

THE SCIENTIFIC-TECHNOLOGICAL REVOLUTION AND THE PROCESS OF INDUSTRIALIZATION

Dr. GUNTER BARTHEL*

We are at present witnesses of a dynamic process of technological revolution which exerts an increasing influence on both material production and social conditions and relations. The successful mastering of the scientific-technological revolution becomes a major prerequisite to social progress on a worldwide scale. For example, it is inconceivable for the developing countries to surmount the ever-widening gap between them and the highly industrialized nations without making radical changes in the means of production employed.

The scientific-technological revolution does not only imply the revision of old laws and principles, but is also closely connected with the reorganization of the entire technical basis of the whole apparatus of production. Similarly to a chemical chain reaction, revolution in certain industries will give rise to a number of drastic changes in other industries.

An expression of the unfolding revolution of the productive forces is, on the one hand, the considerable growth of labor productivity; on the other hand however, some contradictory tendencies developed in the world's raw-material economy, which chiefly affect the economic development of the emergent countries of Africa, Asia, and Latin America.

The proportion of traditional raw materials decreases with the increasing demand for synthetic products and raw materials, the better utilization of secondary materials, and the reduction in the expenditure of material per unit of production. At the same time other resources (e.g., petroleum,

* KARL MARX University - Research Centre for Arab Studies, G.D.R.

natural gas, aluminium are being utilized to a greater extent than previously, since entire industries are based upon them.

Although the sales of most raw materials did not recede, the majority of the developing countries are suffering heavy losses of foreign currency due to falling prices on the world market. Superficially considered, the scientific-technological revolution thus seems to have a detrimental effect on, and be a disadvantage for, the developing nations.

While specialized communications satellites now provide for radio and television broadcasts to be beamed to all parts of the world, the majority of the people living in Asia, Africa, and Latin America still lack the financial means necessary for buying radio and television sets.

At the same time the governments of those countries found that the efforts made with a view to expanding production in the traditional branches of industry did not give the desired results because the price difference between the raw materials and industrial goods shows a distinct tendency in favor of the latter. The way out of this situation is to be sought in a consistent reconstruction of the respective national economies, in order to be able to cast off the fetters inherited from the past. While it is comparatively easy to proclaim such a goal, its realization frequently proves to be rather complicated. In addition to the availability of a certain raw-material basis and the appropriation of large funds, in order to be able to take over and make successful use of the results and technical know-how of highly developed industries, efforts to overcome economic backwardness also have as their primary prerequisite socio-economic changes liquidating both outdated rights of property and inhibiting and retarding factors in the sphere of individuals.

A number of Arab states enjoy particularly favorable conditions for remodeling their national economies and for achieving high rates of growth.

In contrast to the majority of developing countries, the resources of most Arab states are an immanent part of those branches of production which in Europe and North America stimulate the growth rate of the entire economy. Thus, those

Arab countries not only indirectly participate in the process of development, but also benefit by it to a certain degree.

What has been said above is true chiefly of the petroleum, natural-gas, and cotton-supplying countries. A look at the oil-production statistics of the past decade will graphically underscore that which has been said above. With an overall oil production in 1968 of 596,5 million tons, the oil-producing countries in the Arab area accounted for 35.9 percent of the world's petroleum production (exclusive of the socialist camp). The vast petroleum deposits as well as the growing consumption of petroleum and its derivatives in all parts of the world allow to conclude that the output and the payments made by the corporations will continue to increase in the coming years.

The proceeds from the export of petroleum — which in 1968 were as high as 3,510 Urd. US\$, in such countries as Kuwait, Saudi-Arabia, Iraq, Qatar, Bahrein, Abu Dhabi, Oman and Libya could indeed be much higher if these Arab countries were in full control of their own natural resources. It therefore is the deep national desire of the people in the U.A.R. and S.A.R. to have absolute control of the production, processing, and sale of petroleum in their areas.

Numerous other examples could be given to show that many Arab countries have at their disposal large material and financial reserves. But this factor would be one side only and, moreover, would be quite inadequate. What is of decisive importance is that useful programs be put into practice, i.e., that plans be tackled which were devised with the view of establishing dynamic branches of industry.

It is in connection with the specific policy of industrialization that many governments are confronted with various problems. The emphasis of the discussion is upon the following questions :

- Should priority be given to labor and capital-intensive projects ?
- What branches of industry should be developed in preference to others ?
- Shall production be oriented to the requirements of the domestic market only or should a further expansion of export be considered from the very beginning ?

The answers to these questions can be summary answers only, as a detailed clarification would require each country's historical peculiarities to be taken into consideration.

On the other hand, it is doubtless possible to formulate general lines which have already proven useful in practice. Permit me, therefore, to enter into some basic principles of economic policy in the G.D.R., which I consider appropriate for discussion in this particular context. Although I am fully aware of the difficulties inherent in such a global comparison, inasmuch as the initial level is entirely different, I do believe, however, that a number of experiences are entirely worthy of generalization in their general nuclei.

The successes achieved during the 20 years development of the German Democratic Republic actually speak for themselves, and this country's position No. 10 among the leading industrialized nations is abundant proof of the soundness of socialist economic policy.

The law regarding the perspective plan for the development of the German Democratic Republic's national economy comprises the decisive premises for the future organization of the structure of production.

The principal orientation is towards — and I quote — «products and methods for which the conditions for relatively inexpensive production on the highest scientific and technical level are available or may be created, which effectively serve the development of our own national economy, and which in the long run, will ensure a high profitableness of export.»

Included herein are also those products and methods «which, being important supplies and technological conditions, respectively, control the rate of development of productivity as well as the scientific- technological level in important branches and areas».

A further basic thought is the demand for domestic raw materials and sources of energy which in the process of production may be given a high degree of refinement. A demand that arises from the fact that the G.D.R. is among the industrialized countries poorest in raw materials and that import-in-

tensive methods of production usually require considerable expenditures of foreign currency.

According to the present state of science and technology the G.D.R. is concentrating upon those rate and structure-determining industries which place data processing equipment, business machines, semiconductor and microelectronic equipment, precision-made, optical and electronic equipment, and scientific instruments and apparatus on the market.

Why it was just those branches which were placed in the center of the most recent politico-economical measures will now be demonstrated by reference to one particular example.

Let us consider, for example, the so-called integrated circuits which were placed on the market in 1960 and which are of extreme importance to high-frequency engineering, computers, controls, etc.

By the end of 1964 research had progressed to a state where a super-purity silicon crystal of no more than 0.02 cm^3 used as a switching circuit could assume the function of 50 to 70 conventional components such as transistors, resistors, and capacitors. But this is by no means the latest «craze» of technological development. By modular unit construction methods it is possible to replace entire circuit complexes, so that micro-miniaturization is feasible and, consequently, major savings in raw materials may be realized.

It should be noted in this context that a U.S. firm succeeded in developing for the National Aeronautics and Space Administration (N.A.S.A.) a computer weighing 280 g and having a volume of 213 cm^3 . This new type computing machine is capable of receiving and processing one million bits a second and transferring 64,000 bits in the same period.

A corresponding machine with transistor circuits, which, after all, would represent a recent production technique, too, would weigh 100 times as much and would occupy 600 times as much space.

In addition to the saving in material, the new technology also results in a major reduction in the time required for repairs. For instead of perhaps 50 components there is now

one component only which, incidentally, has a much longer useful life. This remodeling and reconstruction will gradually free the G.D.R. from the large imports of raw materials; this is planned to be reduced from 100 t per 1 million marks worth try with the absolutely highest per capita import of steel. In machine building, for example, the consumption of material is planned to be reduced from 100 t per 1 million marks worth of gross production in 1966 to 70 t per 1 million marks worth of gross production in 1970. In order to be able to keep pace with the technological revolution, it will, of course, be necessary in the future to realize even greater savings in material, so that it will be possible for us to stay in export business as regards both weight and cost of equipment supplied.

Modern technology, therefore, is the key to the solution to many problems. In the concrete, its application means reduced raw-material consumption, modern equipment, favorable possibilities of sale, and increased national income.

Thanks to this economic policy it is possible to eliminate the dependence of the increase in national income on an expansion of the imports of raw materials and fuels. The intensive utilization of all funds available is a prime consideration for practical activity in all spheres of the national economy. Thus, the qualitative parameters of the economic process are gaining in importance, which are directed towards the development of the leading branches of industry and of what is called «impulse production», modern and dynamic structures, the application of micro-miniaturization and light-weight construction methods, the reduction in the time for returns from investments, the reduction in the intensity of funds, improved utilization of capacities, etc.

The end to be attained by these considerations is to exchange more and more finished products for finished products on the basis of certain raw-material imports. Consequently, the principal task of foreign-trade policy no longer only consists in procuring the necessary primary products, but rather — with a further absolute increase in these imports — in modernizing their structures and reducing their proportional share in total imports. Thus, space is cleared for importing more finished goods, which is essential to the considerable international

specialization of the chemical industry, machine-building industry, etc.

The realization of this particular concept holds definite advantages not only for the G.D.R., but also supports the developing nations in their struggles for economic independence.

As you know, the majority of young national states have not so far been able to cast off their unilateral ties to the world capitalist market, and they will not be able to do so until they have an economic basis of their own and until they have developed extensive relations with the world socialist system. But an independent national economic basis and closer contacts to Comecon countries are largely dependent upon an increasing efficiency of the world socialist system.

It can be said and very rightly so, that a quantitative and qualitative expansion of exports on the part of the G.D.R. will also be for the benefit of the developing countries.

The G.D.R. has never so pithily faced with the question of whether priority should be given to capital-intensive or labor-intensive technologies as are the Arab countries.

The G.D.R. was never so pithily faced with the question of World Wars I and II, required all of our new objects of investment to be unhesitatingly adapted to the capital-intensive type of technology. A twofold economic compulsion called for orientation towards the capital-intensive form of technology. On the one hand, the labor shortage required the search for rational methods. On the other hand, the need for making use of the most modern methods resulted from the urgent necessity of opening up new export markets, in order to be able to pay for growing imports.

This general assessment, however, does not eliminate the fact that thousands of medium-sized and smaller plants are, and will be, a primary prerequisite to a workable apparatus of production within the framework of our national economy. Although almost 90 percent of the German Democratic Republic's industrial production is concentrated on large plants having more than 100 employees, the existence of small and medium-sized plants is imperative, because larger plants are

not usually in a position to perform the functions of the other category of plants.

Small-scale series production and the production of various custom-made articles will also in the future be assigned to the smaller and medium-sized factories rather than to large specialized industrial plants.

By gradual modernization of the smaller firms rational methods of production will become established here, too.

With their simpler technology and organization, with their shorter manufacturing times and comparatively small basic funds the small — and medium-sized plants actually play an irreplaceable role. They relieve the large plants of the small-batch production of products or component parts as well as of direct customer service, thus supporting specialization of large-scale production.

But let us return to where we started from. How could questions as those which were raised above be answered for the Arab countries ? In consideration of the present economic situation, existing resources, and international experiences, which I briefly outlined by reference to the G.D.R., the following principal aspects crystallize out.

First, it can be said that the present state of industrialization, the relatively limited investment capital, and the surplus of labor, on the one hand, but also the necessity of overcoming the gap existing between the industrialized and developing countries, on the other hand, make it absolutely impossible for any of the Arab countries to give top priority to either the capital-intensive or labor-intensive form of technology.

The conclusion that the economic backwardness of the Arab countries might be overcome through tremendous financial expenditures and by the aid of the capital-intensive type of technology must be considered an absurdity even for the rich oil-producing countries.

The effect on employment of an industrialization based upon high-production machines and units is very small, as the organic make-up of the industrial funds is constantly shifted to

the prejudice of the variable capital with increasing degree of mechanization and automation, so that the financial resources would be inadequate for achieving the desired object.

It is within the framework of the scientific and technical revolution that the number of employees per investment unit is reduced and that the investment sums required for one job are increased.

True, the Arab countries cannot resist this trend, but in the present phase this would go beyond their potentialities, especially since the reduction in surplus labour would not be guaranteed.

Superficially considered, the labor-intensive form of industrialization then would appear to be of greatest advantage, for it would help create a large number of jobs and thus absorb a considerable labour force, the expenditure of money being relatively small.

Giving precedence to the establishment of small- and medium-sized plants would certainly bring immediate relief to the labor market, but would at the same time prevent the creation of effective material and technical production conditions for an ultimate solution to the problem of employment. In the long run, it would not be possible for the necessary changes in methods of production and structure to be realized, because the backward technology would cramp any real progress. It is imperative, therefore, that the Arab countries should find an optimum between technical progress and increase of employment, which consists in a combination of the two ways, which in the course of mobilizing the material and human resources, will ensure a maximization of the national income and a minimization of underemployment.

However, this particular combination will be successful only if concentration is actually on the leading branches of the respective national economy and if agriculture is also fostered in its most important areas.

Referred to the actual situation in the Arab area the following considerations could show their correctness in practice.

The availability of petroleum, natural gas, and phosphates constitutes a stable initial basis for fertilizer production. Aside from a few exceptions, many Arab countries are importing annually increasing quantities of fertilizers, for which they have to pay in foreign currency. However, their own production and the import of fertilizers are far from meeting the actual requirements which constantly increase because of the need for higher food production.

That is why the development of a national fertilizer industry is all-important, which may, of course, only be realized by way of the capital-intensive form of industrialization. In spite of high capital expenses per ton of installed capacity, which are particularly high in case of ammonia synthesis (Haber process), it has been found profitable to design and construct large-capacity plants. It has been found, for example, that the capital cost per ton of installed capacity of a factory for the production of 20,000 tons of nitrogen is more than twice that of a factory producing 100,000 tons of nitrogen annually.

It is quite conceivable, because of the availability of cheap raw materials, that the fertilizers could be sold on the domestic and world markets at entirely competitive prices. In order to meet the urgent necessity of increasing productivity in agriculture, the agrarian sector should be allowed to derive greatest benefit from the production of fertilizers. The widespread use of fertilizers in agriculture would improve the degree of self-sufficiency so far as the food supply is concerned, bring relief to the foreign-currency budget, and change the fellahs' attitude towards modern methods of productions.

Let us now turn to a labour-intensive project which offers the advantage of requiring low capital cost, affording a large number of employment opportunities and providing for the sale of the products on the world market.

The climatic conditions in many Arab countries permit a rapid expansion of fruit and vegetable growing, but major domestic and export sales still founder on inadequate stores, relatively tasteless and nondurable packing, and the lack of a sufficient number of canneries.

On the other hand, however, Lebanese enterprises as well

as some enterprises in Maghreb show that the preparation for export of tropical and subtropical fruit, which involves a considerable amount of manual labour, creates a large number of jobs, of which the actual cost is extremely low.

The favorable export chances, especially for fresh fruit and fruit juices, which will further improve in the next years through increased purchases by the socialist states, will provide excellent opportunities particularly for the Arab countries because of their distinct advantages with regard to transport as well as to the relatively early ripeness date.

Mention could still be made of a number of other examples of establishing labor-intensive technologies such as, for instance, the production of small agricultural implements within the framework of small and village-based industries. They are basically similar in their respective consequences. They are, as a rule, a historically conditioned transitional stage for overcoming economic backwardness. This does not, however, imply that small industries should be regarded as necessary evils, so to speak. Small industries are an absolute necessity, as may be convincingly demonstrated in the light of examples from the various highly industrialized countries. The potentialities presented here altogether amount to the combination of the two said methods, the concentration of financial means on structure-determining branches of industry — in many Arab countries, therefore, the chemical industry — and the orientation towards export.

The more rapid and more rational the available resources are utilized and mobilized, the more rapid will be the stabilization of the growth of population as well as the reestablishment of a sound balance between production and consumption, between the material basis and the development of population.

It is evident from the wealth of problems still awaiting solution in the Arab countries that only those countries will be successful which will succeed in breaking the resistance offered by reactionary forces and whose governments will consistently take and enforce measures in the interest of social progress.

The elimination of profiteering and the full utilization of the scientific and technological revolution for the creation of

a solid material basis can only be the result of radical political, economic, and social changes, a task to which, for example, the U.A.R., Syria, Iraq, and Algeria have already subscribed.

I am absolutely confident that those countries which have subscribed, or will subscribe, to this particular approach will be able to fully utilize the scientific-technological revolution in the interest of both economic and social growth.