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USSR Report

ECONOMIC AFFAIRS

(FOUO 7/79)

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NOTKIN DISCUSSES OPTIMUM RATE OF ECONOMIC GROWTH

Moscow VOPROSY EKONOMIKI in Russian No 5, May 79 pp 6-16

[Article by A. Notkin, corresponding member of the USSR Academy of Sciences]

[Text] Analysis of the interaction of the productive forces and production relations has decisive importance to determination of optimum rates of economic growth. Production relations, which correspond to the character, level of development and development needs of the productive forces, are an active form of their growth, one which also has an impact on rates.

"In the most different socioeconomic formation there occurs not only simple reproduction, but also reproduction on an expanded scale, though the latter is not accomplished on an equal scale."* Achievement of higher levels of productive forces in the formations that replace one another and the development of new production relations and incentives have created possibilities of speeding up rates of expanded reproduction. To be sure, the decline of entire countries and civilizations has been observed at times in history, but humanity as a whole has moved forward. The material and social conditions for attaining more or less high rates of expanded reproduction come about with the development of large-scale machine production.

Socialism does not merely inherit large-scale machine production. In replacing production for profit by production aimed at raising the well-being of the people, it creates new conditions and incentives for raising the rates of its development. In the bourgeois literature the high rates of economic growth of the USSR and then of the other socialist countries were explained for a long time in terms of "economic immaturity." However, even in the present period, when one can no longer deny the high level of development of a number of socialist countries, higher rates of economic growth are being maintained in them than in the capitalist world, as indicated by the figures in the following table.

* K. Marx and F. Engels, "Sochineniya," Vol 23, p 611.

Average Annual Growth Rates of National Income in the European Socialist Countries and in the Advanced Capitalist Countries (in percentage)

Socialist Countries	1951-1977	1971-1977	Capitalist Countries	1951-1977	1971-1977
Bulgaria	8.8	7.4	Great Britain	2.4	1.8
Hungary	5.7	6.1	Italy	4.9	2.8
GDR	6.6	5.1	United States	3.5	3.1
Poland	7.3	8.8	FRG	5.4	2.5
Romania	9.8	11.0	France	4.8	3.9
USSR	7.8	5.6	Japan	9.0	5.6
Czechoslovakia	5.8	5.2			
Yugoslavia	6.9*	5.8			

* 1963-1977.

Japan has attained the highest rates of economic growth among the capitalist countries. Remuneration of labor at a lower level than in the United States and small military expenditures have made it possible to intensify accumulation of productive capital along with an extensive borrowing of recent achievements of world science, engineering, technology and organization of production and a saving of enormous amounts of time and money in creating the potential for its own science and technology. When major investments in that potential began, and production costs rose because of dependency on imports of raw materials which were becoming more expensive (petroleum above all), competition became stronger, and Japan's rates of economic growth began to drop sharply. This is one of the manifestations of the operation of the law of uneven development in the era of imperialism. But in analyzing growth rates at the present time, the discussion mainly concerns the rivalry between the entire world socialist and world capitalist economic systems.

Average Annual Growth Rates of Industrial Output (in percentage)

	1951-1977	1971-1977
Throughout the world	6.6	5.5
Socialist countries	9.7	7.7
Advanced capitalist countries	4.9	3.5
Developing countries	3.5	6.5

Differences in growth rates are determined above all by the peculiarities of socioeconomic systems. Production is expanding in the capitalist countries so long as the rate and absolute amount of profit are maintained at a certain level. When that incentive ceases to operate, production drops, and an economic crisis ensues. Since 1948 the gross national product of the United States has experienced absolute decreases in 1954, 1968, 1970, and the 1974-1975 period, and industrial output (in 1967 prices) dropped 5.4

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percent in 1949, 5.3 percent in 1954, 6.5 percent in 1958, 3 percent in 1970 and 9.2 percent in the 1974-1975 period.

Under socialism higher rates of economic growth are achieved primarily because production is carried out in the interest of the fullest satisfaction of the constantly growing needs of the people. The rise of the prosperity of the people intensifies efforts to expand the production of consumer goods, the assets of the nonproductive sphere and means of production. A steady growth of the productive forces becomes necessary and possible; it is achieved thanks to the planned nature of the socialist economy's development.

When the USSR entered the period of advanced socialism, the opinion was expressed that rates of economic growth are not an end in themselves and that a radical solution to the problem of popular consumption should be moved to the foreground. But rates of economic growth were not an end in themselves even in the transitional period from capitalism to socialism. At that time they were a means of the country's social and technical reconstruction in a short period of time. Even in that period the correlation between growth rates and consumption of the masses of the people was achieved to a certain degree.

In 1937 the output of Group A of industry rose 9 percent, while that of Group B rose 15 percent. In the period of advanced socialism the growth rates of the production of the means of production and of consumer goods are coming closer together, which indicates the new character of the relation between growth rates and consumption. The larger the growth of the national income, the larger the growth of resources to be consumed. In the 1966-1970 period the share of the growth of resources for consumption in the growth of the national income used was 73.9 percent, while in the 1971-1975 period it was 79.3 percent.* In the 1976-1980 period the share of the growth of resources for consumption in the growth of the entire national income of the USSR should be 81.3 percent.

In the period of advanced socialism the growth rates of the national income and its distribution into the consumption and accumulation funds are supposed to guarantee the largest possible satisfaction of the needs of the workers. This is a most important condition for optimalization of growth rates.

The growth of resources for consumption depends to the highest degree on augmentation of the physical volume of the national income. In the Ninth Five-Year Plan the growth of the national income used increased 71 billion rubles, and the growth of resources for consumption (including nonproductive accumulation) 74 billion rubles. But the growth rate of the national income may under certain conditions run into contradiction with the necessary growth

* The increments were computed as the sum total of increments for all the years of the 5-year plans indicated.

rate of resources for consumption. If raising the growth rate of the national income through intensified accumulation greatly detracts from consumption in a given period, then it becomes necessary to limit somewhat the growth of the national income in order to combine long-range and current interests. Thus optimum rates of economic growth are determined by the possibilities of achieving the national-economic optimum which makes it possible to avoid both excessive rates of economic growth, which tie up large resources for long periods of time and postpone satisfaction of the growing needs of the people, and also the one-sided consumerist approach, which restricts the scale of scientific-technical progress and holds back fulfillment of the major long-range programs because of excessive reduction of the rate of productive accumulation.

Under socialism, when the social limitation on the use of resources is overcome, the rates depend on the availability of production, labor and natural resources which can be drawn into the production process, on the efficiency of their utilization, on the intensity of scientific-technical progress, on the possibilities of foreign economic relations and the proportionality of the national economy itself, and not on the scale of production in and of itself.

It would be erroneous to conclude from what we have said that under socialism there is no interdependence between the rates and absolute scale of production. First of all, economic growth rates, which are a relative quantity expressed in percentages, have great importance to performing the tasks of advanced socialism not only in and of themselves, but because behind them stand absolute increments of the physical volume of the national income and resources for consumption. One and the same rates in different periods represent different dimensions of growth. It is on the latter that the satisfaction of growing needs depends. The optimality of growth rates can be determined, then, only in relation to the dimensions of growth. In the period of advanced socialism we are talking not merely of a certain improvement in the material situation of the workers, but also of carrying out increasingly important programs for raising the prosperity of the people, which require substantially large increments of the national income and resources for consumption. In the Eighth Five-Year Plan the growth of the national income of the USSR, computed in 1965 prices, was 370.5 billion rubles (43.6 percent) over the Seventh Five-Year Plan, and the growth in the Ninth as compared to the Eighth Five-Year Plan was 444.8 billion rubles (36.4 percent).* Thus in the Ninth Five-Year Plan the absolute size of the growth of the national income increased greatly, which made it possible to substantially increase resources for consumption and to make progress in solving a number of social problems.

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* The increments for the 5-year periods were taken as the difference between the sums of the totals for the national income produced in all the years of each of the 5-year periods.

Using data on fulfillment of the 10th Five-Year Plan, we can illustrate the approach to optimalization of growth rates. If we are to judge by the figures for the 3 years that have passed, then the average annual growth rates of the national income are approximately 4.5-5 percent. In the Ninth Five-Year Plan the total size of the national income produced, computed in 1965 prices, was 1,665.3 billion rubles. If the average annual growth rates are equal to 4.5 percent in the 10th Five-Year Plan, then the size of the national income for the entire 10th Five-Year Plan will increase 24.62 percent, and its absolute growth will be as follows: (1,665.3 billion rubles x 1.246) = 2,075.3 billion rubles - 1,665.3 billion rubles - 410.0 billion rubles, that is, it will be 34.8 billion rubles smaller than in the Ninth Five-Year Plan, when it was 444.8 billion rubles. Yet if the growth rates are 5 percent, then the absolute growth of the national income for the entire 10th Five-Year Plan will be as follows: (1,665.3 billion rubles x 1.276) = 2,125.4 billion rubles - 1,665.3 billion rubles = 460.1 billion rubles, that is, 15.3 billion rubles than in the Ninth Five-Year Plan. A still more sizable increase in the absolute growth can be achieved at the 5.6-percent average annual rates achieved in the 1971-1977 period: (1,665.3 billion rubles x 1.313) = 2,186.5 - 1,665.3 billion rubles = 521.2 billion rubles. This growth is 76.4 billion rubles greater than in the Ninth Five-Year Plan.

We should emphasize that obtaining specific absolute increases of national income must unfailingly be combined with raising the quality of the implements and subjects of labor and consumer goods. Economic development is adversely affected by their level of quality, which is not high enough. At the same time the relation of growth rates to the absolute size of growth imparts a quantitative determinacy to optimalization of rates from the standpoint of the goal of socialist production.

Second, economic growth rates are also related to the scale of production through the additional resources required to augment that scale and which represent a limitation when one is determining optimum rates. Large increments of the national income are based first of all on augmentation of fixed productive capital: in the 1961-1965 period its average annual growth was 9.7 percent, in the 1966-1970 period it was 8.2 percent, in the 1971-1975 period it was 8.7 percent, and in 2 years of the 10th Five-Year Plan it has been 7.7 percent. The relation between the increments of fixed productive capital and national income is complicated by the fact that a portion of the growth of capital is used to mechanize manual labor within the context of simple reproduction and probably is not a direct basis for obtaining a growth in the physical volume of the national income. This portion of capital serves as such a base only indirectly in that manpower is made available for expanded reproduction.

Augmentation of fixed productive capital is not only an extensive factor of growth, but also an intensive factor insofar as it promotes a rise in the capital-worker ratio and labor productivity on that basis. At the same time changes in the character of the effect which the development of machine production has on the growth of output, which began approximately in the twenties and have continued throughout the entire 20th century with variable success, lie in the fact that mechanization of manual labor on the basis of advanced machine production is more and more being supplemented and replaced by further introduction of systems of machines which operate at high speeds and are more productive, which is also facilitated by the specialization of production. Manufacturing processes undergo intensification. For example, in ferrous metallurgy replacement of open-hearth steel production with oxygen-converter production, whose technology is simpler, which is more subject to automation, which economizes on capital investments and manpower, provides equal output of high-quality steel and growth in the productivity of equipment. This substitution is so advantageous that in Japan in 1977 two recent open-hearth furnaces were shut down, and almost all the steel is made in oxygen converters; in the United States in 1976 62.5 percent of all the steel came from these converters, and in 1973 the figure in West Germany was already 67.8 percent.

Full mechanization and automation of production have an exceptional effect in invigorating the use of all available means of labor. As systems of machines are introduced and there is a rise in the level of full mechanization and automation in the functioning means of labor, there is an increase in the relative share of their active portion, which has a direct impact on the growth of output. The return on all means of labor increases thereby.

After the most capital-intensive industries (rail and water transport and the fuel and raw materials industries) reach a large scale, the center of gravity of economic growth is shifted to the less capital-intensive industries (machinebuilding, etc.). To be sure, proportionality in economic growth requires development of the entire system of the social division of labor, including the capital-intensive industries. But the point is that by contrast with the previous period the saving on live labor is more and more supplemented by a saving on the means of labor, which is also a consequence of shifts in the pattern of social production.

As a result of all these processes even in the first decades of the 20th century there began to be a change in the ratio of the growth rates of the physical volume of fixed capital to the growth rates of output. In the U.S. manufacturing industry this ratio was still continuing to rise in the 1900-1909 period (25 percent in 1899 prices). But in the 1921-1929 period it dropped 18 percent (in 1919 prices), and in the 1930-1937 period it dropped another 5 percent. In the 1948-1977 period capital investments (the ratio of conventional net output to fixed productive capital) in the manufacturing industry of the United States remained almost without change: in 1977 it was 0.5 percent lower than in 1948, but in the 1948-1953 period it rose 1.3 percent and in the 1957-1969 period it rose 0.5 percent.

Very recent research (Soviet and non-Soviet) has shown that the capital-saving type of economic growth is beginning to predominate since World War II in Japan, West Germany, France and England as well.* In the 20th century it becomes possible to raise labor productivity systematically without a drop of the output-capital ratio, which is very important. Under capitalism the impact of the output-capital ratio on economic growth is contradictory. Raising the output-capital ratio makes it possible to save on fixed capital and thereby shrinks the market for means of production. Under socialism raising the output-capital ratio brings about a growth of the resources for accumulation and consumption and on that basis contributes to faster and fuller satisfaction of the needs of the entire society. Moreover, under socialism the obstacles to the growth of the output-capital ratio related to crises and production slumps are eliminated. That is why prospects are opened up here for stable use of this source of obtaining additional increments of labor productivity and national income along with a saving on capital investments.

There have been periods in the USSR when the output-capital ratio rose mainly by virtue of improved use of existing capacities. But in recent decades the predominant tendency has been toward a drop in the output-capital ratio. For instance, in the 1961-1975 period the output-capital ratio dropped 23 percent in social production as a whole, and the drop in the 1971-1977 period was 13 percent.

Various factors have had an impact on that dynamic behavior. Greater involvement of the resources of the eastern regions in economic circulation, the partial approach to mining iron ores with a lower metal content, the need for accelerated development of capital-intensive transportation and of all aspects of the infrastructure, the tremendous growth of fixed productive capital in agriculture, the output of most of which will be attained in the future--all these things have tended to raise the capital intensiveness of social production. The same impact has been exerted by the fact that the prices of new equipment have risen faster than the growth of their capacity. Moreover, the socialist countries have been confronting and are still confronting the tasks of mechanizing manual labor and of protecting the natural environment, requiring the creation of additional fixed capital on a large scale. At the same time, a systematic improvement in the use of existing production capacities can be used to counteract the process of a rise in capital intensiveness of social production in the socialist countries.

In the USSR and the other socialist countries a huge production apparatus has been built. Systematic improvement in the utilization of this apparatus (along with introduction of up-to-date equipment into the processes of replacement and accumulation and the setting of equipment prices so as to take into account the rise in its capacity) should offset the effect of the tendency toward a drop in the output capital ratio. In the USSR this means

* See, for example, M. V. Barabanov, "Izmeneniye struktur konechnogo obshchestvennogo produkta glavnykh kapitalisticheskikh stran" [The Change in the Composition of the Final Social Product of the Principal Capitalist Countries], Izdatel'stvo Nauka, 1976, pp 237, 238.

raising the coefficient of utilization of fixed productive capital another 2 percent on an average annual basis. Part of this increase can be achieved by increasing the shift coefficient of the operation of equipment in machinebuilding and certain other industries.

Furnishing raw materials, fuel and power to social production has great importance to improved utilization of fixed productive capital. The production of raw materials has a great influence on the rates and increments of the national income in such a country as the USSR, with its vast agriculture and comprehensively developed extractive industry. In 1977 Soviet agriculture produced 14.6 percent of the social product and 16.9 percent of the country's national income. The substantial dependence of the growth rates of the national income of the USSR on the dynamics of agriculture can be seen from the table below.

Dynamics of the National Income and Agricultural Output, in percentages of the previous year*

Year	National Income Produced	Output of Agriculture	Year	National Income Produced	Output of Agriculture
1961	106.8	103.0	1970	109.0	110.3
1962	105.7	101.2	1971	105.6	101.1
1963	104.0	92.5	1972	103.9	95.9
1964	109.3	114.5	1973	108.9	116.1
1965	106.9	101.9	1974	105.4	97.6
1966	108.1	108.7	1975	104.5	94.7
1967	108.6	101.5	1976	105.9	106.5
1968	108.3	104.5	1977	104.5	103.0
1969	104.8	96.7	1978	104.0**	104.0

* Years when the volume of agricultural output dropped have been put in boldface.
** National income used for consumption and accumulation.

The dynamic fluctuation of harvests exerts not only a direct effect, but also an indirect effect on the growth rates of the national income. Within agriculture itself it is manifested in the dynamics of livestock raising and its output, while in industry it is manifested in the scale of processing of all agricultural raw materials and stocks representing working capital, and in transportation it is manifested in the volume of shipments of agricultural products.

Socialist society is carrying out a set of measures to increase the stability of agriculture's growth and to diminish the impact of weather conditions on that growth. Foreseeing the inevitability of fluctuations in the production of specific resources even under socialism, Marx emphasized that "these fluctuations can be averted only by means of constant relative overproduction;

on the one hand fixed capital is produced that exceeds what is immediately necessary by a certain quantity; on the other hand a stock of raw materials and the like is created above and beyond immediate needs of the given year (this especially applies to articles necessary to life), this type of overproduction is equivalent to society's control over the material means of its own reproduction. But within the limits of capitalist society overproduction is one of the elements of general anarchy."*

In the USSR there is every opportunity to develop agriculture to the point where even a minimum yield can satisfy all the current needs of the economy, and the surplus of the harvest would be used as emergency stockpiles or for export. In that case the adverse influence of bad years on economic growth would be greatly mitigated.

The growing increments of the national income are also related to expanded extraction of raw materials and fuel. By contrast with agricultural raw materials, which undergo constant reproduction, stocks of minerals are irrecoverably exhausted, which has an effect on the character of simple and expanded reproduction in the extractive industry. Simple reproduction can be accomplished only by making the transition to deeper depths of existing open pits and deep mines or by creating new enterprises. In the extractive industry, then, a large portion of new construction serves simple reproduction of a given type of raw material, and this imposes additional requirements on its development.

The USSR possesses enormous and varied natural resources. Even at the present scale of needs for raw materials and fuel the increments of the output of the extractive industry ensure continuity of economic growth and make it possible to furnish raw materials and fuel to the other socialist countries. The data in the table below allow one to judge the magnitude of the growth of their production.

Average Annual Growth Rates and Absolute Increments of the Production of the Most Important Types of Primary Raw Materials in the USSR and the United States in the 1951-1977 Period†

	Growth Rates, %		Absolute Increments	
	USSR	US	USSR	US
Petroleum (including gas condensate), millions of tons	10.4	1.6	18.8	5.2
Natural gas, billions of cubic meters	16.4	4.8	11.7	16.4
Commercial coal, millions of tons	3.6	0.7	15.1	3.7
Iron ore, millions of tons	6.9	-1.0††	7.4	-0.7††
Timber (skidded), million solid cubic meters	1.2	0.9††	4.1	2.8††
Commercial timber alone, million solid cubic meters	2.3	1.5††	5.0	4.2††

* K. Marx and F. Engels, "Sochineniya," Vol 24, pp 532-533.

Footnotes to table:

† See "Narodnoye khozyaystvo SSSR v 1977 g." [USSR National Economy in 1977], statistical yearbook, Izdatel'stvo Statistika, 1978, p 61.
†† 1951-1976.

Among the advanced capitalist countries only the United States possesses large and varied natural resources, and yet it imports petroleum, gas, iron ore and the ores of a number of nonferrous metals. Part of the reason for this is that exploitation of its own resources is more expensive, and another part is that these resources have either been exhausted (in any case those of high quality and with low production costs) or they are experiencing exhaustion, or they are being held in reserve. Of course, we must economize on primary raw materials, but the very fact of the large absolute increments of their extraction in the USSR indicates the existence of large commercial reserves of these raw materials. Moreover, given the tremendous area of the USSR and the fact that it has not all been sufficiently studied by geologists, it is possible that major new deposits will be discovered. The history of industry abounds in examples where science and technology have found the solution to the raw materials problem without allowing it to become extremely acute. At one time a transition was made from charcoal to coke in metallurgy. In the recent period the development of chemistry has made it possible to eliminate the scarcity of many types of raw materials. In the near future the problem of petroleum economy and replacement in transportation must be solved, and in the more remote future the problem will be solved of using thermonuclear energy, the energy of the sun and the wind, geothermal energy and the resources of the oceans.

The resources of raw materials and fuels do not represent an absolute limit on economic growth, but their possible proportions, just like the necessary amounts of capital investments to develop them in any given period, are limited, which is being taken into account in 5-year and long-range plans when the rates and increments of social production are being set. The need for the products of the extractive industry is growing very rapidly in the USSR and the other socialist countries. For that very reason (and also because of the high capital intensiveness and labor intensiveness of most extractive industries) the question of economizing on raw materials is an extremely urgent one. The methods of accomplishing this economy are well known. Were we to summarize them, they can be reduced primarily to reducing specific rates of consumption of raw materials. The specific rates of consumption are dropping in many industries. Technical and organizational progress are constantly discovering new possibilities for reducing them. Optimalization of inventories plays a large role in economizing on materials. The instability of the supply of materials to enterprises and construction projects not infrequently results in an endeavor to build up superfluous inventories in order to ensure that there is no interruption in fulfillment of the plan, and this tends to increase the overall consumption of materials for a given volume of output. Often the absence of inventories results in disruption of the normal course of production and crash efforts to make up for lost time.

It is therefore very important to the saving of materials and to ensuring regularity in the operation of enterprises to establish a compulsory short-interval schedule for supply of materials and to build up inventories to match that schedule.

In certain industries reduction of specific rates of consumption of materials is not adequately reflected in a reduction of materials intensiveness of social production as a whole if we compute it in value terms. For instance, the share of material costs (not including depreciation) in the USSR social product was as follows: 49.31 percent in 1960, 49.42 in 1965, 50.43 in 1970 and 52.15 percent in 1975. Since we are talking about value, this is completely subject to explanation: first of all, the relative share of industry, for which higher than average material costs are typical, is constantly rising in the social product;* second, as labor productivity rises, the share of expenditures of live labor in the value of the social product decreases, and the share of material costs rises. At the same time, we should take into account that in 1967 current prices for a number of raw materials increased. But a different picture is obtained when computations are made in comparable prices.

Relationship Between the Growth of the Gross Social Product and the National Income Produced in Comparable Prices by 5-Year Periods (taking depreciation into account)

	1961-1965	1966-1970	1971-1975	1976-1977
Social product	137.0	143.000	136.00	109.500
National income	137.0	145.000	132.00	111.000
Ratio of the social product to the national income	1.0	0.986	1.03	0.986

A saving amounting to about 3 billion rubles was achieved in 1978 by reducing the materials intensiveness of the social product. If comparable prices are used to express the dynamic behavior of the physical volume (and it is precisely for this that economic science and statistics use them), then the materials intensiveness of the USSR social product in the 1961-1965 period remained without change, and it decreased in the 1966-1970 and 1976-1977 periods. To be sure, because in certain industries less rich raw materials were drawn into economic circulation and losses of raw materials and fuel were still large, the reduction of the specific rates of consumption was not large on the whole.

Reduction of losses of raw materials and fuel in connection with their extraction (in deep mines and open pits, quarries, and during timbering and

* This is what some economists see as the reason for the systematic rise in the specific materials intensiveness in the national economy (PLANOVOYE KHOZYAYSTVO, No 8, 1978, p 76). But it goes beyond that.

rafting in the case of timber, etc.), the consistent combination of production operations that complement one another in order to utilize production waste, the creation and introduction of various full-fledged substitutes, especially those making it possible to save on natural raw materials, replacement of scarcer and heavier materials with those which are not so scarce and lighter, and reuse of natural materials have great importance to expansion of raw materials resources. Reuse of ferrous and nonferrous metals plays an important role; salvage scrap, that is, metal contained in machines and other equipment that are retired, in household articles, in buildings being torn down, and so on, and recirculated metal, consisting of waste in ferrous and nonferrous metallurgy and also industries processing metals (waste in the rolling of ferrous metals in the USSR machinebuilding amounted to more than 18 million tons in 1976). The task is not only to utilize all the waste, but also to reduce this waste to a minimum by improving the assortment of metal and thereby to save on production capacities and manpower. In the final analysis the yield of salvage scrap is determined by the size and pattern of the countr.'s stock of metal and by the times of retirement and renewal of its individual parts. Reduction of metal scrap, though it reduces the amount of metal recirculated, by the same token increases and speeds up the yield of the end product of the metal industry.

All the methods enumerated and other methods of economizing on the subjects of labor have a large role to play in improving the utilization of available production capacities and manpower and in ensuring sufficiently high growth rates and larger increments of national income. They are aimed at conquering those limits which nature puts--at a given state of science and technology--on economic growth.

In a number of socialist countries a slowing down of the growth of manpower resources in material production is an important limit on economic growth. This slowing down has to be overcome by speeding up a rise of labor productivity thanks to technical progress and improved organization of production and work. Meanwhile, in the first years of the 10th Five-Year Plan the average annual rates of increase of fuel and power, power alone and capital in per-worker terms and of labor productivity have decreased somewhat in the industrial sector.

Average Annual Growth Rate of the Fuel and Power Per Worker Ratio, the Electric Power Per Worker Ratio, the Capital Per Worker Ratio and Labor Productivity in the Industrial Sector of the USSR, in percentage

	1961-1965	1966-1970	1971-1975	1976-1977
Fuel and power per worker ratio	7.4	5.6	4.7	2.4
Electric power per worker ratio	6.6	4.9	4.8	2.3
Capital per worker ratio	7.4	6.0	7.3	6.8
Labor productivity	4.6	5.7	6.0	3.5

In 1978 labor productivity in the industrial sector of the USSR rose 3.6 percent. The average annual growth rates of the productivity of social labor, which also reflects the dynamics of the materials intensiveness of production in comparable prices, was 5.6 percent in the 1961-1965 period, 6.8 percent in the 1966-1970 period, 4.4 percent in the 1971-1975 period and 4 percent in the 1976-1977 period. The growth of the physical volume of the national income and its increment depend mainly on the rates of increase of the productivity of social labor, and in recent years these rates have tended to drop. Acceleration of the rates of increase of labor productivity is a priority problem whose solution will determine to the greatest degree the rates of economic growth on the scale of the entire national economy.

One of the greatest advantages of socialism is the absence of unemployment. This advantage makes it necessary to utilize the most progressive directions of scientific-technical progress on a broad scale. There is a need for a new stage in the scientific-technical revolution in which the automation of production would become a commonplace in socialist production. In the USSR and the other socialist countries there are personnel capable of solving this problem. At the same time, we need to be persistent in carrying out measures to raise the level of mechanization of manual work, which there is still a great deal of in all sectors of the economy (40-50 percent in social production as a whole). The mobilization of internal potential is very important. It is well known that a sizable portion of worktime is lost because work discipline is not high enough, because of idleness, because of personnel turnover, because of interruptions and downtime related to the irregularity of the supply of materials to enterprises, because there are surpluses of manpower fully utilized in order to fulfill plans only at the end of the month, the quarter or the year. A faster rise of labor productivity and improved organization of production and work make it possible to use the manpower made available for expanded reproduction and, in particular, to raise the shift coefficient of the operation of equipment. The saving on the means of labor and reduction of materials intensiveness serve in turn as factors contributing to economies of labor resources. The bulk of manpower is employed in production of the means of production, and a saving on them tends to reduce not only capital intensiveness and materials intensiveness, but also the labor intensiveness of material production as a whole. Systematic accomplishment of all these interrelated forms of saving on social labor will signify a transition to a comprehensively intensive type of expanded reproduction and will increase the share of the final product in the gross product.

We noted above that the growth of the scale of production does not in and of itself signify that rates of economic growth have to drop. In the 10th Five-Year Plan lower rates were planned than in the previous ones, mainly in order to speed up the growth of consumption, to raise product quality and to achieve proportionality among all the sectors of the national economy. At the same time, the level of economic growth rates is affected by the following: an insufficiently high pace in making the transition to the comprehensively intensive type of expanded reproduction, the "above-plan" growth (instead of a reduction) of partial completion of production (from 75 percent of the total volume of capital investments in 1975 to 85 percent in 1977); the reduction of the growth rates of employment in material production, which was not offset by the substantial rise in the growth rates of labor productivity; reduction of the rate of productive accumulation without a corresponding rise in its efficiency.

In summing up, we can draw the general conclusion that optimum rates of economic growth under socialism are rates that fully realize the advantages of socialism in the utilization of resources and economic growth factors to attain absolute increments of the national income that increase from one 5-year period to the next.

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SITING OF SCIENTIFIC FACILITIES ANALYZED

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[Article by Yu. Kanygin and V. Botvin: "The Siting of Our Research Potential"]

[Text] At the 25th CPSU Congress the task was set of improving the methods of an overall solution of major state interbranch and territorial problems. Among the problems of this kind which are of great importance for the further socio-economic development of the country are an improvement of the territorial siting of science and of the use of the research potentials of regions.[1] The development work being performed in our country on long-term plans of socio-economic development and of overall programs for technological progress both on a state-wide scale and with regard to union republics and regions is closely connected with the territorial siting of research, planning, and experimental and testing bases.

The increased needs of the current economic development of the country and the tasks of accelerating scientific and technological progress demand a further theoretical development of the problems of the regionalization of science on an all-union, republic, and branch level. First, the buildup and utilization of scientific potential in a regional aspect and the overcoming of the historically developed gap between "scientific capitols" and the "periphery" are relatively new problems. They arise at a specific and quite high stage of the scientific and technological development of a country. An improvement of the organization and increase in the effectiveness of scientific research and experimental designing work on a state-wide level depend upon their solution. Secondly, the territorial division of labor in production has not given rise to a corresponding division of labor in science, and to date applied research work has not become a highly important factor (component) of the production process. Thirdly, the problems of regional scientific and technical development and of the siting of a research potential are marked by especial difficulties and, in our opinion, cannot be a starting point for analysis. They have to be approached during the process of an ascent from the more general and abstract conceptions of technological progress and its organization.

The development of the theory of the siting of production and of the research base is following the line of increasing the number of considered factors and of expanding the analysis of an increasingly complex system of direct and feedback relations between them. The spacial development of a scientific and technical potential is subordinated to the action of the general factors which influence the siting of material production and also of specific factors (culture, the educational potential of a region, the information infrastructure, and others). The latter also have a definite importance for the siting of industry; however, they have a greater influence on the spatial development of science. It can be said that the siting of science is a complex function of an hierarchical system of arguments. The basic argument here (the chief factor in the regionalization of scientific research and experimental designing work) is, of course, the siting of material production. But arguments of the "upper level" (specific ones which determine the gnoseological process) which are usually of a probability (more precisely, heuristic) character are also important. They include: the level of scientific exchange in one or another area (city), historical traditions, the so-called "intellectual microclimate," psychological aspects, for example, the desire of major scientists who are recognized as leaders of scientific schools to establish themselves in a new area, and so forth.

Centrifugal tendencies can be observed in the territorial development of scientific research and experimental designing work which are the result above all of the outstripping growth rates of the scientific potentials of the country's peripheral areas, including areas of new settlement, and the rapid formation there of powerful scientific and technical centers. Academic science may serve as an example of the territorial dispersion of scientific forces. The organization of the republic academies of sciences and also of a large number of branches and research bases of the USSR Academy of Sciences in various areas produced the first important change in the regionalization of academic research.

The next big change which occurred during the past two decades is connected with the creation of multibranch regional scientific centers. The Siberian Branch of the USSR Academy of Sciences (a system of research centers with their basic nucleus in Novosibirsk), the Urals and Far Eastern academic centers, the North Caucasian Higher Educational Center, the regional centers of the All-Union Academy of Agricultural Sciences imeni V. I. Lenin and of the Academy of Medical Sciences, and others emerged and rapidly took shape. As of today 17 major territorial research centers have been created in the country, and of them 4 are in the system of the USSR Academy of Sciences and 5 in the system of the Ukrainian SSR Academy of Sciences.

The territorial deconcentration of academic research is characterized by the following data: 52 percent of the scientific workers of the USSR Academy of Sciences and the republic academies are now concentrated beyond the borders of the RSFSR, including 13.9 percent in the Ukraine, 6.3 percent in Belorussia and Moldavia, 14.4 percent in the Transcaucasian Republics, 12.5 percent in Kazakhstan and the Central Asian Republics, and 4.9 percent in the Baltic Republics.[2] Twenty-six percent of the scientific workers of academic institutions are working east of the Urals, and of them 11 percent are in Siberia and the Far East. In the Siberian branch of the USSR Academy of Sciences alone in 1978 there were approximately 7,000 scientific workers, including 24 academicians, 54 corresponding members of the USSR Academy of Sciences, 575 doctors of sciences, and more than 4,000 candidates.[3] In 1951 almost 90 percent of the institutes of the USSR Academy of Sciences were concentrated in Moscow and Leningrad, while in 1966 the figure was 65 percent.

The tendency for research to become territorially deconcentrated is characteristic not only for academic science, but also for branch scientific research institutes. This can partially be judged from the following data: If one takes the scientific research and experimental designing work which was performed in the country by all of the organizations of the republic and union-republic ministries and departments in 1975 as 100 percent, then 41.2 percent of it was concentrated in the Ukraine (in 1970 -- 40 percent), 8 percent in Belorussia and Moldavia (in 1970 -- 6.9 percent), 11.7 percent in the Transcaucuses (in 1970 -- 11.2 percent), 10.3 percent in Kazakhstan (in 1970 -- 10.8 percent), 7.1 percent in the Baltic (in 1970 -- 6.5 percent), and 5 percent in Central Asia (in 1970 -- 4.7 percent). Siberia and the Far East (according to our very approximate calculations based on the amount of appropriations for scientific research and experimental designing work) accounted for 2-4 percent of the scientific research and experimental designing work, and the European part of the RSFSR and the Urals -- 12 to 14 percent.[4]

The increase in the number of large city scientific and VUZ centers also testifies to the territorial deconcentration of our research potential. In an historically short period of time a far-flung system of major scientific research and experimental designing work centers and VUZ training for specialists were created:

Table 1

	1. Количество городов — университетских центров	2. Количество городов с числом научных работников:				3. Количество городов с числом студентов:			
		4. свыше 20 тыс. человек	5. свыше 10 тыс. человек	6. свыше 5 тыс. человек	7. свыше 1 тыс. человек	8. свыше 100 тыс. человек	9. свыше 50 тыс. человек	10. свыше 20 тыс. человек	11. свыше 10 тыс. человек
1914 г.	12	—	—	—	4	—	—	2	4
1950 г.	33	2	4	6	32	2	2	14	32
1975 г.	63	5	26	44	98	6	26	56	98

Key:

1. Number of cities, university centers.
2. Number of cities with number of scientific workers
3. Number of cities with number of students
4. More than 20,000
5. More than 10,000
6. More than 5,000
7. More than 1,000
8. More than 100,000
9. More than 50,000
10. More than 20,000
11. More than 10,000

Before the revolution there were four cities with more than 1,000 scientific workers, including two cities (St. Petersburg and Moscow) with more than 20,000 students. At the present time there are 98 and 56 of these cities, respectively. Of them there are 44 cities with many thousands of scientific workers and 26 large cities with more than 50,000 students. The processes of the territorial deconcentration of scientific research and experimental designing work are inseparable from the quantitative growth of our scientific and technical potential.

In order to improve our regional scientific and technical planning work it is important, first of all, to separate those factors which exercise a direct influence on the spatial development of scientific research and experimental designing work, isolating them from secondary factors. It is obvious that in its regional development science, like the processing industry, cannot be connected with a territory in the purely geographical sense.[5]

The siting of a research potential is also not a direct function of the siting of population (in contrast, for example, to the potential for school education). Population density is far from always correlated with the developed industrial levels of areas and with the future tasks of their development. For this reason, in our view, it is incorrect to plan the growth of science in regions on the basis of their demographic potentials. This kind of approach could create unwarranted priorities from the state point of view for areas with a high population density and condemn areas with a low population density to scientific and technical backwardness.

Scientific and technical policy has to be founded on the basic factors of the regionalization of research, planning, and experimental testing bases but, at the same time, of course, the above aspects of a geographical and demograhpic character cannot be ignored. The basic role in the regionalization of scientific research and experimental designing work is played by the branches of the processing industry which are distinguished by a more science-intensive technology and by relatively short equipment obsolesence and output renewal periods. True, there is a tendency to strengthen the regionalization of equipment and technology as well as toward the ecologization of technological processes. This is connected basically with the development of the extracting industry and the primary processing branches, which makes them "involved" in the formation of regional bases for the development of technologies which are specific for individual areas.[6]

Most of the development work of an applied scientific character, and also of the experimental designing work in industry both in our country and in other countries is performed in the processing branches, especially in the innovative ones (electronics and electrical engineering, aircraft building, chemistry, and a number of subbranches of machine building).[7]

According to our calculations, the proportion of workers employed in the research, designing, and experimental testing subdivisions of the enterprises of the processing branch in Siberia comprises an average of 18 percent of total industrial production personnel. For the enterprises of the extracting branches the corresponding indicator is 10 times lower.

The processing industry creates the basis for the industrial development of regions and for their urbanization and for the growth of large cities in which scientific research and experimental designing work bases are primarily located. Of course, the emergence of city settlements is connected not only with the development of the processing but also of the extracting branches. Thus, many cities and urban settlements in Siberia and the Far East arose as a result of the need to develop various mineral deposits. But their subsequent growth and the transformation of a number of cities into large ones is connected with the development of the processing industry. From 1926 through 1970 more than 1,000 new cities were created in the USSR, and of them more than

70 percent arose as "plant cities." The singling out of the processing industry as the leading factor in the regionalization of scientific research and experimental designing work makes it possible to reveal the still little studied connection between urbanization processes and the formation of the research potential in one or another region.

The growth of large cities is the next important factor which influences the territorial development of the country's research potential, the territorial deconcentration of science, and an increase in the research potential of regions.[8] This is pointed to by the data of frequent surveys (particularly those which have been carried out by the Council for the Study of Productive Forces of Gosplan USSR) of city settlements which are located in all of the six zones that are singled out in the general scheme of the location of the country's productive forces. Thus, in cities with a population of 100,000 people there are 11 people employed in science and in servicing it for every 100,000 inhabitants, in cities with a population from 101,000 to 500,000 people -- 13, and in cities with a population of more than 500,000 -- 42.[9] It is clear from this data that a sharp leap (by more than 3 times) occurs when we move from the group of medium to the group of large cities.

It is characteristic that in our country the number of cities with the greatest concentration of scientific and technical resources is growing especially rapidly. Thus, during the last quarter of a century the number of cities each with 1,000 and more scientific workers has increased by 3 times, while the number of cities which have a lower limit of 5,000 scientific workers has increased by 7 times, and the number of cities which have a lower level of 10,000 scientific workers has increased by 6 times. The same factor characterizes the VUZ potential. From 1950 through 1975 the number of cities with 10,000 and more students increased 3 times while the number of cities with 50,000 and more students increased 13 times.

It can be said that the location of the processing industry and the inter-regional distribution of cities and, above all, of large ones with a developed system of functions are factors of a single order which are at the basis of the territorial distribution of our research potential.

In the siting of scientific research and experimental designing work a large city engenders centripetal tendencies which, as it were, "superimpose themselves" on the above noted centrifugal tendencies and lead to the emergence of unique geographical points with a high concentration of scientific and technical resources (see following table, in percentage of total).

Table 2

	1970 г.			1975 г.		
	1. количество организаций, выполнявших исследования	2. количество разработанных тем	3. планируемые ассигнования на выполнение тем	1. количество организаций, выполнявших исследования	2. количество разработанных тем	3. планируемые ассигнования на выполнение тем
4. Исследования во всех городах СССР	100	100	100	100	100	100
5. в том числе:						
6. в Москве, Ленинграде, Харькове, Новосибирске, Свердловске и столицах союзных республик	54,2	62,9	63,7	48,9	56,9	59,3
7. в прочих городах СССР	45,8	37,1	36,3	51,1	43,1	40,7
8. В Москве	15,7	27,2	24,7	14,7	23,9	24,7
9. Ленинградс	6,7	9,2	8,1	5,8	8,0	8,7
10. Киеве	4,8	4,3	8,7	4,0	4,3	7,1
11. Харькове	3,0	2,8	3,9	2,7	2,8	3,0
12. Новосибирске	1,5	1,1	1,6	1,8	1,7	1,6
13. Свердловске	1,9	3,1	2,0	1,7	2,6	1,9
14. Минске	2,9	1,9	1,5	2,5	2,0	1,8
15. Ташкенте	2,2	1,2	1,1	2,4	1,7	1,5
16. Алма-Атс	2,3	1,6	2,9	1,7	1,4	1,6
17. Тбилиси	2,7	2,9	1,0	2,0	2,4	1,0
18. Баку	1,8	1,0	2,8	1,7	1,1	2,1
19. Итого в 11 городах	45,5	56,3	58,3	41,0	51,9	55,0
20. В прочих городах СССР	54,5	43,7	41,7	59,0	48,1	45,0

Key:

1. Number of organizations which have performed research;
2. Number of topics;
3. Planned appropriations for development of topics;
4. Research in all USSR cities;
5. Including;
6. In Moscow, Leningrad, Kar'kov, Novosibirsk, Sverdlovsk and the capitols of the union republics;
7. In other USSR cities;
8. In Moscow;
9. Leningrad;
10. Kiev;
11. Khar'kov;
12. Novosibirsk;
13. Sverdlovsk;
14. Minsk;
15. Tashkent;
16. Alma-Ata;
17. Tbilisi;
18. Baku;
19. Total in 11 cities;
20. In other USSR cities.

It can be judged from the data in the table that a small group of very large cities is maintaining its dominance in the country's scientific and technical potential, despite the clearly expressed tendencies towards the regionalization of scientific research and experimental designing work and toward an acceleration of the growth of the scientific potential in new areas and cities which in the past were almost without a scientific base. True, the number of organizations which perform research in such cities as Moscow, Leningrad, Khar'kov, Novosibirsk, Sverdlovsk, and in the capitols of the union republics is growing more slowly than in the country as a whole. However, the growth rates of planned appropriations for scientific research work and of the number of people employed in science and servicing it in these cities are practically the same as in the country as a whole. In individual cities (Moscow, Leningrad, Kiev, Minsk, Tashkent, Tbilisi, and others) there is an outstripping growth of the number of scientific cadres, especially with top qualifications. As an example, let us examine the dynamics of the cadre potential of science in Kiev (proportion in percentages in relation to the corresponding indicators of the Ukrainian SSR and the USSR):

Table 3

	1. Удельный вес Киева в кадровом потенциале науки:					
	УССР			СССР		
	1960 г.	1970 г.	1975 г.	1960 г.	1970 г.	1975 г.
2. Занятые в науке и научном обслуживании	18,7	24,6	26,1	1,1	3,2	3,6
3. Научные работники	21,9	25,5	24,8	2,9	3,6	3,5
4. Доктора наук	38,5	39,5	40,5	4,6	5,1	5,3
5. Кандидаты наук	29,6	31,8	30,4	4,1	4,7	4,4
6. Аспиранты	41,1	38,2	41,4	5,0	5,2	5,6

Key:

1. Kiev's proportion in sciences cadre potential;
2. People employed in science and serving science;
3. Scientific workers;
4. Doctors of Sciences;
5. Candidates in Sciences;
6. Aspirants.

A similar picture can be seen in a number of other cities, especially of the capitol type. Thus, within the RSFSR more than half of the scientific and technical resources (scientific cadres and appropriations for scientific research work) is concentrated in three cities -- Moscow, Leningrad, and Sverdlovsk; and within the Ukrainian SSR -- in Kiev, Khar'kov and Donetsk. As for the other union republics, in each of them more than half of the scientific and technical resources is concentrated in the capitol. In 1975 more than half of the country's research potential (scientific cadres and appropriations for science) was accounted for by 11 cities -- Moscow, Leningrad, Kiev, Khar'kov, Novosibirsk, Sverdlovsk, Minsk, Tashkent, Alma-Ata, Tbilisi, and Baku. If an additional 11 cities were added to these (Donetsk, Gor'kiy, Riga, Perm', Kazan', Dnepropetrovsk, Rostov, Chelyabinsk, Krasnoyarsk, Irkutsk, and Vladivostok), it will turn out that in a group of 22 of the larger cities which comprise only 13 percent of the number of capitols of union and autonomous republics, krays, and oblast centers there is a concentration of around 80 percent of the country's scientific and technical resources.[10] In such cities as Moscow, Leningrad, and Kiev, with regard to the number of people working in it, science (including planning development work) has become the second sphere of the application of labor and has turned into an important city-forming factor and into a branch of the all-union specialization of these cities.

The greater role of science in the formation of the economic structure of regions leads to a polarization of the production of scientific and technical information and technological innovations in large cities, especially in large administrative centers, which act as "generators" of technological progress not only in the economic zones adjoining them, but to one or another extent throughout the entire country. The appearance of a relatively small group of sectors in each of which exceptionally large resources of science, higher education, and planning and designing and experimental testing work are built up is a consequence of the current industrial and scientific and technical development of the country.

The relative distribution of scientific cadres through the cities of the country, of a union republic, or of a region can be characterized by coefficients of the localization of scientific personnel (J):

$$J = \frac{\gamma_H}{\gamma_6}$$

where J -- is the coefficient of localization; γ_H -- is the proportion of the scientific categories of the city being considered in the total number of the country's (region, republic) scientific cadres of the same category; and γ_6 -- is the proportion of the base indicator in the given city in relation to the same indicator in the country (republic, region). The number of people employed in the economy, the number of industrial production personnel, and the size of the population may be the base indicator. The coefficients of the localization of scientific personnel which have been calculated by us for 23 cities of the Ukrainian SSR (moreover, the number of workers and employees in the economies of the corresponding cities in relation to the same indicator in the Ukrainian SSR was taken as the base indicators) show essential differences from one another. Their maximum values are characteristic of Kiev (4.1 -- for all those employed in science and servicing it, 4.0 -- for scientific workers, 4.5 -- for scientific workers with scholarly degrees); their minimum values are characteristic of Sumy, Zhitomir, Chernovits, and Lutsk (.5 for all those employed in science and in servicing it, .2 -- for scientific workers, .1 for scientific workers with scholarly degrees). Thus, in the oblast centers of the Ukrainian SSR the maximum and minimum values of the coefficients of the localization of scientific personnel differ from one another by 8 times for all those employed in science and in servicing it, by 20 times for scientific workers, and by 45 times for scientific workers with scholarly degrees.

The developed social infrastructure of large cities (the spheres of culture, education, everyday life, and recreation), the higher qualifications of its labor power, the science-intensive branches of industry which are concentrated here, their developed transportation infrastructure and the intensity of communications -- all of this together forms a specific "city" environment and "city" way of life which is oriented to the greatest degree toward the adoption of the results of scientific and technologic revolution and which favors a growth of scientific activity and the materialization of its results. The historically developed scientific and cultural traditions of certain cities must be taken into account also. This, in particular, explains the attractive force of such old cultural and scientific centers of Moscow, Leningrad, Kiev, Khar'kov, Tbilisi, Baku, and others. There is also the phenomen of cumulativeness in the development of scientific bases. Thus, previously created scientific centers attract new scientific forces, and the more substantial the center, the better the conditions it posesses for its own further growth.

Our present-day territorial scientific and technical agglomerates with their characteristic concentration of research potential are undoubtedly an outcome of an orientation toward increasing the economic effectiveness of scientific research and experimental designing work and accelerating technological progress. In planning the territorial development of scientific research and experimental designing work it is important to take account of the above-described factors. Progress in communications is increasing the effectiveness of scientific and technical resources. In specific geographical points, it is leading to a strengthening of the influence of powerful scientific and technical complexes on the space "adjoining" them, and is creating the preconditions for specialization and cooperation in research work in a territorial breakdown.

The solution of the problems of the siting of science is closely connected with the formation of regional research potentials which have been engendered by the scientific and technologic revolution. However, the formation of the regional potentials of scientific research and experimental designing work is occurring with a certain belatedness and is insufficiently supported organizationally, in contrast to the development of development work "along the vertical" -- within ministries and departments.

The combination of powerful research, educational, and production complexes and settlement systems is becoming the dominant form of the territorial organization of the scientific and technical potential.[11] Their economic effectiveness depends upon the joint use of intellectual and technical resources for an intensive technological reorganization of mass production. Large technological systems of the highest level are engendered here and the saturation of the economy with them leads to radical progressive changes in labor productivity. Along with innovative branches, innovative areas and cities have appeared which functionally supplement the "through" and vertical structures which determine production intensification. The all-union functions of the research potentials of large regions occupy first place. For this reason, the role of the scientific centers of, for example, the Ukraine, Siberia, the Urals, and the Far East do not amount solely to their regional significance.

At the same time, it is necessary to distinguish the potential of regionally directed scientific research and experimental designing work as an especial element in the system of the regional scientific potential. The latter's functions may be reduced to the following: information services for an area; ensuring the intensification of production in a given region by means of the technological application of science and an effective use of scientific and technical resources; the creation of the conditions for the processing and material embodiment of scientific and technical knowledge and technological innovations which come to the given region from all-union scientific and educational centers, and also from abroad; the creation of the foundations for scientific and technological cooperation between a given economic region and other areas of the country; and the creation of the conditions for raising the level of the education and culture of the region's entire population and for the accumulation of spiritual goods and the comprehensive development of the individual.

The siting of scientific research and experimental designing work is to a substantial extent subordinated to the tasks of improving the structure of the research potential of regions. The experience during the 1950s and 1960s in creating powerful bases of academic science in the new areas of Siberia and the Far East raised a number of problems in the regionalization of scientific research and experimental designing work which, in the past, for example, during the prewar period, did not seem to be important. Conventionally speaking, these problems can be called problems of overallness. During the 1930s when the regional forms of research amounted to expeditions, the organization of branches, and the creation of small research bases the problems of the industrialization of science in the periphery and of the development of its relations with production practically did not exist. The branches which were created in the new areas (the largest regional formations of that time) were simply "small" and structurally "truncated" academies which were marked, in addition, by not too highly qualified personnel, although during that period they played an important role in the development of regions.

During the era of the scientific and technological revolution the development of a regional research potential in the above-named forms has proven to be clearly inadequate. Life has demanded that so-called "big science" be brought into new areas.[12] This concept, despite its vagueness, reflects a number of important principles in the formation of a contemporary scientific centers which are capable of providing for sufficiently profound socio-economic changes in large regions. First of all, such centers have to contain the conditions for carrying out on a modern level basic theoretical research of an overall character and in many directions. Secondly, they have to have sufficiently powerful bases of applied, designing, and experimental testing development work. Thirdly, a center has to have a developed system of relations with production. And, fourthly, a center has to "generate" sufficient cadres, including cadres with the highest scientific qualifications.

The above-enumerated principles have been put at the basis of the creation of all of the country's seventeen regional interbranch scientific centers. These principles have received a vivid embodiment in the Siberian Branch of the USSR Academy of Sciences. The strengthening of the experimental testing and technological bases of academic centers "attracts" into the appropriate areas branch research institutes, their branches, experimental plants, planning organizations, and so forth. Powerful scientific and technical complexes headed by centers of academic science arise in the regions.[13]

An improvement of the structure of the scientific and technical potential of one or another area has to include an improvement of the branch and organizational structure of scientific research and experimental designing work. The cycle "science-production" and its stages comprise the basis of the functional structure. Of course, the progress of these cycles does not have a purely regional character: They frequently embrace a branch as a whole or a number of branches which are located throughout the country. However, in all cases time periods and the resources being invested remain important aspects which determine the expediency of developing scientific production cycles. For this reason it has become essential to have a geographically "compact" concentration of the entire complex of intellectual and material-technical resources which insure the development of ideas, their transformation to the level of concrete production innovations, and also the introduction of the latter into practice.

If consideration is given to the production specialization of a region and to the specific nature of regional scientific and technological progress, it then turns out that the above-considered complex has to include research, planning, and experimental testing bases which are "profile" for the given condition; that is, it has to have a definite branch structure. Thus, the need is rapidly increasing in the eastern areas for applied scientific, pre-planning, and planning work, and also for experimental and testing work.

A disproportion has developed between the scope of the fundamental research which is carried out in these areas and the scope and level of applied scientific, planning, and experimental work oriented toward the creation of equipment and technological processes in "Siberian," "Far Eastern," and "Northern" executions. For example, Siberia's share in research on ferrous metallurgy comes to 2 to 2.5 percent of the research in the country. For the Ministry of Nonferrous Metallurgy the corresponding indicator is 15 percent. However, the basic planning organizations which determine the technical policy of the branch (with the exception of three small branches) are located in the European part of the country. This is also characteristic for the coal mining industry in which the amount of planning work which is performed in Siberia is serveral times smaller than the amount of research work, which reduces the yield from the latter.

Siberia has a poorly developed potential for applied scientific and planning work in the branches which in the nearest future have to become the largest branches of this area's specialization -- petroleum extraction and refining, gas extraction, and chemistry and petrochemistry. The testing and development of designs and technological processes in their "Siberian" and "Northern" executions is made difficult by the shortage of centralized and interbranch support bases and testing areas which are equipped with the necessary equipment and located in the appropriate areas. The siting of research, planning, and experimental bases should to a large extent be aimed at insuring a balance for the various functional elements of the scientific and technical potentials of regions. Problems of an organizational character connected with overcoming a certain departmental disunity of research bases will have to be solved here. For example, the scientific research and planning institutions and organizations located in the Ukraine are under the management of almost 80 ministries and departments, and those in Siberia of more than 50 ministries and departments. The scientific research and experimental designing potential which is concentrated in Kiev alone is managed by 57 ministries and departments, while Novosibirsk's potential is managed by 38 ministries and departments.

The principle of an organic combination between the branch and territorial approaches to the organization of research and the use of its results in production is taking on exceptionally great importance for the further territorial development of the scientific research and experimental designing work potential and for increasing its effectiveness. An improvement of the territorial management of research (in combination with branch management) is taking the direction of the development of the functions of the local agencies of authority and of increasing their role in the organization of technological progress, and also the direction of an ever greater use of special-purpose programmed methods.[14]

In accordance with the forecast-plan of the development of the country's productive forces in the future, "...it will be necessary," L. I. Brezhnev noted, "to create many new scientific centers and educational institutions and to have a further and very substantial expansion of the research work front."[15] The task of improving the siting of our scientific and technical potential and of raising the level of its use in individual regions of the country has become one of our top-priority ones. It's accomplishment requires a deepened analysis of the objective tendencies of the territorial development of scientific research and experimental designing work, a generalization of existing experience in regionalizing it, and the performance of large organizational measures which will ensure a fuller realization of the advantages of socialism.

FOOTNOTES

1. The importance of these problems is noted in the works of a number of economists (see, in particular, L. N. Gatoveskiy, "The Economic Problems of Scientific and Technological Progress," "Nauka" Publishing House, 1971). Regional development specialists are devoting a great deal of attention to these problems (N. N. Nekrasov, "Regional Economics," "Ekonomika" Publishing House, 1978; V. I. Duzhenkov, "Problems of the Organization of Science," "Nauka" Publishing House, 1978; O. S. Pchelintsev, "Urbanization, Regional Development, and the Scientific and Technological Revolution," EKONOMIKA I MATENATICHESKIYE METODY, No. 1, 1978; A. V. Kochetkov and

A. D. Oragvelidze, "Regional Development Under the Conditions of a Scientific and Technological Revolution," Tbilisi, 1977).

2. Calculated on the basis of the statistical handbook, "Public Education, Science, and Culture in the USSR," "Statistika" Publishing House, 1977, p. 299.

3. Before the creation of the Siberian branch of the USSR Academy of Sciences one corresponding member of the USSR Academy of Sciences and 19 Doctors of Science were working in Siberia and in the Far East.

4. It is important to consider that the above-cited data does not reflect the territorial distribution of scientific research and experimental designing work which is performed by the organizations of all-union ministries and departments.

5. The calculations which exist in literature and which show a clear unevenness in the distribution of scientific forces over the territory of one or another country do not in themselves provide grounds for any constructive conclusions (see, for example, N. Ye. Polovitskaya, "The Geography of Scientific Research in the United States," "Mysl'" Publishing House, 1977, pp. 67-106). The frequently encountered term "an even siting of productive forces" cannot be understood in the sense of their commensurateness with every square kilometer of territory. The achievement of evenness in this case means overcoming the crowding of industry in large cities and certain old areas, a wider involvement in economic turnover in natural resources of the different parts of the country, including remote areas, a consideration of the special characteristics of the national development of union republics, and so forth. In this sense the scientific and technological revolution is creating the preconditions for a more even siting of production and science.

6. It should be noted that with respect to a number of directions of scientific research and experimental designing work which are oriented toward surveying the extracting branches of industry and are directly connected with the opening up of new areas the problems of siting their bases over a territory are relatively simple. Research bases in the field of oceanology, regional medicine, geology and geophysics, and in the field of the concrete branches of the extracting industry and of agriculture gravitate toward strictly defined areas and geographical points.

7. In 1974 the amount of expenditures of scientific research and experimental designing work in the processing industry of the United States came to approximately 60 percent of total capital investments. Around 90 percent of the expenditures for scientific research and experimental designing work in American industry in 1975 was accounted for by the aviation space and electronic branches, the chemical industry, general machine building, transportation machine building, and the production of scientific instruments.

8. The exceptionally great importance of a large city in the formation of an economic space has already been noted in the literature. A large city plays no lesser a role in the formation of the space for scientific and technical activity.

9. D. G. Khodzhayev, A. V. Kochetkov, and F. N. Listngurt, "The System of Settlement in the USSR," "Ekonomika" Publishing House, 1977, p. 32.

10. A high level of concentration of the research potential occurs in a number of cities and urban agglomerations of the United States and other countries. Thus, in the early 1960s 54.6 percent of all of the scientific research workers in the country (including personnel employed on engineering development work) were living in 20 American cities and urban agglomerations. Moreover, seven of them (New York, Washington, Los Angeles, the urban agglomeration in the San Francisco Bay, Boston, Chicago, and Philadelphia) accounted for 40 percent of the country's scientific workers and around 43 percent of America's scientific administrative personnel (calculated on the basis of the materials: "United States Policy in the Field of Science," "Progress" publishing house 1971, p. 274). American scientific workers who are concentrated in standard metropolitan areas comprise more than three-fourths of the total number (see: "Regional Programming in the Developed Capitalist Countries," "Nauka" Publishing House, 1974 p. 251).

11. With regard to the United States, such forms (territorial research centers, research parks, and scientific and technical and scientific-industrial parks and areas) have received extensive treatment in the literature (see, in particular, V. I. Maslennikov and A. N. Khlystov, "New Forms of the Territorial Organization of American Science," SShA: EKONOMIKA, POLITIKA, IDEOLGIYA, No. 10, 1970; M. Ye. Polivitskaya, "The Geography of Scientific Research in the United States," "Mysl'" Publishing House, 1977).

12. The concept of "big science" is connected in the literature with a "leap-like strengthening of the economic, technological, and

organizational bases of science" (see: N. N. Yanenko, "The Developmental Tendencies of Contemporary Mathematics." In the book: "Methodological Problems of Scientific Cognition," "Nauka" Publishing House, Siberian Branch, Novosibirsk, 1977, p. 65).

13. Thus, during the last decade there has been a radical strengthening of the technological base of the Siberian Branch of the USSR Academy of Science. An "introduction belt" has arisen around the Novosibirsk academic city in whose creation 11 all-union ministries and departments took part. Many designing bureaus, special designing bureaus, and testing and experimental productions are under a "dual" management -- scientifically they are subordinated to the Presidium of the Siberian Branch of the USSR Academy of Sciences, and administratively they are subordinated to ministries and departments. A number of decisions are being realized which are connected with the accelerated development of the experimental and testing bases of other centers of the Siberian Branch of the USSR Academy of Sciences.

14. The problems of the organization and management of scientific research and experimental designing work on the regional level require a special analysis and are not examined in this article.

15. L. I. Brezhnev, "Following Lenin's Course. Speeches and Articles," Politizdat, Vol. 2, 1970, p. 407.

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INCREASED EFFICIENCY FOR NEW EQUIPMENT ADVOCATED

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[Article by V. Senchagov and V. Yankin: "An Increase in the Efficiency of New Equipment"]

[Text] An increase in the effectiveness of expenditures for new equipment is connected with many factors. An important role is played by the methods of evaluating the effectiveness of its introduction, by planning, and by economic stimulation and material incentives for the introduction into production of technical innovations. At the present time a new Methodology (Basic Regulations) is in effect for determining the economic efficiency of the use in the economy of new equipment and inventions and rationalizers' proposals. Its employment is raising the question of material incentives for the creators of scientific and technical innovations in a new way. It makes it possible to calculate the total economic effectiveness of the production of new implements of labor and of their use in the sphere of consumption.

The previous Methodology for determining the annual economic effect obtained as a result of the introduction of new equipment[1] made it possible to calculate an economy only from changes in the consumer's operating expenditures and did not fully take account of the effect from the production of new means of labor. The latter manifests itself in a decrease in the amount of capital investments assigned for the reproduction of implements of labor with improved qualitative characteristics (productivity, service life, reliability), and in a corresponding decrease in the needs of enterprises for fixed capital. The new Methodology has also provided for a computation of the economic effect from the introduction of durable equipment. This kind of procedure for computing economic effect means a fuller consideration of the results of a change in the operating periods of new equipment at the consumer's. The method recommended by the new Methodology for determining the economic effect from the production and use of improved machines makes it possible to increase the material interest of planners and designers in creating fundamentally new and auspicious equipment. At the same time, it has to be noted that the fruitfulness of using this Methodology, and its stimulating effect on increasing the economic effect from technological progress and also on expanding the scope of introduction into production of more promising technical achievements depend to a large extent upon a correctly constructed system of material incentives for development workers for the creation, mastery, and introduction of new equipment. Despite the important changes which have been introduced into the principles of computing the effectiveness of new durable means of labor, the determination of the amounts of bonuses is actually based on the previous methods.

In accordance with the operating "Regulations on Bonus Payments for Enterprise and Organization Workers for the Creation and Introduction of New Equipment" which were approved in 1964, the amounts of bonuses are established in percentage rates in relation to effect which is calculated on the basis of a single year of operations by a new machine, and not its entire service life. The retention in unchanged form of the bonus scales with the use of the new Methodology for computing effect leads to a sharp and, in our opinion, economically unwarranted increase in the amounts of bonuses for the development of durable machines. This increase in bonuses is connected with the change in the methods of computing economic effect, and not with an increase in the real effectiveness of new equipment, and this does not create stimuli for expanding the scope of the introduction into production of new means of labor.

There is no doubt that higher bonuses should be paid for scientific and technical development work which is connected with the creation of new durable means of labor as being more promising, since their use and production leads to a more substantial increase in the efficiency of the use of material, labor, and financial resources. However, excessively high rewards for the introduction of new equipment on the basis of the bonus scale established in keeping with the previous conditions of computing economic effect directs the work of rationalizers and inventors toward the development and introduction into production of numerous minor measures, each of which produces a small effect, to the detriment of the development of large-scale and future-oriented measures.

With the introduction of the new Methodology for determining the economic effectiveness of new equipment this contradiction is partially removed. At the same time, a change in the methods of computing effect without a real increase in it through a concentration of resources for the introduction of fundamentally new equipment should not lead to an increase in bonuses. According to our calculations, for most types of equipment the economic effect which is determined in accordance with the new Methodology is four to six times greater than the effect which was computed according to the Methodology approved in 1961. For this reason, it is very important to determine an economically rational measure of material incentives for an increase in effect which is computed with regard to the service life of new machines.

Toward this end, let us examine the economic content of a formula by means of which the effect from the production and use of new durable means of labor is determined, with the formula first broken down into two parts.[2] In the first part of the formula, with regard to the aggregate of economic indicators which characterize the consumer properties of new equipment (the productivity of the means of labor, reliability, service life), the economic effect ($Э_{пр}$) from the production of new implements of labor is determined:

$$Э_{пр} = \left(З_1 \cdot \frac{B_2}{B_1} \cdot \frac{P_1 + E_н}{P_2 + E_н} - З_2\right) A_2 \qquad (1)$$

Where $З_1$ и $З_2$ --are the adduced expenditures per unit of base and new means of labor (in rubles); $\frac{B_2}{B_1}$ --is the coefficient for calculating an increase in the productivity of a unit of new means of labor compared to a base one; $\frac{P_1 + E_н}{P_2 + E_н}$ --is the coefficient for calculating a change in the service life of a new means of labor compared to the base one; P_1 и P_2 --is the coefficient of the renovation of base and new means of labor; B_1 и B_2 --is the annual amounts of output (work) which is produced with the use of a unit of base and new means of labor in physical units; $E_н$ --is the normed coefficient of effectiveness (0.15); A_2 --is the annual amount of the production of new means of labor in the computation year, in physical units.

It follows from the formula that with an improvement of the qualitative characteristics of machines (productivity, service life) there is a decrease in the need for the means of labor for the production of the same amount of output. This leads to freeing a part of the financial resources which are assigned for the renewal of production equipment. For example, the complete adduced expenditures for a machine which is being replaced came to 1,000 rubles, while for a new one it was 1,500 rubles. The productivity of the new machine is twice as great as that of the older one, and, therefore, instead of two old machines, the consumer will need a single new one to produce the same amount of output.

The effect from increasing the productivity of the means of labor will be expressed in a decrease in the expenditures for their production (1,000 rubles x 2.0) - 1,500 rubles = 500 rubles. The effect from increasing the service life of the implements of labor is displayed in a decrease in the expenditures to replenish the equipment pool to replace obsolete decommissioned equipment. Let us assume that the normed service life of a machine has increased from 5 to 10 years, and, with regard to obsolescence, from 2.86 to 4 years, that is, by 1.4 times $\frac{(0{,}2 + 0{,}15)}{(0{,}1 + 0{,}15)}$. This means that the reproduction of the old machines will require 1.5 times more capital investments than the reproduction of the new ones. The total effect from increasing the productivity and service life of the machines will be (1,000 x 2.0 x 1.4) - 1,500 rubles = 1,300 rubles.

The second half of the formula determines the consumer's economy from using the new means of labor ($Э_{исп}$):

$$Э_{исп} = \frac{(И_1{}^1 - И_2{}^1) - Е_н(К_2{}^1 - К_1{}^1)}{Р_2 + Е_н} \cdot А_2. \qquad (2).$$

Where: $И_1{}^1$ и $И_2{}^1$ --are the annual operating costs of the consumer in using a base or new means of labor in terms of the amount of output (work) produced by means of the new means of labor (in rubles); $К_1{}^1$ и $К_2{}^1$ --are the consumer's accompanying capital investments (capital investments without regard to the value of the base and new means of labor) in using the base and new means of labor in terms of the amount of output (work) produced by means of the new means of labor (in rubles). The above-mentioned economy here in current operation costs and allotments from accompanying capital investments is calculated not for a year, as previously, but for a longer period of the service life of the new machine. For this purpose, the total of the coefficient of the renovation of the new machines and of the normed coefficient of effectiveness ($Р_2 + Е_н$) is introduced into the denominator of the formula by means of which the annual effect from the use of the new durable means of labor is determined.

The reciprocal of the total of the above-named coefficients shows the period on the basis of which the consumer's economy is calculated. The upper limit of this period is limited to 6.7 years, which is possible with a service life for the new machines of over 50 years. In this case the coefficient of renovation ($Р_2$) will approach 0, while the overall coefficient practically coincides with the effectiveness norm (0.15). With a two-year service life for machines, that is, the minimum, the complete effect from the use of new equipment by the consumer will be calculated for 1.6 years ($\frac{1}{Р_2 + Е_н} = \frac{1}{0,4762 + 0,15}$)[3].

Taking account of the existing differences in the service lives of machines and in the depreciation allotment norms, it is possible to determine the length of the period on the basis of which the economic effect will be calculated. Below are cited indicators which have been calculated in accordance with the new Methodology and which characterize the period for which a consumer's economy from the use of new means of labor in production is determined.

Виды оборудования (1)	Максимальная норма амортизации на реновацию (в %) (2)	Минимальный срок службы машин и оборудования (лет) (T_c) (3)	Период, исходя из которого определяется экономия у потребителя от внедрения нового средства труда (лет) $\left(\frac{1}{P_2+E_н}\right)$ (4)
(5) По всем видам оборудования, применяемого в промышленности (в среднем)	7,2	14	5,4
(6) По некоторым видам машин и оборудования:			
(7) турбины	5,5	18	5,8
(8) электродвигатели и дизель-генераторы	9,5	10	4,7
(9) электротехническое оборудование (без оборудования для угольных шахт)	4,4	23	6,1
(10) металлорежущие станки (без особо тяжелых станков)	9,1	11	4,9
(11) кузнечно-прессовые машины и оборудование	8,0	12	5,1
(12) технологическое оборудование для литейного производства	14,9	7	3,9
(13) машины и оборудование для черной и цветной металлургии	20	5	3,2
(14) машины и оборудование для электрогазосварки и резки	50	2	1,6
(15) машины и оборудование для хлопчатобумажной промышленности	6,7	15	5,5
(16) технологическое оборудование пищевой промышленности	14	7	3,9

Key:

1. Types of equipment;
2. Maximum depreciation norm for renovation (in percent);
3. Minimum service life of machinery and equipment (years) (T_c);
4. Period on the basis of which a consumer's economy from the introduction of a new means of labor is determined (years) $\left(\frac{1}{P_2 + E_H}\right)$
5. For all types of equipment used in industry (average);
6. For certain types of machinery and equipment;
7. Turbines;
8. Electric engines and diesel-generators;
9. Electrical engineering equipment (excluding equipment for coal mines);
10. Metal-cutting machine tools (excluding especially heavy machine tools);
11. Forging and pressing machines and equipment;
12. Production equipment for casting production;
13. Machinery and equipment for ferrous and nonferrous metallurgy;
14. Machinery and equipment for electrogas welding and cutting;
15. Machinery and equipment for cotton textile industry;
16. Production equipment for food industry.

It follows from the table that with the actual average service life (14 years) of the machinery and equipment which is used in industry the effect in accordance with the new Methodology will be calculated for 5.4 years. For most types of equipment this period fluctuates from 4 to 6 years.

This is confirmed by the calculations which have been performed on the basis of the new depreciation allowances norms for the fixed capital in the economy which were approved in 1974 (See table below). For only 15 percent of all of the types of machinery and equipment has the service life period been fixed at from 2 to 7 years. For the remaining equipment (85 percent) these periods have been fixed at from 8 to 50 years. Consequently, only for a small part of the new machinery and equipment will the effect from their use by a consumer be calculated in accordance with the new Methodology with regard to a time factor of less than 4 years.

If it is taken into account that in accordance with the new Methodology the economy from the production of new machines is also determined, then the total effect in relation to which the amounts of the rewards for development workers are calculated will exceed the effect calculated in accordance with the old Methodology to an even greater extent. At the same time, the model bonus scale for the introduction of new equipment which was approved in 1964 has, as has already been noted, remained unchanged.

(1) Распределение машин и оборудования по нормативным срокам их службы

(2) Показатели	(3) Нормативный срок службы машин и оборудования			
	от 2 до 7 лет	от 8 до 14 лет	от 15 до 50 лет	(4) итого
(5) Количество видов машин и оборудования	190	609	441	1240
(6) В процентах к итогу	15,3	49,1	35,6	100
(7) Период, исходя из которого рассчитывается экономия у потребителя (лет)	1,6-3,9	4,2-5,4	5,5-6,7	—

Key:
1. Distribution of machinery and equipment by their normed service life;
2. Indicators;
3. Normed service life of machinery and equipment;
4. Total;
5. Number of types of machinery and equipment;
6. In percentages of total;
7. Period on basis of which consumer's economy is calculated (years).

The above-mentioned scale is constructed in such a way that with an increase in the economic effect from new equipment measures the amount of a bonus decreases from 25 to .5 percent of the annual economic effect, with a limit on its absolute amount of 200,000 rubles. It has a wide range which makes it possible to determine the amount of rewards for each concrete job in relation to its importance. However, whereas in accordance with the new Methodology, this effect is computed with regard to several years of operations by new machines, according to the old Methodology only one year was used. It is this which gives rise to a contradiction between the procedure for determining the amount of rewards on the basis of the bonus scale in effect which is being practiced at the present time and the fundamentally new approach to computing the economic effectiveness of the use of durable technical innovations in production.

In the table below data is cited for the Shchebikinskiy Machine Building Plant on the amount of bonuses for the development of an AI-VGS installation for the granulation and drying of baker's yeast.

	(1) По методике, утвержденной в 1961 г.	(2) По методике, утвержденной в 1977 г.
(3) Экономический эффект от внедрения в производство 10 установок (руб.)	104 448	471 187
(4) Размер премий в процентах от экономического эффекта (5-й диапазон шкалы премирования)	2,4	2,4
(5) Размер премий за разработку и освоение новой установки (руб.)	2507	11 308

Key:

1. According to methodology approved in 1961;
2. According to methodology approved in 1977;
3. Economic effect from introduction of 10 installations into production (rubles);
4. Amount of bonuses in percentages of economic effect (5th range of bonus scale);
5. Amount of bonuses for development and mastery of new installation (rubles).

As can be seen from the data in the table, the amount of the bonus which has been established in the lower category of the 5th range of the bonus scale in effect at 2.4 percent of the economic effect in accordance with the 1977 Methodology is 4.5 times greater than the amount of the bonus which would be determined on the basis of a computation of economic effect in accordance with the previously operating Methodology.

When the economic effectiveness of the introduction of the installations at the plant was determined the Methodology was not fully adhered to, and the effect which was calculated for the entire service life of an installation exceeded the annual effect by 3.5 times.

The excessive gap between the amounts of the rewards for the creation of new durable means of labor and for the development of technical innovations connected with the mechanization and automation of production, the introduction of advanced technology, and so forth will be a restraining factor in accelerating scientific and technological progress. There is an especial increase in the amounts of payments for inventions without sufficient grounds for this. The point is that a creator's reward is paid to an inventor over a period of 5 years. If it is considered that an effect which is determined in accordance with the new Methodology is several times greater than the one calculated according to the old Methodology, then with the present bonus payment procedure retained bonuses for the introduction of new equipment will undergo a substantial increase, although there will be no real changes in increasing the effectiveness of new equipment. For this reason, an urgent necessity has arisen for improving the present bonus scale which should be brought into correspondence with the new Methodology for determining the economic effectiveness of new equipment.

In the Ministry of Electrical Engineering Industry, the Ministry of Heavy Machine Building, the Ministry of Tractor and Agricultural Machine Building, and other ministries which have been shifted to the new system of planning, financing, and stimulating work connected with new equipment a principle of forming incentives funds for the introduction of new equipment is employed in relation to the effect calculated according to the new principle. In addition, the procedure for determining the amount of bonuses for the development and introduction of new equipment has been changed in these ministries. Temporary bonus payment scales are used which are essentially different from the operating standard scale. In these scales a uniform percentage of allotments to the bonus fund from the amount of the economic effect has been adopted, while in the standard scale there are upper and lower limits in each range. As has already been noted, bonus payments for the most promising work are carried out in accordance with the upper limit. The maximum bonuses for new equipment calculated for all of the ranges of the temporary scale are 1.5 - 2.5 times lower in the Ministry of Electrical Engineering Industry and 1.3-1.9 times lower in the Ministry of Heavy Machine Building than those calculated according to the operating standard scale. At the same time, the minimum rewards, on the contrary, are 1.5-2.5 times higher. Thus, the amount of the rewards from the economic effect have on the average remained approximately on the same level. However, the chief difference between the previous bonus payment procedure according to the standard scale and the procedure employed in the above ministries in accordance with the temporary scales consists in the different methods of computing the annual economic effect. This leads to great differences in the amounts of the bonuses which are the result not of an increase in the effectiveness of new equipment, but of a change in the principles of determining it.

It is customary to believe that in the electrical engineering industry the amount of the effect determined in accordance with the temporary Methodology which was approved in 1971 is on an average 2.5 times greater than the effect computed according to the 1961 Methodology. In addition, it is assumed that with obsolescence taken into account the products of the electrical engineering industry serve an average of no more than 4 years. It is on the basis of this relationship that the temporary scale for bonus payments to workers for the creation and introduction of new equipment was constructed. However, this service life for the means of labor in electrical engineering has been greatly understated. According to our calculations, on the basis of the new depreciation allotment norms the effect from the introduction into production of new or improved electric engines, diesel generators, and electrical engineering equipment in accordance with the 1977 Methodology is greater than the effect determined according to the previous Methodology by 5 to 6 times. This is a result of the fact that the depreciation norms for renovation for the above types of equipment fluctuate within the range of 3.3-9.5 percent, while their normed service life is from 10 to 30 years.

Thus, the bonus scales which have been established in the Ministry of Electrical Engineering Industry and in the Ministry of Heavy Machine Building do not take sufficient account both of the normed and of the actual service life of equipment. This makes it possible here to establish increased rewards compared with other ministries, which is a result chiefly of the method of determining effect which has been adopted, and not of its large amount which is achieved as a result of the introduction of promising scientific and technical achievements.

Proceeding from the special characteristics of determining the economic effect from the creation and introduction of new durable means of labor it is necessary to change the percentage rates of the allotments to the incentives funds from economic effect. The bonus payment scale has to take account of the relationship which has developed between the amounts of the economic effect computed on the basis of the two methodologies. It is probably necessary in this scale to review the percentage rates of allotments to the incentives funds and to change the relationships between the upper and lower ranges. For example, in accordance with the operating model scale, incentives funds in the amount of 100,000 to 500,000 rubles based on annual economic effect have been established at from 2 to 10 percent, and the maximum amount of a bonus is 35,000 rubles. In accordance with the new Methodology, the amount of the effect of new equipment for most measures will be calculated on the basis of a 5-year period and will come to 500,000 to 2.5 million rubles, that is, 5 times more than with a computation according to the old Methodology. In addition, if the bonus payment norms are left as they were, the amount of a bonus will all the same increase by 5 times. In order that the initial amount of the rewards do not increase as a result of a change in the dimensions of the computation of the effect it is necessary to decrease the percentage rates.

In our example the percentages of the incentives funds allotments from effect which is determined according to the new Methodology can be established at .4-2 percent. Although the amounts of the bonuses based on the operating and proposed scales will remain approximately at the same level, development workers will have a greater material interest in designing durable equipment. But the introduction of inauspicious technical innovations will lead to a decrease in the amount of a material reward. In its turn, this effect will depend to a greater extent than in an annual calculation upon the qualitative parameters of new machines--productivity, service life, reliability, and so forth.

As for such new equipment directions as the introduction of advanced technology and of new objects of labor, and the mechanization and automation of production, the former bonus payment scale can be used since in accordance with the operating Methodology a calculation of economic effect for an annual period of the operation of technical innovations is provided for these measures.

Proposals are being made to leave the bonus payment scale unchanged, and to correct the calculation of the amounts of effect. It is recommended for this purpose to introduce a special corrective coefficient which is individualized for each new equipment measure. It is equal to the amount of the coefficient of renovation for a new machine and the effectiveness norm (P_2+E_H). This kind of proposal, in essence, means a return to the old Methodology of determining effect which was approved in 1961, which will not orient development workers toward the introduction of fundamentally new and auspicious equipment.

The introduction of new principles for determining the economic effectiveness of new machinery and a change in the bonus payment scale does not completely eliminate the problem of stimulating more major technical innovations. For this reason, searches for new forms and methods of providing incentives for new equipment are continuing. At the present time a number of machine building ministries are shifting to a new system of planning, financing, and economically stimulating the creation, mastery, and introduction of new equipment in scientific research, designing, planning, and technological organizations and in production associations and enterprises. For several years now the Ministry of Electrical Engineering Industry, the Ministry of Heavy Machine Building, the Ministry of Energy Machine Building, and the Ministry of Tractor and Agricultural Machine Building have been operating according to this system.

The incentives funds at enterprises which have shifted to this system are formed in relation to the actual effectiveness of scientific and technical development work. They will be created (this is already being practiced in energy machine building) on the basis of the following five sources: 1) the economy from reduced costs resulting from the use of new scientific and technical solutions; 2) the additional profits obtained on the basis of incentive markups for new output and for output with the State Token of Quality; 3) resources which are included in the estimated cost of scientific research, designing, and technological work on the creation of new equipment; 4) resources which are included in the estimated cost of scientific research, designing, and technological work on the creation of new equipment which is performed to meet the orders of enterprises and organizations of other ministries and departments; 5) resources (in the amount of 20 percent of the wage fund) which are included in the estimated cost of work on the creation of new equipment models when the economic effect cannot be calculated.

Allotments to the incentives funds of enterprises and organizations for work on the creation, mastery, and introduction of new equipment from the third and fourth sources are made on the basis of the economic effect from the use of this work in accordance with the operating bonus payment scale which was approved in 1964. A special procedure of forming the incentives funds without the use of the scale is established for the other three sources. However, with a shift to the new procedure of planning, financing, and economically stimulating work on new equipment the problem of observing national economic proportions in determining the amounts of bonuses continues to be an important one. Thus, in the scientific research organizations of the Ministry of Energy Machine Building around 60 percent of the total amount of the incentives funds in 1972-1976 were formed on the basis of the third and fourth sources, that is, using the scale. With regard to this, the problems of coordinating the determination of the economic effectiveness of the introduction of durable means of labor and the operating bonus payment procedure for development workers in scientific research organizations are becoming especially acute.

The first source of forming the incentives funds for the introduction of new equipment is the basic one for industrial enterprises. In 1972-1976 40 percent of the funds were formed from this source at the enterprises of the Ministry of Energy Machine Building, and 60 percent in the Ministry of Electrical Engineering Industry.

In order to simplify the procedure for calculating bonuses for new equipment the allotments are made in accordance with a uniform branch norm (15 percent of the obtained effect) from that part of profits which is a result of a decrease in costs on the basis of the introduction of new equipment. The use of such a norm, although it does not lead to an increase in the total amount of allotments in the branch as a whole, does however interest enterprises (in our opinion) in introducing less major and less promising measures. It is apparent that in order to form incentives funds for new equipment in the first source it would be inadvisable to completely exclude the use of the scale.

At the same time, it has to be noted that paying bonuses for a rise in the technical and organizational level of production which finds a reflection in decreased costs is somewhat isolated from the entire system of the formation of economic stimulation funds for the overall results of an enterprise's economic work. The amount of this type of bonus, as we believe, should become the basic part (and, moreover, a very weighty one) of the total amount of the incentives funds which are built up for the fulfillment of assignments to decrease costs, increase profits, or decrease the losses of an enterprise. Their inclusion in the total amount of rewards will make it possible in the plan to more closely coordinate the results of the technical development of production and the final work indicators of an enterprise which to a large extent depend upon the scope and effectiveness of the technical innovations being introduced.

As a result of the introduction of the new Methodology for computing economic effect, the procedure for forming the production development funds of scientific research and experimental designing organizations also has to undergo changes. In accordance with the new procedure for forming and using economic stimulation funds for work on new equipment which is employed in a number of ministries, the production development fund of enterprises and of these organizations also is created in the amount of 1.5 percent of the estimated annual economic effect, but not more than 6 percent of the estimated cost of the work. In view of the fact that according to the new Methodology, the effect from the use in production of durable means of labor substantially exceeds the annual effect as calculated according to the previous Methodology, this percentage of allotments should be established in smaller amounts than is provided for by the draft of the new regulations on the formation and use of the economic stimulation funds for work on new equipment. Otherwise, excess amounts based on reducing the centralized financial resources will be transferred to the production development fund. Its level, as it seems to us, should not exceed .5 percent.

The interest of development workers in creating and introducing economically effective new equipment depends to a large extent upon the validity of the wholesale prices for this equipment. It is important that they should ensure a higher profitability for the new equipment compared with equipment which was long ago mastered. Toward this end, increasing use is being made of the mechanism of markups on wholesale prices for a high level of effectiveness in new output and for the State Token of Quality. However, the experience in employing the markups shows that they do not produce sufficiently palpable financial advantages for the creators of new equipment, which is a result primarily of the insufficient amounts of the additional profits which are obtained by the developer of the new equipment. Additional profits are established at no more than 50 percent of the amount of the economic effect which is distributed between the producer and the consumer. With regard to the differences in the effectiveness of new equipment, actual additional profits for certified output come on an average to 10 percent of the total amount of the effect. The remaining part of the economic effect is reflected only indirectly in the economic and financial indicators of the consumer, is not subject to directed planned regulation, and is not taken into account in the system of economic stimulation. As is shown by the work experience of the enterprises and organizations of the electrical engineering industry where the mechanism of wholesale price markups has been used for a number of years, the insufficient amount of the incentive markup does not make it possible to ensure economic advantages for the producers of new output. This situation is even more aggravated by the fact that wholesale price discounts for old output are employed on a small scale.

An essential shortcoming in determining the incentive markups consists in the fact that they are calculated in percentages of normed profits which has been made directly dependent upon the cost of new types of output. The markup is established, in essence, in relation to the cost of output, and not in the form of allotment shares from the amount of the economic effect which is distributed between the producer and the consumer. The effect is considered only indirectly in determining the coefficient of the ratio between the upper and lower limits of the price and the maximum amount of the incentive markup (not more than 50 percent of the economic effect).

The existing procedure of determining the incentive markups, in our view, does not create the necessary conditions for stimulating the production of highly effective output, since the methods of calculating them objectively lead to an overstatement of this output's cost. An incentive markup should be established in differentiated percentages of the amount of the distributed economic effect, and not of normed profits. The maximum percentage of the allotments should be increased here from 50 to 70 percent of the amount of the economic effect.

The system of economic stimulation for developers of new equipment should be increasingly based on the indicators of actual effectiveness in close connection with the achieved results of an enterprise; in this way, the importance of an actually obtained effect is strengthened. Only on the basis of reliable effectiveness indicators is it possible to improve the planning of scientific and technological progress and to take fuller account of economic effect in developing the profits plan and the plan for reducing the cost of output. For this reason, the demands are increasing upon the system of calculating the results of the introduction of technical innovations and upon their coordination with the indicators of profits and cost reduction.

However, the actual economy from the performance of new equipment measures and scientific labor organization which is reflected in the statistical reporting forms 10-NT and 19-T (NOT) does not possess sufficient reliability and has an estimated character. Far from all technical innovations are taken into account in calculating this economy. In addition, frequently the economy is calculated on the basis of the use of the same indicators of an estimated character which are employed in determining the effectiveness of new equipment at the stage of its introduction into production and even designing.

In order to increase the reliability of the information on the effectiveness of new equipment it is necessary to organize primary accounting of an actual economy for the expenditure items which change as a result of the introduction of new equipment. The economy from all measures which are carried out should be reflected in the reference sheet 2 of form No. 6 of the annual report, as is already being practiced for the factor "a change in wage conditions." This measure will help to foster an increase in the responsibility of enterprises for the effectiveness of technical innovations.

Certain advanced enterprises are already doing definite work to organize the accounting of an actual economy in costs which is obtained as a result of the introduction of technical innovations into production. Thus, since 1972 the Zaporozh'ye Titanium and Magnesium Combine has been practicing the use of an indicator of the effectiveness of expenditures for new equipment in its cost accounting system. This indicator is applied to individual shops. A special intra-plant calculation has been introduced of the economy from carrying out measures by quarters and for the year as a whole. Depending upon the amount of the actual economy, bonuses are paid to engineering and technical workers who develop new equipment and help to introduce and operate it. However, this effect, in our opinion, continues to have a somewhat estimated character. The results of introducting technical innovations are not always reflected in the materials expenditure norms and in job and wage rates.

In order to increase the realistic nature and reliability of the data on the actual effectiveness of new equipment it is necessary, in our opinion, to develop a special system of primary accounting documents which will record the economy from a decrease in materials expenditure norms and in wage expenditures as a result of the introduction of technical innovations.

Thus, in order to stimulate the effectiveness of new equipment it is necessary to achieve an overall improvement and intercoordination of the methods of determining the projected, planned, and actual economic effect, the amounts of material incentives and of the funds for financing scientific and technological progress, and also of price formation for new equipment. It would be useful, in particular, to introduce a scientifically substantiated bonus payment scale for the introduction of new equipment which would orient workers toward the accomplishment of major measures in overall production mechanization and automation and in an improvement of technological processes. It is essential that the economic effect serve as the basis for determining the level of profitability in forming wholesale prices for new output. An improvement of accounting and of the methods of analyzing the influence of scientific and technological progress on the economic and financial indicators which characterize the results of the work of enterprises, associations, and ministries is acquiring paramount importance for increasing the validity of the entire system of economic stimulation for the effectiveness of new equipment.

FOOTNOTES

1. See: "The Methodology for Determining the Annual Economic Effect Obtained as a Result of the Introduction of New Equipment. Approved in 1961 by the State Committee for Science and Engineering of the USSR Council of Ministers," State Scientific and Technical Publishing House for Mining, 1961.

2. For the calculation formula see: "The Methodology (Basic Regulations) for Determining the Economic Effectiveness of the Use in the Economy of New Equipment, Inventions, and Rationalizers' Proposals," "Ekonomika" Publishing House, 1977, p. 8.

3. The formula in accordance with which the renovation coefficient is calculated is cited on page 24 of the "Methodology (Basic Regulations) for Determining the Economic Effectiveness of New Equipment.

$$P = \frac{E}{(1+E)^{T_c}-1} = \frac{0,1}{(1+0,1)^2-1} = 0,4762,$$

Where T_c--is the service life of the new equipment; E--is the norm

for adducing one-time and current expenditures for the creation and introduction of new and base equipment at a single moment of time (0.1)

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END