weighing, loading, and unloading operations are still inadequately mechanized; much more labor is expended in gathering straw and chaff, and in the laborious post-harvest processing of the grain than in the actual cultivation of wheat. The mechanization of sowing and harvesting of perennial flax, potatoes, vegetables, sugar beet, cotton, hay making, and grain ensilage is also lagging behind, and so is mechanization of laborious processes in dairy farming. Mechanization of labor-consuming operations in animal husbandry, truck farming, and other branches of agriculture must be broadly expanded. Comprehensive and integrated mechanization is the main road toward the development of kolkhoz production, the basis for a rapid growth in the productivity of agricultural labor. The establishment of a machinery system for all branches of agricultural production has priority in the productive and technical assistance rendered to the village by the city.

The Communist Party has correctly defined the road of development in agriculture. The State sheds out funds running into billions of rubles toward improvement

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in mechanization of agriculture, being aware of the fact that great technical capabilities on the part of the MTS will permit a correct combination of the interests of the collective farm workers in the construction of their social economy, with organizational and technical assistance extended by the State.

In order to eliminate the disruption between the level of mechanization of agriculture and the extent to which tools are used in rural districts, permanent mechanizing cadres have been set up, by decision of the September 1953 Plenum of the Central Committee of the Communist Party of the Soviet Union, to supplement the ranks of the agricultural working class and to enhance the organizing and leading role of the latter.

The socialist city has always rendered the kolkhoz village assistance in the form of cadres. The city has become a great reserve of organizatory cadres for large-scale socialist agriculture. As early as 1930, 25,000 skilled workers were dispatched to the villages. They captained the socialist reconstruction of agriculture. In 1933, a total of 17,000 Party workers were transferred to work in political sections of the MTS.

In our day and age, when the struggle for a sharp rise in all branches of agriculture has become an essential task facing the whole people, when the need has arisen to strengthen not only the material and technical base of agriculture in the shortest possible time but also make a decisive improvement in the guidance of agricultural production, aid rendered by the cadres to the kolkhoz village has acquired decisive significance.

Equipped with a wide variety of up-to-date tools, and promoting diversified productive activity on the basis of advanced science, the MTS have grown to the status of large and complex enterprises. The job of running such enterprises is no simple matter and carries great responsibility. Only cadres familiar with modern techniques, agronomical science, and scientific care of livestock, as well as with national economics and production layout, are capable of heading a machine and tractor station.

The Communist Party has nurtured outstanding agricultural cadres. However, these cadres are not sufficient. Even today, there are still quite a few kolkhozes and districts which are lacking qualified, experienced specialists.

Work in rural districts is assuming first-rank importance. This work is acknowledged to be highly important and honorable for every Communist. The Party has taken its stand against any and every manifestation of a supercilious or contemptuous attitude toward agricultural work. The main attention of Party and State organs is from now on to be directed toward strengthening of the MTS, kolkhozes, and sovkhozes by the supply of qualified cadres, and toward the proper choice and distribution of such cadres.

Assistance to the kolkhoz village by cadres is carried out on an unprecedented scale. The appeal by the Party met with warm response among Communists and non-Party Bolsheviks. Thousands of skilled workers, engineers, technicians, and other specialists have been dispatched to permanent assignments in MTS units and collective farms.

At present, agronomists and zoologists are included in the staffing of collective farms, with the aim of placing vital aspects of agricultural production, in each of the collective farms, under the supervision of skilled specialists. On large collective farms, each work team or farm must have its own specialist. Specialists in agriculture have thus passed into the sphere of material production, and spend less time in paper work and red tape.

The contact between city and kolkhoz village is being broadened and is assuming continually more varied forms.

The actual form of assistance to the kolkhoz village by the socialist city, and one of the means for strengthening the bond between workers and peasants is the patronage system of assistance. This has already left its mark as one of the finest traditions in Soviet society.

The patronage of the socialist city for a kolkhoz village is varied in form and content. Patronage enterprises and organizations render practical assistance to collective farms, MTS units, State farms, and agricultural districts, contribute to the penetration of advanced technology in the maintenance of machinery, participate in the building of production and service installations and dwellings, and cooperate in strengthening cultural and mass work, etc.

The Communist Party and the Soviet government have elaborated and are carrying out a whole program of measures designed to achieve an intensification of the technical capabilities and equipment available to agriculture, and the mechanization of collective farm production.

We are now manufacturing powerful caterpillar tractors driven by diesel engines, which are cheaper than a carburator engine such as used in older caterpillar-tread and rubber-tired tractors. The diesel engine operates on cheaper liquid fuel and, at that, consumes 30 - 40% less fuel than a carburator engine. While a conventional wheeled tractor uses up about 14 - 15 kg of kerosene, crude oil, or gasoline in soft tillage of a single hectare, the diesel tractor burns only 9 - 10 kg of a cheaper oil - either fuel oil or petroleum crude - to do the same work.

During the closing years of the fifth Five-Year Plan alone, the production of high-power crawler tractors increased by 14 times in our country. There are now over 1.4 million tractors working in the fields (15 per farm unit).

As stated earlier, along with the high degree of mechanization in plowing, sowing, and harvesting of grain crops, the level of mechanization achieved in raising and harvesting vegetables and potatoes in particular, as well as other truck crops, is still comparatively low.

Our industry manufactured six different makes of tractors in 1955: the S-80, DT-54, KD-35, the "Byelarus'", the "Universal", and the KhTZ-7, in addition to six other variants of these makes.

Plans now call for manufacturing new tractors. These were designed as a result

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of further improvements in existing vehicles, taking into account the perspectives of development in kolkhoz production. In contrast to many foreign firms, which manufacture too many tractors of different types, from small horsepower jobs to high-power vehicles, our industry is using the principle of a minimum number of basic models. The different needs of agriculture will perhaps be satisfied by an adaptation of the basic models to the working of different crops. Such basic models of tractors will number less than ten. In addition, fifteen other models of specialized tractors will be manufactured on the principle of the basic ones.

The first three tractor types include lightweight and medium tractors. These will be rubber-tired vehicles with low-pressure tires. In horsepower, they will be similar to the KhTZ-7, "Byelarus'", and the Vladimir T-24 model tractors. These tractors are designed to work truck crops, using overhung tools. In this connection, the KhTZ-7 is being modified. It will appear in three forms, as a truck-farming tractor, as a garden and vineyard tractor, and as a mountain-terrace tractor, for working tea plantations and other subtropical cultures.

The "Universal" model tractor has been taken out of production. It will be replaced by new machines from the Vladimir Tractor Works. The basic model is designed for short-stalk crops such as potatoes, beets, root vegetables, for separate harvesting of grain and olive crops, and for haying. The second model will be used for handling tall-stalk plants. The third tractor model is designed especially for cotton growing.

The "Byelarus'" tractor will be manufactured in two improved forms.

Instead of the KD-35 tractors, six forms of medium-class vehicles will be produced. These will be put to use in all types of field activities, in vineyards and in rice field. Separate vehicles will be used to handle beets, upland cotton, and gardens, while a special tractor will be equipped for operations in sandy soils.

Heavy tractors will be entirely different in design. In addition to the DT-54 tractor, agriculture will be furnished other high-power machines, the DT-70 and the DT-100 tractors. These tractors were designed by the designer bureaus in Kharkovo, Stalingrad, Lipetsk, and at the NATI.

The S-70, S-100, S-140 tractors and others of that line will be useful for work under heavy soil conditions in virgin lands, for deep tillage of soil, in accordance with the procedure worked out by the Kolkhoz innovator, comrade Mal'tsev, and also under particularly difficult conditions encountered in grubbing, soil amelioration, and in construction work.

In addition to all these vehicles, a tractor and self-propelled chassis, the SSh-14, is being readied at NATI, for transportation and field operations.

The All-Union Scientific Research Institute for Design of Agricultural Machinery (VISKhOM) has designed a new grain-cleaning machine, the OV-10. This machine is designed for cleaning grain and adjusting the degree of cleaning to consumer specifications. It may also be used to produce grain seed.

The new machine is a general-purpose type and may be used to clean seeds of different agricultural crops: grain seeds, bean seeds, technical, vegetable, and grass seeds.

Suggestions submitted by workers and engineers at the Stalingrad Tractor Works will make it possible to step up tractor production by 92.4% under the sixth Five-Year Plan. Labor productivity will increase by 80% in 1960.

In order to carry out the specified measures in the shortest possible time and with greatest success, a special section has been organized at the plant to handle mechanization and automation of production, concentrating under its supervision over 80 of the most highly skilled designers, production experts, and engineers. Offices have also been established to bring about modernization of equipment and planning of blocks of automated and semi-automated production lines.

In-plant designers are at work designing tractors with more economical performance indexes. The blueprints for a new general-purpose crawler tractor, designed for working with overhung tools, are ready. The tractor will be much more

STAT

rugged in design and cheaper than the DT-54 tractor now being produced. The plant has put out two experimental prototypes of the new DT-61 tractor, which packs higher power than the DT-54 and weighs 500 kg less. Mass production has begun on DT-55 tractors, capable of working in swampland, and preparation is going on for the production of DT-57 tractors, capable of negotiating steep inclines. The engine of the DT-5 tractor has been upgraded to 70 hp, which enables it to power DT-70 tractors. Experiments have been successfully completed on improving the economical performance of the engine used in the DT-54 tractor. After it has been redesigned, the engine will consume much less fuel than its predecessor (185 gm fuel, per unit power, per hour). Modernization of all of the DT-54 tractors throughout the country (which can be readily achieved within the capabilities of each MTS) will yield savings in diesel oil up to 500,000 tons per year.

During the sixth Five-Year Plan, machines will be completely switched to overhung soil-working tools and other tools used in the cultivation of agricultural crops. The manufacturing plants will develop and manufacture special appurtenances to handle the trailing-type tools which are not amenable to overhung designs (e.g., heavy plows), making it possible for the tractor operator to work without having an assistant to manage the trailing tool. The transition to overhung tools will enable hundreds of thousands of auxiliary workers to be freed for other activities, will cut the use of metal in machine manufacture almost in half, will lower fuel costs, and will result in increased labor productivity.

It is extremely important to effect a considerable expansion in the production of machinery for the separate harvesting of crops, so that a transition may be made in the coming years to the separate harvesting of grain in the basic wheat-growing districts.

Like the tractor, the combine is an excellent tool in Soviet agriculture.

The Rostov Agricultural-Machinery Works is one of the pioneers dating back to the days of the first Five-Year Plan. In 1930, when the staff of the Rostov Works successfully completed the construction of the plant, the program for manufacturing agricultural machinery was set at 115 million rubles. In 1955, workers in the Rostov Agricultural-Machinery Works were making machines with gross values in the hundreds of millions of rubles, and had produced 29,000 units of the "Stalinets-6" combine alone.

In 25 years, the Rostov works manufactured 186,000 wheat combines, i.e., over half of all farm machinery in the country. Four automated production lines are engaged in this activity, raising labor productivity by 40%. Two more lines are being organized in the plant.

Under the sixth Five-Year Plan, plans call for even wider use of electric power in agriculture. The number of electrified collective farms must be doubled, and electrification must be completed in State farms and at MTS units.

Under the sixth Five-Year Plan, the role of machine and tractor stations in the development of all branches of agricultural production and in the ultimate organizational and social strengthening of collective farms will be enhanced still more, their responsibility for the fulfillment of production plans and of stock for agricultural products, for the mechanization of laborious processes in the raising of crops and livestock will be increased. The sequence of activities in machine and tractor stations will permit the employment of permanent MTS workers over the entire year, by tying in the skills of mechanizing cadres and expanding the production aid to collective farms.

Collaboration between Science and Production

Soviet scientists rely, in their work, on production innovators, making use of and generalizing the experience of the latter. In turn, leading workers and engineers apply the achievements of scientists in their own practical activity.

Thousands of in-plant laboratories are in a more intimate relationship to production than any other scientific organizations. They constitute the points of sup-

STAT

port for science and techniques in the enterprises, and represent the promoters of technical progress and of high scientific and technical culture in production. They help to vitalize new discoveries and inventions, the latest achievements of scientific and research institutes and of advanced experience. Wherever plant laboratories have adjusted their work to serve the interests of technical progress, they are rendering tangible aid to production. Included among such plant laboratories are the scientific staff of the laboratories of the Kuznetsk "Elektrostal'" Metallurgical Combine, the Gorky Molotov Automotive Works, and many others. These carry on scientific research activities which yield great economic benefits to the enterprises, initiate serious theoretical research, and put to use great scientific discoveries in their own productive activity.

Soviet scientists are devoting their attention to the further appropriation of already familiar technical processes (e.g., the use of oxygen in metallurgy, pressure-working of metals, precision-casting of metal) and at the same time are working on new processes not yet known in practice, and on more advanced methods of production, transportation, and communications.

Up-to-date machinery consists of many dozens of mechanisms, some of which rotate at speeds of tens of thousands rpm and are subject to loads in the tens and hundreds of tons. For that reason, individual subassemblies and machine parts must possess sufficient strength and long service life.

The increase in the speeds of operating processes demand of science the development of new materials for machine manufacture. Modern science is pioneering along novel and previously unknown paths. There is much interest in the effect of radioactive radiations on the mechanical properties of materials, useful in the manufacture of machinery.

When steel parts of various machines and mechanisms are subject to friction during service (with some individual parts, particularly thin parts, undergoing wear of as little as fractions of a millimeter), the friction and wear result in distortion of the parts, subassemblies, or particular mechanisms. This increases the need for a stock of spare parts.

Hundreds of tons of metal are consumed each year for spare parts in machines, machine tools, and motors. It is quite natural that scientists and engineers are searching for methods of prolonging the "life" of metal parts. Knowing under what conditions the part is operating (temperature, pressure, chemical environment), to what kinds of loads it is subjected (tensile stresses, torsional stresses, impact loads), scientists select that grade of metal or alloy which corresponds to the most stringent specifications for the job. The scientific approach to physical processes makes it possible to effect a considerable increase in resistance to wear, which also entails a lengthening of the service life of machinery.

Machine designers are increasing the durability of steel parts by improving the quality of tempering and using new methods of heat treatment.

Steel is the basic material for new designs of machinery. It possesses great strength and has excellent machinability in the shaping of forms of the most complex shape. An unusual property common to many grades of "hardenable" steels, enriched in the manufacturing process or, as it is commonly called, "alloyed" with carbon or other elements, is their capacity to undergo hardening.

Particular attention is being paid to grades of non-molybdenum steel and to grades of steel used to replace tungsten steel. Those steels provide savings in molybdenum and tungsten.

The method of high-frequency current induction heating has been in use for many years in our plants, for heat-treating of metals. Scientists and production innovators are engaged in further improvements and in introducing the method of induction heating of metals - primarily of steel - into various branches of machine-building. High-frequency current induction heating is now employed to some extent in almost all metal-working plants.

In the new press and forging shops, established under the supervision of

STAT

Corresponding Member of the Academy of Sciences of the USSR, V.P.Vologdin, the usual din of drop hammers is no longer heard, and the usual fumes and smoke from the heating furnaces and ovens are absent. The shop resembles a laboratory in its appearance. In place of the pressman and hammerman in soot-covered overalls, we now see standing next to the press a machinist-operator dressed in a clean smock, thoroughly familiar with the innumerable devices and appurtenances, acquainted with metallography and with the heat treatment of various metals and alloys.

The fundamental form of power used in the shop is electricity. The bulky steam-driven hammers are replaced by noiseless hydraulic presses, and the furnaces laden with oil and soot are replaced by high-frequency induction heaters.

A scientific research institute for work on high-frequency currents has been established in our country. The institute has developed a unit for automating stamping processes on horizontal press machines. This unit also basically alters the character of labor in forging and presswork production.

Automation frees the pressmen from heavy and burdensome operations, makes it possible to do without heating furnaces, and brings the labor in presswork and forging shops closer to the type of work done in machine-assembly shops. The unit produces heating of ingots by high-frequency currents, loads the heated ingot into the machine, and moves the ingot from one pass through a die to another.

New methods of welding and original types of welding units have now come into ever wider use, as a result of the research efforts by Academician E.O.Paton and Academician V.P.Nikitin, who were the first to develop them.

Welding of metals is becoming increasingly common in production, particularly the automatic welding under a layer of flux (dip arc welding), developed by our engineers and scientists.

Flux is a fine mineral powder; it protects the molten metal from combining with the oxygen or nitrogen present in the air, which would lower the strength and shorten the life of the metal parts and articles being welded. This method makes it possible to obtain an even, dense, and homogeneous welded seam, and ensures a rise in productivity and improvement in working conditions for the welders.

The quality and economic index of machinery, metal parts, and other products manufactured depend to a great degree on electric-arc welding. The domestic machine-building industry produces the most advanced equipment for electric welding.

Automatic welding has become a leading technological process in the manufacture of boilers and high-pressure vessels, hoisting and hauling facilities and mechanisms, electric locomotives, railroad cars, automobiles and trucks, in the construction of such huge installations as blast furnaces, the shells of tall buildings, hulls of ships, bridges.

Active Member of the Academy of Sciences of the Ukrainian SSR, K.K.Khrenov developed a method of automatic welding under water, which has been employed with great success in the erection of hydraulic engineering facilities, and in the repair of ship hulls. The welder covers the metal electrode with a layer of special grease impermeable to water. The grease first begins to melt under the effect of the electric arc, and then instantaneously becomes vaporized. In the course of the process, the gas forces the water away, setting up a gaseous medium at the point of contact between the parts to be welded, thus establishing the conditions required for welding.

Automatic electric-arc welding in the USSR is distinguished by the enormous scale on which it is carried out and the excellent quality of the work, clearly reflecting the advantages of Soviet science over science in the capitalist world.

Soviet scientists have developed improved fluxes for welding low-carbon, medium-carbon, and high-alloy steels, have developed new technological processes for multiarc welding, welding by means of a three-phase arc, automatic welding by means of a nonconsumable electrode in a medium of various protective gases (argon, nitrogen, carbon dioxide), have designed various automatic welding units and transformers, and have done research on the basic problems involving automatic control of heat-

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transfer processes and weldability of metals.

Our scientists have introduced new techniques into the processes of machining metals as well. Electric-spark discharges are now being used to erode particles of metal, thus imparting the desired shape to the metal blank. Up to the present time, three methods have been employed: anode machining, electric-contact machining, and electric-spark erosion. Research work has now been done on a fourth technique, electric impulse machining.

The electric impulse technique forms the basis of a special-purpose machine tool. Control of the machine tool is automatic. A pushbutton is pressed and the traverse arm moves to one side, freeing a space for the stock. An automatic overhead grab gently lowers the workpiece onto the working table. The "cutting tool", i.e., the electrode, is then fed slowly into the work. A red light flashes on. The electric impulses enter into action. They are excited by a generator attached to the machine, located in the rear section of the machine tool. Within one second, 600 pulse discharges are sent through in the same direction at specified intervals. Each pulse acts as a sort of cutter, removing a small particle of metal. The flux of these pulses is converted into a powerful cutting force.

The part is machined while in a bath under a layer of oil. The fluid medium imparts stability to the process and helps to float away particles of molten metal. And although the machine operator does not inspect the work visually, he orients himself by means of instruments.

The electric impulse machine tool easily and rapidly performs operations involving the machining of die molds, die sets, turbine blades, and other complex parts from tempered, mild, magnetic, and heat-resisting steels.

This machine tool operates with 3 to 4 times the capacity of the electric spark erosion tool, and consumes 2 to 3 times less electric power.

A new machine tool is known as a profile broacher. The name itself indicates its function. It broaches small openings and slots in the work as if with a needle, and duplicates surfaces of any configuration.

Soviet engineers have harnessed electric discharges, to machine even particularly obstinate and hard metals, converting rough stock into parts of complex geometry and of class 4 - 5 of surface finish, with precision to a tenth of a millimeter.

Science and technology are alive with new ideas in our time. What was being created yesterday in the laboratory is today already an accomplished fact in production, in industry. It was not long ago, for instance, that a new theory was formulated on the relation between the magnetic and mechanical properties of metals. Already today, there are devices based on that theory, known as automatic magnetic micrometers. On contact with a part, such an instrument will determine the thickness of the protective coating of the metal, without altering the part. Thus theory is converted into practice in metallurgy, machine-building, in aviation, in transportation, and in other branches of the national economy.

Many of the achievements of physics have been placed at the disposal of production. The task of inspectors in laboratories attached to machine building works is performed by visible and invisible rays, by audible and inaudible sound.

Research work on improving methods for flaw detection in metals is extremely interesting. Here a veritable revolution has taken place: The old techniques for testing specimens, which were cut out of the piece to be tested, are being more and more relegated to the archives of technology. The use of gamma radiations, ultrasonic vibrations, magnetic feelers, and other new approaches to nondestructive testing opens the possibility of inspecting the entire batch or lot of parts manufactured.

X-rays are used to inspect castings, stampings, forgings, pressed parts, and welded joints. The technique of X-ray analysis is such that it enables inspection to be carried out in a negligibly short interval of time.

The functions of a technical inspector in a machine-building plant are also per-

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formed by ultrasound. Ultrasonic vibrations detect fine flaws in the metal which go unnoticed by X-rays. Such vibrations determine the size of crystals in the metal, which also entails a determination of the correctness in the way the metal was machined.

Machine-building with its wide range of interest, the chemical and petroleum industry, power engineering, and transportation impose new and higher demands on metals and alloys. The development of special branches of technology, the use of atomic power, jet propulsion, radio engineering, all these are based on the use of qualitatively new metallic materials.

The course mapped out to advanced techniques, to the acceleration of technical progress, requires an absorption of the latest achievements of science into industry. Such achievements include, in particular, the discovery and utilization of the properties of new materials.

Each large phase in technology is usually associated with materials of some new type. Automobile manufacturing was promoted largely thanks to the appearance of alloyed steels, and the aviation industry is much indebted to duralumin. A new material occasionally produces a true technical revolution in a number of production branches.

With the development of the national economy, needs for metals and alloys are continually on the increase. Hand in hand with the growing demand for generally familiar metals and alloys, the demand for new metals and alloys increases constantly.

This in turn induces a significant growth in the production of not only iron but also of other metals.

Our country disposes of the richest raw material resources for a sizable increase in aluminum production. The possibilities of obtaining new high-strength corrosion-resistant aluminum alloys are far from exhausted. The exceptional significance of aluminum - and of another light metal, magnesium - in the form of alloys,

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lies in their value to the development of transportation. These metals have an important function, for example, in reducing the weight of trains and rolling stock in transportation. The ways in which they can be put to use in the different branches of technology are many and varied.

Science is probing deeper and deeper into the forces of nature and the magnificent natural resources of our nation, utilizing those forces on a continually wider scale.

Soviet scientists carry out prospecting for useful minerals, conduct exploration for natural riches locked in the bowels of the earth, and study the depths of the earth throughout the length and breadth of the immense territory of our homeland. Nature does not reveal its vastness to man all at once.

Science is striving to solve complex problems in our country. Drilling deeper and deeper boreholes, several kilometers into the interior of the earth's crust and discovering there ancient deposits of petroleum, scientists have tackled the problem of developing techniques for obtaining a fuller picture of the structure of the various layers of which the bedrock is formed. This makes it possible to discover the presence of different kinds of minerals in particular districts, and to detect new riches in the earth in less time, using them as a basis for the further development of various branches of the socialist industry.

This cause is served by the excellent results of geophysical explorations into the earth's interior, techniques widely utilized in prospecting for useful minerals and in studying the geological structure of the earth. Highly sensitive, high-precision physical instruments enable the scientists to "inspect" the interior of the earth.

Science yields improvements in tools and production processes, expands raw materials resources, and improves the techniques which the Soviet worker has at his disposal for exploiting natural resources for the benefit of society.

The metallurgical industry smelts metals of high purity. But production branches have now appeared on the scene where impurities of even so much as one part per ten thousand are impermissible. Individual parts of a nuclear reactor must be practically free from impurities of such "poison" elements as boron, samarium, and others. In this case, scientists are already down to the level of individual atoms. In the new metal germanium, for example, only one phosphorus atom per 10 million atoms of the basic metal is sometimes tolerable. It is no easy job to get rid of the impurities in a metal, but magnificent results have been achieved. The pure metal acquires some new and valuable properties. Titanium, a brittle metal, lends itself easily to stamping, drawing, and forging when in pure form. Chromium and aluminum become plastic. By the end of the sixth Five-Year Plan, Soviet metallurgists will have considerably improved the purity of metals and will have succeeded in eliminating impurities from twice as many metals as before.

Particular attention will be devoted to the electrosmelting of copper, zinc, lead, and other concentrates. This technique is excellent for high-melting ores; it reduces evolution of gases and raises labor productivity and culture. Under the sixth Five-Year Plan, complex ore processing will reach the point where not only the basic metal is extracted from the ore, but also the metals associated with the latter.

Under the new Five-Year Plan, the volume of production of titanium and of other rare metals, such as germanium, zirconium, columbium, tantalum, etc. will be stepped up. It should be noted, however, in this respect that the term "rare metal" has become an imprecise concept. Remember that aluminum was also once upon a time considered a "rare metal" and was more expensive than silver. But in our time aluminum has been recovered in such large yield that even household utensils are made from it.

Germanium, titanium, zirconium, vanadium, columbium, chromium, molybdenum, and many other metals have been known until quite recently as just additives for improving iron. Now, our chemists are striving to increase the amount of germanium re-

STAT

covered from various natural resources, and particularly from resources which are process for industry (e.g. as a byproduct of anthracite working).

Germanium is one of those new metals. It was discovered in 1886 in one of the minerals, on the basis of the scientific predictions by D.I.Mendeleyev. Together with silicon and some other elements, germanium belongs to the family of semiconductor materials. The unusual properties of semiconductors are particularly suited to the development of modern automatic control, electrical, and radio engineering.

Semiconductors are capable of sharply changing their properties when acted upon by external disturbances. The presence of rather minute impurities is sometimes sufficient to multiply the electric conductivity of a semiconductor a millionfold; in response to temperature, the conductivity may vary by a factor of hundreds or even thousands, and in response to exposure to light or electric fields, by dozens of times.

Semiconductor devices are now crowding electronic vacuum tubes out of an entire range of fields of radio engineering. Semiconducting devices are very small in size, and the power they require is much lower than that required by vacuum tubes. They are much more reliable and have a longer service life than vacuum tubes.

This is particularly important for applications in complex computers. High-speed electronic computers with conventional tubes radiate a large quantity of heat. About a third of the power consumed by such computers is used for ventilation. Semiconductor devices, and machines incorporating them, require no ventilation and are considerably smaller in size than conventional computing machines.

Semiconductor switches are capable of directly converting light and heat into electric energy, without any intermediary devices. Semiconductor photocells, utilizing this property, have long been of service in automatic control applications.

The first device of that type was the miniaturized TGK-3 generator. In this case, a heat flux, emitted in response to the burning of a kerosene lamp, heats the junctions of thermocouples. The opposite ends are cooled by the surrounding air.

The electric power generated thereby proves sufficient to energize radio receivers of the "Rodina" type. The TGK-3 generator renders reception of radio broadcasts possible in remote corners of our country.

In remote districts, not yet electrified, it is necessary not only to make reception of radio broadcasts possible, but also to produce electric light and to charge storage batteries. This requires hundreds of watts of power. The usual iron stoves fired with wood, peat, or some other local fuel provide the required electric power, with the aid of thermoelectric devices. It will not be long before thermoelectric cells, generating a power of dozens of kilowatts, will be developed.

The efficiency of the electric generators is still low. But they do not require steam boilers or machines with moving parts or dynamos. Heat is converted directly into electric energy. The electric generator makes use of the liberated heat, which was previously lost in enormous quantities. How much electric power could be obtained, for example, by connecting a thermoelectric cell to boilers in a central heating plant? Free electric power with plenty to spare could satisfy the household needs of residents in the building.

Formerly, it was possible to make use of only a small fraction of the energy from the sun. Thanks to semiconductors, it is now possible to extract a hundred times as much energy from solar rays. Recent achievements in that field justify the expectation that the problem of direct conversion of solar energy to electric power, for satisfying the demands of technology, industrial, and household needs will soon be solved. The first solar energy units, using semiconductors, are already in operation and are generating current.

The development of automatic control and the perfection of process control and measuring techniques depends to a large measure on the success achieved in radio engineering and electronics. In radio engineering and in electrical engineering, the use of semiconductor devices and equipment is reaching ever broader scopes.

Devices have already been designed to replace rheostats.

A circuit incorporating a semiconductor is switched on, the latter is heated, and the current, at first weak, builds up to the specified value. By a judicious choice of semiconductors, electric motors or other machinery can be turned on and run up to a desired speed, in time intervals from fractions of a second to fractions of a minute.

By directing a ray of light to impinge on semiconductors, mechanisms may be brought into action or stopped, and these may be remote-controlled. Semiconductor devices are so sensitive that they detect a luminsecent or heated object many tens of kilometers away.

Recent investigations by Soviet physicists and chemists have demonstrated that a certain number of catalysts (chemical agents which speed up chemical reactions) are typical semiconductors. The development of semiconductor theory serves to help perfect catalysts, which form the basis of all chemical production processes.

Semiconductors include, in addition to the immense number of catalysts (i.e., agents serving to speed up chemical reactions), also substances capable of luminescence in response to irradiation by light, electrons, radioactive particles, etc.

It is possible to point out still more fields of technology where semiconductors serve to advance technical progress: These include radio engineering, radar, computers; semiconductors have already won a notable place in power engineering and automatic control, are making their way into chemistry and electronics, and have acquired great importance in physics.

Semiconductor materials make it possible to develop automatic control instruments which are fundamentally new in character. On the basis of semiconductor materials, new devices are designed which enable the energy associated with emissions, including the energy from nuclear reactions, to be converted into electrical energy.

Semiconductor technology, opening up broad and promising roads toward technical progress, have attracted the attention of scientists and manufacturing personnel.

The Semiconductor Institute of the Academy of Sciences of the USSR will be able to solve difficult problems in collaboration with many other physical and chemical institutes, including designing and drafting bureaus and plants.

Among the most imposing problems, whose solution would bring about radical changes in science and technology, is the development of high-speed computers and data-processing machines as well as automatic control equipment.

Soviet scientists have already designed computers which perform mathematical operations many times faster, and much more accurately, than human operators ever could.

The BESM high-speed computer, designed by the Institute of Precision Mechanics and Computer Techniques, has been in operation for over three years. The computer is a powerful tool assisting Soviet scientists. It permits a completely new approach to the solution of the most important problems in physics, mechanics, astronomy, chemistry, and other fields of knowledge.

The computer performs 7000 - 8000 arithmetic operations, on the average, within one second. One human calculator, working with an arithmetic calculating machine, can perform about 2000 arithmetic operations during one shift.

In order to form a clearer picture of the rapidity of the operations of such a computer, it suffices to say that it is capable, for example, of computing the flight trajectory of a shell faster than the projectile itself moves. One computer replaces a hugh army of calculating personnel.

In three years, a multiplicity of problems relating to different fields in science and engineering have been solved on electronic computers.

In compiling maps on the basis of data from a geodesic survey of a given locality, it was required to solve a whole system of algebraic equations in a large number of unknowns. After performing 250 million arithmetic operations, an electronic computer gave an answer in less than 20 hours.

The computer devised Tables for determining the forms of the contours of the

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steepest possible inclines of canals without producing cave-ins. This resulted in savings in materials and time in the building of hydraulic engineering facilities. Attempting to solve that problem, even for a single variant, by using the efforts of 15 human calculators over the course of several months met with no success. Calculations embracing tens of variants took an electronic computer less than three hours. As a result, the nation saved hundreds of millions of rubles.

A computer works around the clock. It contains about 5000 electronic tubes. Replacement of tubes is carried out by preventive inspection of the machine. Two engineers and one technician are assigned to maintenance of the computer.

The new mass-production general-purpose "Ural" computer is meeting with great interest. This digital computer is designed to solve engineering problems in scientific research and planning organizations and in advanced technical schools. Within a short time, our engineers master the operation of such computers, and are capable of carrying out all of the necessary calculations with their aid.

At the present time, not one of the branches of technology could develop fruitfully without the aid of automatic control instruments, especially those branches which are associated with heavy and complex production processes, employing high process rates, high pressures, high temperatures, etc.

Automatic computers will play a particularly important role in the realization of automation, with the computers themselves determining and maintaining the optimum process conditions, and also establishing and maintaining quality control over the products.

Modern computers present a wide range of variants. A new type of facility has now been added to computer activity, namely a combination of machine and computer, in which the machine supplying the power, the operating machine, and the controlling computer are integrated into a single unit.

Machines of this type have already been assigned the task of regulating power loads in electric power stations. These compound machines represent the best basis

STAT

for complete automation of a number of manufacturing processes, for example in metallurgy and in machine-building.

The introduction of high-speed computers opens unlimited perspectives in ferrous metallurgy. The computer takes into account, within fractions of a second, data relating to the melting process: temperature, pressure, composition of the gases, makes necessary corrections and transmits them to the automatic controls, regulating the melt. This type of control, together with improved technology, increases the productivity of electrorefining of steel, of the blast-furnace process, etc.

The control system selects the optimum data for each technological process, guides the process with maximum economy and acquires practical "experience", perfecting itself, as it were.

All of those systems are already in existence - they have been designed by Soviet mathematicians, physicists, engineers, and designers. Similar computing assemblages will be used to control powerful rolling mills.

Control computers are being tried out on the electric-arc steel melting furnaces of the "Elektrostal'" plant. Thanks to those machines, it has become actually possible to change over to continuous processes of steel melting; this greatly accelerates production of high-alloy steels.

In transportation, a computer has been developed which makes it possible to run trains with high accuracy, taking into account not only the timetable, but also the condition of the road, the weight of the rolling stock, and temporary deviations from schedule occurring for some reason or other on the road. This setup has already been tested out on railroads.

Electric centralization of railroad switches and classification of hump yards with the aid of computers, radar sets, and television circuits have definitively obsoleted the professions of switchman and brakeman.

In the future, passenger airplanes will land at large junction airports with the aid of automatic pilots composed of special-purpose computers.

In our own time, computers are becoming a powerful tool in the hands of research scientists, engineers, and designers. They are used to establish physical laws to greater precision than previously possible; they can do a better job of designing construction jobs, and design machines faster. An electronic computer has already been designed which is capable of designing other electronic computers. It is understood, of course, that that particular task, i.e., that of designing some type of computer, is programmed into the computer by a human being.

Electronic computers may prepare different production documents and waybills, keep account of complex inventories, compile analyses and summaries, and perform a number of other operations according to some specified scheme. Highly significant results are expected from computing machines in planning, and in the compiling of material balances. These are only some of the examples of actual utilization of up-to-date means of automatic control and electronics. The sphere of their applications is practically limitless.

Under the new Five-Year Plan, our industry will be equipped with the latest devices capable of facilitating the work and bettering the working conditions of the Soviet people.

The directives of the Twentieth Congress of the Communist Party of the Soviet Union call for intensifying work on the design and manufacture of automatic high-speed computers for the solution of complex mathematical problems and of computers for effecting automation of process control.

Soviet science will strive to make use of all forms of energy, including the energy of the wind, ocean tides, and other powerful forces of nature.

Continuous disintegration of atoms of radioactive substances goes on [illegible] the earth's crust. The foci of this disintegration, natural nuclear reactors in their own way, give off such an enormous quantity of heat that even earth strata at a depth of 30 – 60 km are intensely heated. From the interior of the earth, making

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their way through deep cracks and fissures in the crust, hot springs, gushers of boiling water, steam, and gases often break through to the surface.

Hydrothermal electric power stations could be built on the basis of this subterranean heat. Such a station would be very simple in design. Steam from the depths of the earth would be admitted through a well to turbines, which would in turn drive a generator.

There are many hot springs, geysers, and steaming fissures in Kamchatka, on the cold Chukotka Peninsula, where green grass shows in between the snows, on the permanent frozen land, warmed by those sources. There are hot salt lakes in the craters of extinct volcanoes, and hot springs on the Kurile Archipelago. These places, however, are not the only ones where subterranean heat comes through to the surface.

Such sources can be found in the Caucasus, in Kirghizia, and in Kazakhstan, in Altai, in Pamir and Tyan'-Shan', in the Trans-Baikal area and in the Maritime Province. The zone over which such sources are spread extends over the entire length and breadth of the Soviet Union.

Electric power stations utilizing power from the interior of the earth are not yet in existence in our country, but scientists are at work to make them a reality. They are studying and generalizing on the experience of electric power stations and heat power plants in Italy, New Zealand, Spain, and other countries.

Geothermal electric power stations are more suitable than the existing fuel-fired stations, even more so than hydroelectric stations.

Geothermal power stations would have no need of boiler rooms or steam boilers. They would do without stockpiles of fuel, supplied from thousands of tons of coal by railroad. They would not require transportation for the haulage and recharging of fuel, and would not contaminate the atmosphere. They could be readily automated and made to operate without human supervision.

Natural hot springs and wells would be readily suitable for heating open

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ground and the soil of hothouses and greenhouses, and also for space heating in villages and small towns.

The Dagestan Branch of the Academy of Sciences of the USSR is working on a project for providing heat power to Makhachkala by means of hot water from depleted oil wells. The hot-water resources of the Caucasus, Tadjikistan, and other regions are being studied.

Extensive research on the location of resources of underground steam is being conducted on Kamchatka and on Kurile Islands. In the Far Eastern districts, it will be possible to build electric power stations delivering hundreds of thousands of kilowatts, at very low electric power costs. These stations will become the base for an extraction and processing industry, and will make it possible to electrify various production processes. The low power cost will also make it possible to build long-distance power transmission lines in these districts, connecting geothermal power stations with towns and enterprises.

A major achievement of Soviet science and engineering are the techniques for harnessing the energy contained within the atomic nucleus, for peaceful purposes. Soviet scientists have written a new page in the chronicles of important discoveries in science. The use of the colossal energy locked within the nucleus of the atom for peaceful purposes is a most important phase in the development of humanity.

Nuclear engineering is only taking its first steps, but has already opened possibilities heretofore unknown in history, for the development of all branches of production. The use of the energy of nuclear transformations, the use of isotopes leads in essence to radical modifications in all branches of technology. Soviet science and production truly stand at the threshold of a new scientific, technical, and industrial revolution, far surpassing in importance the industrial revolutions ushered in by the appearance of steam power and electricity.

With the constant and active support of the Communist Party and the Soviet government, our scientists and engineers have achieved outstanding results in

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nuclear physics.

In the planning of the world's first atomic power station, Soviet scientists solved complex scientific and technical problems. For a power reactor with a high temperature and high neutron flux, it is necessary to design the fuel element in such a manner that it will transfer a large quantity of heat from the heated uranium to the circulating water coolant. Much effort was also required to develop the equipment - devices, instrumentation and automatic controls for controlling the reactor and ensuring reliable operation of the power station.

The vital installations of an atomic power station are controlled by engineers, scientists, and workers. These have mastered the new techniques in a short time, are applying their creative thought to the improvement of production and to the development of atomic power, at the same time expanding their technical knowledge.

Alongside the highly skilled scientists and engineers doing work on a high level, there are also young scientists, engineers, and technicians at work. The friendly labor of the entire staff contributes to the accumulation of experience in the field of exploitation of atomic power stations, and sets up the conditions for successful training of cadres for new and more powerful nuclear power stations.

Workers in the station are continually engaged in improving the facilities, devices, and instrumentation. For example, the circulating pumps are automated, with independent back-up standby units available in case of a breakdown of the operational unit. Steam generators are fully automated.

On the basis of the powerful socialist industry, Soviet scientists are developing new methods for the production of atomic power.

The achievements in nuclear engineering in the USSR, as in any other nation, depend on the scope of scientific research, on the most far-reaching development of scientific research work in the area of experimental and theoretical physics. The deeper scientists penetrate into the interior of the atom, the more fully will they be able to understand the properties and the laws governing the interactions of the smallest particles, and the more detailed study they will make of the nature of intranuclear forces.

Our government has provided the scientists with laboratories and institutes in which they conduct research in the field of nuclear physics with the aid of first-class accelerator facilities.

The work of the scientists have made feasible the utilization of atomic energy liberated in the fission of nuclei of heavy elements. This is an important step along the road of harnessing nuclear energy, since the fundamental responsibility for developing electric power is now invested in fuel-fired power stations, burning enormous quantities of coal. Sooner or later, the production of electric power must be shifted to some other base. This new base will be precisely the utilization of the energy from fissioned nuclear fuel and various thermonuclear reactions. Soviet scientists are engaged in persistent work on learning how to control thermonuclear reactions, as the chain reactions of the fission of uranium, thorium, and plutonium nuclei are controlled at present. The power base for the development of electric power will be expanded in extraordinary fashion. The source of fuel, millions and billions of times more concentrated than coal, will be provided, in particular, by the hydrogen in water.

Intriguing perspectives in the transformation of nuclear energy into electric energy are opened by radioactive substances which are produced in large quantity in atomic reactors. As a result of the fission of heavy nuclei (uranium or plutonium), fragments are formed, these being radiactive atoms of chemical elements. If, in a channel built into the protective shielding of the reactor, various substances are placed, the bombardment by neutrons produced in the pile will render many of those substances radioactive. Radioactive isotopes, emitting alpha or beta particles, may be used to produce atomic cells, i.e., sources of electric energy in which the energy of the decaying nuclei is partially transformed into electric energy.

Atomic reactors are complex engineering installations. They are "put together"

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with a multiplicity of different metals and alloys. These include fissionable elements, such as uranium and plutonium, and structural materials, graphite, beryllium, zirconium, aluminum, stainless steel, needed for promoting the fission of uranium and plutonium atoms, for removing the energy liberated in the process, and for preserving neutrons, these most valuable "atomic primers".

One of the laboratories of the Academy of Sciences of the USSR serves for research on metals and alloys which had been exposed in reactors.

The main chamber in that laboratory is a "hot" machine shop, to where the metals and alloys are brought. The metals and alloys are cut and shaped as required on a special milling machine, in the "hot" shop. With the aid of a master-slave manipulator, a remarkable instrument which acts, as it were, as an extension of the human hand, the operator can reach through the thick shielding wall of concrete and cast iron to the "hot" cell.

Observation and monitoring of the performance of equipment and manipulators, and of physical measurements, in the "hot" cells, just as in a microscopic "hot" cell, is carried out by means of special protective viewing goggles (and in some cases, with the aid of closed-circuit television viewers).

The method of radioactive tracers or, as it is still often called, the method of tagged or labeled atoms, is being used with success for scientific research work.

Tagged atoms are used with success to determine the distribution of various component parts in the metal alloys. By means of this technique, it became possible to solve the important production problem of manufacturing highly valuable refractory steels.

Radioactive isotopes of various elements are coming into continually wider use for the development of the scientific foundations of alloying of metals and for the study of physical-chemical reactions in metallurgical production.

By reducing the duration of a heat in the open-hearth furnace, steelmakers obtained a more rapid slag formation and at the same time freed the steel from harmful impurities in less time. In order to determine the sequence of charging ore and limestone which would result in the most rapid formation of molten slag, scientists made use of radiotracer isotopes. Tagged atoms of calcium, iron, and phosphorus were introduced into the layers of ore and limestone. These atoms can be differentiated by the character of their emissions. After the pig iron is poured into the furnace, samples of slag are taken. Certain radioactive atoms indicated that part of the ore and limestone into which tracers had been introduced had already melted. By means of radioactive cobalt, it was discovered how the technique of charging scrap metal affected the rate of melting, and how the steel moved.

Radioactive isotopes presage a great future for rapid assaying of alloys and slag. At the "Azovstal'" Works, tracers are already in use for phosphorus assay.

The radioactive isotope of sulfur made it possible to study the rate of the desulfurization process of steel, and also the dependence of the equilibrium of sulfur in steel on the composition of the slag, temperature, and other external conditions.

Radioactive isotopes give alarm when a dangerous state of deterioration of the firebrick lining may start in a blast furnace. It is common practice in plants to line the hearth and bosh of the blast furnace with a thick layer of refractory firebrick. The firebrick refractory lining is destroyed gradually under attack by the molten pig iron and slag. This process takes place at a rather slow rate. But if the furnace is not shut down in good time for major preventive overhaul, damage may result. Scientists have suggested using the radioactive isotope of cobalt as a monitoring control. When the refractory firebrick lining begins to deteriorate, a small lump of cobalt dissolves into the pig iron, the cobalt being embedded very close to the surface. It is sufficient to hold a radiation counter to that spot on the outer surface of the blast furnace to immediately detect the disappearance of radioactivity. Since the rate of wear of the layer of refractory firebrick lining is known, the blast furnace may be shut down at any convenient moment for repairs.

X-ray inspection of large castings was previously very difficult, due to the bulkiness of the X-ray apparatus and due to the fact that modern X-ray tubes are not capable of penetrating metal more than 3 cm in thickness.

Scientists recommend using radioactive gamma-emitting isotopes. Inspection of parts by means of such rays is known as gamma radiography. Gamma rays are used to inspect the quality of ferrous and nonferrous castings, and also of welded seams.

Radioactive isotopes are capable of monitoring processes in stamping, and of selecting the most feasible design for the dies.

Usually, the wear resistance of individual machines (e.g. in the automotive and aviation industries) is studied in the following manner, in mass production: The engine is dismantled. Its parts are carefully measured. The engine is then reassembled and prolonged tests are performed.

Tests on wear resistance may be conducted much faster and cheaper by the technique of radioactive isotopes.

In testing automobile engine piston rings, a ring is used on which radioactive iron has formed in response to neutron bombardment in a nuclear reactor. The engine is started. In the process of operation, bits of metal worn loose from the piston ring get into the grease and oil used to lubricate the vehicle. Oil comes into contact with the counter, which determines the amount of radioactive iron present. This serves as an indication of the amount of wear on the piston rings.

Testing of many different parts is carried out with the engine running, not only without taking the engine apart but even without stopping the car. Isotopes are also used to study wear of cutting tools. For this purpose, the cutting tool is activated by neutrons in a reactor or is fabricated from metal into which isotopes had been introduced during the melting. By collecting the chips and shavings and measuring their radioactivity, the amount of wear suffered by the cutter may be calculated. On the basis of these data, it is possible to choose the most suitable materials for manufacturing the cutting tool, to select the best geometry for the tool and also the optimum pattern for the cutting operation.

Isotopes participate in the fight against corrosion of metals. Radioactive isotopes can trace the process of corrosive attack on various metals under highly varied conditions and thus make it possible to develop reliable techniques for protecting the surface of machines.

Radioactive isotopes are used in other fields, in the most varied fields, of the national economy. New research techniques based on the achievements of atomic physics are introducing basic changes in many scientific concepts, and are contributing to the perfection of production.

In the chemical, petroleum, metallurgical, electrical industries, in machine-building and other branches of industry, new possibilities are available for controlling, inspecting, and automating production processes. A whole series of novel instruments and devices for production quality control have been developed, which can determine and automatically regulate, by means of radioactive irradiation, the interfaces between different liquids, between a liquid and a gas, or control the change in the meniscus of liquids and of free-floating materials as well as the gas pressure in closed vessels of different kinds. Special instruments automatically monitor the process of separation or chemical filtering of a given substance and exercise automatic process control.

In the performance of earth-dredging machines - dredgers - it is important to know the composition of the mixture of water and mud passing through the machine at different moments. The throughput of the dredger depends on these data. Until recently, it was impossible to define the composition of the mixture. Now, Soviet scientists have designed a special device which, by means of a radioactive cobalt tracer, senses and indicates the water/mud ratio at any moment.

Automatic operative devices have been designed which trip out various mechanisms (e.g., presses) in case of danger, stopping the operation of the unit or machine tool. Other instruments sense areas of different configurations or determine the extent of corrosive attack on the inner walls of tubes.

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Very promising perspectives in the field of production step-up are opened before the national economy by a new field in physical chemistry, that of radiation chemistry. This discipline studies the chemical transformations of substances in response to or with the participation of radioactive radiation. The investigations of Soviet and foreign scientists show that, under the action of nuclear radiation, profound changes occur in the microstructure of inorganic and organic materials and substances. Some of these materials are converted to an infusible or insoluble state, others are decomposed under liberation of large quantities of gas, etc. The use of radioactive radiation results in remarkable successes in the production of new, highly varied, and technically valuable materials and substances with pre-assigned properties.

Radioactive prospecting for petroleum is being developed on an expanding basis: In 1954 alone, this technique was employed to test 3.5 million meters of sections of boreholes, which resulted in putting many inoperative wells back into production.

Radioactive isotopes are used in petroliferous areas, are particularly useful for detecting leaks in pipelines, and are lowered into the borehole when water is being injected into an oil stratum.

Isotopes are of aid in studying the basic reactions taking place in the oil refining industry. Isotopes of hydrogen and carbon were successfully employed to determine a number of features of high-temperature and catalytic cracking of petroleum derivatives.

Radioactive isotopes contribute to the improvement of the quality of concrete and reinforced concrete, and to the development of more rugged and inexpensive structural materials of longer service life.

Under the sixth Five-Year Plan, radioactive processes will be used to still greater advantage in production. Research work will be done on the further use of radioactive radiation in industry, in particular for quality control of materials and for process control.

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Our scientists are furnishing seamen and polar-region workers with new tools for taming the violent nature of the Arctic. Under the sixth Five-Year Plan, a powerful icebreaker propelled by atomic power will be built. This icebreaker will be capable of lengthening the time available during the year for navigation in the Arctic, and will enable ships to sail under conditions of heavy ice formation. Scientists, designers, and shipbuilders are already at work on its design.

A small crew will be needed to man such an atomic vessel. Atomic-powered ships will be equipped with up-to-date navigational aids and radar.

Installation of atomic engines will not be limited to atomic icebreakers. In time, there will be cargo and passenger ships propelled by such engines. They will be faster and capable of carrying a larger cargo than conventional ships.

The Soviet Union has moved out in front of other nations in the utilization of atomic power for peaceful purposes. The Soviet government takes its stand as a consistent fighter for the banning of tests and of the use of all forms of atomic and hydrogen weapons.

Our government readily shares its achievements in the field of the peaceful use of atomic energy, and renders friendly and disinterested assistance to other nations.

For China, for example, the erection of an atomic reactor of 5 - 6 megawatts power and of a cyclotron designed to produce particles possessing 25 million electron-volts energy is being prepared. The Soviet Union will prepare, and render assistance in the way of rigging up and setting in place, the installation of atomic reactors of 2 megawatts and of cyclotrons producing 25 million electron-volts energy, designed for scientific research institutions in Poland, Czechoslovakia, the German Democratic Republic, Bulgaria, Hungary, and Rumania.

The successes achieved by science have created the prerequisites for fulfilling the task posed by the Twentieth Congress of the Party, to effect a significant expansion of the use of atomic energy for peaceful purposes under the sixth Five-Year Plan. A new scope will be given to research work on the further utilization of

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radioactive radiation in industry, agriculture, medicine, and scientific research, since the utilization of atomic energy expands the power of man over the elemental forces of nature without limit, and opens colossal possibilities for the growth of the productive forces, for technical and cultural progress, and for increasing social wealth.

Science and technology are achieving such a degree of maturity that the complex utilization of different forms of energy is becoming fully realizable.

The greatest problems will be resolved on the basis of State plans and of scientific laboratories, combining the efforts of many institutes, laboratories, mills, and factories.

These plans envisage, further, work on the assimilation of achievements of science by production. In time, it will be necessary to concentrate major scientific and engineering forces on the most important research, to manifest persistence and continuity, and to bring initiated investigations to conclusion.

The Communist Party appeals to Soviet scientists to persistently and attentively study and generalize upon the achievements of science and technology in our country and abroad, to broaden ties with scientific research institutions in different countries, to apply scientific findings already known from the foreign literature to concrete engineering problems, to study the status of techniques, and to monitor the organization of production in industrial enterprises.

Soviet scientists must assimilate everything valuable of foreign techniques. However, foreign work must not be copied blindly.

The Socialist State is creating all of the conditions conducive to the growth of a new scientific generation. The State is channeling most of the young specialists, graduating from educational institutions, directly into enterprises. After having acquired production experience, many of them will be sent to work in scientific research and planning institutes. This will ensure a flow of mature, well-trained specialists, capable of independent creative activity, into scientific endeavors.

The directives of the Twentieth Congress of the Communist Party of the Soviet Union pertaining to the sixth Five-Year Plan envisage a rounded development of science, an expansion in theoretical research in all fields of knowledge, an enlargement of the role of scientific institutions in the cause of technical progress and in the organization of production. The task has been posed to reconstruct the work of scientific research institutions, to bring their activities closer to the concrete needs of society.

The sixth Five-Year Plan will be the Five-Year Plan of the broadest penetration of new techniques and of the versatile utilization of the achievements of science.

Scientific workers in the USSR are filled with the desire to fully meet the demands of production, to intensify their role in the construction of communist society. Each worker in a plant laboratory, branch, or academic institute will advance science in a creative and inventive manner, and will strengthen the ties between science and practice.

* * *

The latest techniques in the USSR are radically changing the position of labor and are creating the conditions necessary for the conversion of labor, from mere existence for sustaining life, to a primary living need and to a conscious effort of laboring for the general welfare.

Acceleration of all aspects of technical progress is a task of tremendous State importance. In successfully fulfilling this task, the Soviet people will make possible a further mighty rise in socialist production, and make a new contribution to the great cause of building communism.

The creative strength of the working class, having found such clear expression in the heroic exploits during the struggle against the Russian autocracy and against capitalism, during the epoch of the Great October Socialist Revolution, during the years of building socialism, is manifested with still greater power in the unflagging work in the name of communism. The gigantic efforts of the working class, which go unnoticed in the workaday routine of days, weeks, and months, are transforming the face of our Fatherland, from the coast of the Baltic to the Far East, from the snowy polar regions to the hot steppes of the central Asian Republics.

The working class of the Soviet Union, in collaboration with engineers and technicians, scientists and inventors, is building major industrial enterprises, coal-fired, hydraulic, and atomic-fueled electric power stations, high-capacity power networks, canals, railroads and highways, oil and gas pipelines, new agricultural bases, irrigation and water works, cities and industrial centers. Millions of innovators, inventors, and rationalizers are working in the enterprises, in the shops, in the laboratories of scientific research institutes, in designer bureaus. They are developing and bringing into production thousands of rationalizing suggestions, inventions, and improvements.

The maturity of our science and engineering is manifested in all branches of the national economy.

Our scientists are faced with a number of highly important problems yet to be solved. There is much work to be done in designing still more improved and sophisticated machinery, which might permit higher quality to be achieved in production, and labor productivity to be raised while economizing materials and means.

Technical progress is of concern not only to men of science, engineers, and technicians. It must become a matter of vital concern to all Party members, to all Soviet and economic workers. All of them must untiringly aid in furthering technical progress, seek out all new reserves of production, put them to work for the national economy, achieve savings in material resources, and at the same time contribute to the most rapid rise in the capabilities of our State.

In carrying out the decisions of the Twentieth Congress of the Communist Party of the Soviet Union, the Communist Party now sees as its task a more complete and better utilization of the glorious superiority of the socialist system of economy in the interests of further advancing the welfare of the people. The December Plenum of the Central Committee of the Communist Party of the Soviet Union (in 1956) took note of the fact that our country has become still stronger, its economic and defense capabilities have grown, and the material welfare of our people has been enhanced. The balance sheet of the development of the national economy during the first year of the sixth Five-Year Plan has demonstrated, with renewed force, that the socialist system opens an unlimited vista for the creative initiative of the multimillion masses of workers, peasants, and intellectuals. In addition to a powerful production and technical base, we have at our disposition experienced cadres of workers, and a capable apparatus for guiding the work. Our cadres are capable, with their profound knowledge of the task at hand, of solving the most complicated production-economic and scientific-technical problems at lowered expenditures of labor, means and materials, and of achieving excellent results of work in all sectors of economic construction.

At the same time, the Plenum noted that, despite the increase (over the 1955 level) in coal mining, output of metal, cement and lumber, the production plan for those commodities was not fulfilled in 1956. The matter also stood unfavorably with respect to placing into operation of productive capabilities in the above branches of industry and in several others. The failure to meet the plan in the output of several types of commodities is explained both by serious shortcomings in the planning of the national economy, and by unsatisfactory supervision of enterprises and construction projects on the part of ministries, control boards, and departments. The Plenum has adopted concrete measures to eliminate such shortcomings. For this purpose, an adjustment of the tasks set in the directives of the sixth Five-Year Plan and in the draft plan for 1957 is being carried out. These adjustments will ensure the most rational and effective utilization of the material resources and financial means directed toward the development of the national economy, in order not to permit the available means to be spread thin over many construction projects.

In that way, material and financial resources will be concentrated on the most important construction projects and work projects. The Plenum also proposed looking into the possibility of organizing the necessary material reserves in industry, with the object of creating normal conditions for uninterrupted and rhythmic operations.

In the resolution adopted by the Plenum of the Central Committee of the Communist Party of Soviet Union on improving management of the national economy of the USSR, a clear program was outlined for the work of Party, Soviet, economic and trade-union organizations in the field of economic construction.

The resolutions adopted by the Plenum of the Central Committee of the Communist Party of the Soviet Union have inaugurated new possibilities for the working class, kolkhoz peasantry, and the Soviet intelligentsia to develop, on an even broader basis, socialist competition for fulfilling and overfulfilling the plans for production, and for a maximum utilization of production resources and of the reserves latent in each industrial enterprise, each construction project, each collective farm, and each State farm.

The Communist Party and the Soviet government are doing and will continue to do everything necessary so that the needs of the Soviet people will be better and more fully satisfied – in this they see their most important obligation to the people. Proceeding along the road of improvement of all branches of the socialist national economy, in all aspects, along the road of technical progress, along the road of an unswerving rise in the material welfare of the whole people, the working class, and all Soviet peoples will unquestionably build, under the leadership of the Communist Party of the Soviet Union, a communist society in our country.

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Table of Contents

Page

Chapter I. In the Name of the Welfare of the People 1

The Aims of Socialist Production 1

The Most Important Point for the Victory of Communism 10

Chapter II. The Concern of the State with the Development of the Productive Forces of the Country 22

Socialist Industrialization of the Nation 22

Specialization and Coordination of Industry 34

The Planned Allocation of Productive Forces Under the Sixth Five-Year Plan 46

The Working People - Our Basic Production Asset 67

State Labor Reserves 74

New Techniques and the Problems Involved in Training Workers 85

The Growth of Culture and of Creative Activity on the Part of Industrial Workers 97

Chapter III. Technical Progress - The Path to a New Rise in the National Economy of the USSR 116

Machine-Building 117

Mechanization and Automation of Production 131

Electric Power Development 145

Metallurgy 174

The Coal Industry 193

Petroleum and Gas 204

Chemical Processing 213

Transportation and Communications 219

Construction 232

Advances in Agriculture 240

Collaboration between Science and Production 250

STAT