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**MODERN SCIENCE, TECHNOLOGY and
the DEVELOPING COUNTRIES**

By

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During the last decades science and technology have made unprecedented progress. Many things which recently were mentioned only in fairy tales have today become a reality. In less than a century man has not only torn himself away from the earth and learned to fly, but has also rocketed into outer space. Unlimited energy resources are beginning to be tapped. Airlines, radio, television are bringing people and countries closer together. Unheard-of commodities are being turned out on a mass production basis. Results which took mankind many centuries to achieve are now doubled and trebled in a decade. All this is already bringing about far-reaching changes in all spheres of life.

At the same time, more than half of mankind is still living under the same conditions as their ancestors hundreds of years ago. Many countries in Asia and Africa have achieved political independence but they are just starting to overcome the economic and cultural backwardness inherited from colonialism.

The problems facing these countries (those of mobilising resources and increasing productive capacities, of creating new attitudes and a new system of social relations, the accelerated population growth, the food problem, etc.) are numerous and closely interconnected. It is not without reason that many people speak of vicious circles facing countries which strive to overcome economic backwardness.

The scientific and technological revolution and the complex problems facing the developing world are each, in their own way, exerting an ever growing influence on the future of mankind. Scientists all over the world are trying to foresee and assess the

magnitude and character of this influence. But usually these assessments are made separately in respect to the concrete problems confronting the developing countries, on the one hand, and in relation to the impact of modern science and technology on the industrial states, on the other. However, it is becoming more and more evident that the achievements of science and technology are going to exercise a profound and manifold influence on the problems facing the Afro-Asian and Latin American countries.

The mere fact that man is now capable of rapidly increasing production, of controlling many forces of Nature, etc., opens up new avenues for solving such problems. The construction of giant hydroelectric, irrigation and industrial projects plays an important part in overcoming the economic backwardness of the developing countries. The building of the Aswan Dam in the UAR, for example, has to a great extent helped in solving the power supply and the irrigation problems facing the country.

Technologically it is now quite possible to achieve a 6-8 per cent increase in the GNP of the Afro-Asian countries, this could double their per capita incomes in 15-20 years. But such an opportunity runs up against economic and social factors.

Up to now discussions about the influence of the scientific and technological revolution on the developing countries have somewhat concentrated on this or that practical problem which at each given stage seemed to be all-important. During the 1950s, paramount attention was devoted to the shifts in the structure of raw material consumption caused by scientific and technological progress, and their impact on the export possibilities of the Afro-Asian and Latin American countries. At the beginning of the 1960s, particular emphasis was laid on defining those trends in scientific and technological progress which could be of most value to the developing countries. In 1963, a special UN conference was convened to study this problem. Though its results were limited, it gave a certain impetus to research into this special field.

But over the last few years it has become increasingly clear that an overall, multidimensional and long-term assessment of the influence of modern scientific and technological progress on

the developing countries is necessary. Only such an assessment can bring to light the new problems which the countries in Africa and Asia will have to face in the near future. And although we still do not have all the necessary data to produce a complete picture of this impact, it is nonetheless possible to define some major issues and to evaluate their importance.

First and foremost is a group of problems which stem from the well-known facts of recent years. Scientific and technological achievements have only in a very small degree been applied in the developing countries; and therefore their influence on the course of events in these countries is so far very small. On the other hand, the scientific and technological revolution has tended to widen the gap between the industrial countries and the developing world. What are the reasons behind such a situation ? What are the prospects for the future ? What is hindering a broad application of modern science and technology in the developing countries ?

Some people believe that the main issue lies in the fact that science and technology are being developed in a way beneficial to the already developed, not the developing countries. It is primarily aimed at saving labour inputs and increasing productivity. In the developing countries capital is more scarce and labour more abundant than in the industrial countries. Correspondingly these people advocate the need for concentrating research on problems of intermediary techniques and labour-intensive methods of production. Some of them even go so far as to propound the idea of applying the brake on many of the existing lines of scientific development (e.g., labour-saving techniques, or the development of synthetic raw materials which compete with the raw materials exported by the developing countries).

Undoubtedly, some results could be achieved by directing scientific research and technological development towards the specific needs of the developing countries. More attention, for example, could be devoted to increasing agricultural production in tropical conditions, soil conservation, better use of local building materials, etc. For countries poor in traditional fuel resources, the construction of atomic power plants could be of special importance. Since the problem of water is becoming more and

more acute in many countries, work on water desalination plants and other methods of obtaining fresh water can be of paramount practical importance.

In certain cases it might be useful to exclude some of the more sophisticated and costly labour-saving innovations in modern techniques. But generally speaking, it would be unrealistic to think that the scientific and technological revolution could on the whole be turned to production methods demanding more labour inputs and correspondingly presupposing a decline in labour productivity (or a slow-down in the rates of productivity growth). Throughout the ages man has sought for methods of increasing output per unit of work. Increased productivity is a vital factor in any long-term increase in the national income. Increased productivity is a major source of capital accumulation. Faced by a multitude of difficult problems inherited from the colonial period, the developing countries are often forced to adopt partial and conflicting solutions. One of the most difficult and important of these problems is that of mobilizing and efficiently using their manpower and material resources given the limited capital at their disposal. In some specific cases they may have to take decisions contrary to the interests of modernizing their productive apparatus. But in the long run economic development in these countries will have to take into account the need to rapidly increase production (which should overtake the rapid growth of the population) and the need to raise competitiveness on world markets. Therefore, the developing countries cannot adhere to a strategy of development which does not envisage a serious rise in productivity. In all these respects the scientific and technological revolution in its present labour-saving forms is also essential to the developing countries.

Since it would thus be unrealistic and useless to try and reverse the productivity-raising essence of the modern scientific and technological revolution, let us try to concentrate on what is hindering the application of modern production methods and techniques in the developing countries.

The majority of modern inventions lead to a rise in productivity at the cost of an overall increase in capital-output and capital-labour ratios; usually increased productivity means that the same results are achieved with a smaller amount of labour-

input and employment. New production methods and techniques demand a rise in capital accumulation and also in the size of consumer markets. In an economically backward region, the introduction of modern production methods and techniques are apt to create new economic problems. Since such an introduction cannot be carried out simultaneously in all sectors of the economy, it intensifies the uneven, unproportional growth of different parts and sectors of the economy; the existing interrelations inside the economy must be replaced by new ones. If a new modern enterprise is built it needs permanent sources of energy, raw materials and other inputs, it needs a working transport system, a constant market for its goods, etc. Thus the creation of a modern enterprise presupposes the existence of numerous interconnected branches of industry; the introduction on a broad scale of new technology presupposes serious changes in the whole economic structure of a country, in the proportions and ratios existing between the various branches of industry.

Structural changes have always accompanied economic development. But in those countries which were in the forefront of technical and economic development these changes were brought about less violently and sharply. During the previous centuries scientific and technological discoveries were relatively few and dispersed in time. Each new invention was superimposed on a more or less up-to-date (according to the standards of the time) economic pattern. The structural shifts accompanying the introduction of new production methods and techniques into the economy of the more advanced countries were therefore comparatively small-scaled and gradual. Such structural shifts (though at a heavy cost of numerous bankruptcies, large-scale unemployment, periodic crises, etc.), could be accomplished by means of a free market mechanism.

To-day the developing countries are faced with a much more difficult task. They must superimpose the scientific and technical achievements accumulated over centuries on a basically backward economy. This inevitably brings about very violent and large-scale shifts in the economy. Some sectors develop rapidly, others lag behind; but nonetheless (if economic development and technological progress is to proceed) it is necessary during each given period to brake up the old proportions and ratios in the economy and, at the same time, to achieve a new balance,

a new and workable interaction between the interdependent branches of industry and sectors of the economy. Modern literature on economic development is plagued with references to «booms» and «gaps» which in fact only reflect the magnitude of this double problem of changing the existing structure and simultaneously balancing the interconnected parts of the economy.

Such a big and difficult task cannot be entrusted to private enterprises, to a free market mechanism. The profound and rapid changes which must take place in the whole structure of the national economy make it practically impossible for any entrepreneur to foresee the future of his enterprise for a period of five-ten years, to individually forecast the structure of the market, the level of prices and other vital factors without which there is no way to calculate the profitability of an enterprise. Such calculations can only be carried out within the framework of an overall national plan, under conditions when the state can see to it that development proceeds along the lines laid down in the plan.

To bring about large-scale shifts inherent in modernization and the elimination of economic backwardness a more sophisticated and modern mechanism is needed; one based on a growing degree of state planning and efficient state control and ownership of the major means of production.

The scientific and technological revolution leads to an increase in the scope and magnitude of the shifts which are necessary if economic backwardness is to be overcome. And in this sense it only accentuates the need for planning and for a more active government participation in economic development. Moreover, achievements in science and technology tend to complicate the choices facing the developing countries (choices between accumulation and consumption, between different technologies, etc.).

Only far-reaching socio-economic transformations can remove such barriers to a wide application of modern science and technology in the developing countries, as the market problem, the problem of accumulation, the problem of skilled manpower resources, etc.

The scientific and technological revolution tends to change the international setting in which the developing countries are

to solve their problems. Until the middle of the century the place of Afro-Asian countries in the world economy, their competitive possibilities were defined primarily by the following circumstances. The economically advanced imperialist countries were gradually increasing the productivity of their industries and on this basis improving their competitive position. But the export of their goods to Afro-Asian countries was restricted by numerous factors, such as the relative cheapness of local hand-made products, the comparatively low level of transport development and the vitality of traditional and semi-traditional productive units. At the same time, the competitiveness of many Afro-Asian export commodities on world markets was based chiefly on the cheapness of local labour and on certain natural advantages.

Over the last few decades many of these circumstances have undergone tangible changes. With the increase of transport facilities and the rapid development of synthetic goods industries, many of the advantages enjoyed by the developing countries are disappearing. With the attainment of political independence and the growing struggle of workers for their rights, a strategy which bases the competitiveness of exports on the cheapness of labour becomes doomed to failure. Moreover, the rapid development of science and technology (which are greatly accelerating the growth of productivity and the competitiveness of industries in the imperialist countries) makes futile any attempt to base the future competitive position of the developing countries' industries on cheap labour. The scientific and technological revolution and the ensuing changes in the world economy make it imperative for Afro-Asian countries to increase productivity in their major industries. Unless they do this quickly and on a vast scale, the productivity gap between the rich imperialist countries and the developing world is going to widen with great speed; and the imperialists will not only strengthen their competitive positions and capture markets in the Afro-Asian countries, but will also obtain new levers for economic expansion and pressure.

In present circumstances the scientific and technological revolution creates more favourable economic conditions for those countries which have larger capacities for accumulation, bigger markets, more skilled labour resources, etc. In other words, the

latest achievements in science and technology tend to accentuate the economic mechanism which increases the differentiation between countries. This manifests itself not only in the relations between the imperialist group of countries and the developing world, but also in the relationship among the developing countries. Under the impact of modern science and technology the newly independent countries are apt to develop more unevenly and the differentiation between them will grow. Some countries will be able to derive more benefit from the scientific and technological revolution and they will make more headway in overcoming their economic backwardness than others.

In separate Afro-Asian countries this revolution also serves to increase the differentiation between individual economic units, between branches of industry, between different regions and social groups. In view of the limited resources of these countries, modern production methods and techniques (which almost always lead to an increase in capital-output and capital-labour ratios) can only be introduced by mobilizing and concentrating large resources in some well-defined areas. This often calls for a redistribution of resources which in the earlier stages of development can, as a rule, be achieved only at the cost of slowing down or even retarding the development of other economic units, regions, social groups. Within certain limits economic development always presupposes such a situation; it can never be compared with a rubber balloon which stretches uniformly when it is being inflated. The construction of new modern enterprises, the investment of new capital and the introduction of new techniques inevitably demand a larger effort from certain areas and spheres and at the same time create an economically more favourable position for them. But the magnitude of economic shifts, the extent to which economic development leads to an overall change in the position of certain social groups, regions and areas, the degree to which it brings about a concentration of income and wealth, a concentration of political power, etc., may be extremely different. The scope and accordingly the character and consequences of the social and economic differentiation (which accompanies the application of scientific and technological achievements in the developing societies) depend largely on the social conditions and policies under which economic development takes place.

The private enterprise pattern of development creates numerous problems in this respect. In view of the necessity to re-allocate and orientate major resources towards the vital areas of development, it is both economically and morally unjustifiable to turn these resources into private hands. Resources accumulated through the budget, the credit system, the pricing mechanism and numerous financial institutions come from the various sections of society and in fact are their contribution to national development; these resources should continue to belong to the whole of society and should be used in its interests, not in the interests of separate individuals. Moreover, the private enterprise system introduces a major additional element, which increases and accelerates economic disparities. If one quarter or one third of the national income is distributed on the basis of property ownership and not that of current development efforts and labour inputs, then social disequilibrium and economic differentiation will quickly increase without any real benefit for the development process as such. Instead of meeting the interests of the broad masses and national progress, the whole development will tend to reflect the demands of the more privileged and higher income groups.

The socialist pattern of development not only eliminates private ownership of the means of production as a highly important factor of social inequality but also creates a whole system of measures (administrative, economic, ideological, etc.) aimed at actively counteracting, limiting and lessening the trends toward inequalities which in the earlier stages accompany the application of new production methods in an economically backward society. In relations between different socialist countries this assumes the form of free transfers of technological patents and know-how, of advantageous terms of economic and technical assistance, of long-term mutually beneficial trade agreements. In the history of the Soviet Union the whole socialist concept of a top-priority and concentrated effort to overcome the economic and cultural backwardness of former colonial territories in Central Asia and the Caucasus led in the 1920s and 1930s to a wide range of long-term political measures: All-Union budget resources were allocated in their favour, an advantageous pattern of prices and economic specialization was elaborated, thousands of teachers, specialists and skilled wor-

kers were sent to those regions, etc. A socialist transformation of society creates new prerequisites for economic progress and the introduction of new production methods. Mass education and medical care change the essence of the manpower problem. Social welfare, a socialist wage policy, a more even distribution of income influence the whole pattern of the market, provide the necessary conditions for modern mass production methods. Overall national economic planning opens up broad vistas for mobilizing and concentrating the available resources and for their most rational utilization. Such measures cannot discontinue inequalities at the earlier stages of overcoming economic backwardness, though they can seriously lessen them and subordinate them to the needs and interests of social and economic development. Moreover, experience has shown that an ultraradical policy which aims at eliminating all differences and at establishing a system of equal distribution of all resources (irrespective of the individual efforts and contributions to national development) may in certain cases slow down development and the introduction of new production methods. Certain material incentives can and must be used to encourage additional efforts, the acquisition of new skills, the introduction of new techniques, etc. But these incentives should be closely linked with interests of the broad working masses and the national economic effort and applied within strict limits (defined in each case by the concrete conditions and level of development in each country). Otherwise the growth of economic and social differentiation may become incompatible with socialist ideals and the needs of national development and may seriously hamper further progress.

Modern production methods and techniques can be introduced on a broad scale only if the existing traditional and semi-traditional segments of society are broken up and their human and material resources are used in the interests of national development. Moreover, a radical transformation of society demands not only an active participation of the majority of the people, but also their conscientious approach to the country's problems, their willingness to make sacrifices to achieve their ideal, to create a society capable of meeting the needs and desires of the broad masses.

The application of modern scientific and technological achievements in the developing economies cannot be a smooth and easy process. It inevitably entails numerous problems which

have to be solved. In a single article it is impossible to discuss all these problems. But it is necessary to dwell on at least one of them since it is most widely discussed and often misinterpreted.

In the beginning of the article it was mentioned that some people stress the acuteness of the employment problem and the scarcity of capital in the developing countries; it is on these facts that they base their arguments against a broad introduction of modern production methods and techniques in these countries. Their concept of development in Afro-Asian countries presupposes an even distribution of capital among all the economically active population and, correspondingly, the wide use of intermediary and labour-intensive techniques.

Undoubtedly, the employment problem and the scarcity of capital create serious difficulties for the developing countries. But a strategy based on a preponderance of labour-intensive techniques, though it may temporarily soften the employment problem, cannot provide the basis for a constant rise in production or a better position on world markets. On the contrary, such a strategy excludes any possibility of solving these problems in the future. Moreover, since outmoded techniques allow for only a low level and slow rate of accumulation, such a strategy does not even provide a basis for solving the employment problem for the future generations.

The experience of most countries which succeeded in overcoming economic backwardness shows that they followed another strategy. The major part of capital resources which could be mobilized and concentrated were utilized for investments into modern enterprises with up-to-date technology and production methods. (At times such an efficient use of capital resources is limited by a lack of skilled and semi-skilled labour). The main criterion for the allocation of large-scale investments was not their employment-creating capacity but the largest output of necessary products, the expansion of the most needed capacities in their most efficient form. This use of capital investments creates a nucleus of highly productive and competitive capacities which inter alia help to accumulate resources for the future transformation of the less developed spheres. On the other hand, there exists the difficult problem of utilizing the vast resources of unskilled labour as well as numerous dispersed small capital resources which are hard to concentrate. The problem of

increasing productivity in this large sphere is a very acute one. If it is not solved, a major part of accumulated resources will have to be redistributed as subsidies to inefficient producers or as social security to the unemployed. The advocates of intermediary and labour-intensive techniques see only one solution to this problem : through small-scale highly dispersed capital investments. But this method, as we have seen, can be used on a very limited scale, or else it will undermine the possibilities of creating a highly productive basis for the overall transformation of the economy. Therefore, other solutions must also be scrutinized. There are, for example, certain untapped possibilities of accumulating scattered local resources and small-scale productive capacities. But the best results can be achieved by such organizational measures as cooperation and specialization which make it possible to use the existing small-scale productive capacities more fully and efficiently. Of special significance are measures intended to increase the manufacture of means of production — tools, instruments, etc.

A combination of different approaches — the most efficient use of capital in economic branches where capital investments are more intensive, and the most efficient organization of labour in industries where capital resources are scarce — can contribute to the solution of a whole range of problems facing the developing countries. This does not exclude the use of intermediary techniques in certain cases. An evaluation of the optimum relationship between these different approaches in the light of an overall socialist policy aimed at counteracting the growth of exploiting relations is just one of the numerous problems which has been brought to the forefront by the scientific and technological revolution.

The scientific and technological revolution has opened up new possibilities and has raised many and difficult problems before the developing countries. It has set into motion a series of far-reaching and often contradictory changes in the economic, political, social, cultural and other spheres of life in the developing countries. Further development in these circumstances necessitates profound socio-economic changes, creation of new production and social relations, constant increase in the influence of the state on socio-economic processes, higher degree of overall national planning and ever wider active and conscientious participation of the broad masses in the creation of the new society.