Vladimir Turchenko was born in Tomsk in 1928. He is graduate of the Tomsk Teachers Training College. At present he works in the Siberian Branch of the Academy of Sciences of the USSR.

"At the present time," writes Turchenko, "education has merged organically into a single system of social production, science and technology, in a system that is as a whole undergoing revolutionary changes at an historically unprecedented rate."

The book examines the fundamental directions that the revolution in education will take: introduction of teaching machines, instruction from a younger age, linking instruction with productive labour, "continuous" education, and so on.

The author stresses that education is a necessary but far from sufficient condition for the emancipation of the personality. To obtain the latter, it is necessary above all to do away with the social conditions that, continually and on a large scale engender ignorance, illiteracy and semi-literacy among the masses. Under socialism, education has become not only the personal affair of every individual, but also a concern of society as a whole. Independent of its utility, education is the essence of the new man.))

The Scientific and Technological Revolution and the Revolution in Education

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V. TURCHENKO

The Scientific and Technological Revolution and the Revolution in Education

Translated from the Russian by *Kristine and John Bushnell*

В. ТУРЧЕНКО

НАУЧНО-ТЕХНИЧЕСКАЯ РЕВОЛЮЦИЯ
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CHAPTER ONE

THE STRUCTURE OF THE SCIENTIFIC-TECHNOLOGICAL REVOLUTION AND EDUCATION

1. THE SCIENTIFIC-TECHNOLOGICAL REVOLUTION AND ITS INTERCONNECTION WITH EDUCATION

In the intricate complex of historical processes in the second half of the 20th century, one of the most crucial is the scientific-technological revolution. It is going on in socialist and capitalist countries and is beginning to take hold in the countries of the Third World; it is thus acquiring a global character. The scientific-technological revolution itself is a profound, qualitative revolution in the forces of production—in this lies its importance. It offers possibilities for a radical transformation of the methods of production, creating advanced instruments of production, incorporating new principles, advanced materials, it brings new industries to life and makes possible a previously unheard-of increase in efficiency in all aspects of production.

A task of historical importance—joining the accomplishments of the scientific-technological revolution with the strengths of socialism—is being carried out in the Soviet Union.

Many interesting and valuable monographs on the scientific-technological revolution have been published in the USSR,[1] as well as papers from scientific conferences and articles in periodicals. All authors are agreed that the essence of the scientific-technological revolution are simultaneous revolutions in technology and science that complement, reinforce and deepen each other. Many theoretical questions still await resolution—there is a whole "labyrinth" of views on the nature of the interrelationships of the main components and structures of the technological revolution.

What, then, is the revolution in technology?

The current revolution in technology is usually considered to be the automatisation of the processes of production — from automated production lines and shops to automated factories, automated control of industrial sectors and associations. Here the leading role is played by the introduction of electronic technology and computers. The technological revolution also encompasses the development of nuclear engineering, space exploration and the creation and widespread application of new synthetic materials with special properties. Along with this, the technological revolution is apparent in the spread of new industrial methods in construction, in agriculture, and in the application of fundamentally new means and methods of communications.

Today, the new potential for transforming the technology of production that has come about with the creation of optic and quantum generators (lasers) seems almost fantastic. Lasers make it possible to process materials in fundamentally new ways and to create computers more powerful than the present ones by several orders of magnitude. The use of holographic principles allows the creation of high-speed computers with practically total recall, it allows maximum simplification of the process of feeding data into the computers, and allows us — on an essentially new basis — to solve the most difficult, central problem of cybernetics — pattern reception.

All this signifies a profound transformation both in the instruments and other technical means of labour and in the methods of managing and organising the process of production (i. e., with respect to process engineering) and even in the objects of labour. Consequently, *it is necessary to think of the technological revolution in the broadest sense of the term — as a revolution in the very elements of the productive forces.*

And what does the revolution in science consist of at the present day?

The revolution in science is a dialectical negation of all the previous and essentially mechanistic views of the world. The process of revolutionary transformation encompasses almost all the natural sciences. Their paradigms, i.e., the established, basic premises, canons and conceptions that yesterday seemed

certain today reveal their shortcomings and limitations and are being rapidly replaced with new paradigms.

As a result of the headlong development of the branches of natural science connected with technological progress, a group of sciences, consisting of physics, chemistry, biology, cybernetics and mathematics, is coming to the fore. And the mathematicisation that is going on in all the individual sciences leads to a substantial elevation of their theoretical level and practical utility, which in turn effectively augments technology and man's transformation of nature. New sciences arise, such as cybernetics, information theory and operations research. Various hybrid disciplines arise at the junction of different sciences: physical chemistry, biochemistry, biophysics, economic cybernetics, bionics, astrobiology, engineering psychology, etc. Along with further differentiation, a tendency to integration and synthesis is acquiring great significance in the development of scientific knowledge. In connection with this, philosophy acquires particular significance, as do sciences combining different disciplines focusing on common, specific structural aspects in the process of cognition — the general theory of systems, cybernetics, semiotics, etc.

The revolution in science cannot be reduced, of course, to changes in the content and structure of knowledge; it is apparent, too, in the exponential growth of scientific personnel, in the number of publications, the financial expenditures, etc., and also in the "industrialisation" of science, i.e., in the high level of its use of technology. Particle accelerators, nuclear laboratories, electron microscopes, radiotelescopes, hydrocannons, modern equipment for studying the depths of the earth, computers, and experimental factories — all of this profoundly transforms not only the technical base, but also the content and organisation of science. At the same time, scientific research institutions are to an increasing extent concerned with production (on an experimental and on a mass scale) of various material goods.

How does the revolution in science relate to the realm of productive forces?

Not so long ago, some authors asserted that science has only an indirect relation to society's productive forces, inasmuch as science is a product of mental labour and studies the

regularities of the objective world. How did this point of view come about? Science is a form of social consciousness and productive forces are the most important element of social being. These two categories have been often viewed as absolute opposites, influencing each other only superficially. In reality, their interrelationship clearly reflects the tenet of the Marxist dialectic "that all dividing lines, both in nature and society, are conventional and dynamic, and that *every* phenomenon might, under certain conditions, be transformed into its opposite..." [2]. Marx's thesis on the role of science as a direct productive force is based on a dialectical understanding of the interrelationship of the material and the ideal. Soviet scholars have given this problem no little attention and the author feels it unnecessary to dwell on it.[3]

Today, Soviet science often speaks of science's direct role as a productive force. However, the nature of this process is understood in different ways. Many authors feel that science merely "permeates" all the material elements of the productive forces and is not an independent element. Others hold that science is embodied not in technology alone, but is itself a factor in production, science being in fact a cause of the development of production. Science gives production new, more progressive objects of labour, more rational forms of organising technology and methods for running individual enterprises as well as the whole of the national economy.

Injecting science into the processes of production will, according to many scholars, lead in the near future to fundamental breakthroughs in our understanding of "technology", "instruments", "machines", "instruments of labour", and "object of labour". The production processes of the future, for example, will not be based on the principle of tools coming into contact with the article produced, but on non-contact and continuous working. It will take place in a controlled field according to a set programme. The electromagnetic field will serve as the energy carrier. Instead of the huge machines of our time, ions and electrons will be the tools acting directly on the article; the working agent will be chemical reactions and high-temperature plasma. Gas jets, laser beams, the lines of force of the electric field, etc. will be both tool and transmission mechanism.

Taking all these facts and tendencies into account, many scholars come to the conclusion that under modern conditions *science turns into an element in the productive forces*, an element that, along with the human forces of production and technological means, acts directly on the object of labour. This formulation of the question encompasses the content and essence of the process of turning science into a direct productive force. With this in mind, one must recognise that a revolution in the field of science has a direct relationship to the revolution in modern productive forces.

The technological revolution has a particularly profound impact on the *main element in the forces of production — the worker.* Today, machines do 99 per cent of all work — 100 years ago they did only six per cent and the remaining 94 per cent was the physical labour of workers.[4] The proportion of physical labour has been reduced drastically, but one observes paradoxically: the role of the "human factor" has not been reduced in proportion to the increase in mechanisation, as was the case during the first industrial revolution — on the contrary, the role of the "human factor" has increased. We are speaking here neither of "man in general" nor of abstract producer of material wealth, but of man in the concrete sense, i.e., of man who has the necessary work habits, professional training, and who possesses specific knowledge and culture. The centre of gravity in production moves from abstract to concrete labour. Thus, the technological revolution to an ever greater extent makes necessary not only highly developed skills, but also harmonious development of the human element.

The question of man's place and role in the contemporary scientific-technological revolution has already received wide-ranging theoretical consideration.[5]

Contrary to bourgeois scholars, who assign man the role of passive victim vis-à-vis the "demons" of science and technology, Marxist philosophers show that man is not only the object acted upon by the technological revolution, but also the subject — an active, creative force. They show, too, that the new, objective demand in the progress of the productive forces — the need to ensure the harmonious development of the working man — first, coincides with the principal social goal of communism and, second, is contrary to the nature of

bourgeois society and therefore leads to the aggravation of all the internal contradictions and of the general crisis of capitalism.

One of the most important results of Marxist research on the problem of the technological revolution is the conclusion that *it is impossible to restrict the modern technological revolution to scientific or technological progress.* To the extent that science becomes a productive force, the universal education of people, the development of the creative forces of every man, becomes a crucial parameter in the development of the material base of civilisation and all the more becomes an inseparable component and an independent factor in the growth of the forces of production.

Thus, the revolution in science and technology and the development of the workers themselves are related aspects of the transition of the productive forces to a qualitatively new level, a process in which science is transformed directly into a productive force while the human element in the productive forces — the worker — no longer takes a direct part in production, but manages or controls it. Thus for the first time in history man has time to think of himself, of his cultural development. This circumstance is in turn a new and powerful factor in accelerating the technological progress.

The influence of the human factor on industry, science and technology is no longer determined chiefly by physical labour, but by the man's spiritual potential and, most of all, by his scientific knowledge, which to a great extent is provided by the *system of education.* Consequently, the question of the place and role of man in the modern technological revolution can be viewed through the prism of this system.

The question of the interrelationship of education with technological progress is a question that has not been yet given much attention. Everyone recognises that in general technological progress requires substantial changes in the present system of education. Whether the extent and speed of these changes make this a revolution in education or whether they should be limited, at least in the next decade, to gradual improvements of an evolutionary character — this question is not yet clear.[6] In general theoretical models of the scientific-technological revolution proposed by different authors, the system of education is usually not even given separate treatment.

But the question of a revolution in education has been raised by life itself. Therefore, the author sees his tasks to be, first, to give this question a consistently scientific, Marxist, treatment and, second, to analyse methods of arriving at a practical solution to the problem, a solution that would answer so far as possible to the demands of the scientific-technological revolution.

There is reason to believe that today, on a theoretical and even on a practical level, there is a definite underestimation of the role of education in scientific and technological progress and in economic development.

Researchers stress that education should promptly reflect the changes going on in science, technology and production. But this is only one side of the question. The other side is whether, in the context of the technological revolution, education can and should be *not only a necessary condition* but also an *active cause* of progressive changes in all the other elements, as a factor that accelerates scientific and technological progress and the development of production. Therefore there is reason to suppose that education should indeed be considered a crucial element in the theoretical models of the technological revolution.

It is legitimate to picture the structure of the scientific-technological revolution as consisting of three fundamental elements: *production-education-science.* "Production" in this case means that sphere in which a specific product — material wealth — is produced. "Technology" is an indirect element in this sphere. "Education" is the sphere that prepares the labour force in specific ways. The tasks of this sphere cannot be reduced, of course, simply to reproducing the labour force; but since, in this instance, education is viewed as a constituent part of the scientific-technological revolution — a revolution in the forces of production — such an approach is legitimate. "Science" is that sphere in which new knowledge is produced.

The fact that these three elements objectively form a certain entity and are decisive factors in the efficiency of the national economy is the basis for their theoretical union in a systems

model. The formal basis of this model is the fact that all three elements can be considered from a single point of view—as spheres producing a certain interrelated product. At the same time, the three spheres are separate from each other in the labour resources they require, in finances, and in management—as is reflected in statistics. The latter circumstance has significance also in that it substantially facilitates both theoretical research on the problem on the basis of the model proposed and the transition to practical control and optimisation of the scientific-technological revolution.

2. THE DEFINITION OF EDUCATION

Because it occupies a central place in the present study, it is necessary to analyse the concept of "education" and to define exactly the sense in which the term will be used.

"Education" is defined differently and it is used in such different ways in scholarly literature that it is often the cause of misunderstanding and debate. Definitions of the concept vary widely both in terms of the "breadth" of the subjects it encompasses and in terms of the aspects included in the subjects themselves. In some cases "education" is understood to mean primarily *the process of acquiring knowledge*, while in others it is the *result* of this process, i.e., *the totality of organised knowledge and the habits and skills connected with it*—and not infrequently, both the process and the result. Quite often the concept signifies a specific *social institution*, the totality of educational institutions or "forms of instruction" including secondary, vocational and technical, specialised secondary, and higher education. In such cases people speak of "public education". Expanding this term somewhat, Professor V. A. Zhamin includes, in addition to the above, the system of measures for raising the skills and self-education of blue- and white-collar workers.[7] Since education is objectively a relatively independent, self-contained, autonomous system, it is entirely legitimate to include in the concept of "education" the corresponding administrative organs, as does, for example, the Bulgarian economist R. Donev.[8]

Sometimes education is interpreted very broadly: any conscious or unconscious assimilation of culture and all

socio-cultural factors influencing man are considered educational. But in this case, as the sociologist S. N. Yeremin from Siberia duly noted, delimiting fundamental concepts such as upbringing, education and schooling is quite problematic, and framing the question of the relationship of education to other social factors is at the very least incomprehensible if everything that imparts any information to man is considered educational.

The first thing that distinguishes education from all other processes connected with the reception of information is that it is functionally geared to shaping personality. The Russian word *obrazovaniye* (education) is analogous to the German *Bildung*—both are based on the root word for 'image' in these languages. A. V. Lunacharsky observed that "it was obvious that when people had to determine what a man should make of himself and what society should make of him, they envisaged a human image arising out of some sort of material".[9] In the broadest sense, education can be taken to mean the entire process of the physical and mental formation of the personality, a process consciously oriented to several "ideal images"—social standards that are historically conditioned and more or less clearly focused in the social consciousness. In this sense, education is an inseparable aspect of life in all societies, affecting each and every individual.

However, a definition of the specific character of education based on its role in upbringing does not go far enough. The most important aspect of education is the transmission and reception of knowledge. The American professor Fritz Machlup, for example, views education as the process of training, of acquiring knowledge in general—including education in academic institutions, industrial training, educational television, education at home, "enlightenment" in church, military training, self-education and education based on personal experience.[10] In this approach, such qualitatively different processes as acquiring scientific knowledge and common experience in general are subsumed in one concept.

In Soviet literature, "education" often takes on a very broad meaning, education becoming synonymous with "enlightenment". The system of education is defined as a system of educational institutions, including pre-school education, children's extra-curricular institutions (Young Pioneers,

Young Technicians and Naturalists), children's homes, the network of cultural-educational institutions for adults, clubs, libraries, museums, etc. Inasmuch as both the system of educational (academic) institutions and the system of cultural-educational establishments have the function of transmitting cultural values, of educating people, then in its specific goals education can be understood to mean "enlightenment". However, these systems—in their concerns and the nature of their functions—are so crucially different that more often than not it is necessary to examine them separately. Unfortunately, this is not always done.

The variety of definitions of "education" cannot be explained simply by the subjective inclinations of different authors, or by lack of theoretical treatments of the question. This variety stems above all from the complexity and multi-faceted nature of the object being defined. Inasmuch as the object has so many aspects, definitions based on these different aspects will be different. As V. I. Lenin observed: "There can be many definitions, for objects have many aspects."[11] When a researcher examines one or another aspect of the problem in isolation, he gives definitions and builds theoretical models that correspond to specific cognitive goals. So we find different working definitions in the literature. Each is perhaps the most adequate in relation to a specific class of cognitive goals. For example, the definition of education as the totality of systematised knowledge and the skills connected with it is quite suitable for focusing on the content of training and for studying the cultural level of the population or of one or another social group. The definition of education as a process of acquiring knowledge is more adequate in relation to many pedagogical tasks.

The task of the present author is to examine the system of education in its sociological aspect as a relatively independent system within the economy, a system fulfilling specific functions connected with spreading scientific knowledge and knowledge of industrial processes, with the social reproduction of the labour force, and as an element in the structure of the scientific-technological revolution. Therefore we will define "education" in accordance with the specific task at hand.

One of the most important functions of education today is

the *professionalisation of the younger generation*, the preparation of a skilled labour force for the national economy.

The productiveness of labour is determined by various factors, among others by the "average amount of skill of the workman",[12] or in other words, the worker's qualifications. The latter, as technology progresses, is more and more connected with general education. In the mid-1930s, a high level of worker's skill meant, above all, the development of an exceedingly high level of very specialised practical skills acquired through long years of experience. Today, instead of skills acquired through practical experience, industry demands more and more workers with high skills based on a general education. For example, according to the calculations of some American economists, in 1930 eight-grade education was adequate for mastering 58 per cent of the jobs, while in the 1970s eight years is sufficient for mastering only six per cent of the jobs. The proportion of jobs demanding education beyond high school has grown in this period from 10 to 68 per cent.[13]

Education has become a necessary requirement for the reproduction of the labour force. If an individual hasn't had at least several years of formal education, he is today practically deprived of the chance to master a modern trade. And vice versa, educational preparation in academic institutions is a surety and an important factor in production skills.

Higher and specialised secondary educational institutions and vocational schools supply skilled professional workers for social production. Schools offering a general programme of education form the basis of practical professional preparation for all areas of specialisation, without exception. In this way, the educational system produces the labour force for all areas of social production, preparing either the "finished product"—specialists, skilled workers, or the "semi-finished product"—people with the necessary general education who are capable of developing the required production skills directly on the job.

While stressing the major role education plays in shaping individuals into participants in social production, it would be incorrect to reduce all its functions to this. A second task, though not secondary in importance, is *to ensure the socialisation of the younger generation.*

The essence of socialisation, according to the Polish sociologist Jan Szczepański, is expressed in Robert E. Park's notion that an individual is not born a person but becomes one through a process of education. A child at the moment of birth is but a biological organism that turns into a person or rational human being capable of working and creating only in the process of adults influencing the child by training and by "introducing" him to value systems and patterns of behaviour.[14] Therefore it is necessary to examine socialisation as, above all, a process of forming the social personality. With regard to assimilation of new values and norms connected with the transition of "adults" (in the sense of people already socialised) from one set of social conditions to another, one should speak of social adaptation.[15]

In bourgeois sociology, socialisation is often understood one-sidedly—as a passive acceptance of a system of patterns of behaviour sanctioned by the group.[16] Actually, an individual not only perceives and assimilates certain models of behaviour, he also acts upon them—whether he accepts and reinforces them or negates them. In so doing he shows himself not only an individual but also a socially active personality. In a class society, socialisation necessarily takes on a class character. As he masters the set of general cultural values and norms of behaviour, the individual masters the values and norms of specific classes.

Socialisation is thus a process of introducing the younger generation into a system of social roles determined by the socio-economic structure of the given society, by means of active mastering and development of existing systems of values and norms of behaviour.

Till the middle of the 19th-beginning of the 20th century, even in the most developed countries, socialisation, like professionalisation, of the younger generation took place basically in the family, the immediate social environment and through direct participation in labour processes. Under present conditions, the educational system is acquiring ever increasing significance.

Today, before entering the system of social production and social life, every individual in every industrially developed country undergoes many years of preparation in the educational system. As a consequence of the growing complexity

of production and of all other areas of human activity, the family can no longer prepare children for life to the extent that it used to. The inclusion of an ever growing portion of the female population in social production, the expansion of their role in all areas of social life, a limiting of the size of the family, the persistent tendency of the young to form independent families—all this objectively reduces the family's role in education. So, according to the degree of industrial development and scientific-technological and social progress, the role of the schools as institutions for socialising the younger generation is growing steadily.

The educational system thus has two basic functions in society: socialisation and professionalisation of the younger generation. At the early stages (elementary and secondary general schools) the first function is predominant while the second goes on beneath the surface: obtaining a general education can be viewed as the creation of a foundation for a future profession. In specialised secondary schools and at the college level the function of professionalisation comes to the fore. By this time young people have come a long way in their socialisation and complete it through study and further work.

Of course, these functions actually form a whole, one cannot exist without the other. Nevertheless, objectively, the whole also includes their differences, and this provides the basis for differentiating them on a theoretical, on an abstract level. Such an approach facilitates contrasting and comparing the systems of education in countries with different socio-economic and political structures, facilitates arriving at a more profound knowledge of the essence of the systems of education and defining their place and role in the mechanism of the scientific-technological revolution.

The processes of socialisation and professionalisation, the dissemination of knowledge, or experience, skills, the inheriting of spiritual values and norms, the education and upbringing of members of society—all this goes on, of course, not only in specialised educational institutions. Moreover, the general material-technical, socio-economic, political and cultural conditions of the lives of individuals play the predominant role in these processes. In connection with this, we shall try to define the characteristic features distinguishing the sphere of educa-

tion from other social mechanisms of disseminating knowledge and education.

As a rule, bourgeois scholars view the educational system in a social vacuum, without taking into account the fundamental differences in the content and aim of education systems in countries with different socio-economic and political structures.[17] Moreover, absolutising the relative independence and efficacy of the educational system, they sometimes see the system as the source of the Soviet Union's economic and social accomplishments. In so doing, they pursue far-reaching political goals: bourgeois ideologues try to diminish, to reduce to naught the significance of the socialist structure as the source of strength and progress of Soviet society. "We know now," writes the American sociologist Peter F. Drucker, "that the Russian achievement does not rest on the communist tenets of 'socialist ownership of productive resources', the 'dictatorship of the proletariat', 'collectivisation of agriculture' or 'national planning'. Every one of them has been as much an impediment as a help, a source of weakness fully as much as a source of strength. The achievement rests squarely upon tremendous concentration of resources, time and effort on producing an educated society."[18]

In fact, history convincingly shows that the socialist revolution made possible and gave birth to an unprecedented upsurge of education and culture among the masses of working people, an upsurge that in turn had an exceptionally positive influence on all aspects of social life. In a subjectivist manner, Peter Drucker destroys the complex, dialectical cause and effect relationship and views everything narrowly, one-sidedly from a distorted, inverted point of view.

The social structure has always determined the essence and character of the educational system, not the reverse. Although education fulfills economic functions, it is, as a whole, part of the superstructure. As the Soviet sociologist L. N. Kogan has pointed out, the social model of education, which includes its goals, structure, system of institutions, and, above all, its content, is elaborated by ideologues of the ruling class, and the model is often sanctioned by state power. It also reflects all the specifics of a given society, its national traits. Therefore, even in societies with similar socio-economic and political structures,

the educational systems are not identical. However, given all the specific features of individual countries and differences in the social model of education in different socio-political systems, there are still points of similarity in the structure of education.[19]

We will try to formulate just what these similar factors are that express the specific character of education, that define it as a special sphere of activity and that must be reflected in the definition of education.

On the most abstract level, education is, first, a specific sphere of activity in a system of the social division of labour, a sphere whose basic task is to disseminate knowledge and related practical experience, to socialise and professionalise the members of society. Second, it is a dialectical unity of three components: institutions of education, processes of education and results of education (knowledge gained). Third, education is pre-eminently connected with spreading systematised, scientific knowledge, the assimilation of which occurs chiefly in cognition at a level of abstraction and systematic logic (as opposed, for example, to cultural institutions in socialist society that are oriented mainly toward general spiritual and cultural development primarily through an emotional-aesthetic apprehension of reality). Fourth, the activity of educational institutions is clearly directed to concrete people (while the scope of cultural institutions only coincidentally focuses on concrete people). Fifth, education is connected with the attainment by students of formally determined patterns of knowledge and skill. Sixth, the operation of the educational system requires strict (mainly state) controls for determining (through examination) an individual's mastery of established standards of knowledge and skill as well as the dispensing of so-called licenses, i.e., legal dispensation for individuals who have reached a certain level in a particular type of professional activity, to pursue that profession.

From a sociological standpoint, education is a social institution consisting of professional pedagogues and of students for whom learning is most likely a fundamental occupation or an activity that exists alongside their main work. Its basic task is to educate the younger generation that has not yet entered the system of social production, and also a certain part of the

working population. Long years spent in this social institution are today a prerequisite for the professionalisation of every member of society. The content of education and upbringing as well as processes of socialisation and professionalisation is determined by demands deriving from the material-technical conditions of social production, from the socio-economic and political structures.

In summary, education can be defined as *a relatively independent system, the goals of which are the systematic training and education of the members of society. Education and upbringing are oriented to the mastery of a specific body (in accordance with formally determined standards) of knowledge (above all scientific), the mastery of values, skills and norms of behaviour connected with this body of knowledge and values which will, in the final account, be determined by the socio-economic and political structure of a given society and its material-technical base.*

3. THE "EDUCATION EXPLOSION"

One of the most notable phenomena in the post-war world development has been the unprecedentedly rapid expansion of all parts of the educational system and the system's transformation into what resembles a gigantic industry employing (as instructors and students) hundreds of millions of people. Schools, specialised secondary schools and institutions of higher education have turned into major organisations similar in many respects to industrial enterprises. The traditional demand of democratic forces—expansion and increased accessibility of the educational system to all strata of the population—has become in this age of scientific and technological revolution an expression of an absolute necessity for progress in material production and has become a categorical imperative of our time. So, despite opposition from conservatives and reactionaries, it is difficult to find in the world today a country which has not witnessed substantial progress in the realm of education in the past 20 years.

Thus in the 1950s-1960s, the number of students in the world more than doubled and reached (according to incomplete data) approximately 650 million. And there is an interesting pattern: the higher the educational level, the more

rapid the growth. From 1950 to 1966, the number of elementary school students increased 1.8 times, while students at the secondary school level increased by 2.4 times, at the college level by 3.2 times. The rate of the growth of the total number of students many times outstripped the rate of the world's population growth.

The fastest increase in the number of students is in developing countries, which today are making a tremendous effort to overcome their age-old technical-economic and cultural backwardness. Thus, for example, while the total number of students in the world increased in this period 1.9 times, in Latin America the increase was 2.6 times, and in Africa, 3.4 times.[20] Since these countries began to develop from an extremely low level, they are still, by the basic indices of the level of education, many times behind industrially developed countries. Their initial task is to give the majority of children an elementary education, or at the least to provide them with the basic tools of literacy.

Under pressure from the objective needs of technical progress and from the struggle of the working masses, the number of students in the 1950s and 1960s grew in the developed capitalist countries through increased access to secondary schools and colleges. For example, in Japan during this period, the number of students in elementary schools and incomplete secondary schools even fell, while in secondary schools the number more than doubled, and quadrupled at the college level.[21] At the same time, the proportion of people with higher education is sharply increasing. In the most developed countries, youth in colleges comprises 10-30 per cent of their age group.[22]

Moreover, the understanding of what constituted an "educated person" has undergone a change in social scale. At the beginning of the century, just finishing secondary school had, in many instances, greater significance for social mobility than graduating college does today. Thus, in the period of the industrial revolution students as a rule finished elementary school, while today in the most developed countries about 70 per cent of youth finish secondary school.

In socialist countries, the education of the population is a constant concern of the Communist Party and the state. The

USSR is completing its transition to a universal secondary education, in other socialist countries a universal secondary education is the principal policy in school affairs.

A striving for knowledge, for training, has been a characteristic feature of the Soviet way of life. At a time when the system of education all over the world was evolving slowly, education in the Soviet Union in the 1920s-1930s underwent a rapid expansion. In 1940, the number of students in general schools was 3.7 times greater than in 1914-1915; the number in specialised secondary schools was 18 times greater, and at the college level—6.5 times greater.

The last two decades have witnessed a new, rapid, leap-frog growth in the entire Soviet public education system. Even during and after the war (from 1940-1941 to the 1950-1951 academic year) the number of students in all types of education (not including political enlightenment programmes) grew by 1,223,000. In the following decade it grew by 3,923,000, in the last decade by almost 27 million, and in 1974 totalled 85.6 million. From 1950-1951 to the 1969-1970 academic year, the number of students in grades 1 through 4 increased approximately by 5 per cent, students in grades 5 through 8 increased 50 per cent; in specialised secondary schools by more than 230 per cent; at the college level 260 per cent and at the graduate level 350 per cent.[23] The number of students in all types of educational institutions in the USSR is continuing this rapid increase.

The "education explosion" is seen, too, in the mushrooming expenditures for education. At the beginning of the 1950s, the majority of industrialised capitalist countries spent from 2-4 per cent of their GNP on education, by the end of the 1960s they spent 6-7 per cent—the increase in absolute terms being many times above this.[24]

The tendency for the rate of expenditure on education to outstrip the growth of the GNP, volume of investments and national income was in the 1920s and 1930s characteristic only of the USSR but can be observed in almost all countries of the world after 1950.

An especially rapid increase of expenditures on education is noticeable in the developing countries of Africa, Asia and Latin America. In 1950, these countries contributed five per cent of

the world's expenditures on education, in 1964—ten per cent. Between 1950 and 1965 their expenditures on education (in current prices) grew 8 to 15 times, and education's share of the monetary portion of the national income reached 10-14 per cent. In India, for example, expenditures doubled regularly every 5-7 years.

At the same time, in terms of absolute expenditures and especially in terms of per capita and per student expenditure, developing countries are 10 times, and some even hundreds of times, behind the most developed capitalist powers. For example, at the beginning of the 1960s, according to UN statistics, the per capita educational expenditure in the US was $97, while in Bolivia it was $2.50, in Ethiopia, less than $.50. Educational expenditures in the countries in Central and South America, Africa and Asia amounted to only 10 per cent of the total world expenditures for education while more than two-thirds of the world's population and four-fifths of the school-age children live in these countries.[25]

Thus, the so-called "education explosion" that has in fact begun in the second half of the 20th century is, in the capitalist world, of an especially contradictory nature. The rapid leap toward a universal secondary education and to wide-ranging college-level education contrasts sharply with the fact that the majority of working people still do not generally have opportunities to study. Education does not reach a huge section of humanity. A significant portion of the adult population of developing countries is illiterate. In many instances, the relatively high rate of growth in education in these countries is accompanied by an increasing gap between the level of education of the peoples in developing countries and that in the most developed countries.

Nevertheless, the "education explosion", the rapid, uneven expansion in the realm of education, an expansion connected with education's transformation into the largest area of human activity in the world, is without a doubt the most significant phenomenon of the present day. The question is: What are the main reasons for this process? How is it connected to the scientific-technological revolution? Is the explosion a mere "accompaniment" to the revolution, its derivative, or a direct expression of one side of the scientific-technological revolu-

tion, an essential element in the structure of that revolution? The Director of the International Institute of Educational Planning, Professor Philip H. Coombs, sees as the reasons for the "education explosion", first, the mounting educational aspirations of parents and their children; second, increased attention to education by the governments of many countries; and, third, the population explosion.[26] The latter is, of course, a motive cause of the expansion of education, but it cannot be considered a fundamental cause. It is already apparent that it is not only the absolute number of students that is growing by leaps and bounds, but also the percentage of different age groups who are students, and, moreover, an analogous process is observed in countries not experiencing a population explosion. So far as Coombs' first two points are concerned, both need elaboration. It is not very convincing to ascribe the jump in the growth of education by a "snowball" effect: every person who received a minimum education wants his children to receive more, which results in a rise in the demand for more education, etc. The question is why did all this suddenly start to happen in the last 20 years?

To clarify the real reasons for the swift development of education and also to clarify the question of what connection this has with the scientific-technological revolution, we must, as is apparent, take a broader philosophical-sociological approach. In accordance with the requirements of Marxist-Leninist methodology, the system of education must not be considered in a social vacuum, but as a part of specific socio-economic systems and in relation to a definite level of development of productive forces.

So we must seek the reasons for the "education explosion" in those profound changes occurring today in the productive forces and in the social relations in the different countries of the world. The educational system in any society has under contemporary conditions certain social and economic functions. If we are to understand what these functions are, we must analyse concretely and thoroughly the profound, qualitative differences between the social processes in socialist and capitalist countries.

CHAPTER TWO

THE CONTRASTING SOCIAL FUNCTIONS OF EDUCATION UNDER CAPITALISM AND SOCIALISM

1. THE ANTAGONISTIC CHARACTER OF THE SOCIAL FUNCTION OF EDUCATION UNDER CAPITALISM

In a broad sense, one can speak of the "social function" of education as the impact of education on all aspects of life in society. In a narrower sense, this social function is education's impact on a society's social (as opposed to economic), political and cultural development proper. The term will here be used in this second meaning.

At present, the bourgeoisie cannot ignore the needs of scientific-technological progress and is forced to introduce universal elementary and secondary education and even to expand the working people's access to higher education. The New Program of the Communist Party of the USA notes: "The student population grows apace as modern technique requires ever higher levels of education. The college student body now includes a rising proportion of youth from families of workers."[1]

Bourgeois sociologists and propagandists try in every way to exalt the increased enrolment of the working class in secondary schools and colleges. They attempt to treat this as a demonstration that the educational system in capitalist countries can overcome social antagonisms and eradicate class boundaries. If you agree that at the present time education is a factor in the freedom of an individual, "...you will get some sense of the frustrations that the modern-day illiterate has to live with".[2] One cannot, in principle, deny that education, as John Kenneth Galbraith stated, "...is among other things, an apparatus for affecting belief and inducing more critical belief...".[3]

However, one must stress, first, that education is a necessary but far from sufficient condition for the emancipation of personality. Above all, it is necessary to eliminate those social conditions that continually give rise to ignorance, illiteracy, semi-literacy among the masses. Second, education, by itself, means nothing. It can be not only an instrument of enlightenment, but can also be a weapon in the ideological enslavement of the masses.

The cause and effect relationship between the social structure and educational system is inverted by bourgeois scholars and politicians. David Eccles, for example, correctly notes the reactionary nature of the social role of Britain's educational system, but then views education as one of the main reasons for class antagonisms that "...bedevilled industrial relations".[4] Similar views are extremely popular among liberal-minded ideologues inclined to see enlightenment simultaneously as the source of all evil and as a panacea for all social ills. The sociologist Roger Charles contends: "Unless the whole of our educational system is reorientated to reducing the barriers of ignorance, distrust and hate, industry will simply reflect the defects educated into us."[5]

Others feel that the spread of education among all strata of society is already minimising differences between representatives of the different social groups, that class struggle has already been overcome and that now, as Peter F. Drucker writes, it is only a spectre of the nineteenth century.

Research shows that there is a rather close correlative connection at certain quantitative intervals between individuals' levels of education and income. Seizing upon this fact, some bourgeois sociologists contend that under present conditions the individual's social status is determined above all by his education—and only secondarily by the level of income and other parameters of his social position.[6] And they usually ignore completely the one determining indicator—the individual's relation to the means of production.

The ruling classes, while permitting the expansion of the educational system, do not at all renounce using it as a weapon of social selections, as a means of strengthening their class privileges. Robert Lowe wrote, back in 1867: "...The lower classes ought to be educated to discharge the duties cast upon

them. They should also be educated that they may appreciate and defer to a higher cultivation when they meet it, and the higher classes ought to be educated in a very different manner, in order that they may exhibit to the lower classes that higher education to which, if it were shown to them, they would bow down and defer."[7] This cynical statement sums up in effect the bourgeoisie's general political programme in the field of public education, a programme by which it is guided to this day. The American economist Zvi Griliches writes that in spite of the tremendous increase in the number of college graduates in the US, the distribution of college students by social origin (father's occupation) has not changed significantly or adversely in the last thirty years. In the majority of West European capitalist countries, too, very little has changed in the period from 1955 to 1964 in terms of the proportion of children from the working class who attend college. In Austria and Greece the enrolment of this group has actually decreased.[8] So the system of bourgeois education, from the standpoint of its social function, moves toward reproducing and reinforcing the existing class structure of society.

In the majority of capitalist countries, usually no more than 20 per cent of all students completing the first stage of education enter secondary schools offering students the right to go on to college. In France, for example, 94 per cent of the children of the privileged strata of society enter lycées, as opposed to 45 per cent of the children of industrial workers and 32 per cent of the children of agricultural workers. The number of students from working-class families markedly declines in the process of education. Thus the percentage of dropouts in the senior classes of secondary school in Britain is 40 per cent, in Sweden—50 per cent, in West Germany—80 per cent. The overwhelming majority of dropouts come from working-class families. Elite secondary schools undoubtedly provide a high level of preparation but, as the Swedish educator Torsten Husén observes, this is achieved at the cost of lowering the level of education of the broad masses.[9]

Children of low-income families who enter secondary school, as the statistics convincingly show, have many fewer opportunities, in comparison with their coevals from well-to-do social

circles, to get a complete schooling and to receive certificates granting the right to enter college. The social position of a young person's family determines also the opportunity to receive a higher education. In France, for example, only two per cent of the children from the working class study in the École Polytechnique and École Normale Supérieure. The French Communist Party took note of this fact in its *Proposals for a Democratic Reform of Education*: "Education is understood above all as a rigid process of classification and selection. This is the essential feature of a school system in a society that is dominated by state-monopoly capitalism." [10]

In a working paper of the 32nd Session of the International Conference on Education held in Geneva in 1970, it was observed that opportunities to obtain a secondary, and even more, a college education are quite limited for specific classes and social groups. Children from propertied and ruling circles in the countries of the capitalist world are 80 times more likely to enter college than children of agricultural workers; 40 times more likely than the children of workers; and twice as likely as children from white-collar working families. The unequal representation of the different social classes in colleges is not a result of the college's selection process, it develops automatically from one age level to another, at every stage of school education.[11] In other words, the whole system of bourgeois education, from elementary to the highest levels, is a complex and rigid mechanism of class selection and discrimination against the working people.

In such a way, the basic social function of the system of bourgeois education today, as 100 and 200 years ago, is to reproduce and reinforce the existing class structure, to reinforce the privileges of the ruling classes, to spread the bourgeois ideology.

However, the social function of education under capitalism is contradictory. Along with its conservative and reactionary role, by which it reinforces exploitation and oppression, education without a doubt also plays a progressive social role. Not in vain have progressive thinkers of all times and peoples always urged the spread of enlightenment, of knowledge, urged the broad development of a system of educational institutions for the working masses. Many of them naively

supposed that the enlightenment of all strata of the population would by itself bring emancipation from the yoke of exploitation without revolution, simply from the fact that people would become "more intelligent" and would gradually carry out the necessary "rational" reforms.

Nevertheless, the demand for spreading scientific knowledge among the people, for extensive development of institutions of public education, has always been a progressive demand. Since modern technology has forced the bourgeoisie to give the working people a good education, young people receiving an education, above all students from the working classes, have, to an ever greater extent, proved capable of critically evaluating and analysing the material taught them. They learn to separate the wheat from the chaff and to evaluate vital issues. The most progressive and active students use the knowledge they gain in the class struggle against the bourgeoisie. History demonstrates that bourgeois educational institutions produce not only qualified specialists and defenders of the status quo but also the strongest of its opponents—leaders of the proletarian and democratic strata, fighters and revolutionaries.

Consequently, the social function of the system of education in the conditions of bourgeois society has a dual, antagonistic character: on the one hand, the educational system tends to reinforce and reproduce the existing relationships of exploitation of man by man, to reproduce social inequality and the political rule of the bourgeoisie. On the other hand, the education system leads to the aggravation of class antagonisms, to the growth of the self-awareness and cohesion of the exploited and their ability to conduct an organised struggle. Communists struggle in all ways possible to strengthen this aspect by democratising the educational system, by eliminating class barriers and by progressive renewal of the content of education and upbringing. However, while bourgeois relations prevail in society and the political dictatorship of capital is maintained, it is the first aspect of the social functioning of the system of education that unavoidably predominates—the defence and strengthening of the capitalist system.

2. THE SOCIAL FUNCTION OF THE SYSTEM OF EDUCATION UNDER SOCIALISM

Only after the socialist revolution and the establishment of the dictatorship of the proletariat is there a chance for fundamental change in the social function of education, a chance "...to convert the school from an instrument of the class rule of the bourgeoisie into an instrument for the overthrow of that rule and for the complete abolition of the division of society into classes".[12]

With the establishment of the power of the working people, the role of the educational system as a factor in social progress has grown immeasurably and its social direction has acquired a qualitatively new content. Above all, education becomes not only the individual's personal affair, but an object of social concern. The state, the family and social organisations join forces to assure the education of the new generation. The development of education under socialism is, in a certain sense, a goal in itself. Apart from its utilitarian value, it becomes an independent value, an essential characteristic of the new man.

It is especially necessary to stress this circumstance, since in the scholarly literature there has been a certain underestimation of this aspect. For example, the Corresponding Member of the Academy of Sciences of the USSR, V. S. Kruzhkov, believes that the unbroken rise in the cultural-technological level of working people, as one of the regularities of the development of socialist society, plays a role subordinate to such other regularities as achieving the highest productivity of labour, which is the main goal of communist society.[13]

Apparently, the rise of the cultural-technological level of the worker and, consequently, of his education, is not only a means of attaining the highest productivity of labour, but also an independent goal of Soviet society, the most important step toward assuring the harmonious development of the personality. As the Fundamentals of Legislation of the USSR and the Union Republics on Education, adopted at the Sixth Session of the Supreme Soviet of the USSR on July 19, 1973, state with

regard to education: "The purpose of public education in the USSR is to produce well-trained, harmoniously developed, active builders of communist society, brought up on the ideas of Marxism-Leninism, in the spirit of respect for Soviet laws and socialist law and order, and communist attitude to labour, physically healthy people capable of working successfully in various fields of economic, social and cultural development, actively participating in social and government activity, people who are ready to selflessly defend the socialist Motherland, preserve and multiply its material and spiritual wealth, protect and conserve nature. Public education in the USSR is to provide for the development and satisfaction of the Soviet man's spiritual and intellectual requirements."

From the technical and socio-economic standpoint, highly educated members of society are today an absolute necessity and a prerequisite for including the individual in the system of social production and in relations of production. As modern technology and the system of relationships in production become more complex, varied, and diverse, they demand, not specific and narrowly specialised abilities but the most diverse abilities — not only in performance but also in creation. In practical terms, this means that progress in socialist production, from both the technical and the social standpoints, objectively demands highly educated members of society.

So that the worker can in fact realise in everyday life his rights as a co-owner and manager of the socialised means of production, so that he can take part in making and carrying out collective decisions, he must, above all, be familiar with these means of production, be able to use them rationally from the technical and the social points of view. Under modern conditions, this is tied to the necessity, above all, of a high level of general and specialised education.

As the research of Soviet sociologists shows, the participation of workers in disposing of the means of production, in directing production, is directly dependent upon the level of their education. As their level of education rises, workers manifest ever more organisational activity,

and show more initiative and real concern in their daily work.[14]

In September 1971, the Central Committee of the CPSU adopted a resolution ("On the Improvement of the Economic Education of the Working People"), which recognised a knowledge of economics as a mandatory part of working skills. Economic education, as the resolution notes, is an important condition for raising the level of the working people's attention to their work, for a growth in initiative and in the activeness of the workers in managing production.

An individual can acquire solid economic knowledge that meets the needs of modern production only after a thorough grounding in general education. Where the worker performs his direct job, lack of knowledge of many aspects of the work at hand can be compensated for by practical experience. Carrying out organisational and managerial functions places increased demands above all on the education of the worker. The results of an analysis of the materials of sociological research on the young workers of Nizhny Tagil persuasively testify to this. Thus, the correlation coefficients of the level of the workers' education and various data of their productive activity were as follows: fulfillment of the production norm — .109; raising qualifications — .112; participation in rationalisation — .211; participation in introducing the plans of NOT (Scientific Organisation of Labour) — .318; participation in directing production — .344![15]

Under modern conditions, demands in the areas of education and culture as prerequisites for social activeness have grown immeasurably. While technical conditions of production still do not demand everywhere even eight years of education, from the social point of view universal secondary education has long been a pressing necessity. The research of Soviet sociologists shows that the political and social activeness of working people is directly dependent on the level of their education. For example, the results of research among the workers of Krasnoyarsk Territory, carried out in 1963, show that the amount of time devoted to socio-political activity was directly dependent on the level of education. The sociologist A. G. Pusep from Siberia compiled the following table[16]:

TABLE 1

Time Spent by Workers on Social Activities
(hours per week)

Level of education	Time spent	
	Men	Women
3 grades	.22	.09
4 grades	1.25	.36
5-6 grades	1.36	.61
7-9 grades	1.70	.80
10-11 grades	1.56	1.78
Specialised secondary education	3.73	2.76

This dependency is extremely stable and is borne out by other research data. For example, in industrial enterprises in the Urals, the time spent on social activity by young workers who had a 4-grade education was on the average.7 hour per week; 5-6 grades — 1.2 hours; 7-8 grades — 1.4 hours; 9-11 grades — 1.5 hours; specialised secondary education — 1.3 hours. Young collective farmers with a 9-11-grade education took part in social activity 5 times more than those with a 4-grade education and 3 times more than those with a 5-6-grade education.[17]

As industrial and social life becomes more complex, the need for education of the individual as a necessary condition of his social activity grows. Thus, while in 1927, 71.4 per cent of the deputies of city Soviets had only an elementary education and only 3.8 per cent had higher education, in 1963, only 12.9 per cent had an elementary education and 25.2 per cent had higher education. Analysis of the changing composition of the deputies of the Kazan city and district Soviets shows that there was a rapid reduction in the number of deputies with only an elementary education (from 7-8 per cent in 1959 to 0.6-0.9 per cent in 1965) and in the number of deputies with 5-9-grade education and a rise in the number of deputies with secondary, specialised secondary and higher education.[18]

If earlier the system of education reinforced social inequality, under socialism it has a diametrically opposite function — to remove gradually social distinctions. Social inequality in the USSR is above all due to the fact that remnants of the old

division of labour have not yet been overcome, that substantive distinctions between skilled and unskilled, and between mental and physical labour continue.

Some authors consider the rise in the cultural-technical level of the workers to be the principal factor in the process of gradually eliminating the substantive distinctions between mental and physical labour. It is difficult to agree with this. The decisive factor in this process belongs to the change, on the basis of technical progress, of the substance and nature of labour. If not, then college graduates have to carry out functions of unskilled manual labourers, which sometimes happens in practice. Apparently, V. S. Kruzhkov is right when he says that the rise in the cultural-technical level plays a "subordinate" role in overcoming the existing distinctions between physical and mental labour, but that the solution of this problem in practice, of course, depends to a great extent on the cultural-technical level of working people.[19]

The educational system is directly connected, too, with overcoming the substantive differences between town and country. The educational system not only has an indirect influence on this process—through raising the working potential of those employed in town and country and, consequently, through developing the productive forces of society—but also a direct influence, since it aims at liquidating the gap between the levels of education of the urban and rural population.

In pre-revolutionary Russia, the juxtaposition of town and country permeated literally every sphere of life. In the realm of culture, it was expressed above all in enormous differences in the level of education and in the opportunity to obtain it. For instance, in 1897, for the ages of 9 through 49, only 21.7 per cent were literate in rural areas, as against 55.6 per cent in towns. From 70 to 80 per cent of the students of secondary and higher educational institutions were city dwellers, while only 13.4 per cent of the total population of Russia was urban. In 1914, among the urban estates 30 of every 1,000 people were receiving an education above the elementary level, while among the rural estates, only one out of a thousand was. For the children of the peasantry, secondary and higher education was virtually inaccessible.

As a result of the cultural revolution, as early as the beginning of the 1940s illiteracy had for all practical purposes been eradicated both in city and in country. In 1951, the transition to universal, compulsory seven-year education was completed, and by the end of 1961, to eight-year schooling for children of school age. The differences between urban and rural population in the level of education are being eliminated.

TABLE 2

Education Obtained by Persons 10 Years and Older
(per 1,000)

	Higher, incomplete higher and secondary (including incomplete secondary) education			Complete higher education		
	1939	1959	1974	1939	1959	1974
Urban	218	469	660	19	40	75
Rural	52	256	347	2	7	16

Source: *National Economy of the USSR in 1973*. Moscow, 1974. (In Russian.)

Differences in the opportunity of urban and rural youth to receive a secondary education are being overcome, too. For example, while in 1939 the number of students per 1,000 population in the senior classes in cities was 190 per cent more than in rural areas, in 1959 it was 55 per cent, in 1965 47 per cent, and in 1970 only five per cent.

The transition to universal secondary education being effected at present will mean that in the immediate decades the differences between city and country both in the number who have a secondary education and in the opportunity to obtain an education will for all practical purposes be eliminated.

The former contrast between formal education in urban and rural areas has long since disappeared. However, substantial differences still remain. Today, the question of the *quality* of education has come to the fore in the overcoming of substantive differences between the urban and rural school. The formally equivalent certificates awarded in city and village conceal unequal knowledge. "As experience shows, the level of general education of the pupils in rural schools still lags

significantly behind that of urban pupils. Entrance exams to higher educational institutions show that rural pupils, as a rule, have weaker theoretical preparation, inadequate practical skill in a number of subjects, etc."[20] Although there are no few rural schools that provide their students with deep and solid knowledge, nevertheless statistical data do not favour rural schools. For example, only 12-13 per cent of those entering Moscow University at the end of the 1960s were graduates of rural schools.

Under socialist conditions, the educational system draws together workers, peasants and intelligentsia, equalises the general level of culture among all classes and strata and creates conditions for their closer community. In a socialist society, there are no social barriers preventing workers from entering universities and special technical schools. On the contrary, in fact, representatives of those social groups that have, as compared to other groups, less favourable conditions for the development of their intellectual abilities and for acquiring knowledge (workers and collective farmers, soldiers discharged into the reserve) are extended supplementary opportunities to prepare for entrance into an educational institution.

Several years ago, research on the social composition of students was undertaken in various cities of the Soviet Union; the results provoked concern, since the percentage of the children of workers and, especially, of collective farmers, in many higher educational establishments was much less than their weight in the population. It must be stressed, however, that the sociologists who studied the social composition of the students on the basis of higher educational establishments' records as a rule greatly understated the proportion of children of collective farmers' families. This is because many children of collective farmers, before entering a college, work in town and are entered in the records as workers or employees, in accordance with their new social position. Moreover, some applicants from collective farmers' families misstate their social position in their application forms. For example, if the father is a collective-farm machine operator, mechanic or blacksmith, it is often stated under "social position": "worker family". A study of this problem carried out by the sociologist A. V. Cheremnov from the Urals on the basis

of acquaintance with students' personal records and talks with students showed that the true percentage of children from collective farmers' families among college graduates studied was 16-18 per cent, while according to the data of the colleges it was only 5-7 per cent. Thus, the percentage of children from collective-farm families among students is only slightly smaller than the weight of collective farmers in the population of the USSR—about 20 per cent.[21]

Socialist society renders assistance to those who did not have a chance to obtain a qualitatively adequate education and general development in their school years and who show in deed their desire and ability to make up what they have missed. In accordance with the resolution of the CC CPSU and the Council of Ministers of the USSR of August 20, 1969, preparatory departments were created for "raising the level of general educational background of workers and rural youth and for providing this youth with the necessary conditions for entrance into institutions of higher education". The results of the work of these departments have shown that the overwhelming majority of those who have attended and have been admitted to examinations have passed the exams and entered colleges. The establishment of preparatory departments and other privileges and advantages are intended to secure equal opportunities of entrance into educational institutions for representatives of all classes and social groups. Preparatory departments, for example, help young people attain that level of preparation that they had not reached before owing to circumstances beyond their control.

The Party and state organs consciously use the educational system to secure equal opportunities of social mobility for representatives of different classes, strata and groups of society, and also to accelerate the process of achieving social homogeneity in Soviet society.

The educational system, in particular specialised secondary and higher education, has a direct and quite substantial influence on change in the social structure of Soviet society.

The process of social mobility, note the Soviet sociologists M. N. Rutkevich and F. R. Filippov, is realised to a significant degree through the medium of the educational system.[22] Annually, hundreds of thousands of village dwellers, entering

higher and specialised secondary educational establishments and graduating from them, become city dwellers. At the same time, a significant number of the city dwellers, on obtaining their education, go to work in the country and shift to the category of rural inhabitants. Millions of people from workers' and peasants' families, having obtained adequate education and professions, change their social position: they shift to the category of working intelligentsia.

The increase in the weight of college graduates leads to substantial changes in the social structure of the country's population. On the one hand, the intelligentsia is enlarged absolutely and relatively, and, on the other hand, this stratum is distributed ever more evenly in town and country. For example, while in 1939 of every 1,000 persons of the working population there were 32 urban and 3 rural inhabitants with a higher education, twenty years later the figures were 59 and 11 respectively, and in 1974—106 and 33.

The social functions of education under socialism and capitalism are diametrically opposed in their direction and substance. In bourgeois society, the social function of education encompasses antagonistic tendencies that reflect class antagonisms, and education functions basically to reinforce the relationships of domination and subordination, the exploitation of man by man. The whole of the educational system is subordinate to the conservative and reactionary goals of the ruling classes.

The socialist educational system functions in the interests of all the working classes and social groups. The social function of education in socialist countries is directed to the all-round development of every member of society, to the development and strengthening of socialist social relations. It accelerates progressive changes in the socialist structure of society, changes in the direction of achieving social homogeneity.

CHAPTER THREE

THE FUNCTION OF EDUCATION IN THE NATIONAL ECONOMY

1. SCIENCE AND EDUCATION

The concept of the social function of education is used to signify the action of the educational system on social, and above all production, relations. The economic function denotes the influence of this system on the productive forces, on the efficiency of social labour. Accordingly, in the first case educated man is viewed as the subject of definite social relations, and in the second as a subjective factor in the process of labour, as an element in the structure of productive forces.

How and in what directions does the education system in contemporary conditions influence the process of social production?

Under the conditions of the scientific-technological revolution, as was stressed in the first chapter, the leading role in the development of productive forces belongs to science, which, together with education, constitutes the so-called "knowledge industry". The productivity of labour depends on two basic factors: the level of the knowledge used in production and the equipping of labour with the means of production. And the chief place in this complex belongs to knowledge, since the means of production—machines, apparatus, materials, fuel and in part raw material—are, in essence, the material expression of knowledge. According to the calculations of Academician V. A. Trapeznikov, each ruble invested in science, that is, in "research and development", yields 1.45 rubles' increase to the national income, while the increment to the national income from ordinary investment is 38 kopecks

per ruble. Consequently, expenditures on science are almost four times as efficient as ordinary investment made with a view to technological progress and 6.5 times more efficient than expenditures on increasing production assets (this increase being carried out in the absence of technological progress).[1] Implementation of the achievements of science secures the basic share of the rise of the social productivity of labour, from 50 to 75 per cent of the growth of national income.[2]

Science and education are usually viewed as a single whole, as a system of the production and distribution of knowledge. Such an approach, while legitimate from the point of view of specific cognitive and practical goals, is inadequate. The specific functions of science are the production of knowledge and the development of concrete ways and means for the material embodiment of scientific ideas. The basic functions of the educational system, on the other hand, are the dissemination of scientific knowledge and the systematic education and training of people capable of mastering and applying this knowledge in practice.

Naturally, such a delimitation is increasingly relative: the educational system not only prepares personnel for science, but (if we are speaking of higher educational establishments) in increasing volume produces new scientific knowledge, and the system of science to an ever growing degree participates in the training of highly skilled personnel, in the development of curricula and texts, and exercises a direct influence on the improvement and development of education. But at the same time, science and education are in function and structure substantially different. Therefore, to make analysis more specific, we will view education and science as two "related", mutually connected, but quite different systems.

The influence of scientific knowledge on production occurs along two lines: through the material and human elements of the productive forces. However, as the Soviet sociologist G. N. Volkov has justly noted, study of the economic efficiency of science is usually carried out today one-sidedly, taking only the first line into account. Scholars often try scrupulously to calculate all financial expenditures and the returns on the results of scientific researches that are embodied in technology,

but ignore results that are embodied in the labour force, that develop the latter and raise its quality and capacity.[3]

When science was the province of a comparatively narrow circle of people, who made up an exceedingly insignificant part of the population, its development depended little on the educational system. Society's demand for scholars was extremely limited. Today, science demands people no less than any other branch of the economy. In the USSR, there were 1,108,500 scientific workers in 1973, and if technical and other service personnel were taken into account, more than three million people were engaged in science. More and more people to an ever greater extent are engaged in scientific research at the site of production. So in contemporary conditions science can no longer count on a natural reproduction of its cadres. Society demands not individuals, and not hundreds, but hundreds of thousands of people who not only possess, but, above all, can produce new knowledge. It is now necessary to arrange for the mass production of people with "the gift of God"—creators and researchers—and this unbelievably difficult task has fallen to the lot of the educational system. The development and efficiency of science now depend overwhelmingly on the product of the educational system.

The mutual connection between the scientific achievements of a country and its educational system can today be traced very accurately.

The interconnection of science and education consists, first, in the fact that science delivers the educational system its product in the form of new knowledge for refining and dissemination. The educational system, in its turn, delivers science its product—adequately educated and trained cadres, the quantity and quality of whom is the decisive factor in the efficiency of science's functioning.

The best and most promising scientific ideas, the discoveries, theories and inventions, in order to become a productive force, must pass through a design stage. Then they must be embodied in test models, must be "shaken down" until they meet a number of demands. And this depends on the availability of highly skilled engineers, technicians and workers able to grasp the last word of science and creatively to embody

it in production and technology. Even more highly educated, skilled personnel are needed to move from experimental models to mass production. And of course, scientific knowledge already materialised in the best machines and equipment will remain dead, unproductive capital until it is joined with the live thought and live labour of skilled personnel.

The more complex and intricate the technology, the higher the level of scientific knowledge working people must have to create and use it. And on the other hand, the higher the level of education of the working population, the more rapidly it is possible to create new means of production — materialised scientific knowledge. A high level of education in the working class becomes today the determining condition in the implementation of the achievements of science.

Consequently, science becomes today a direct productive force, too, through the system of public education, which arms the working masses with scientific knowledge. Having arisen on the basis of production and being stimulated by production, writes V. N. Stoletov, President of the Academy of Pedagogical Sciences, science helps man to transform nature. However, the potential to transform nature discovered by science can only be implemented when people directly engaged in material production master the data of science. This task is solved by education, which should be viewed first of all as an active link between science and production. Education turns scientific ideas into material force.

This means that the system of education becomes a very important factor, influencing directly the process of economic development.

2. THE DENIAL BY BOURGEOIS POLITICAL ECONOMISTS OF THE ECONOMIC EFFICIENCY OF EDUCATION

As a factor influencing the national economy, education has a specific economic efficiency. The economic efficiency of education can in a general way be expressed in the difference in the values of overall social expenditures on education and the growth of the national income from these expenditures.

However, bourgeois economists down to the present day have not even raised the question of the economic efficiency of education. They have viewed economic growth only as a consequence of simple quantitative changes in the expenditure of labour and capital, completely ignoring the influence of the level of education of the labour force.[4]

One of the reasons for this is the extraordinary complexity of the mechanism through which education is connected with material production. Technical, economic, political, cultural and socio-psychological factors are all tightly bound up in it. Therefore, quantitative estimates of education's effect on the economy are, as we shall see shortly, fraught with great methodological difficulties. But the chief reason for the negative attitude to economic investigation of education has been connected with the class position of bourgeois political economy.

True, individual representatives of this science (for example, Alfred Marshall) as far back as the last century viewed education as a national investment and one of the chief sources of social wealth. Some Russian economists and statisticians — I. I. Yanzhula, A. I. Chuprov and others — even undertook to evaluate quantitatively the economic role of education, tracing the connections between literacy, the occupational structure of the population, length of service and earnings.

None of this, however, changed the general direction of bourgeois science, which insistently ignored the economic significance of education. This fully corresponded to the interests of the ruling class. When a capitalist bought a labour force, he was not interested in its spiritual potential and, consequently, did not pay for it. The mental development of a worker, noted Marx, "in no way directly influences his pay...".[5] The ignorant, barely literate worker, especially at the initial stages of the capitalist mode of production, was even more desirable for the entrepreneur than the educated, for he was less capable of organised, conscious struggle against exploitation, less demanding, quicker to yield, easier to deceive, etc.

Large-scale, mechanised production, based on the practical use of the achievements of science, ever more sharply puts a new demand on the subjective factor in labour: it is no longer

physical strength, practical skill or knack, but intellectual potential, the background knowledge of individuals that moves to the fore. The cost of the labour force to an increasing degree includes the expenses of educating and training personnel. "In order to modify the human organism, so that it may acquire skill and handiness in a given branch of industry, and become labour-power of a special kind, a special education or training is requisite, and this, on its part, costs an equivalent in commodities of a greater or less amount. This amount varies according to the more or less complicated character of the labour-power. The expenses of this education (excessively small in the case of ordinary labour-power), enter pro tanto into the total value spent in its production."[6]

As the productive forces develop, ever more skill is demanded of workers and, consequently, ever greater expenditures on education as an integral item in the remuneration of the hired labour force are necessary. Education has become a necessary phase in the process of reproducing and developing the labour force. The time spent on the development of the worker seems ever more obviously "a supreme productive force", which from the point of view of the direct process of production "can be viewed as the production of *fixed capital*".[7] So the socially necessary expense of educating the working people objectively enters into the cost of the labour force.

In the conditions of the scientific-technological revolution, the absolute magnitude and the relative weight of these expenditures in the total cost of the labour force grow especially rapidly. The bourgeoisie, however, not wishing to meet these costs from its own profits, shifts them with the aid of the state to the whole population. It is just this circumstance, and not the humane intentions of the ruling classes, that explains the fact that in the capitalist countries the last two decades have seen a sharp jump in (state) expenditures for education.

"...The educated worker, engineer or scientist represents much more profitable 'raw material'. It is 'produced' by the capitalist state at the expense of the working people, albeit at a relatively high cost, but the capitalists still find that it yields a high profit."[8] So it is advantageous for the bourgeoisie to pretend that the value of the labour force is determined only

by physical potential and by purely practical skills, that the expenditures on education are purely consumer-oriented and, consequently, have no relation to the productiveness of the worker. Capitalism has long and zealously appropriated the fruits of the worker's education in the form of super-profits, but in doing so has made a pretence that the education of the worker is of no concern to it. It argues in this case much like a character in one of Krylov's fables: "If only there were acorns; it seems I'm getting fat because of them." Bourgeois political economy, declaring that questions of the education of workers lie beyond the bounds of economics, justifies this position theoretically and, independently of the subjective intentions of its scholarly representatives, objectively defends the interests of capital.

Engels noted that human labour includes, along with the physical elements of simple labour, the mental element of invention, of thought, with which bourgeois economists have nothing to do. He expressed confidence that, in a rational order, which has gone beyond the division of interests, "...the mental element certainly belongs among the elements of production and will find its place, too, in economics among the costs of production".[9]

3. DETERMINATION OF THE EFFICIENCY OF EDUCATION. THE CALCULATIONS OF S. G. STRUMILIN. SOVIET EXPERIENCE WITH EDUCATIONAL PLANNING

Engels' vision has been fully justified. The socialist state from the first days of its existence has devoted extraordinary attention to public education, connecting education with the future of the country's economic development. Lenin in particular viewed the educational and cultural uplift of the mass of the population as a first and very important condition for raising the productivity of social labour.[10]

Relying on Marxist-Leninist theory, the well-known Soviet economist, Academician S. G. Strumilin, as early as the 1920s, made concrete calculations as to the economic effectiveness of expenditures on education on a nation-wide scale and convincingly showed that the education of working people is not only socially necessary, but also economically beneficial.

These calculations were based on a comparative analysis of the economic efficiency of education in school and industrial training.[11] On the basis of an analysis of much statistical data, it was shown that elementary education raised the efficiency and earnings of the labour of workers and employees by 43 per cent in comparison with illiterate workers of equivalent age and seniority, secondary school resulted in a 108 per cent rise, higher education—300 per cent. Strumilin came to an important methodological conclusion: "...Expenditures ... for raising the cultural level of the country should be considered as important as expenditures for the technical reconstruction of production, as *capital* investment completely equal in value in their significance for our economy." [12]

These theoretical conclusions and calculations had direct practical application. They were attentively studied by the Central Committee of the CPSU and by the Soviet Government during the elaboration of the plans of socialist construction. And the economic function of education was assigned special significance. "Is it possible," the People's Commissar for Education, A. V. Lunacharsky, said in 1925, "to forget even for one minute the economy's connection with enlightenment? We sometimes hear that the People's Commissariat for Education is not an economic commissariat. I always deny this, and I think that the time will come when the comrades will say that the Commissariat for Education is an economic commissariat...." [13]

Theoretical calculations by Soviet scholars served as the basis of the ten-year plan for the development of public education worked out in 1924. These calculations showed that expenditures on the education of schoolchildren, with their number increased from 4 to 6 million, would be 1,622 million rubles, and the growth of the national income from the increased skill of the pupils' subsequent labour would be more than 2,000 million rubles after 5 years of work. All capital expenditures by the state would be recovered in full during the process of construction, and the total economic effect of the plan would in the course of two to three decades be more than 40 times the expenditures connected with it.[14]

In 1962, Strumilin proposed a new methodology based on the difference in the economic effect of skilled and unskilled

labour, calculated with a view to pay. Application of this method showed that the profitability of investments in the national economy of the USSR rose between 1940 and 1960 almost three times and that about 23 per cent of the national income—more than 33,000 million rubles—was due to investment in education and the attendant increase in labour skills.[15]

The high efficiency of the Soviet educational system is determined not only by timely and correct scientific evaluation of its importance, but also by large input of resources. Above all, it is a result of socialist social relations, which have allowed the use of resources, including resources applied to education, very effectively and in the interests of all working people, and to use them in a planned way, on a nation-wide scale. The USSR was the first country in the world to engage in comprehensive planning in the realm of education in close coordination with national economic plans.

When the First Five-Year Plan was being outlined, A. V. Lunacharsky stressed that it was impossible to plan industrialisation without taking into consideration the training of personnel, from people possessing one or another skill to the most skilled engineers. "On the contrary, everything must be tightly intertwined," he said.[16] Industrialisation, by increasing the national wealth, created the material base for increasing the number of schools, secondary technical schools and institutions of higher learning. This development of education, in its turn, accelerated the process of socialist industrialisation.

The principal peculiarity in the Soviet experience of educational planning has been a strict consistency in the preparation of the material conditions necessary for the realisation of the goals set and a strict coordination between the number of graduates of academic institutions and the real needs of the national economy.

Even bourgeois scholars are today forced to recognise the historic significance of the Soviet experience. Unity in planning the economy and education, the British Professor B. Fletcher writes, was one of the necessary conditions in the impressively successful transformation of an enormous agricultural country into an industrial power. He recognises that

in socialist countries "there was an early realisation that educational expansion depends ultimately on the economic, financial and human resources of a country and that efficient educational planning permits the best possible use of these resources. These countries have also shown how close must be the relationship between educational planning and comprehensive plans for economic and social advance. They have realised that educational plans must cover a long period, not less than twenty years, and that they should be integral in the sense of planning for all stages of education...".[17]

The matter is, of course, far from simply understanding the need for a single plan. Such comprehensive planning is, objectively, possible only when both the national economy and the educational system belong to the people. Beginning with the mid-1950s, there have been attempts to plan the development of education in France, Sweden, Britain and other capitalist countries. However, as Fletcher admits, because of the presence in these countries of a significant private educational sector (and most importantly, we should add, because of the rule of private property in all areas of human activity), planning is incomplete and poorly connected with the goals of economic development.

4. THE GROWING ROLE OF EDUCATION AS A FACTOR IN ECONOMIC DEVELOPMENT AND THE PROBLEM OF EVALUATING ITS ECONOMIC EFFICIENCY

In the face of the irrefutable fact of the growth of the economic role of education, bourgeois economists are beginning to reconsider their former view that education is beyond the sphere of their interests and competence and are more and more determinedly raising the question of its role in the development of modern production. Moreover, assertions that education and educated people are a basic resource and capital in a modern industrial society, that investment in education is the most beneficial use of capital and so on, have become current. This is what Peter F. Drucker says: "...Yet this is the only real capital today. The development of educated people is the most important capital formation, their number,

quality and utilisation the most meaningful index of the wealth-producing capacity of a country."[18] "Education becomes, then, a major form of investment for the economy as a whole," declare the American sociologists Jean Floud and A. H. Halsey. The efficiency of social labour, in their opinion, depends to a decisive degree on the educational system.[19]

Even quite recently, bourgeois scholars refused to see any link between education and the economy. Today they not only recognise it, but often even point to education as the principal factor in labour productivity and as the panacea for resolving all economic contradictions. So they have swung to the other extreme — they absolutise the role of education, thus arriving at a sort of "educational determinism".

Naturally, the question becomes: what provoked this sharp turn in bourgeois political economy?

In this case, one must speak of a whole complex of factors. First, the convincing achievements of Soviet education, which have secured for socialism the leading positions in the field of scientific-technological progress, the breakthrough into space and undeniable successes in economic competition with capitalism, have forced bourgeois ideologues critically to reevaluate their own economy, science and education. Second, the influence of education on scientific-technological progress, and so on the economy, has grown so much in the last two decades that it has simply become impossible to ignore it. Third, new facts have come into sharp conflict with old theories. Conceptions of economic growth traditional for bourgeois political economy, conceptions that explained growth as a direct function of two factors — expenditure of labour and capital — have revealed their inadequacy.

Research carried out in the last few decades has shown that, in industrially developed countries, the increase in national income has substantially outstripped the rate of increase of expenditure of labour and fixed and circulating capital. For example, in Solomon Fabricant's estimation, the increase in the national income of the United States from 1919 through 1957 was three times as rapid as the growth of fixed assets and labour force.[20]

Attempting to resolve this contradiction, some investigators (Robert M. Solow, Solomon Fabricant) have begun to refer

the "unexplained" part of growth to "intangible capital"—scientific and technical progress, improvement in the quality of labour used, an improvement connected with the increased education, etc.

At the end of the 1950s, Professor Theodore W. Schultz of the University of Chicago advanced the theory of "human capital" according to which "additional" economic growth is explained by "investment in man", including expenditures on his education. He proposed likewise a method for calculating the economic efficiency of education on a global scale.[21] American academic literature now often refers to Schultz's "pioneering" role in investigating education as a factor in the development of the economy.

But Schultz contributed to the study of this problem only at the very end of the 1950s, that is, about 35 years after the well-known publications by S. G. Strumilin.[22] Schultz's real service is that he was the first bourgeois scholar to overcome the traditional views of economists, that he undertook a serious elucidation of the economic role of education. Schultz's work has contributed significantly to the fact that, in the West today, economic research on education has become an "honourable and even fashionable" theme.

At present, no few attempts to evaluate quantitatively the efficiency of education are being undertaken around the world. According to the estimate of the American economist Edward F. Denison, for example, from 1909 through 1929, 12 per cent of the national income was a result of the educational factor, the corresponding figure for the period 1929-1957 being 23 per cent.[23] However, such conclusions are at present based on highly imperfect methods of calculation and are subjected to sharp criticism in the literature.

Many foreign scholars, for example, in calculating the economic efficiency of education propose to deduct "income lost" by those who study in the senior classes of school, in specialised secondary and higher educational institutions, since they could have begun to work after elementary school.[24] Such an approach is methodologically wrong. If one can speak to some extent of "income lost" with respect to individuals, such a framing of the question has no sense whatsoever for society. Young people who have not obtained an adequate education

simply would not be able to occupy places in the system of the social division of labour and would be "unproductive".

Suppose that all of American youth, on finishing elementary school, were suddenly and unexpectedly to enter the labour market. The overwhelming majority would find no demand for their labour and would swell the ranks of the unemployed. Moreover, they would lose completely the chance of ever obtaining work. If American industry were suddenly and systematically to fill its ranks primarily with people who had only an elementary education, it would be not only slowed down, but would be thrown far back. Therefore, "income lost" is in reality a fiction that cannot be taken into account in calculations of the economic efficiency of education.

It is necessary to stress that the elaboration of a sufficiently strict method for calculating the economic efficiency of education is a very complex problem, but one that is, for practical reasons, urgent. The precise estimation of the economic efficiency of education is at once a generalised quantitative appraisal of the economic function of education; it would serve, too, as an objective criterion for determining the level at which the educational system is functioning, at least in one of its most important aspects.

A research group led by Professor V. A. Zhamin that is working on this problem obtained the following data: in 1962, 27 per cent of the national income resulted from investment in education and the growth of labour skills that was connected with this, and for the period 1960-1964, the corresponding figure was 30.3 per cent.[25] Yet, in Soviet literature on the problem, there are significant differences in evaluating the economic efficiency of education. Some consider that the yield on every ruble invested in education is 53.3 kopecks, others feel that it is 6 rubles, still others—4 rubles.[26]

To a large degree, these differences are caused by the fact that, inasmuch as the economic efficiency of both science and education is connected with the use of scientific knowledge in production, it is very difficult to separate the one from the other.

Edward Denison, for example, calculated that the growth of the economies of the United States and the countries of Western Europe from 1950 through 1962 was from 10 to 32

per cent due to the use of the results of scientific research in technology and 2 to 15 per cent due to a rise in the level of education.[27] But the reliability of such calculations is not great.

Some economists argue that attempts to represent the general index of economic efficiency of the whole sphere of education as a formula in which the numerator expresses the growth of the national income as a result of education and the denominator represents the expenditures on education are unfounded in principle, since this scheme has inadequate theoretical and practical basis.[28] Objections of this sort are not without foundation, for attempts to determine quantitatively the "weight" of education, as of science, in the creation of national income meet with difficulties that are not always fully taken into account.

The national economy as a whole is a complex system, the behaviour of which is determined by a multiplicity of mutually related factors (variables), and the influence of any factor, including education, depends in turn on the state of the system as a whole. The task of isolating and determining precisely and quantitatively the influence of one factor on the development of the whole system (which is manifest, we will assume, in the growth of national income) is formally insoluble. "...Thus, if a variable changes in value, can we distribute the cause of this change among the other variables? In general," notes W. Ross Ashby, "it is not possible to divide the effect into parts, with so much caused by that.... In general, the change of a variable results from the activity of the whole system, and cannot be subdivided quantitatively...."[29]

Yet this does not mean that all calculations of the economic efficiency of education are fictitious. The existing methods for such calculations yield, for the time being, quite conditional and very approximate results, which must be used with great care in practical calculations and economic planning. Nevertheless, the data obtained in general and on the whole adequately reflect the objective process of the growth of the economic role of education.

In favour of this, first, is the fact that the use of the results obtained has been justified in working out and implementing various state measures in the field of education in the USSR and abroad.

Second, although the application of different methods yields numerically different indices of efficiency, nevertheless the general tendency is maintained. The data of foreign research, too, supports this. For example, calculations made by the State Planning Commission of the German Democratic Republic on the basis of Strumilin's method showed that in the period 1958-1964 the "contribution" of education to the national income of the republic was equal to 18.5 per cent. Calculation according to a different method, connected with the determination of the complexity of labour through calculation of the expense on reproducing a labour force with a different level of skill, yielded a figure of 15.9 per cent.[30] Results quite close to these are obtained using Denison's method.

Third, the degree of precision and reliability of the calculations of economic efficiency of education can obviously be significantly raised in the future. But this entails not only a search for new economic-statistic approaches, but also development of a new mathematical apparatus.

5. GENERAL EDUCATION AND THE EFFICIENCY OF THE WORKER'S LABOUR

From the point of view of working out better methods for calculating the economic efficiency of education, the results of research on the interconnection of the level of workers' education and their productive activity are of special interest.

How is the productivity of the worker's labour determined? Some authors consider only production experience and work skills as factors in labour productivity, considering the educational level an ideological phenomenon. With reference to the productive forces of past centuries, such an approach is apparently legitimate. But in the conditions of highly mechanised and automated production, the worker's skill and, consequently, his role as an element in the productive forces, is no longer determined so much by the level of his practically acquired production skills, by experience and dexterity, as by the degree to which he has mastered the scientific-technological bases of industry, the level of his theoretical training.

Soviet researchers note that, today, among many workers the level of education transcends the real needs of production. For example, in sociological studies of industrial enterprises by sociologists from the Urals, it was found that 31.9 per cent of the workers with an 8-9-grade education and 26 per cent with a secondary education were doing work that did not require even an incomplete secondary education.[31] Such disparity is often the cause of workers' dissatisfaction with their jobs.

Some sociologists, arguing that education demands no small expenditures by society, have raised the question of "surplus" education and have proposed to delay the transition to universal secondary education in the USSR, to limit general education and to switch to earlier professionalisation. A number of works by Soviet scholars have already shown convincingly that such a one-sided approach is illegitimate in both social and political respects. Under socialism, there is a definite social need for education: society is interested in the harmonious development of all its members, the development of their knowledge and culture.

If the need for the transition to universal secondary education is admitted by Soviet scholars to be indisputable in its social aspect, doubts are not infrequently expressed as to the utility of this transition from the point of view of the national economy and economic effectiveness. Many economists, especially practical economists, consider the decisive, and almost the sole, factor in high labour productivity to be length of service in the given profession. Others see the wage scale as the principal factor.

In this connection, the conclusions of the laboratory for socio-economic research of the Lenin State Pedagogical Institute in Moscow, conclusions obtained from research conducted under the guidance of V. A. Zhamin and S. L. Kostanyan at the Moscow Lenin and Dynamo factories, at the Kharkov Tractor Plant named after Ordzhonikidze, and at a number of textile mills in Ivanovo, are of great interest.

In all, 3,000 workers were studied; they were grouped according to speciality, complexity of the work, wage scale, and working skill (age being taken into account). For the majority of workers, the percentage to which they met their production

norm increased in proportion to their level of education. For example, among toolmakers with 5 years of work experience, workers of the 4th skill category who had completed 8 grades in school meet an assignment on their shift that is on the average 35 per cent greater than that of workers who had completed only 5 grades. The figures for output norms among workers with a secondary education are 25 per cent higher than among those who had completed only 8 grades. Among machine toolers with the same skill category and seniority, the proportion meeting the production norm was 15-20 per cent higher as to the level of education. Among packers of the 3rd scale with 4 years seniority, workers with 10 years of education meet a norm 25-30 per cent higher than workers who have completed 5 grades.[32]

Other scholars have obtained similar results.

With a rise in the level of workers' education, the amount of damage to equipment is reduced. Among turners and milling machine operators, more than 70 per cent of the breakage in tools is caused by workers with a 5-7-grade education. Moreover, every additional grade of general education (from the 6th through the 10th) accelerates the mastery of new types of work by an average of 50 per cent and facilitates the growth of production skills. Toolmakers with a 10-grade education spend almost 5 times less time in moving from one labour skill category to the next than workers with a 5-6-grade education.[33] Miners with a 10-grade education reach 7th-8th skill category twice as rapidly as workers with only an elementary education.[34]

The results obtained by the laboratory for socio-economic research under the department of political economy at the Sverdlov State Teachers Training College are of great interest. In 1967-1968, under the guidance of B. L. Tsypin, a major investigation of workers of the most diverse trades was carried out at several machine-building plants. As a result of thorough comparative analysis, it was established that, given identical seniority and wage scale, workers with more than 8 years of education have significantly higher production indices than workers with education of up to and including 8 years. For example, the percentage of norm fulfillment by workers of the first group (more than 8 years of education) was on the average

8.3 per cent higher than by workers of the second group. Moreover, while among workers with less than one year of seniority this difference was on the average 4 per cent, and between 2 and 3 years of seniority, 6.2 per cent, for those with between 4 and 5 years on the job the difference was 9.4 per cent, and with more than 5 years, 20 per cent. Which means that differences in individual labour productivity connected with education not only are not levelled up with increased work experience, but in fact grow. And in most cases, given an equal wage category, workers with a higher level of education more often did work characteristic of a higher skill category.

This research shows, too, the strong dependence of reduced wastage on a higher level of education. Workers with more than 8 years of education, given identical seniority with other workers and with a higher-level work (but with an identical wage scale), produced 9.7 per cent less wastage than the rest and were much more likely to produce work that passed on the first inspection. Moreover, workers with more than 8 years of education, compared to those with education up to and including 8 years, much more actively and fruitfully engage in rationalising production, combine crafts more often and less often violate labour discipline.[35]

Thus, although in some cases (especially in semi-skilled and assembly-line work) workers with a higher level of education have production indices that are worse than those of the poorly educated, in general and as a whole, use of workers with more than an eight-year education is economically beneficial for enterprises, even when the substance of the work does not in itself require such an education.

Under contemporary conditions, a completely new demand is made on the labour force, a demand for professional mobility, that is, the ability quickly to renew and even change skills. In the course of 25 years of labour activity, a person must renew his skill on an average of no less than four times; in industry taken separately, the figure is almost six times. It is most often necessary to renew skills in the fields of electric power development, chemistry and transportation, that is, branches with the most rapid technological progress. The worker's ability to raise his skills, to change and combine trades, is again, as the research of sociologists and economists shows, decisively affected by the level of his general education.

All of this persuades us that, in the conditions of the scientific-technological revolution, *the transition to universal secondary education has become not just a socio-political, but also a national economic necessity.* It has been convincingly demonstrated that the education of workers is one of the important causes of the growth of their labour productivity.

So the impact of the system of education on material production is realised both through science and directly through people engaged in the production of material wealth. Indices of economic efficiency can serve as a generalised characterisation of education's economic function.

Despite the relativity and approximateness of calculations, it is today possible to assert that, given the current distribution of investment among branches, investment in education is more profitable than investment in any sector of material production. In this respect, only the realm of science can compete with it, but the productivity of the latter is again decisively determined by the product (especially in its qualitative aspect) of the educational system. According to the formulation by Academician S. G. Strumilin, the efficiency of science as a productive force is "directly proportional to the volume of knowledge, multiplied by the depth of mastery and the breadth of its dissemination among the working masses".[36]

The materials of the research conducted in the USSR and abroad show that the progress of science and technology and the rate of growth of the economy are substantially dependent upon the quantity and quality of the product of the educational system. They speak to the fact that, in theoretical models of the modern scientific-technological revolution, the educational system, taken in its national economic function, must be represented without fail.

CHAPTER FOUR

THE NEED FOR A REVOLUTION IN EDUCATION

1. THE STRATEGIC ADVANTAGES OF SOCIALISM IN THE REALM OF EDUCATION

Under socialism, both the economic and the social functions of the educational system are directed to securing the highest possible level of scientific knowledge and general education to all members of society. The social goal of Soviet society — harmonious development of every individual — coincides with the objective requirements of the progress of the productive forces.

On the contrary, under capitalism the social function of education, consisting in reinforcing and increasing class inequality and in discriminating against working people in the realm of spiritual values and benefits of culture, is in sharp conflict with its economic function, which is directed to supplying all sectors with an adequately educated, skilled labour force.

Thus, while in bourgeois society the social function of education hinders the realisation of its economic function, in a socialist society the social function reinforces the economic, guaranteeing that the skilled labour force grows faster than the rate of technological development.

In the pre-war years, despite the urgent need for enormous expenditures on industrialisation, collectivisation and strengthening defence in the face of a growing threat from the imperialist powers, the Soviet Union invested enormous resources in education (cf. Table 3).

TABLE 3

Growth of the Number of Students and of Financial Expenditures on Schools and the Training of Personnel in the USSR from 1929/30 through 1940/41

	1929/30	1932/33	1940/41
Students in general schools (in thousands)	13,500	21,256	35,552
Students in specialised secondary schools and institutions of higher learning (in thousands)	441	1,227	1,787
Expenditures on schools and personnel training (in millions of rubles)	1,162.6	3,838.0	16,563.1

Sources: *Public Education in the USSR*, Moscow, 1957; K. Subbotina, *Public Education and the Budget*, Moscow, 1965; *National Economy of the USSR in 1970*, Moscow, 1971. (All in Russian.)

The growth of expenditures on schools and the training of personnel outstripped the rapid growth rate of capital investment. Thus, the volume of investment during the Second Five-Year Plan increased 2.2 times as compared to the First Five-Year Plan, while expenditures on schools and training of personnel increased 5 times. After three and a half years of the Third Five-Year Plan, the volume of investment was 3.5 per cent greater than for the whole Second Five-Year Plan, while expenditures on schools and training personnel were 41 per cent greater. "In those years," notes L. I. Brezhnev, "we had to save on everything. But for the promotion of education, science and culture the Party and the Government allocated funds with a generosity that even the richest capitalist countries could envy. And if today the Soviet Union amazes the world with its scientific and cultural achievements it is due to the fact that the foundations of these achievements were laid back in those days when the Land of Soviets began to build a ramified network of schools, libraries, workers' faculties, technical schools, institutions of higher learning and scientific establishments."[1]

In the USSR from 1929 through 1940, the number of students in general schools increased 2.7 times, in specialised secondary and higher educational institutions, 4 times. As a

result, the number of students from primary through higher education per 10,000 people in the USSR was by 1940 higher than in any other country in Europe and was not far behind the United States. Expenditures on schools and personnel training grew more than 14 times in this period.

At a time when the USSR was accelerating the development of its educational system, in the capitalist countries, education passed through a period of great stagnation, decline, or at best, slow evolution. In the United States, for example, during the 1930s, the total number of students in general schools not only failed to grow, it even decreased; the number of students in specialised secondary and higher educational institutions increased by approximately a third (cf. Table 4).

TABLE 4

Number of Students and Total Expenditures on Education in the USA from 1929/30 through 1939/40

	1929/30	1939/40
Students in elementary and secondary schools (in thousands)	28,552	28,257
Students at colleges and universities of all types (in thousands)	1,101	1,494
Expenditures on education (millions of dollars)	3,233.6	3,199.6

Source: *Digest of Educational Statistics*, Washington, 1969, pp. 3, 18.

The cultural revolution that unfolded in the 1920s and 1930s created the base on which the USSR relied in triumphing in its military-technological competition with the major imperialist powers, in winning the Second World War and then, making an unprecedented leap, in taking the forward positions in the contemporary scientific-technological revolution.

The level of education of the working people in the USSR continues to rise swiftly. In 1939, among the working population of the USSR, 24.2 per cent of the urbanites had complete or incomplete secondary and higher education, while 6.3 per cent of the rural population had such education. In 1974, the corresponding figures were 81 and over 60 per cent.

The historic successes, and the fact that the Soviet school has taken the most advanced positions in the world, do not mean that there are no contradictions and unsolved problems in this field. Although the country has come close to meeting the goal of universal secondary education, that goal has not been met in full. In 1975, the transition to universal secondary education will be completed; measures are being taken to improve the material base of the general schools; and the quality of the pupil's education is being improved. More cadres are being prepared for the new and potential directions of science and technology, young specialists are being armed with up-to-date knowledge, organisational and socio-political skills and the ability to apply the knowledge obtained in practice.

At the same time, the scientific-technological revolution and the new social tasks of communist construction are making objective demands on the educational system that are incomparably greater than ever before. The economic and social significance of this system and its influence on all aspects of the life of society are growing. Not coincidentally, the Party and the Soviet Government devote a great deal of attention to the problems of developing education.

In 1972, the CC CPSU and the Council of Ministers of the USSR adopted resolutions "On Completing the Transition to the Universal Secondary Education of Youth and the Further Development of General Schools", "On the Further Improvement of Vocational Education" and "On Measures for Further Improving Higher Education in the Country". These important documents outline a detailed programme for the development of the whole Soviet system of public education.

General schools in the Soviet Union are the basic form for receiving a general secondary education. That is why they have a special place in the system of public education. By 1975, the introduction of new teaching programmes and curricula for all subjects had been completed; methods of teaching are being thoroughly renovated and diversified; and contemporary teaching aids are being much more widely and effectively

employed. Special attention is being devoted to the further strengthening of the connection of school with life, with the practice of communist construction. Polytechnical education is being developed on the basis of a combined study of school subjects and the bases of modern production. Patronage relations between schools and industrial and agricultural enterprises are being encouraged in every way, as are diverse, pedagogically based forms of student labour in the national economy.

Half of the pupils in the Soviet Union live and study in rural areas. The rural general school has great significance in realising the economic and social tasks of communist construction, in overcoming the substantial differences between town and country. It has already acquired much positive experience in educating and bringing up rural youth. But at the same time, the organisation of education in the countryside has serious shortcomings. The level of the educational work of some rural schools lags behind current requirements.

In the summer of 1973, the CC CPSU adopted a resolution "On Measures for the Further Improvement of the Conditions of Work of the Rural General School". It envisages significantly increased investment in school construction, the allotment to schools for educational purposes of automobiles, tractors, harvesters and other modern machinery, and also a number of measures for improving the conditions in which children are supported in boarding schools. It is deemed advisable to have a general secondary school in every state farm and every large collective farm. A system of measures for the improvement of the working conditions of rural teachers and for providing all rural schools with qualified teaching personnel is also envisaged.

Under contemporary conditions, the economic and social role of vocational and technical education, which becomes a basic form of the professional training of youth and of the formation of the working class, grows especially. The network of vocational schools, which prepare skilled workers in the most complex trades and simultaneously provide a secondary education, expands. While in 1972, 188,000 students were accepted in vocational schools, from 1975 on 300,000-400,000 boys and girls will be accepted every year. From 1972 through

1974, programmes and curricula were drawn up specially for this type of educational institution; they provide for the scientifically grounded correlation of vocational training and general education, for the interconnection of the academic, educational and production processes.

According to the prognoses of some Soviet sociologists, secondary vocational schools will in subsequent years (1976-1990) become, along with the general school, a fundamental route for obtaining a complete secondary education. Graduates of these schools, having worked for a certain period in the economy, will be able, on an equal basis with graduates of schools and technicums, to enter day divisions of institutions of higher education or to continue their education, without quitting their jobs, at evening departments or by correspondence, immediately upon graduating from vocational schools.

In turn, the principal task of the higher school is to deepen its connection with production and scientific institutions in order to ensure as close an approximation as possible of the level and types of the preparation of specialists to the real needs of the national economy and social life.

In the spring of 1973, the Government of the USSR worked out and, by decision of the Presidium of the Supreme Soviet of the USSR, issued for public discussion, Draft Fundamentals of Legislation on Public Education. This draft was considered at sessions of the executive committees of a number of city and district Soviets, at sessions of township and rural Soviets. Many letters approving the draft law were sent to state organs, newspapers, journals, television and radio. At the same time, these letters contained valuable additions, clarifications and new formulations.

In July 1973, the Sixth Session of the Eighth Supreme Soviet of the USSR adopted a resolution "On the State of Public Education and Measures for the Further Improvement of General Secondary, Vocational, Specialised Secondary and Higher Education in the USSR". After thorough discussion, and taking the numerous proposals and observations by working people into account, the Fundamentals of Legislation of the USSR and the Union Republics on Education were passed; these Fundamentals reaffirm and make specific the

right of Soviet people, as proclaimed in the Constitution, to education. For the first time in the history of mankind, this document observes, the Soviet Union created a truly democratic system of public education. The citizens of the USSR have a real opportunity to obtain secondary and higher education and to work in accordance with their profession and skill.

2. THE INCREASING COMPETITION BETWEEN SOCIALISM AND CAPITALISM IN THE REALM OF EDUCATION

The historic competition between socialism and capitalism, in the centre of which is the duel between the two giants, the USSR and the United States, is most often seen in the competition for increased output of steel, cement, oil, electricity, grain, meat, and so on, and in the competition to turn out ever improved civil and military hardware. In recent years attempts have been made, too, to undertake a generalised quantitative analysis of the course and results of competition in the realm of science.

The fact that education has become a powerful factor in the scientific-technical progress and economic might of states is today generally recognised. However, researchers have not yet paid sufficient attention to the competition in this area. This is a result, first, of the great difficulty in gauging the "quality of the product" of the educational system, and, second, of the difficulty in comparing the systems of education in different countries. These difficulties are especially great with respect to countries with different socio-economic and political structures.

Among bourgeois scholars, there are two opposite points of view on this question. Some consider that the problems of education in all countries are generally identical—they do not depend on the socio-political structure and are determined only by the level of development of science and technology. Others, on the contrary, hold that comparison of the systems of education of such countries as the United States and the Soviet Union are generally senseless, for it is like comparing two utterly different satellites of two utterly different worlds.[2] This

incomparability in principle of the educational systems in the Soviet Union and the United States supposedly makes the very question of competition between socialism and capitalism in the field of education irrelevant.

Representatives of the first point of view absolutise some common features and aspects of the educational systems of countries with opposing social structures, while representatives of the second, on the contrary, absolutise differences. In effect, however, the class political position of both groups is identical: it comes down to a denial of the advantages of the socialist system of education vis-à-vis the bourgeois. Reference to the "incomparability" of the educational systems of the Soviet Union and the United States are used, in addition, as a shield against criticism of those groups of the ruling class that bear direct responsibility for the lag of the American school behind the Soviet.

Comparison of the efficiency of the educational systems of capitalist and socialist countries is in fact quite difficult when we speak of their social functions, which act in diametrically opposite directions. However, with respect to their economic function, comparison of their efficiency, even quantitatively, is both possible and necessary.

Competition between the two opposing social systems in the area of education has, objectively, been going on for a long time and, more, has been especially intensive in recent decades. Many bourgeois scholars express concern that the socialist system has much more potential than the capitalist in the use of native talent. They note, too, that the curricula of schools and institutions of higher education in the USSR are much more suited to the requirements of the scientific-technological revolution than curricula in academic institutions in the United States. The development of the Soviet economy alarms them, above all the fact that the people's talents grow in the Soviet Union—the creation of human capital has assumed extraordinary proportions in the Soviet Union.

Since, under contemporary conditions, production-education-science constitute a single, integral system of mutually dependent elements, economic and scientific-technological competition inevitably extends to the area of education. The efficiency with which their educational systems function today

to a great extent determines the achievements, prospects and scientific-technological potential of the competing states.

In comparison with capitalism, socialism possesses enormous advantages and potential for maintaining and increasing its superiority in this exceptionally important area. However, one must not underestimate the strength of the capitalist powers and hope that the superiority of socialism in this field will be automatically secured simply on the strength of the nature of the socialist social system. "...We do not want," L. I. Brezhnev has stressed, "to underrate the forces of those with whom we have to compete in the scientific and technological sphere. Here the struggle will be a long and difficult one. And we are fully resolved to wage it in earnest so as to demonstrate the superiority of socialism in this sphere as well. This meets not only the interests of communist construction in our country but also those of world socialism and the entire revolutionary and liberation movement.

"To achieve, as we should like, a further considerable advance in science and technology is a very difficult task involving great effort and large capital investments. It demands the training of vast personnel—even though already today our country has one-fourth of all the scientists in the world. Furthermore, it is necessary to raise the educational level and the professional skills of millions upon millions of people who will have to operate the new technology."[3]

One must approach the problem of competition between socialism and capitalism in the area of education as one approaches competition in the area of technology: first, carefully study the development of education in bourgeois countries, use everything really progressive that furthers the labour productivity of teachers and students; second, resolutely expose and excise everything that is reactionary and anti-scientific in the theory and practice of bourgeois education; third, on the basis of critical analysis and generalisation of world practice, ensure the choice of the most promising and decisive tendencies in the development of public education in order with the least expense to achieve the most results possible and to obtain superiority in this area in all basic aspects.

Developing a methodology and methods for comparing the achievements of different countries in the area of education,

working out objective criteria of the efficiency with which educational systems function, acquires special urgency. In recent decades, there has even arisen a new academic discipline, "comparative education", or, as we say, "comparative pedagogics". Although its subject and methods have not yet been precisely defined, this science without a doubt has a future. In our view, the goal of this discipline is to develop theoretical methods for the quantitative comparison of the efficiency with which educational systems function. One must scrutinise not only the purely pedagogical, but also the economic, sociological, historical, legal and other aspects.

Competition between socialism and capitalism in the area of education has two sides. The first consists in achieving a better use of the educational system for socio-political goals both within the country and in the international arena. The second, closely connected with the first, yet relatively independent, is the struggle for the most efficient use of the educational system as a factor in the progress of the economy, science and technology. It lies basically within the framework of the economic function of the educational system. In this second aspect, competition in the area of education emerges as one of the most important sides of economic and scientific-technological competition between the two opposing social systems.

The efficiency of education in economic relations can be raised in two basic directions. The first is to determine the optimum (from the point of view of increasing national income) scale of investment in education, which is in this case considered as part of the production-education-science system. The second stems from the fact that education can be taken as an independent system, the effectiveness of the functioning of which can be increased by improving its internal structure and can be measured in the "yield" of the educational system to other systems adjacent to it.

In the period from 1940 through 1950, capital investments in the Soviet Union grew 2 times, while expenditures on education grew 2.7 times, on science—3.3 times.

Until 1950, the supremacy of the Soviet Union vis-à-vis the United States with respect to the share of national income expended on education and training personnel was quite

substantial, and this to a great extent explains the higher rate of growth of national income in the USSR. However, in the following decades, while there was a significant increase in the rate of expenditure on science, the rate of growth of expenditures on education in the Soviet Union was reduced and began to lag considerably behind the rate of growth of capital investments. In the 1950s-1960s and early 1970s, the United States took energetic steps to bridge the gap between itself and the Soviet Union in the field of education and in a number of important areas of scientific-technological progress. This was graphically reflected in the structure and scale of financial investments in the corresponding areas (cf. Table 5).

TABLE 5

Rate of Growth of National Income, Capital Investment, and Expenditures on Education and Science in the USSR and the USA
(using 1950 as the base year)

		1960	1970	1973
National income	USSR	265	528	632
	USA	133	198	228
Capital investment	USSR	329	643	773
	USA	119	168	203
Expenditures on education	USSR	157	369	443
	USA	268	767	1,025
Expenditures on science	USSR	390	1,170	1,570
	USA	457	921	1,003

Sources: *National Economy of the USSR in 1973*, Moscow, 1974; *USA: Science and Education*, Moscow, 1974. (Both in Russian.)

In the 1960s, as is obvious from the table, in the USSR there was a sharp increase not only in the absolute, but also in the relative magnitude of investments in science and education — a fact to which researchers have not yet turned sufficient attention. The share of the national income invested in science increased between 1960 and 1970 from 2.7 to 4.7 per cent, and the corresponding figures for education are — from 5.9 to 7 per cent. While in the preceding decade expenditures on science grew more rapidly in the United States than in the USSR, in the 1960s the Soviet Union moved to the fore in these

indices. While the rate of growth of expenditures on education in the 1950s lagged behind the growth of national income and capital investments, in the 1960s it moved significantly forward. So that the picture of these changes be clearer, we will take 1960 as the base year (cf. Table 6).

TABLE 6

Rate of Growth of National Income, Capital Investment and Expenditures on Education and Science in the USSR and the USA

		1965	1970	1973
National income	USSR	137	199	238
	USA	127	149	171
Capital investment	USSR	136	195	235
	USA	129	141	170
Expenditures on education	USSR	165	234	281
	USA	158	286	360
Expenditures on science	USSR	177	300	403
	USA	150	203	220

Sources: *National Economy of the USSR in 1973*, Moscow, 1974; *USA: Science and Education*, Moscow, 1974. (Both in Russian.)

As we see, in rates of growth of national income, capital investments and expenditures on science, the USSR significantly surpasses the USA, but the latter continued to increase expenditures on education more rapidly than in the USSR.

In the post-war period, notes the Soviet economist S. M. Zagladina, in the United States expenditures on science have grown most rapidly, followed by expenditures on education.[4] This is true if we take the period 1948-1969 as a whole. But one very important fact must be stressed: after 1957, there was an abrupt shift in the rates of growth of these two areas: education moved to the fore. While earlier the rate of growth of expenditures on science was 1.5 times the rate of growth of expenditures on education, for the last decade this ratio has been reversed. This follows, too, from the data adduced by S. M. Zagladina (cf. Table 7).

The question of the optimum distribution of investments among production, education and science is of primary

importance from the point of view of economic and scientific-technological competition. Academician V. A. Trapeznikov, for example, considers it wise to envisage an annual growth rate in science of 20-25 per cent.[5] The Bulgarian scholar E. M. Andreyev comes to similar conclusions; he proposes that it would be justified to somewhat reduce capital investment and to channel the funds released into development of science and the application of its results. "Reduction of capital investment by seven per cent will allow the doubling of expenditures on science. With this, the rate of annual growth of labour productivity will increase from 6 to 8-9 per cent."[6]

TABLE 7

Average Annual Rate of Growth of Expenditures on Science and Education in the United States
(1958 prices)

	Period			
	1948-1953	1953-1957	1957-1960	1960-1969
Science	10.7%	13.2	8.9	5.0
Education	7.3	8.6	9.1	8.2

In the majority of such calculations, the area of education is usually not considered an independent factor or is considered to be a constant. Yet it is quite possible that redistribution of investments to the advantage of just this sphere would have the most effect in accelerating scientific-technological progress and the growth of the productivity of social labour.

The efficiency of education can be raised in two ways: extensively, through an increase in the number of institutions of higher education, teachers, increasing their load, extending the period of instruction, etc.; or intensively, by raising the productivity of the labour of the teachers and students by applying new technical aids, forms and methods of instruction. Under current conditions, the second course seems more suitable. However, the transition to a qualitatively higher level of instruction obviously demands an increase in capital investment in the area of education. In economic terms, this will mean a higher rate of "return".

The extent of education in the Soviet Union and the United States, expressed in quantitative indices of the number of

pupils, students and teachers, seems close to the limit at which further expansion at the previous rate is impossible or inexpedient. Because of this, the centre of competition in the field of education should move to the qualitative side, which is connected above all with improving content, forms, methods and the material-technological base of education. This will be a competition for the most rapid and fullest implementation of a revolution in education.

It is obvious that education is "a very far-reaching factor, which is laying the foundation for our successes in the future". Therefore, rapid development of education is needed so as to accelerate scientific and technological progress. However, this proposition needs to be made concrete and be theoretically substantiated.

It is obvious, too, that it is not spending on education by itself that is decisive, but the way in which the expenditures are used. So it is necessary above all to turn our attention to a search for unexploited ways to raise the efficiency with which the educational system functions through improvements in its own structure.

3. EDUCATION-PRODUCTION-SCIENCE. CONTRADICTIONS THAT HAVE COME TO A HEAD

Despite the enormous success of the educational system in the Soviet Union, it has a few characteristic shortcomings. Critical observations and the proposals for radical change come most often from the consumers of the product of the educational system, and especially from those on the cutting edge of scientific-technological progress: leading scholars, designers and innovators in production.

There are no methods yet for a strictly quantitative evaluation of the quality of education and its conformity to social needs. The matter is complicated by the fact that verification in practice of the quality of education requires a significant amount of time. If any element in the economic organism begins to function unsatisfactorily, it is clear to all rather quickly: the volume and quality of production are reduced, productivity falls, cost prices rise, etc. Inadequacies in the educational system become obvious to all only after 10-15

years, when today's first-graders begin their independent, working life. This circumstance can give rise to a sort of "optical illusion" resulting in an unjustifiably complacent mood.

Yet as life itself shows, the contradiction between the product of the educational system and the demands made on it has already become quite sharp. The general school, for example, does not yet adequately prepare its pupils for life, does not adequately develop among them an interest in production. And the higher the level of instruction in the schools, the more strongly is this predominant orientation toward mental labour expressed. As the results of sociological research carried out in different areas of the country show, the overwhelming majority of schoolchildren (more than 80 per cent) aspire to continue schooling in institutions of higher education and only 5-7 per cent intend to work after finishing school. Yet calculations show that in 1975 about half of those finishing secondary school will have immediately to enter the economy. The negative attitude of pupils to the prospect of selecting working trades is increasingly at variance with the objective situation and the real socio-economic and political role of the working class in Soviet society.

Some Soviet scholars try to justify this orientation by saying that modern, educated youth quite naturally aspires to creative labour. But why then were the requisitions of the Moscow Dynamo factory and the Likhachev Automobile Works for "clean" work (controllers, lab assistants, messengers, timekeepers, etc.) met with a 130-140 per cent response by graduates of secondary and eight-year schools, while requisitions for machine-tool operators met with only a 5-8 per cent response? Is the work of a controller or messenger really more creative than the work of a highly skilled turner or a milling machine operator? Obviously, something else is at work. This behaviour by young people is connected with shortcomings in the work of professionally orienting and educating the younger generation. Pupils have at times a very confused picture of many professions and are not clear as to the significance of such extremely necessary and important trades as turner, milling machine operator, fitter, grinder, and so on. In the education of pupils, as the Minister of Education of the USSR,

M. A. Prokofiev noted, there is a formalism that leads to the oft observed gap between knowledge and the ability to use it in solving problems, in discussing real life, etc.[7]

Scholars and production workers both have come to the conclusion that the quality of the training of specialists in specialised secondary and higher schools lags behind current requirements. For example, nearly half of the young research engineers surveyed in Leningrad enterprises noted gaps in their knowledge of general sciences. About 46 per cent of the engineers interviewed by sociologists noted inadequacies in their knowledge of specialised disciplines. In 1972, the CC CPSU and the Council of Ministers of the USSR, in the resolution "On Measures for the Further Improvement of Higher Education in the Country", turned attention to the fact that the level of theoretical and professional knowledge among graduates of some institutions of higher education did not meet the growing requirements of science and industry. Modern methods of the organisation of the educational process, as well as technical aids in instruction, were as yet being only slowly developed and applied. Some curricula and texts do not adequately reflect recent achievements in science and technology. Students are not always set high standards in study and discipline. The training of highly skilled specialists in new areas of science and technology require attention. New specialities are "installed" in institutions of higher education only when the national economy is already in great need of them. If one considers that young specialists do not yield a return immediately, but adapt themselves over a certain period of time, then this lag is significant.

In order to avoid this, scientific forecasting is necessary in the field of education, and a plan for introducing new specialities in institutions of high education, a plan running ahead of practical requirements, must be based on such forecasts. "Only then," feels the Deputy President of the Presidium of the Siberian Branch of the Academy of Sciences of the USSR, Academician G. I. Marchuk, "will the appearance of new tendencies not take our system of higher education aback."[8]

One must evaluate the present structure of the training of personnel from the position of new requirements, too. In the

USSR, three times more engineers are graduated than in the United States, but at present fewer mathematicians, chemists, biologists and psychologists, and specialists in management are graduated. The United States trains more sociologists than engineers, for every two specialists in the area of the natural sciences it trains one commercial major and businessman with a higher education. In connection with growing demand, the USSR will in the next few years increase its training of specialists in automated control systems, information systems and cybernetics, mathematicians, production organisers, and highly skilled economists. The need to expand the training of specialists in the area of applied mathematics in general, and programming in particular, is especially sharp. The lack of personnel with such training severely retards the exploitation of computer technology.

In the opinion of Academician S. T. Belayev, Rector of Novosibirsk University, practice shows that planning on the basis of requisitions by enterprises, institutions and departments does not truly reflect the national economy's requirements for specialists. Such demands are made, first, on the basis of the present-day situation and do not take long-range forecasts into account; second, the demand for specialists at a given moment is, likewise, not always scientifically based, and requisitions tend often to be overstated. One must also take into account the fact that the efficiency of education is determined not only by the quantity and quality of the training of specialists, but also by how they are used. Among other things, heavy saturation with specialists sometimes gives rise to a careless attitude toward them.

The training of personnel with high qualifications does not always satisfy the requirements of research institutions, either. Science, trying to keep pace with a rapidly developing economy, has begun, as Academician M. A. Lavrentiev says, "to be starved for people". One must stress that the reference in this case is not to people in general, but to people with an appropriate education and who are able to think creatively.

In defining the goals of the educational system, one must begin not so much with the requirements of production, science and culture today, as with forecasting future requirements. Those who enter school today, A. N. Kosygin has

observed, "will be developing the country's economy and culture in the nineties and in the beginning of the 21st century. The curricula and teaching methods in general and technical schools and higher educational establishments must already now increasingly take into account future scientific and technological development".[9]

The problem of adjusting the educational system to the requirements of the scientific-technological revolution cannot be solved by limited alterations and minor improvements. The exponential growth of the volume of scientific-technical and social information, which, according to expert calculations, will increase by the year 2000 (in comparison to 1960) by 15-25 times, is undermining one of the basic principles of traditional education, stability. In order to keep in step with the times, the content of education must be just as dynamic as modern science and production. Syllabuses in institutions of higher education change more rapidly than school curricula, but even they do not keep up with that revaluation of values that is continuously taking place in science. Naturally, there must be some stability in the content of syllabuses and texts, but, objectively, it cannot be what it was 20 or 30 years ago.

Instead of passing on to students a relatively complete system of knowledge, education must now teach how to think, how to acquire knowledge independently. But "school practice shows," writes N. Kodak, Director of the Pavlysh secondary school named after V. A. Sukhomlinsky, "that we are better able to present knowledge and have it memorised than to train the mind, to develop it, to train it, if you like, to solve cognitive problems".[10] Learning has acquired too descriptive, fact-oriented a character, requiring memorisation of a large amount of information, much of which quickly becomes outdated or loses its significance. "Focusing chiefly on setting up a definite sum of knowledge and memorising it will lead to the inadequate use of the role of instruction in the mental development of pupils, in particular in the development of their ability to analyse critically and independently to think through the material being studied."[11] One cannot, of course, avoid memorisation and cramming, but this form of mental activity should today come secondary.

The educational system in secondary and higher schools has traditionally been focused above all on training people to perform well. The development of creative abilities has been "a personal affair". This state of affairs satisfied society completely when the level of development of the productive forces demanded a hundred times more good performers than original thinkers. But in conditions of the scientific-technological revolution, the need for people who can think creatively, and independently set and solve problems that are new in principle, has grown sharply. It is now admitted, wrote J. D. Bernal, that scientific education is needed not only for a narrow group of professionals, but for the whole population. Modern automated equipment requires for its operation highly qualified personnel who are able not only to service machines, but can also propose ways to improve them. "In any case, it is clear that the requirements for personnel in research and development in industry, agriculture and medicine will be enormously increased and come to equal and in some cases surpass the number of people involved in the operation of machinery and transport." [12]

In addition, the very nature of labour "in the operation of machinery and transport", in the field and on the farm, increasingly demands of workers the creative use of scientific knowledge in the course of routine work. It is natural that the efficient functioning of production can be secured by workers with a high cultural-technical level, able not only skillfully, but also creatively and rationally to approach their work.

Thus, within the system of contemporary productive forces there are quite serious contradictions. "The quantitative and qualitative changes that have taken place in recent years in science and technology," stresses Academician M. A. Lavrentiev, "demand a fundamental review of the whole system of education, both secondary and higher." [13]

4. CONTRADICTIONS IN PEDAGOGICAL PRACTICE

Some scholars feel that the educational system is conservative by its very nature, for its task is to pass on to new generations an existing system of knowledge. Teaching, Louis de Broglie has noted, has in its very essence a tendency to dogmatism, and tries to give a set form to the fluid state of our knowledge.[14] There is undoubtedly some truth in this, yet the problem is not primarily the conservatism of the educational system, but the fact that the volume of socially necessary labour of the teacher has grown so much and the labour itself has become so much more complicated that it is becoming ever more difficult for the teacher creatively and in full measure to meet his obligations through traditional techniques, forms and methods of instruction.

The mushrooming growth of information, caused by the acceleration of scientific-technological and social progress, not infrequently overwhelms both student and teacher. The latter often simply does not have the time to comprehend, process and pass the new information on. This problem is especially sharp in the general school. Teachers are often criticised, dissatisfaction with the level of their knowledge, craftsmanship and general culture is expressed. This testifies above all to the sharply increased demands made on the professional teacher.

The level of teacher training does not always meet the demands of life and the present state of school education. With the growth of education and culture in society, the general development of the pupils grows rapidly, too. Investigations by the staff of the Academy of Pedagogical Sciences of the USSR of a large group of teachers and senior class students who were making good progress in their studies showed that 60-70 per cent of the students were more familiar with the latest achievements of science, technology, culture and sport than the teachers. Even experienced and meritorious teachers noted that in the last 10-15 years it has become much more difficult to teach, that children have become more intelligent and curious, know much more than before, and that with every year it is "more and more difficult for the teacher to enter the classroom". An older teacher shares her observations: "Before, students raised their hands when we reviewed previous lessons. But now there is a forest of hands when I begin to explain new material. Everyone of them has heard something about what I intend to say."

An insufficiently high level of training and general culture on the part of teachers can be a serious brake on the transition

to a new content in school education. The process of instruction should provide the interrelations between subjects, interrelations that play an enormous role in forming the thinking and the outlook on life of school-age children; but for this, the teacher must himself master the ideas of adjacent disciplines and have a broad mental outlook.

Some teachers' insufficient level of scientific knowledge is explained, on the one hand, by deficiencies in their higher school training and in the system of retraining and raising teachers' skills. On the other hand, the teacher is often so overloaded with daily concerns and cares that he is simply physically in no condition to develop himself. And today even the solidest store of knowledge brought from the higher school does not free one from the need to study continually.

As the results of sociological research show, the teacher now spends incomparably more time on preparing lessons than 40 or 50 years ago. Thus, while in 1927 the ratio between time spent giving and time spent preparing lessons was, among teachers in Siberia, about 3 : 1 or 5 : 2, at the end of the 1960s it was 5 :4 or 1 : 1; among teachers of mathematics the ratio was 4 : 5, among teachers of Russian language and literature — as much as 2 : 3. This fact itself undoubtedly reflects positive changes; teachers now prepare lessons more thoroughly and apparently conduct them on a significantly higher level than in the 1920s. On the whole, teachers pay significantly more attention to extra-curricular work. As a result, despite the fact that the official teaching load has been reduced by 25-30 per cent, the amount of working time not only has not decreased, but has grown and is today (given a teaching load close to the norm) 50-60 hours a week.

The teacher's working day is today like an iceberg, with a visible part — the work norm — and an invisible, "submerged", part. Society's growing demand with respect to the total work of the teacher is met today to a significant degree through an increase in the unofficial part of working time, through an increase in the "hours that nobody keeps track of". As a result, teachers are today the only socio-professional group whose working time has grown and free time decreased over the last 40-50 years. Teachers are often criticised for lagging behind the demands of the times. Many teachers simply cannot find the energy or time to solve the new and prospective problems that the school faces.

So, in the teacher's work a whole series of contradictions have come to a head: a) between the expanding flow of information that the teacher must master and the real possibility of handling this flow; b) between the reduction of the standardised part of the teacher's work load, measured in the number of lessons per week, and the real growth of working time through the increase in the unofficial segment of the working day; c) between the objective demands for raising qualifications and the actual reduction of time that the teacher spends studying; d) between the tendency of the overwhelming majority of socio-professional groups to reduce the amount of working and increase free time, and the opposite tendencies in the time budget of teachers.

Results of sociological research show that, in the teaching profession, a number of serious problems have come to a head, and these problems demand practical resolution without delay. On our request, 440 teachers in schools in the Novosibirsk Region responded to a questionnaire on their attitude to their profession and to the subject they teach. In the opinion of the overwhelming majority of the respondents, pedagogical work is multi-faceted and provides much opportunity for creativity. 76 per cent of the teachers felt that way, and only 10 per cent felt that the teacher has few opportunities for creativity and initiative. Almost two-thirds of the respondents were convinced that pedagogical work broadens one's mental horizons and increases one's knowledge; only 16 per cent disagreed. Positive evaluation of the subject taught is especially predominant: 72.5 per cent responded that they liked what they taught, 22.5 per cent chose the answer "like more than dislike".

It would seem that this is quite a satisfactory picture, and some scholars evaluated the results of the survey in just this way: "The overwhelming majority of teachers are clearly satisfied with their profession." But the answers to other, control, questions prompt caution with respect to this conclusion. For example, only 35 per cent of the teachers would choose this work if they were to begin their working life

all over. Only 20 per cent declared quite definitely that they did not want to change their career.

As we see, the answers are contradictory. The reasons for this are to be found in the teacher's contradictory situation. On the one hand, the teacher's labour is extraordinarily noble, has enormous social meaning and provides a broad field for creativity, intellectual forays and for manifesting and developing the most varied abilities. On the other hand, the teacher's work is a constant lack of free time, a constantly increasing circle of responsibilities, and constant stress.

The problem of the teacher's spiritual and cultural growth is above all a problem of rationalising his work and daily routine. The practical solution of the social problems of teachers in the USSR is to a significant degree being aided by raising teachers' pay. Systematic assessment of teachers' qualifications in general schools, begun in accordance with a resolution of the CC CPSU and the Council of Ministers of the USSR, has great importance in stimulating a continual rise in skill and pedagogical craftsmanship, and in raising the prestige of the teaching profession.

5. EDUCATION: EVOLUTION OR REVOLUTION?

In the production-education-science system the two elements at either end have in the last few centuries developed much more rapidly than the middle element, and they have gone through an especially profound revolution in the second half of the 20th century. Yet the field of education has evolved very slowly and, as many authorities note, in many respects has not gone much beyond the 19th century and even the Renaissance. The field of education, write Academician A. I. Berg and Professor B. V. Biryukov, is one of the most "conservative".[15] As a result, profound contradictions have come to a head within the system of education itself and between production and science on the one hand and education on the other. All investigators recognise these contradictions in general. But their depth, meaning, and the ways and means of resolving them are differently evaluated.

Of the two extreme points of view, one holds that the

content, forms and methods of education basically meet contemporary requirements. Consequently, one needs only to improve separate details. And it is usually stressed that all changes should be made carefully and gradually. Partisans of the opposing view stress the need for fundamental changes in the content, forms and methods of instruction; partial changes in mere details, though perhaps useful to a certain extent, cannot solve basic contradictions. As a rule, adherents of this view call for decisive, radical transformations without delay.

The first group is, objectively, defending an evolutionary path of development for the educational system. The second, in effect, talks of the need for revolutionary transformations.

The question arises: is it legitimate in general to speak of a revolution in education at the present day? And if so in what does it consist?

When we speak of such a complex and sensitive organism as the modern educational system, in which the younger generation is nurtured, one naturally thinks first of how to keep alterations and reorganisations to a minimum. Advocates of an "evolutionary" approach are right, first, in the sense that we must exhibit maximum care, for risk is permissible only within strictly defined limits. Second, they correctly stress the need to maintain continuity between old and new. When imperfections begin to make themselves felt, when the inadequacy of old principles, institutions, and the methods and goals of education connected with them, show themselves, one immediately thinks of doing away with the whole system. However, it is wisdom "*...to put the old in a new relationship to the whole and thereby as much to preserve the essential as to change and renew it*".[16]

None of this means that fundamental changes and revolutions in the field of education are excluded in principle. On the contrary, "one cannot view progress in education," as Hegel noted, "as the smooth progression of a chain...". Education, he wrote, "...must preserve the material and object that it previously worked on, while changing and renewing it".[17] "Smooth" development is even less likely in the present era, when education has organically merged into a single system with social production, science and technology, into a system that is as a whole undergoing a tempestuous and historically unprecedented revolutionary transformation. One must deal

first with the character and specific features of the latter and, second, with whether there is a need for such a revolution in a specific historical period.

There was a revolution in education in the USSR during the transition from capitalism to socialism. It was then a constituent element in the cultural revolution. In the course of this revolution in education, first, its social function suffered a complete reversal; second, as was noted above, there was a tremendous quantitative leap in the development of the entire educational system; third, the substance of the social sciences and the methodological and philosophical bases of teaching the natural sciences changed fundamentally. The content of the latter, as determined by the delimitation of syllabuses of instruction (especially in the division of specialities in institutions of higher education) has likewise changed. Hundreds of new educational specialities and academic subjects have appeared. However, in general and as a whole there has been no fundamental change in the natural science content of education to this day.

Requirements stemming from the development of the natural sciences are met in the curricula in institutions of higher education with significant delay. Students study in adequate detail the subjects relating to their profession and acquire a quite superficial acquaintance with adjacent scientific disciplines, the choice of which is largely governed by historical tradition. In an era of interpenetration and integration of scientific knowledge, this is an inadmissible anachronism. "Of course, the latest achievements of science are included in the curricula, but the structure of teaching, in its basic features, corresponds to the structure of human knowledge at the end of the 19th century. This structure of higher education has been basically preserved to our own time.... Secondary education is even more conservative than higher. To this day it has not really been able to reflect the differentiation of science and is still under the sway of universalism." [18]

It is possible that this judgement, made by the late Corresponding Member of the Academy of Sciences of the USSR A. A. Lyapunov, is too harsh. Nevertheless, as a whole it correctly expresses the crux of the matter—the deep chasm between the content of contemporary education

and the requirements of the scientific-technological revolution.

Thus, one can state that education today has come up against the need for profound changes in the content, forms and methods of instruction.

At a certain stage in the development of the scientific-technological revolution, in both socialist and capitalist countries, a contradiction inevitably arises between the state of the educational system and the requirements of further progress in science and technology. Attempts made in many countries of the world to resolve this contradiction mainly by extensive growth of the field of education have not met with success. The tendency toward accelerated, exponential growth in the figures for expenditures on education, number of students, teachers and scientific-pedagogical personnel, a tendency observed in most countries, does not testify only to success. By extrapolation, this will, in the next few decades, assume absurd proportions; this is a red warning light that, in the development of the educational system, contradictions have come to a head that are so profound that they cannot be solved by traditional methods, through simply quantitative changes, i.e., by evolution. To resolve these contradictions, profound qualitative transformations are needed, transformations that would adjust the economic function of the educational system to the scientific-technological revolution. This is to say that *the scientific-technological revolution gives rise to a need for revolution in education.*

6. THE BEGINNING OF AN EDUCATIONAL REVOLUTION IN THE USSR

As we have already said, there was a revolution in education in the USSR in the 1920s and 1930s. Essentially, it consisted in bringing the educational system into conformity with the new socio-economic and political structure. The revolution in education was above all associated with a transformation of the *social function* of the educational system and of all culture. The new revolution should above all take place in its *economic function*, in instruction in the natural sciences, in the forms,

methods and, what must be stressed, in the material-technological base of instruction. This new revolution in the field of culture, given the completion of the transition to universal secondary education, the extension of higher education to a significant part of the population, and various forms of "post-graduate" and continued education through one's whole life, will inevitably be a *revolution in education.*

At present there are clear signs that this revolution is beginning. What are these signs?

The period 1966-1970 holds a special place in the history of Soviet education. During this period, in accordance with the decisions of the 23rd Congress of the CPSU and a number of subsequent important resolutions of the CC CPSU and the Council of Ministers of the USSR,[19] a great deal of work was performed in the area of developing and improving the whole system of public education. An All-Union Congress of Teachers was convened, a Statute for Schools was worked out. Much was done to renovate the content of the teaching process in schools and institutions of higher education. Content is being adjusted to the requirements of scientific-technological progress and to the general level of contemporary scientific knowledge.

The reorganisation of elementary education occupies a leading place in the complex of measures carried out. The studies of A. Zankov, V. Davydov and D. Elkonin are one of the most important achievements in Soviet pedagogical and psychological science; their works showed that it was possible to significantly stimulate the cognitive activity of pupils in junior classes and, on this basis, to reduce the period of elementary education from four to three years. Thousands of educators and teachers participated in an experimental verification of this work.

As a result, the course of instruction in elementary school has been reorganised in full. Now, beginning with the fourth grade, there are separate teachers for every subject. The Academy of Sciences of the USSR and the Academy of Pedagogical Sciences set up a commission that critically analysed the existing school curricula and determined the content of new curricula.

The teaching of mathematics, chemistry, physics, biology

and other natural sciences has changed. From the fourth or fifth grades, pupils get some idea of the most important achievements in these areas. The new mathematics curriculum bridges the gap between arithmetic, algebra and higher mathematics, and acquaintance with the principles of computers is envisaged. The molecular-kinetic and electron theory have become the basis of physics in schools. In senior classes, pupils study the wave and quantum properties of light, and familiarise themselves with elements of the theory of relativity and with the structure of the nucleus of the atom. In the study of physics and chemistry, mathematics is more widely applied. The latest information on achievements in studying the universe is given in astronomy courses. The course of general biology includes the modern doctrine on the structure and functions of the cell, the molecular bases of genetics and selection, the latest concepts on the evolution of organisms. The connections between courses of chemistry and biology, physics and biology, etc., are becoming closer.

Practical application of scientific knowledge (polytechnisation) and labour training are allotted a great deal of attention in the new school curricula. In many schools, study of automobiles, tractors, typing and some other aspects of practical activity have been introduced. In recent years, student production teams, which are a basic form of labour training and professional orientation to agricultural trades in rural areas, have become widespread.

At present, there are about 3,000,000 schoolchildren in student teams and teams of student forest rangers. The connections between schools and industrial enterprises, which serve increasingly as a base for labour training for senior classes, are being strengthened. At the Kharkov Tractor Plant, for example, more than 2,000 schoolchildren are receiving industrial training. During school hours, summer practical work and elective courses, students acquire the skills of a metal turner, a joiner-modeller, an electrician, draftsman, etc.

Essential changes have been introduced in the new curricula in the social sciences. The whole course of the social disciplines is permeated with the basic ideas (of a philosophical nature) of the role of productive forces and production relations, of classes and class struggle in the development of society, of the

decisive role of the popular masses. The basic feature of a course of social science is that it synthesises the information that students acquire in the study of other disciplines, and, to master this course, laws and phenomena from the field of history, physics, chemistry, biology and other sciences are used.

Many textbooks have been rewritten with the aid of outstanding scholars and specialists in all the basic branches of knowledge. Renowned scholars, methodologists, and experienced teachers have taken part in compiling and verifying them.

In order more completely to reveal the abilities of every student, to encourage the aspiration for independent work, many schools have introduced elective courses in the physico-mathematical, natural and human sciences beginning with the seventh grade. In many towns, there are now specialised physico-mathematical and biological schools and schools where instruction is carried on in a foreign language.

Specialised physico-mathematical schools attached to universities are of special interest. The first such school was opened in January 1963 at Novosibirsk University on the initiative of Academician M. A. Lavrentiev. It was founded because there was a need to raise sharply the general level of those entering Novosibirsk University, for the natural flow of applicants in their qualitative make-up clearly did not meet the needs of preparing personnel for major science.

However, the significance of the experience of physico-mathematical schools goes far beyond narrowly practical bounds. The system developed for looking for and selecting young talent not only ensured substantial improvement in the quality of those entering the University, it also allowed solution of a most important social problem: to ensure a more equal opportunity for enrolling in physico-mathematical schools and subsequently in Novosibirsk University capable children from the most remote rural areas, from workers' settlements, from all social groups. While in the 1962/63 school year 60 per cent of those entering the University lived in regional centres, in subsequent years about 40 per cent of the first-year students came from villages and workers' settlements and 30 per cent from small towns. For a majority (about 60 per cent) of children enrolling in recent years in the Novosibirsk physico-

mathematical school, both parents have no more than a secondary education. In addition, instruction in the physico-mathematical school levels out differences in background, differences conditioned by the influence of family and social environment. For example, in 1966, of the applicants for the mathematics department of the university who were not graduates of the physico-mathematical school, 30 per cent of the applicants from families of the intelligentsia were accepted and only 13 per cent of the applicants from workers' families. At the same time, among graduates from the physico-mathematical school, 84 per cent of the candidates from families of intelligentsia were accepted and 82 per cent from workers' families. Nullifying the differences connected with social status and place of residence, instruction in the physico-mathematical school at the same time has a beneficial effect on positive qualities of the personality and helps more fully to reveal the creative potential of every student. Almost all graduates of this school enroll successfully in Novosibirsk or other leading institutions of higher education in the country. Former students of the physico-mathematical school have distinguished themselves at competitions of students' scientific papers. They graduate from the University with honours two and a half times more often than other students, and they are sought out for work in research institutes.

In the organisation of the physico-mathematical school, new content, forms and methods of instruction, meeting the needs of the contemporary scientific-technological revolution and overcoming the substantial gap between instruction in secondary and higher schools, were elaborated. At the same time, the effectiveness of early professional orientation and training in a given direction was demonstrated in practice.

At the present time, schools of this type are operating at Moscow, Leningrad, Kiev, Tbilisi and some other universities. The number of such schools, of course, cannot be great. They meet a special need: instead of the previous "amateur" methods of searching out, selecting and preparing cadres for science, this task is being put on a significantly higher footing, which corresponds to the needs of the modern education industry. At the same time, specialised schools at universities provide a firm basis for developing a broad network of

physico-mathematical schools in other cities, which has great importance because of the growing demand for mathematicians.

The creation of physico-mathematical schools has laid a solid bridge between science and education, between the secondary and higher school. Major Soviet scholars are now constantly involved with problems not only of higher, but also of secondary education and are doing a great deal to further public education as they help to develop new teaching programmes and provide new texts and manuals. Many of them themselves teach in physico-mathematical and ordinary schools.

The scholar in a school is a significant phenomenon that is characteristic precisely of the Soviet school. The scholar comes to the school not only as a teacher, but also as aid and adviser for teachers. In this regard, the experience of the Novosibirsk physico-mathematical correspondence school, in which students and teachers both study, merits imitation. Courses for raising qualifications are offered systematically, and this helps to raise the level of instruction in the schools of Siberia and the Far East.

The development of specialised schools has strengthened the working relations between the Academy of Sciences of the USSR and the Academy of Pedagogical Sciences of the USSR, between the Ministry of Education and the Ministry of Higher and Specialised Secondary Education. This in turn has given a strong impetus to the improvement of content, forms and methods of instruction.

Higher education has recently undergone a significant reorganisation, too. In connection with the anticipated structural shifts stemming from the scientific-technological revolution in the national economy and in the professional make-up of personnel, a number of new educational institutions were set up and training in new specialities was organised in many institutions of higher education.

Curricula in all the basic social, engineering and in many specific disciplines were revised. Physico-mathematical training has been expanded in almost all engineering specialities, and new physico-mathematical disciplines bearing on the scientific-technological revolution have been introduced. In the course

of higher mathematics, the theory of probability, theory of numbers, and operational calculus and the calculus of variations have been given more attention. In the physics course, such branches of physics as the theory of relativity, quantum mechanics and so on have been allotted more time. In the curricula of the social sciences, propositions reflecting the socio-economic consequences of the scientific-technological revolution in socialist and capitalist countries have been introduced. The role of theoretical disciplines in the curricula in agricultural, medical and teachers colleges has been increased. Economists are now given almost twice as much training in the mathematical disciplines.

Special accent is placed on combining teaching and research, which allows a greatly accelerated preparation of personnel for science and for industrial research. Various forms of student research have become widespread in Soviet higher educational establishments in recent years. Thus, at Novosibirsk University, beginning with the third year students work in the laboratories of the institutes of the Siberian Branch of the Academy of Sciences of the USSR and by the time they graduate they have become skilled research workers, often defending candidate dissertations soon after defending their undergraduate theses.

"It is important and completely indispensable," declared L. I. Brezhnev in a speech at the All-Union Rally of Students, "to master fully the material in the university curricula. But this alone is not enough. One must learn constantly to improve one's knowledge, to develop the skills for research, to develop a broad theoretical outlook. Without this, it is difficult to orient oneself in the ever increasing volume of knowledge, in the growing flow of scientific information.

"The instruction process in higher educational establishments today relies ever more on the independent activity of the student, who becomes almost a researcher. The participation of students in scientific discussion groups and seminars has become exceedingly widespread, competitions and exhibitions of scientific work have gained greater popularity than ever before." [20]

The transition from optional to compulsory participation by students in departmental research has become a characteristic

of the modern institution of higher education. It helps to merge the teaching process not only with science but also with production, inasmuch as students often carry out projects from industrial contracts.

Thus, substantial and positive changes have taken place in the Soviet educational system, changes that have no equal in the whole history of Soviet public education. Changes of no less importance have occurred in specialised secondary and higher education. All this allows one to say that *in the second half of the 1960s, a revolution in education has begun in the USSR.*

But it would be wrong to suppose that the job of harmonising the educational system with the needs of the scientific-technological revolution has already been accomplished. So far only the first step has been taken in this direction. One cannot picture the revolution in education as a sudden transformation of "explosive" character. It will consist of a number of consecutive transformations, developing through the whole course of the scientific-technological revolution.

CHAPTER FIVE

THE "WORLD" CRISIS IN EDUCATION

1. THE CRISIS IN EDUCATION: BASIC SYMPTOMS

The contradiction between the requirements of the scientific-technological revolution and the level of the educational system is of a global nature. It arose at a specific stage in the development of the productive forces as a necessary and inevitable result of the revolution in science and technology. However, there are qualitative differences in its manifestations in societies with different socio-economic structures. The objective demands of production for raising the level of education are met in capitalist countries with opposite demands from the ruling classes—demands for restricting and limiting the education of the working masses as much as possible and giving truly quality education only to the elite. The economic function of the bourgeois educational system is in irreconcilable contradiction with its social function. Therefore, under capitalism the contradiction between the level of development of education and new requirements of the scientific-technological revolution assumes the form of a profound *crisis in education.*

Bourgeois politicians and scholars generally admit this and are greatly concerned.[1] However, they usually believe that the crisis in education is worldwide and is characteristic not only of capitalist but also of socialist countries. In October 1967, in Williamsburg (USA), there was a special international conference on this topic; 160 specialists from 53 countries took part. A report on the conference was published and distributed by UNESCO. In 1968, Philip Coombs' *The World Educational*

Crisis. A System Analysis appeared and was translated into many languages, including Russian, and obtained wide renown.

There are heated disputes over the substance and extent of the crisis. In the face of the impressive growth of the number of educational institutions, the number of students at all levels, the sharp and steady increase in expenditures for education, it seems at first glance paradoxical to speak of a crisis in education, let alone a worldwide crisis. And some educators and scientists in fact deny that it exists, attributing talk of a crisis to people who are far removed from the realm of pedagogy and to irresponsible demagogues who would criticise the schools to gain political capital. Others, on the contrary, believe that the whole world is in the grip of an educational crisis that threatens mankind with serious repercussions in the future.

So it is necessary, first of all, to clarify the following: what do we mean by the "crisis in education"? What are its essential features? Should it be considered "worldwide"?

In the broadest sense, "crisis" means a certain break in the development of systems, a difficult transitory phase. As applied to social life, "crisis" is a situation in which the old social forms effectively impede further development of the content and come into sharp contradiction with the requirements of progress. The only solution possible for contradiction of this sort is a basic break with the existing forms of social relations.

Apparently, the "crisis in education" should be taken to mean those situations when, on the one hand, there is an urgent objective need to improve the educational system, a need shown in the disparity between the products of the system and the demands of scientific-technological and social progress. On the other hand, it is when existing social relations retard the internal potential of the educational system and arrest its development.

Not all disparities and contradictions arising in the course of the development of the educational system necessarily signify its crisis. The crisis occurs only when these contradictions become so pronounced that objectively they *cannot be resolved within the framework of the existing social system.*

Bourgeois scholars today talk and write a great deal about the crisis in education, but they treat it one-sidedly, concealing the social, class antagonism that is its essence. Usually, they cite several factors: first, the tremendous growth of the school-age population that stems from the "population explosion". This explosion leads, on the one hand, to a growing demand for education from all social groups and, on the other, to a lag in the development of the educational system behind the snowballing "demand" for education. Second, there is a disparity between the knowledge and skills students receive at educational institutions and the social expectations and objective demands of the scientific-technological revolution. Third, there is a characteristic conservatism in the educational system and an increased resistance to innovation and change. Fourth and finally, one observes a persistent tendency for expenditures to increase rapidly, to absorb an even greater share of the national income and to threaten seriously to unbalance national budgets.

We shall examine each of these factors separately.

The contradiction between the increasing demand of the masses for education and the possibilities for satisfying these needs stems from the socio-economic nature of bourgeois society. Objectively, scientific-technological progress has made it necessary for all strata of society to have access to all levels of education, including access to higher education. While some headway is being made, the ruling classes set many official and unofficial barriers before the working masses in the realisation of their true educational potential.

The rapid growth in absolute and relative (in relation to the national income) expenditures on education, a growth that bourgeois scholars also view as a manifestation of the crisis, is "unjustified" only from the narrowly egoistical, bourgeois point of view. "Investment in man" is not only more humane but also extremely economical (as was noted above) in the affairs of society. However such investment lies beyond the purview of private, entrepreneurial interests. Moreover, rational expenditures on education, in terms of the interests of society, can only be realised through a close, scientifically based coordination of national plans for education and plans for developing the nation's economy. This, however, is possible only under socialism.

In most countries, there is in fact a disparity between the quality of education and the demands of the scientific-technological revolution, and in most countries the educational systems increasingly resist change. However, scientific methodology demands that we examine all social processes, including education, not abstractly, but in the context of specific historical conditions, keeping in mind the decisive influence of the socio-economic structure. As is well-known, superficially similar phenomena in different social systems can have entirely different import. Consequently, an abstract focus on the problem of the "crisis in education" is not enough. A more concrete approach is required, one that takes into account the fact that the educational system is determined by larger systems—by socio-economic structures—a circumstance that has till now remained beyond the purview of bourgeois scholars. For a more substantive treatment of the question, one must examine the actual contradictions that have arisen in the educational systems of the capitalist countries.

2. THE CRISIS OF THE BOURGEOIS EDUCATIONAL SYSTEM FROM THE STANDPOINT OF ITS ECONOMIC FUNCTION

The contradictory state of affairs in education in developed capitalist countries is graphically evident in the United States. On the one hand, that country demonstrates the maximum that can be achieved within the framework of bourgeois society. In the number of students, teachers and college instructors, in financial expenditures and technical equipment for education, the United States has left all other capitalist countries far behind. In 1971, for every 10,000 inhabitants, the US had 269 students, while Great Britain had 87, Italy 110 and the Federal Republic of Germany 70. Of the 110,000-120,000 million dollars annual expenditure for education in the capitalist world, more than half was spent in the United States.[2] In education, the US is the "showpiece" of the capitalist world. On the other hand it is here that social antagonisms within the educational system show themselves at their sharpest and eat away at the bourgeois school. Here we find the educational system unable to meet the requirements of social progress.

Inasmuch as the US is the most developed capitalist country, in it we can see the changes that the educational systems of other capitalist countries will have to undergo. In other words, a study of American education gives us the key to understanding the essence of many problems that the bourgeois system faces as a whole.

The "crisis in education" is an extremely complex and multi-faceted phenomenon. It is expressed, first, in the fact that opposition between the economic and social functions of the bourgeois system of education takes to the extreme the disparity between the latter and the objective needs of scientific-technical and industrial progress. A new situation has arisen, where people remain unemployed even when there is a demand for labour, because their skills and, especially, basic level of education do not permit them to meet the rapidly changing demands of technical progress. Bourgeois economists even have a name for this sort of unemployed worker (to be distinguished from the "technologically unemployed" of the 19th century)—unemployable, i.e., "incapable of being employed"—concealing the fact that the "incapability" is caused by the capitalist social structure and not by technology.[3]

The fundamental reasons for unemployment lie not in an inadequate level of skills or education, but in the socio-economic conditions of capitalism. In the US, despite the increase in the educational level of the population and the new policy of systematic governmental intervention in the professional training of working people, the number of unemployed is steadily increasing. Among the unemployed are engineers and technicians, administrators and even scholars. According to a forecast by A. Carter, Vice-President of New York University, from 30 to 50 per cent of the young scholars who are now in some phase of their training may find themselves without a job in the 1970s and early 1980s.

Those who suffer most from unemployment are the poorly educated. The percentage of the unemployed is particularly large precisely among those with little education. For example, those who have not finished secondary school are unemployed twice as often as secondary school graduates.

Along with this, the quality of education is becoming more and more important. The level of education (even though

sometimes, formally, quite high) of the majority of those who have studied in ordinary, i.e., not elite, schools, does not allow them to master the complex, modern specialities or to change their skills and type of work. The unsatisfactory state of general education is apparent in the economy. One of the most important needs of today's economy, with its constantly developing technology, is flexibility in the professional qualifications of personnel. More and more employers in Europe complain, not of a lack of special training among young people, but of their inadequate general education.

Today, complete secondary school graduates are more readily taken on as factory workers than incomplete secondary school graduates with a technical bias. To master modern trades, one needs a rather broad background in mathematics, physics, chemistry and other natural sciences.

This has shown how pernicious is the principle of dividing secondary schools into those that prepare students for college and serve basically the privileged strata of society and schools for the working masses that prepare their charges for work in production. The traditional bourgeois policy of two types of education has shown itself to be economically unsound. Therefore the ruling classes themselves, paradoxically, are forced to voice alarm at the low quality of the working people's education.

In the US, the traditional policy of the ruling class of dooming working people to a second-rate, ersatz education was reinforced by the pragmatic pedagogical theory of John Dewey. In the guise of satisfying the vital needs of young people, courses and subjects were included in the school curricula that did not teach pupils chemistry but rather how to use disinfectants — not physics but how to drive and take care of a car — not biology but how to find a zoo. The fundamental principle of pragmatic pedagogy, "to teach what is necessary for life", despite extreme utilitarianism and demagogy, commanded the respect of the traditional American business mentality and enjoyed wide popularity.

Thus, amidst tremendous progress in science and technology, not only were the class hours of disciplines such as physics, chemistry and mathematics reduced, but sometimes these subjects were eliminated entirely from secondary school

curricula. From the beginning of the century right down to the 1950s, the proportion of students studying mathematics and the natural sciences steadily decreased. Only 25 per cent of the secondary school students studied a foreign language and even of this small number less than half studied a language three or more years. However, disciplines that did occupy an important place in the curriculum were meant to prepare the student for his future life — secretarial work, typing, repair of machines and domestic appliances, problems of the family, on engagement and dating, retail trade, etc. At the same time, substitution of one course for another (for example, automechanics substituted for physics) was readily permitted and everywhere the practice was adopted of letting students pass on from grade to grade regardless of how well they fared. As the American sociologist Arnold M. Rose wrote, "Schools push the children along from grade to grade without there being the slightest possibility that they can learn much in the grades to which they are advanced...."[4]

A similar situation became characteristic for other capitalist countries, too. In French schools, for example, a vulgarised form of the Montessori method acquired great popularity. Believing that the student has the ability "to choose his path freely", supporters of these views have drawn the conclusion that in principle the school pupil should not be evaluated by the teacher. This approach was viewed as an attack on barrack-style discipline and on demeaning students. In practice, however, it denied the need for teachers to have any effective pedagogical influence on their students. As a result, students formally ceased failing while in fact the level of schooling fell sharply. The teacher willingly relieved students of the obligation to attend school regularly, and students often ceased entirely to attend school. "Free" schools, then, were a contradiction in terms — freedom from any education whatsoever led many students, especially those from worker and peasant families, to drop out of school.[5]

Young people with little or inferior education are unable to master the modern and most needed trades and are the first to swell the ranks of the unemployed. Moreover, the low quality of workers' general education has in recent years begun to slow down the growth of labour productivity, especially in the

United States. The scientific-technological revolution has confronted America with the question: Just what is the educational level of American citizens? Are diplomas and degrees a real measure of knowledge? The conclusions drawn by researchers have been bombshells: Harvard scholars contend that barely half of the adult population in the US can read well enough to understand an ordinary printed text. Washington officials accused these researchers of using texts that were too difficult. However, according to a Harris Poll, 13 per cent of Americans were unable to read the simplest children's verse, 24 per cent of American adults were for all practical purposes illiterate. This "functional illiteracy", as sociologists call it, is concentrated basically on the lowest rungs of American class society. Yet official US statistics say that only slightly more than 2 per cent of the population is illiterate.

The poor quality of education in the US has assumed the proportions of a national disaster: every year, millions of young people enter all branches of material and cultural production, formally educated but in fact undereducated and often incapable of carrying out their productive functions in new conditions. This situation is aggravated by the widespread falsification of diplomas. Documents of the Department of Health, Education and Welfare reveal that the country has hundreds of "education institutions" that often consist of nothing more than a desk and a mailing address — they are "degree mills". The Federal Government has been helpless in its struggle against this evil, which relies on laws protecting private enterprise.

Lowering the quality of and "devaluing" education proceeds on the basis of a number of factors, among which the most fundamental and important is the outmoded capitalist structure. Surely the drop in the quality of education, the increasing gap between the demand for education and the government's ability to satisfy the demand, like the other above-mentioned negative features in this area, are characteristic not only of the US, but also, in varying degrees, of all other capitalist countries. The bourgeoisie everywhere wants to have an educated labour force. However, when the question of increasing expenditures for public education comes up, the bourgeoisie strives to reduce them as much as possible. The

Canadian Tribune, organ of the Canadian Communist Party, noted: "Monopoly capitalism will continue to need more highly trained labour power, but will not pay to develop it. The people need higher education but can't afford it...." [6]

The peculiarity of the crisis in education in the most developed capitalist countries arises despite the fact that there is formally universal education at the elementary and sometimes even at the secondary school level; it arises despite the relative widespread facilities for college education. In the US, for instance, the problem is not that there are too few high schools and colleges, but that "mass", i.e., "cut-rate", education that the overwhelming majority of Americans receive does not correspond to the demands of the scientific-technological revolution. In American education, the crisis is qualitative, not quantitative, according to the American scholars August Kerber and Wilfred Smith. [7]

Meanwhile, the need for well-educated personnel grows so quickly that it cannot be satisfied simply by educating the elite. The scientific-technological revolution objectively has set a demand not only for a higher level of education (at least secondary education), but also a higher-quality education for the whole working population — a demand that, as it turns out, is in sharp conflict with the interests of capital. This contradiction lies at the basis of the crisis in education and can be remedied only when the capitalist system is overthrown.

3. THE CRISIS OF THE BOURGEOIS SYSTEM OF EDUCATION FROM THE POINT OF VIEW OF ITS SOCIAL FUNCTION

The sharp disparity between the bourgeois system of education and the social needs of economic and scientific-technological development expresses only one aspect of the crisis of the educational system. The second aspect that bourgeois scholars tend to overlook is that the social function of education today has begun to work in a direction contrary to the one that capitalism assigns it.

The dialectics of the bourgeois system of education are such

that the more the ruling class treats education as an instrument for strengthening its economic and political domination, the stronger the force within it that undermines and shatters the existing order. Capitalism always strives to use the system of education, especially higher education, as its main support in the class struggle against the working people, against socialism. As John Hannah, President of Michigan State University, said in the autumn of 1961: "Our colleges and universities must be regarded as bastions of our defence, as essential to the preservation of our country and our way of life as supersonic bombers, nuclear-powered submarines and intercontinental ballistic missiles."

At the end of the 1950s and beginning of the 1960s a campaign began in the US to abolish loyalty oaths, to end discrimination against teachers for their political views, and to improve scholarship programmes. It was at this time that young people began to realise that "pure student" demands could be satisfied not by "struggling merely for academic (student) freedom, but for *the freedom of the entire people*, for *political freedom*".[8] By 1964-1965, students at Berkeley united the struggle for their own democratic rights with the struggle for political freedom in the country and against the social vices in the system of higher education and against racial discrimination. Police with billy clubs and tear gas confronted the students and made arrests. In response, 80 per cent of the 27,500 students went on a strike lasting several days. Progressive professors supported the students. Many lawyers volunteered to defend without pay the arrested students. The workers also came to the support of the students. Members of the Teamsters' Union refused to drive through the student picket lines.

In April of 1968, students from Columbia University, one of the oldest universities in the US, supported Black youth in opposition to racism and demanded the University break its ties with the military-industrial corporations. In 1968-1969, student unrest flared up in other universities, among them Harvard, until then a staunch bulwark of American imperialism.

In 1970, there was a new powerful wave of student demonstrations. It is especially significant that it was in

connection with the celebration of May Day holiday—the international day of solidarity of working people—that Yale and Kent State held massive political anti-war demonstrations, strikes, and meetings. The National Guard confronted students at Kent State and made May 4 "Bloody Monday": 4 students were killed and 12 wounded. The shots at Kent State echoed throughout the whole country. Almost 2,500 institutions of higher education, including 900 junior colleges, i.e., practically all higher and specialised secondary institutions in the country, became involved in one form of protest or another. The actions were sharply political and anti-military.

American political figures and scholars often try to present the "rebelliousness" of students as though it were, first of all, not political in nature but merely students on a spree and, second, as mainly undertaken by students who are not serious and are not doing well in college. Sociologists cite the "conflict of generations" as the reason for student demonstrations. Lewis S. Feuer, for example, feels that it is simply an individual case of the Oedipus complex—a son's revolt against the father's power—and that this revolt is universal: it occurs without fail in all past, present and future societies.

But even the findings of American sociologists refute these assertions. For example, the grade point average of students actively participating in the Free Speech Movement at Berkeley was higher than average in the University. Students doing poorly were underrepresented in the political movement. Student activists characteristically were seriously concerned about working in the name of national and international goals; in their personal value systems, an important place was reserved for ideas, art, and music. On the contrary, young people with a low level of political activism were concerned most of all with values such as marriage, family, career.

Secondary schools do not remain on the sidelines during social turmoil. Demonstrations, strikes, confrontations with police—all the forms characteristic of student unrest in higher education are being taken up even by high-school students. Senior pupils form groups and underground newspapers

appear. Pupils oppose standardisation, formalism in instruction, blind obedience to the authorities, and the divorce of the school from social life. This movement is assuming a more and more organised and serious character. If at first the grounds for demonstrating were that students did not like certain subjects or were not allowed to wear ultra-fashionable clothes to school, now more and more they express dissatisfaction with the domestic and foreign policies and with the prevailing social structure.

Teachers, who were always considered the traditional bulwark of power and "order", the most "dutiful" and conformist socio-professional group, today enter the arena of class struggle more actively and decisively. Not so very long ago many of its representatives considered it "improper" to enter trade unions or to take part in collective bargaining. Today, teachers actively use the specific tools of the proletarian struggle—strikes, political demonstrations, mass meetings. They demand not only an increase in pay but a democratisation of the entire educational system, and an end to racial discrimination.

Michel de Saint Pierre observes that the teacher considers himself a "veritable intellectual proletarian".[9] The most progressive teachers and instructors are wholeheartedly taking proletarian political positions and are joining the ranks of Communists.

These tendencies in bourgeois education are characteristic of all capitalist countries. Even the British educational system, carefully tuned and infused with century-old traditions, is more and more often working away in a direction contrary to the desires of its proprietors. In London, at the end of the 1960s, a week did not go by that hundreds and frequently even thousands of young people did not stage demonstrations against the Government's policies. Student protests, sit-ins, seizure of university premises, etc., have become one of the main topics in the newspapers.

The wide-ranging student movement in France reached a peak in May of 1968. Student organisations, in protest against the introduction of police force in universities, police occupation of the Latin Quarter, in protest against mass repressions and the provocations of fascist groups, called for a general strike and were supported by the French Communist Party and French trade unions. The Government was no longer able to counteract the protest movement by new acts of violence and was forced to retreat, having satisfied many of the strikers' demands.

According to the UN data, "student disturbances" have troubled 50 countries in recent years. They continue to flare up anew in different regions of the world.

The majority of the participants in the student movement are still ideologically and psychologically dependent upon bourgeois society. They underestimate the significance of organising, of a broad unity of action, they are not armed with a scientific, revolutionary outlook. Psychologically, the majority of students are characterised by individualism, reinforced by the influence of the ultra-left groups. Nevertheless, criticism of the bourgeois system of education is more and more turning into criticism of bourgeois policy, economies, culture and morality, and the objective logic of this struggle leads more and more to conclude that an alliance with the proletariat is needed.

Communists regard highly the rise of the youth movement and especially the student movement, and actively take part in it; they explain the danger of every kind of pseudo-revolutionary, leftist ideas, juxtaposing to them the ideas of scientific socialism and showing that "only close unity with the working-class movement and its communist vanguard can open for them truly revolutionary prospects".[10] The Communist Parties feel that the struggle for the democratisation of education is an important and indispensable aspect of the general struggle for democracy, which in turn is a component part of the struggle for socialism. They strive for the realisation of consistent and decisive progressive changes in the educational system and in accordance with this they formulate concrete demands and specific programmes for practical activity.[11]

Thus, the crisis of education in developed capitalist countries has affected its economic, as well as its social function, and is one of the concrete expressions of the aggravation of the contradiction between labour and capital, of the heightened intensity of the class struggle.

4. THE CRISIS IN EDUCATION. LOOKING FOR A WAY OUT OF THE CRISIS

Thus, as has been shown above, the crisis in education is connected primarily with the contradiction between the new demands of the scientific-technological revolution and the slow pace of education. The dialectical contradiction between education and the objective needs of material production and science, a contradiction necessarily arising at a specific stage of the development of modern forces of production, is implanted in the social antagonisms of capitalist society, antagonisms that take the contradiction to the extreme and prevent its resolution. The objective demand of the scientific-technological revolution—to provide all working people with high-quality education—enters into irreconcilable conflict with the interests of the ruling classes, a conflict that cannot be resolved within the framework of the capitalist structure. This is the essence of the contemporary crisis of education.

The crisis manifests itself concretely in developed capitalist countries, in the fact, first, that the bourgeoisie continues—contrary to the demands of the scientific-technological revolution—to limit in every way possible working people's access to higher education. This leads in practice to two types of schools: one for the ruling elite and the other for the working masses. Second, the "second-rate" education that the overwhelming majority of working people receives is in ever-growing conflict with the new demands of production. Third, within the bourgeois system of education, tendencies arise that undermine its social function and act not to reinforce the capitalist structure, but to undermine it.

The crisis of education is connected above all with the sharp aggravation of class antagonisms in all areas of social life in capitalist countries and consequently also in the area of education. The "world-wide crisis in education" that so many in the West now talk and write about is, in fact, a *crisis of the bourgeois system of education, one of the concrete manifestations of the aggravation of the general crisis of capitalism.*

In socialist countries there are no classes or groups seeking to oppose the enlightenment of the working masses. Therefore the contradiction connected with the gap between education and the needs of production and science does not assume a

crisis character and is successfully resolved in a process of the planned development of the economy and culture.

Of course, it does not follow that no problems or difficulties at all arise in the process of the development of the socialist system of education. The resolution of the contradiction between the development of education and the area of production and science demands exceptionally great efforts, scientific research and at times a difficult struggle between old and new. Expanding the scientific-technological revolution depends to a tremendous extent on success in these areas.

The scientific-technological revolution has become one of the main sectors in the historic competition between capitalism and socialism. Bourgeois political figures and scholars now realise this. It is indicative that this argument should be made by the oft-mentioned American sociologist Peter Drucker, who perhaps most clearly expresses the basic position of modern bourgeois science in evaluating the significance of education. Drucker writes:

"'The Battle of Waterloo,' it is said, 'was won on the playing fields of Eton.' Perhaps, but no one asserts that it was won in Eton's classrooms. 'The Prussian schoolmaster,' another saying goes, 'defeated France in the War of 1870 that created imperial Germany.' But long ago this was exposed as empty boast; the credit belongs to the German railway and the German armaments designers.

"With the launching of Russia's Sputnik, however, the old pleasantry became a grim fact. The higher education of a country controls its military, its technological and its economic potential. In an age of superpowers and absolute weapons, higher education may indeed be the only area in which a country can still be ahead, can still gain decisive advantage.

"The greatest impact of the educational revolution is therefore on international power and politics. It has made the supply of highly educated people a decisive factor in the competition between powers for leadership and perhaps even for survival." [12]

And, as George Bereday, a professor at Columbia University, writes: "It was true that education, the great traditional generator of American dynamism, had begun underproducing." [13]

Political figures, scholars, pedagogues, journalists and military figures in the USA all began speaking of the rottenness of the American educational system, of the gap between the American and Soviet systems. The complacent belief of the overwhelming majority of Americans that the US had surpassed the whole world in the area of education, too, gave way to general disillusionment and the admission that a crisis existed in their system of education.

The impressive successes of the Soviet Union force the American ruling circles to reassess the state of education in elementary schools, high schools, colleges and universities and, moreover, to reexamine the role of education in relation to economic, scientific-technological, political and military matters.

Admiral Hyman Rickover, the "father of the atomic submarine", said in an interview early in the 1960s that education was an area in which the United States had entered into serious competition with the Soviet Union, and the nation that would win this race would be potentially the dominant nation. On another occasion he stated that the seriousness of the Soviet challenge was not that the Soviet Union had military superiority but that it threatens the United States by its system of education.[14]

The Soviet Union in no way threatens anyone, but these statements are, first, indicative of a recognition of the success of Soviet schools and, second, reflect the fact that since 1957 competition with the USSR has become a leitmotif in America's educational policy.

These statements are not merely the personal opinion of the Admiral, they express to a great extent the opinion and basic position of the American ruling circles, aware of the fact that under present conditions the outcome of the struggle of the two worlds is being decided in the area of scientific-technological progress, and consequently—in the area of education. They also understand education's exceptional role as a factor in economic growth and military might and as the most powerful political and ideological weapon. It is no accident that education today holds one of the most important places in the strategic plans of American imperialism. Since 1957, the US has been making great efforts to concentrate its

gigantic financial and material-technical resources to overcome the crisis in its educational system, to raise its effectiveness and to make headway in this area.

In 1958, Congress passed a law with a title unusual for peacetime, the National Defence Education Act, and in the next years Congress produced more legislation in the area of education than it had in the entire first half of the century. The number of students in 9th and 10th grades and in colleges has more than doubled over the past 20 years. James Reston has noted: "Later, by dramatising the already-existing competition between the United States and the Soviet Union in technological achievement, Sputnik set off an unprecedented wave of federal support for higher education and research. The height of this wave is easily measured: during its first 174 years, Congress voted less than $6 billion for education; the 89th Congress voted more than $9 billion."[15]

Great attention began to be turned to the question of expanding scientific study of pedagogy, of the psychology, economics and sociology of education. In March 1970, the US President suggested in a special message to Congress—"Education for the 1970s; Renewal and Reform"—expanding research in the area of education, and creating a special fund for implementing innovations and necessary reforms. A special federal commission considered it necessary to bring the allotment for scientific research from 5 per cent of all expenditures on education in 1970 to 4-6 per cent by 1980.[16]

Significant steps are being taken to improve the quality of teaching in public high schools and universities. Teachers today are being forced to abandon the traditional principles of Dewey, who structured the school on narrow utilitarian, pragmatic approach to teaching and education and an underestimation of the role of theoretical disciplines. Necessity forced teachers to give serious attention to the academic disciplines, especially mathematics, physics, and foreign languages.

The conditions of the scientific-technological revolution forced capitalism to change its tactics in education: no longer having the strength to cut the working masses off from education, including higher education, capitalism is forced to

concern itself with improving the quality of education in the natural sciences in public schools. It is now facing the problem of maximising the system for "brainwashing" the working people in a suitable bourgeois direction by teaching the corresponding social disciplines. Capitalism is trying to compensate for the forced enlightenment of the masses by increasing political propaganda. A former President of Harvard University, James Bryant Conant, believing that the ideological war with communism must be won in the schools, said: "...To insure our future, we must educate the voters of tomorrow, in whose hands vast power is placed...." [17]

All this testifies to the fact that American imperialism is soberly evaluating the colossal power that education has under present circumstances, and is drawing some practical conclusions in accordance with class goals. This power can be used to free man just as it may be used to enslave him, make him a robot obedient to the ruling class. In the US, the system of education has begun to be viewed as the "first line of defence" in the struggle against socialism, as one of the effective means of achieving political aims within the country and in the international arena. August Kerber and Wilfred Smith contend that "education has become a cosmic race for survival". [18]

The reasons for the crisis of bourgeois education are not bound up with errors and shortcomings of leadership but in the general historical regularities of development, as a result of which the capitalist structure as a whole is unavoidably heading toward a decline, toward a general crisis. Therefore the attempts to find a way out of the crisis in American education from above are, in the final analysis, doomed to failure. We do not rule out the possibility that the US monopoly capitalism will be able to use its tremendous financial resources and scientific-technological accomplishments to carry out a revolution in the technical base, a revolution in the scientific content and in the forms and methods of teaching and thereby sharply to increase the productivity of the labour of teachers and students and increase the effectiveness of the economic function of education and enhance its role as a factor in accelerating scientific-technological progress. Nor do we rule out the possibility that American capitalism will succeed in modifying or adapting the social function of education to meet the conditions of the modern scientific-technological revolution so that it will to a greater extent meet the needs of its class interests and political tasks. In the final analysis, this will lead to a tremendous aggravation of social antagonisms in the country as a whole as well as within the system of education. Nevertheless, it is quite possible that at a certain stage American imperialism will become significantly more active than heretofore in using the system of education as a weapon in the struggle for strengthening its position within the country and in the international arena. The battlefront of the struggle of the two worlds in the economic, political and ideological areas has today become, in many respects, the school.

CHAPTER SIX

THE REVOLUTION IN EDUCATION— GENERAL TENDENCIES, PROSPECTS, QUANDARIES

1. ACTUALISING EDUCATION: COMBINING EDUCATION WITH PRODUCTIVE LABOUR

The most important task of education today is to further improve content. This means not simply raising the level of the students' knowledge, but an improvement aimed at bringing knowledge into closer correspondence with the socio-political goals of society, with the demands of the economy and science. This sort of improvement will be *an actualising* of education.[1] This concerns the general schools as well as vocational schools, specialised secondary schools and higher educational establishments.

General schools offering young people a general secondary education are, in the USSR, the most widespread. The goal of a general secondary education, notes the Soviet philosopher E. Ilyenkov, is to guarantee to every member of society the opportunity to discover without hindrance "the leading edge of human culture, the frontiers of what has been done and what has not yet been done, of what is known and what is not yet known"[2] and then to choose freely in which area he should concentrate his personal efforts: in physics, in technology, in poetry or medicine. How well a school can implant the fundamentals of education will to a decisive degree determine the success of the further training of an individual and his potential for mastering a modern profession. It is no coincidence that the Fundamentals of Legislation on Public Education define the general school as the basic institution for the universal secondary education of young people.

The future of secondary schools, the improvement of the forms and methods of general education, has been the subject of heated discussions and has provoked diametrically opposing

points of view. Keeping this in mind, we will examine the problem of actualising education in an attempt to define the basic ways to improve the content of teaching and upbringing in the general education school.

One of the main ways to actualise education is connected with polytechnisation and combining education with productive labour. While the problem of polytechnisation has been treated substantively in the works of many Soviet pedagogues, the notion of combining education and productive labour remains to this time one of the problems that has been dealt with least in theory and in practice. Moreover, a number of scientific studies even question its validity at the present time.

Actually, in the 1920s and 1930s, education and labour were combined by P. P. Blonsky, S. T. Shatsky and A. S. Makarenko. Some astonishing results were obtained, but, unfortunately, they were not widely known.

Attempts to implement the notion of joining education with productive labour were undertaken at the end of the 1950s and early 1960s, but the results were not particularly hopeful. Studies by sociologists demonstrated, first, that on the whole the orientation of students toward workers' trades remained weak and, second, of those graduates who began work, only a small percentage (14-21 per cent) used the special skills they learned in school. In the overall figures for Leningrad, secondary school graduates seeking employment in the profession for which they had been trained made up only 2 per cent of newly trained skilled workers.[3] "An unwarranted, narrow specialisation in school, reinforced by ideas of professional orientation, produced no little confusion in the theoretical realm and in the practical preparation of the new generation for employment.... The actual professional training of secondary school students in the 1959-1965 period was, as experience has shown, unsuccessful," concludes the Soviet sociologist V. R. Polozov.

Many instructors, however, incorrectly understood the essence of the criticism directed at them and began to make mistakes of an opposite nature. They often reduced the task of polytechnisation in school to a general acquaintance with the principles of modern production, to excursions to enterprises, to talks about some of the most widespread professions.

The resolution of the Central Committee of the CPSU and the Council of Ministers of the USSR of August 10, 1964, "On the Change in the Length of Preparation in General Secondary Polytechnical Schools Offering Industrial Training", shows that ending the professionalising of students does not exclude it when there is a suitable material base and good instructors. In practice, because of the lack of class time and funds for industrial training in the overwhelming number of schools, student shops and workshops were closed. By 1969 the number of schools without experimental plots almost doubled and the number of students in the student work teams on collective and state farms dropped noticeably.[4]

A number of scholars today try to justify this situation theoretically, feeling that the idea of combining study with productive labour is outmoded and juxtaposing to it the notion of polytechnisation. They even assert that V. I. Lenin supported the idea of combining schooling with productive labour only before the revolution and that in the period of the creation of the Soviet school he was "in principle against introducing children under 17 years of age to productive labour under socialism".[5]

Such assertions do not correspond to reality. Lenin never dismissed the idea of combining schooling with productive labour, on the contrary, he actively supported it. In the Draft Programme of the RCP(B), for example, along with the demand for "implementation of free, obligatory general and polytechnical education" there is a point on "the closest connection between schooling and productive social labour of the child". Lenin, as all his well-known works and documents show, decisively opposed only attempts to replace broad general education in school with early specialisation or narrow professionalism of the child.[6]

The new school, stressed A. V. Lunacharsky in his report on September 26, 1920 to the Third Session of the All-Russia Central Executive Committee (VTsIK), besides providing the principle of knowledge through labour, puts forth the slogan—knowledge of labour itself, varied knowledge in which labour is connected with all of science, on which it relies, and with the whole world in which it operates. "With this goal," he said, "we advanced to the forefront Marx's idea of

the necessity of a close union of schooling and labour—labour, of course, which is the most modern, the most scientific, i.e., factory work." This is why Lenin, who attended this session, made the following note: "(ß) the union with productive labour (not=the petty-bourgeois *trade* school)

"the connection of the school (2nd level) with the FACTORY".[7]

The principle of combining schooling with productive labour is one of the first principles in the Marxist-Leninist theory of communist education. In his *Critique of the Gotha Programme*, Marx came out decisively against completely forbidding child labour, on the grounds that it was not only a utopian but a reactionary demand. For in the early combining of productive labour with education, he saw one of the most powerful means for reconstructing society and felt that "in a rational state of society *every child whatever*, from the age of 9 years, ought to become a productive labourer..."[8] Engels also observed that productive activity beginning in childhood ensures a practical foundation for scientific training.[9]

Socialist society of course cannot permit child labour in production when it is detrimental to the child's physical well-being. But combining schooling with labour (in certain doses) and with physical training and sports is entirely necessary for ensuring the harmonious development of the individual. Lenin could not conceive of an ideal future society without a combination of education and productive labour. He wrote that "...neither training and education without productive labour, nor productive labour without parallel training and education could be raised to the degree required by the present level of technology and the state of scientific knowledge".[10]

Bourgeois scholars, metaphysically juxtaposing theory to practice, insistently stress that combining education and labour lowers the intellectual value of courses. The Marxist-Leninist principle of combining education with productive labour and the polytechnisation of the school provides for a high level of general education and theoretical training. At the same time, realising this principle to the full extent demands a profound revolution in the entire system of public education. Attempts to mechanically adapt polytechnisation and productive labour to

the traditional content, forms and methods of school instruction have not been successful.

As is apparent, there is no exact definition of the goal of combining schooling with productive labour. The goal must not be to provide fully qualified workers for modern enterprises (however, even this is not overlooked: for example, tractor drivers, chauffeurs, and machine operators are successfully turned out by many schools), but it must be, first of all, to give graduates a positive orientation toward the workers' professions and in doing so it should to a certain extent resolve the contradiction between a "pyramid of desires" and a "pyramid of needs". Second, the goal should be to instill interest and love for physical labour, rational attitude to social production, to the national welfare. Third, it should develop the habit of collective labour, develop economic-organisational skills, the ability to drive cars, to master the skills of electrical repairmen, carpenters, machinists, to undertake the minor repair of motors, radio repair, etc. All this will allow students to master in a short time a wide range of technical specialities at various enterprises. As N. K. Krupskaya wrote: "Our secondary schools must arm pupils with the working habits necessary for modern technology and thus prepare them for a great number of professions."[11]

At the present time, it is apparent that it is necessary to teach everyone how to use computing technology, to work with various automated equipment. This approach, in combination with broad theoretical preparation and polytechnical knowledge, can assure the education of "people who know how to do everything"—not know-it-alls, but people who in a short time can master successfully any profession and freely adjust to modern production, can transfer as required or as they wish from one type of work to another.

The difficulties of this important undertaking, as the practice of the leading Soviet schools and enterprises show, can be overcome. Student production teams have fully proved their worth and are used widely in rural areas. Working in such teams, students acquire rather broad production skills and become acquainted with basic agricultural machines, with different types of internal combustion engines and electric motors, and they drive and repair cars, tractors and self-

propelled combines. Along with this, students learn field management, animal husbandry and the economics and organisation of production.

Practice shows that all this brings good results. Thus, while a survey of the graduates of rural schools in the Novosibirsk Region where there was no practical work showed that only 5.3 per cent wished to choose a profession connected with agriculture, in schools where student teams were organised and worked well, half and more students opted for agricultural professions.

Important joint work in preparing students for agricultural work is carried on, for example, in the Pashskaya secondary school and the Pashsky state farm in the Leningrad Region. A student production team has already been working at the state farm for many years. As a result, of the young people finishing school in the past 10 years, 180 have chosen to work as tractor drivers, 125 have become chauffeurs, more than 170 have come to the state farm as trained field crop growers and stock-breeders. Many of them combine work with studies at higher educational institutions. The school has repeatedly participated in the Exhibition of Economic Achievements of the USSR because of its efficient organisation of the socially useful labour of its students in agriculture.[12]

In cities, it is much more difficult to introduce students to productive labour. But here, too, practice shows that if one has the desire, a lot can be accomplished. Extremely interesting types of combining schooling with productive labour have been developed in Moscow. Approximately 4,000 senior pupils from 23 secondary schools in the capital engage in production and minor technical design at Moscow's experimental Chaika factory. Each of them goes to the factory once a week. They work in four main production shops. The electrotechnical goods shop produces electric micromotors, the radio engineering shop handles miniature radio components, the sewing shop—doll clothes, and the print shop—printed matter. It should be emphasised that the most labour-consuming operations here are handled by adults. The factory administration is also made up of adults, but the student division parallels the administration with its own foremen and shop superintendents

and student management. The students take an interest in all the concerns of the various services—the duties of the chief designer, of the head process engineer, of the production planning department. They take part in working out new types of products and do laboratory work.

Chaika products are delivered to 128 cities in the Soviet Union, as well as abroad. More than 500 research institutes, laboratories and design bureaus are Chaika customers. This factory is a profitable enterprise, and brings in a considerable income.[13]

Unfortunately, this interesting, long-standing experiment has not received all the serious attention it deserves. It is quite possible that it will allow us to find the most effective ways to bring about the polytechnisation of the general education school and combining schooling with productive labour.

Enterprises participating in work-study programmes are playing an important role in the solution of these problems. Stavropol Secondary School No. 8, for example, has been successfully carrying out production training for 10 odd years with a machine-building plant. The school and the plant have established a general programme of training graduates as electrotechnicians. Experienced engineers conduct the theoretical part of the studies in the plant's laboratories. The students work in the plant four hours per week. In addition, excursions and meetings with advanced workers and heads of the enterprise's major services are organised regularly for pupils. It is no coincidence that many of the graduates of the school wind up working in the shops of the plant.[14]

The experience of the collective of the Baranov Motor Works in Omsk is interesting and indicative. The Baranov Works sponsors five local schools. The works has organised six production shops and furnished equipment. Each school is assigned a foreman for industrial training and the necessary personnel. Programmes have been worked out to correspond to the requirements of 2nd and 3rd grades of wage rates and skills.

Of what direct use is this to the enterprise? First, the schools sponsored have become an important source of professionally trained workers. Thus between 1963 and 1973 the works gave

certificates to 1,266 students working as turners. About half of them now work at the works. Of 142 graduates from the 1971/72 school year, 81 began work at the sponsoring enterprise. Moreover, most of them were already rated in the 2nd and 3rd grades. Second, a close bond between the school and the works assures the direct influence of the working class on the process of educating worthy successors. It assures that a deep respect will be nourished among youth for the high calling of the worker. This is an effective method of professional orientation. As the enterprise's director, P. Grigoriev, said: "For the young worker, the factory should begin with school."[15]

The experience of leading schools convincingly shows that the problem of combining education with productive labour can be successfully solved. Moreover, this experience testifies that the majority of villages and cities, workers' settlements and major industrial centres have a tremendous unused potential for combining education with productive labour.

The gradual transformation of vocational schools into secondary schools is of fundamental significance in the solution of the problem of combining education with productive labour. In 1974, there were about 6,000 vocational schools, with an enrolment of 3.1 million young people.

Research conducted in the Ukraine has shown that workers finishing vocational schools of the new type work 5-6 per cent more productively than those trained at ordinary vocational schools and 15 per cent more productively than those trained on the job. A youth receiving a secondary education along with a profession ascends the ladder of job grades almost three times faster than his peers and takes a more active part in scientific-technical creative work. "A modern type of educational institution is being created—the secondary vocational school, which combines a secondary general school and vocational training. Forms of organising the educational process have been developed in which the study of the fundamentals of the sciences is organically connected with future practical activity, and the study of theoretical and technical subjects helps one consciously and firmly to master the general subjects."[16]

Combining education with productive labour in a system of

vocational training also requires major improvement. Nevertheless, it is significantly better than the general education school. Therefore, bringing these two systems together should be a mutual process: not only should the vocational school become a secondary school, but the general education school must take up the best aspects of combining education with productive labour and to a certain extent it must adopt the experience of preparing qualified workers.

When the overwhelming majority of young people began work lacking a complete secondary education, and when secondary schools prepared their graduates primarily for higher education, the question of combining education with productive labour was not so urgent. Today, in connection with the transition to a universal secondary education and the further expansion of higher education, a significant portion of youth, especially 18-20 year olds in cities, do not develop a taste for productive labour. And is this not connected with the defects and shortcomings in the raising of the new generation, about which so much is being written in the press and in scientific literature?

When we tell students about the necessity to care about the cleanliness of towns and villages, to take care of nature, protect it, this is, of course, all to the good. However, the effect of conversations and lectures will be incomparably greater if from an early age students participate with adults in voluntary public work on city and village improvement, in cleaning up parks, in "green patrols", building bird-houses and feeding points for birds and animals in winter. Lenin said that we must tackle "educational tasks in such a way that every day, in every village and city, the young people shall engage in the practical solution of some problem of labour in common, even though the smallest or the simplest".[17]

Talk alone will scarcely develop in the students a love for physical labour, keen interest in working professions and craftsmanship. The more scientific-technological progress brings everyday services to children, especially in cities, the less need there is to perform manual labour as a daily necessity and, in the family, the inculcation of respect for labour disappears or leaves much to be desired.

So that industrial training can meet the tasks of the present

day, it must not rest on a primitive, rule-of-thumb basis. Technological progress, on the one hand, complicates the task of attracting the new generation to productive labour, since production processes in the city and countryside are becoming so involved that taking part in them demands ever lengthier professional training. On the other hand, the scientific-technological revolution allows, in the process of training students, the use of comparatively easily operated, extremely efficient tools, which make labour interesting and are fascinating in themselves and in the way they are used. This creates the material possibility, the social, economic and pedagogical expediency for introducing the new generation to productive labour. Such an introduction will not detract from but, on the contrary, bolster the students' physical and spiritual development.

Without a doubt, the actual solution of this problem requires that we tackle a great many other complex problems, which are being explored by many Soviet scholars and teachers.[18] However, turning to pedagogical works and practice still does not allow us to find satisfactory enough solutions to many urgent problems. Many problems demand special, basic research. Nevertheless, the experience of the best schools already shows that polytechnical training is effective only when it is organically connected with the productive, creative labour of the students.

A great pedagogical mistake is being made in those schools where production training is subordinated to purely academic goals without concern for the social utility of the students' labour. Often, school workshops mass-produce goods of no use to anyone, goods that are later tossed in the scrap heap or in the trash. Perhaps we sometimes forget the words of A. S. Makarenko, that the labour "which does not seek to create something of value is not a positive element in upbringing", that so-called student labour must be carried out with something valuable in mind that labour can create.[19]

"In our work," observes G. Legenky, a docent (associate professor) at the Pedagogical Institute in Slavyansk, "the problems of economics and pedagogy are often viewed as being completely different, mutually exclusive. Therefore we often do not view, in a pedagogical way, productive labour as a

basis of life. Student labour is selected with pedagogical goals in mind. It is true that we often cite Marx's thesis about combining education with productive labour, but this has become a "fine point" which we are not always in a hurry to make specific: in the final analysis, any kind of labour is useful if only the young would work." [20]

It is well known that the student workshops directed by A. S. Makarenko produced not only extremely useful and even quite intricate goods, they also guaranteed solid profits. Some pedagogues, citing the fact that this went on under extremely specific conditions in the children's educational colony in the 1920s and 1930s, consider this experience inapplicable to modern general education schools. Of course, directly copying the Makarenko experiment would scarcely be of use. However, as practice shows, the productive labour of pupils today can be organised seriously on a fully modern, technical and economic basis.

There are, however, fervent opponents of such proposals. Their students, they say, are so overloaded with schoolwork and homework that all in all their working day is often up to 8-9 hours, i.e., a longer day than that of adults. Moreover, the level of demands upon students' knowledge is constantly rising, with every year they must master more and more information. Therefore, the one type of work which students can objectively carry out today is—schoolwork.

At first glance, such arguments seem quite reasonable. However, the question of overloading the students must be viewed more concretely. Actually, there are many students who waste a lot of time on homework, reading extra literature, at times to the detriment of their physical development. Moreover, all this talk of overburdening all or the overwhelming majority of students with schoolwork has no solid basis. In truth, study time is usually much less than pedagogues and parents think. The Soviet scholar and educator N. F. Kotov, for example, relying on research data on students' use of time, concludes: "...One should sooner speak of the reverse, of the generally smaller amount of time spent on study activities than is permissible." And, the time spent on schoolwork by the very best and the poorest students does not really differ from average time spent. Students "suffering" from remedial

work, it turns out, do not overload themselves with homework.[21]

Overloading students who actually do spend too much time studying at home is not a consequence of the great volume of academic material but of the absence of sufficient skills for independent work, the lack of an ability to organise work. The child tires not from the abundance of information that he must study, but because of the mechanical, monotonous process of memorisation because of the low level of emotional energy generated by monotonous work.

"Excessive work" occurs often because students' mental powers are not fully developed. In a similar way, a weight may seem especially heavy to one athlete while more trained athletes can pick it up with no particular difficulty. Therefore the way to eliminate the overburdening of students, however paradoxical this seems, is often to increase their mental stimulation—which develops their intellectual potential. "In educational publications," said the Soviet Minister of Education M. A. Prokofiev, "the question of the danger of overworking or underworking students is legitimately being raised. The first is generally recognised, but the second is underestimated. We cannot but agree with the assertion that to underwork the mind is not only to slow down its development, but also to accustom it to limited thinking, to train it to think in stereotypes, to reject all creativity." [22]

In resolving the question of a reasonable workload for the student and of the expedient amount of time spent on productive labour, one cannot apply a simple arithmetical calculation, mechanically tabulating study time and working time. If this approach is followed through, then one must include in working time time for sports, for helping parents with household chores and for other activities. Then non-working time would include only time spent on physiological needs and time spent "doing nothing".

Marx, citing numerous reports from factory inspectors and observations by teachers and sociologists, felt that the system of labour alternated with study turns each of these two types of activity into alternating periods of rest from the others and, consequently, the child enjoys this more than uninterrupted labour or study, since the child sitting in school from early in

the morning—especially in hot weather—is unable to compete with the child who cheerfully and energetically comes back from his work. A long, monotonous school day uselessly increases the work of the teacher and pointlessly wastes the pupil's time, health and energy. Marx drew the following conclusion:

"From the Factory system budded ... the germ of the education of the future, an education that will, in the case of every child over a given age, combine productive labour with instruction and gymnastics, not only as one of the methods of adding to the efficiency of production, but as the only method of producing fully developed human beings." [23]

There are many grounds for believing that a certain increase in the number of hours in the curriculum channeled into productive labour in Soviet schools will not increase the physical and mental strain on the student. On the contrary, it will be a good release and will aid the greater productivity of learning by raising the pace of study activities (usually students work productively in class for 15-20 minutes). It is also quite possible that the total class hours (because of a quicker mastery of material) can remain as it is or even be reduced. The concrete solution of this problem is possible only on the basis of further experimental research.

But along with this it must be emphasised that the problem of increasing the economic effectiveness of students' labour in socialist society is always fully subordinated to the educational task of producing a harmoniously developed personality. In other words, raising the productivity of adolescents' labour and the profitability of expenditures on organising the combination of education with productive labour is justifiable and necessary insofar as it is connected with positive educational effects, insofar as it aids the development of the students' creative initiative and independent activity.

Organising the labour activities of students should guarantee the acquisition of technical knowledge and corresponding work skills as essential parts of polytechnical education. However, in light of the scientific-technological revolution, the concept of productive labour as a component of the educational process should be interpreted in a broader sense. For

example, in schools and in courses with a physical and mathematical bias, the students may work predominantly in laboratories, in computation centres or repair shops. Students interested in medicine may become acquainted with it by working several hours a week as orderlies, nurses, medical assistants, as doctors' assistants in hospitals and polyclinics. Students with other interests will work in the food service industry, trade, etc.

The problem of combining education with productive labour goes far beyond the framework of the general school and has significance *for the educational system as a whole.* Applied to the specialised secondary and higher school, it consists primarily in closely linking theoretical instruction with production work in an appropriate speciality.

Inadequacies in the practical resolution of this problem seriously reduce the level of training of specialists and the economic efficiency of education. The latter is seen, first, in the excessive drawing out of the time it takes for young specialists to adapt to their profession, to the enterprise and to the production collective. It is seen, second, in the fact that the potential to obtain an economic effect from the instructional-production activity of students during their training in specialised secondary and higher schools is poorly exploited. The isolation of educational institutions from real life has negative consequences, too, in the theoretical knowledge of their graduates.

In a resolution of 1972 "On Measures for the Further Improvement of Higher Education in the Country", the Central Committee of the CPSU and the Council of Ministers of the USSR noted, in particular, that many institutions of higher education were still but weakly connected with industrial and agricultural enterprises and with research institutions, and do not give enough attention to solving current scientific and technical problems. The resolution envisages improving the production training of students and for this purpose strengthening the cooperation between institutions of higher learning and specific enterprises. To acquire the necessary practical skills, graduates of institutions of higher education are assigned to enterprises, organisations and institutes for up to one year. The general guidance of this probationary work is

excercised by the ministries and departments under which the enterprises and institutes work.

All this, no doubt, has a positive influence on the professional competence of young specialists and significantly accelerates and facilitates the process of their "entry" into industrial life. At the same time, the problem of combining instruction with productive labour in institutions of higher and specialised secondary education involves a number of unresolved questions that require many-sided, special investigations that take the profile and specific nature of specific educational institutions into account.

2. ACTUALISING EDUCATION. REVOLUTION IN THE CONTENT OF INSTRUCTION

Actualising instructional content involves, on the one hand, ensuring that the content of education is relevant to the needs of contemporary material production, which is connected above all with the polytechnisation of instruction, providing students with a knowledge of the scientific principles of production and with the general technical knowledge necessary for productive labour. On the other hand, actualising education means adjusting its scientific content to the dynamic structure of contemporary scientific knowledge.

All subjects must be taught, as the well-known Soviet mathematician and teacher A. Y. Khinchin has demanded, in precise accord with the principles of contemporary science, not at a distance from it of several centuries.[24] In doing this, one must solve an extraordinarily difficult and contradictory didactic problem — to combine the increasingly complex and continually changing content of contemporary science with a method of exposition fully accessible to students. And this task has remained to this day one of the principal stumbling blocks not only for schoolteachers, but also for university instructors.

This problem cannot be solved by simple additions to traditional courses or by a certain "renovation" of old material. It is far from reducible to "selecting", from the totality of modern scientific knowledge, material for school or university disciplines. Attempts to simplify scientific content through techniques in method have very little effect. This gives rise to

the idea that modern scientific theories are inaccessible in principle without an increase in the time devoted to preliminary training.

Many scholars consider it necessary in the near future to increase the time of training in secondary school to 11-12 or more years and to set up a system of "post-university" education. While not rejecting in principle the possibility and utility of doing this, it is appropriate at the same time to ask: is it not possible to improve didactically the content of school disciplines within the system of scientific knowledge itself? In the Middle Ages, for example, university students often mastered the theorem of the equality of the angles at the base of an isosceles triangle only with great difficulty, and only masters approached an understanding of Pythagoras' theorem, which is now completely comprehensible to 11-year olds. Even Leonhard Euler insisted that imaginary numbers are, by their nature, "impossible", though he himself did a great deal that they could be successfully employed in mathematics. The real understanding of the essence of imaginary numbers came when it was discovered that a simple geometrical interpretation both of the imaginary numbers themselves and of operations with them was possible. In an analogous way, new scientific ideas and concepts are rapidly becoming completely accessible and comprehensible because the expanding intellectual horizons and growing cultural level of students allow the use of new didactic models that appeal to what is known and mastered.[25] Therefore there are no permanent, absolute age or time limits of accessibility (from the point of view of an average number of years or months needed for study).

Investigators have concluded that it is possible to simplify for didactic purposes the material of modern science and to restructure almost completely all subjects of instruction in secondary and higher schools in accordance with the logic and structure of the science of our day. However, the practical realisation of this task requires much expert labour and a combination of deep scientific erudition with elementary logic, knowledge of pedagogics and the psychology of students. Who should take on this enormous work? Scholars advancing the front of science often have no time for restructuring its rear,

and problems of methodology usually interest them less. Specialists in education, on the other hand, are as a rule not sufficiently competent in what is being done on the cutting edge of modern science. The Chairman of the Department of Pedagogics at Novosibirsk University, Y. I. Sokolovsky, sees a way out of this situation in forming a new science at the intersection of pedagogics and other scientific disciplines — *ontodidactics*.

The object of this new science should, in Sokolovsky's opinion, be the analysis of the content of the appropriate branches of modern science in their essence, but with the purpose of *interpreting them didactically*. Such an approach has allowed, for example, the Department of Pedagogics at Novosibirsk University to devise for senior classes a comprehensible exposition of the "mysterious" theory of relativity and modern ideas of molecular biology and genetics. This ensured both an adequately scientific level and the liveliest interest of the students.

Such elaborations would be extremely useful in many other areas of modern science. However, at present there are few enthusiasts. This is because, from the point of view of "major science", such intermediaries ("ontodidacticians") make no discoveries, and, from the point of view of pedagogics, they are far removed from the traditional object of pedagogics, for they are concerned with the content and logic of specific sciences. Yet, by removing numerous archaisms and other flaws in existing courses of instruction, it is possible to bridge the gap between the content of education and the spirit of modern science. At the same time, according to preliminary estimates, it is possible in this way to save 20-30 per cent of instructional time.[26]

A. A. Lyapunov, a Corresponding Member of the Academy of Sciences of the USSR, felt that the existing course in mathematics in secondary school did not provide a basis for dealing with problems that arose within the framework of the higher school. So it is necessary to restructure, from the point of view of ontodidactics, the whole system of public education from the kindergarten and general school to the university and graduate study. And this must be done without extending the period of education or overburdening the students. This

puts heavy demands on the systematisation and rational exposition of the material taught; these demands must be met in the process of the ontodidactic reworking of the scientific information.

Until now, the efforts of science have been directed almost entirely to the production of new knowledge. Scholars now feel that the need to direct a good part of mankind's intellectual energy to ordering the knowledge gained, to making it a means for developing the intellect and abilities of the individual, is growing. And also, we should note, to giving contemporary scientific knowledge the form most rational from the point of view of its assimilation by the younger generation. It would follow, in our opinion, that it is necessary to "legitimatise" the ontodidactic tendency as an independent science in the family of pedagogical sciences. Carrying out intensive investigations within its framework will help to overcome that enormous gap that has come between the content of education and the structure of modern scientific knowledge.

Under modern conditions, actualising the content of education consists concretely, first, in increasing the weight of theoretical disciplines and, above all, in raising the level of mathematical training in schools. It has become necessary to include in the secondary school curriculum a study of programming and acquaintance with computers and their potential. In the higher school it is necessary simultaneously to increase sharply the number of mathematicians trained and raise the level of their theoretical training, and, very importantly, to train mathematicians with a broad range of knowledge and applied mathematicians for work in other areas of science (economics, biology, sociology, medicine, technical sciences, etc.). It is also necessary to increase the mathematical training of all other specialists, including those in the biological and human sciences.[28]

Second, actualising the content of education consists in fleshing out knowledge by fixing it with new techniques "that make possible a more suitable and more rapid assimilation of the knowledge accumulated and its effective use in cognitive and practical activity".[29]

Third, actualisation involves shifting the focus of instruction from memorisation to teaching how to think, to nourishing the

need and ability to study independently and produce new knowledge. Modern instruction should be not so much a transfer of information as an invitation to reflect on problems raised by the teacher. Problem-centred instruction must become the principal means of instruction at all school levels. "In new circumstances," writes the Soviet researcher A. I. Markushevich, such habitual concepts as 'the store of knowledge', 'intellectual baggage', 'enrichment by knowledge', etc., which presuppose a change in man's cognitive activity through a simple addition of new to old, are unsuitable for characterising the essence of the matter."[30]

The need to introduce elements of research into the process of education is also caused by the fact that, in the conditions of the scientific-technological revolution, an ever greater number of people have to search out and use scientific knowledge in their work.

Fourth, an important aspect of actualising education is connected with its further differentiation both at the general school level and at the level of specialised secondary schools and higher educational institutions. In the secondary school, it is apparent that a number of subjects are furcating (physics and mathematics, natural science and mathematics, and so on). As N. K. Goncharov, a member of the Academy of Pedagogical Sciences of the USSR, notes, the differentiation of education, with strict observance of identical volume of knowledge in the basic subjects taught, enriches schoolwork and elicits and develops the interests of students, their inclinations and abilities. Correctly organised, differentiated instruction is a dependable basis for professional orientation. It allows a more individualised approach to instruction.[31] Differentiation of instruction must be complemented, too, by an integration of the content of education so that the results of work in one subject are supported, used and strengthened in studying other subjects. The problem of interrelating separate subjects must hold a central place in the school curriculum.

Last but not least, actualising the content of education will show in a greater attention to the humanities. In view here is no mechanical increase of the required hours or courses, but a fundamental improvement of the teaching of human disciplines, an improvement connected with the development of

dialectical, logical thinking and aesthetic feeling. Probably, optional courses of interest to students will be more widely introduced.

In the present era, the rate of scientific-technological progress depends to an enormous extent on how rapidly specialists become familiar with all that is new in science and technology the world over. In this regard, one of the most important aspects of the increased attention to the humanities is a sharp rise in the level of teaching foreign languages.

Actualising the content of education must be reflected in secondary school curricula. The latter, as, for example, the Polish Professor V. Okoń feels, will in the next few decades change in the following basic directions: enrichment of the content of instruction with the ideas of socialist humanism; augmentation with the most important achievements of modern science; liberation from an excessive number of details, facts, descriptions; alteration of the arrangement of instructional material so that regularities and general ideas are central; an increase in the role of the problem-centred principle and the elaboration of as many variants as possible of practical assignments that encourage the use of knowledge and technical skills obtained in the school. In the majority of socialist countries, these tendencies are already present and are felt more strongly with every year. At the same time, other new factors are beginning to show, too.

In order to realise the fundamental object of instruction — to develop thinking and creative potential in the student — it is necessary to turn sharply toward individualised instruction, to take the potential of each student into account. This means that the content of education, while at bottom sufficiently general for all students in a general school or for specific types of specialised educational institutions, must at the same time be subject to maximum variation when applied to the particular characteristics and inclinations and interests of the individual.

Some teachers oppose individualising instruction on the grounds that this somehow contradicts the principle of collectivism and the organisation of the instructional process on the basis of the single-class system. These objections stem

from an unwarranted identification of "individualising instruction" with "individualism"; the single-class system should hardly be thought of as something stable and eternal.

In the era of the scientific-technological revolution, the question of the stability of the content of education is put in a new way. Teachers ever more often complain of the frequent changes in curricula and textbooks. It is mandatory, of course, to avoid any unfounded changes—innovation for the sake of innovation. However, for education adequately to reflect the state of scientific knowledge and the uninterrupted progress of technology, it must be just as dynamic. It is necessary to develop a system for continually updating the content of education, a system that includes a planned introduction of new school curricula, schedules, directives, texts, manuals, etc., and the corresponding retraining of teachers. Innovations will then find their place in schools and higher educational establishments without upsetting the established rhythm of the process of education and upbringing.

In order in these circumstances to avoid constant revision of textbooks and manuals, it is necessary to orient teachers to the fact that they themselves should continually update the content of the subject as they teach it, giving supplemental information and clarifications as needed. It would also be justified, as the Ukrainian scholar and teacher K. Prisyazhnyuk proposes, to publish before every school year pamphlets by subject on the achievements of science, and to indicate the literature that has been published on these questions. The interests of instructing the younger generation demand that major scholars in the country take part in preparing such pamphlets.

Of course, we have far from exhausted the question of the prospects and tendencies in improving the content of education. This question is quite complex and requires further and more concrete investigation. Without going into detail, we feel it necessary to draw attention to one more, very important, factor: profound, qualitative (and, moreover revolutionary) changes in the content of education cannot be achieved simply through changes in curricula. To carry them out, it is necessary first of all to increase the amount and quality of pedagogical labour. However, the balance of the teacher's labour is now, as has been shown above, so tightly drawn that it is very difficult

to find the reserves necessary for broad manoeuvre and the great qualitative leap that is dictated to education by the contemporary scientific-technological revolution.

A sharp increase in the productivity of the teacher's labour is the way out of this situation. This is made necessary, first, by the sharp increase over the last half century of the number of students in all types and forms of education; second, by the multiple increase in the volume of scientific knowledge that must be transmitted to students, by the increasing complexity of the structure of knowledge; and, third, by the increased importance of the pedagogical tasks met in the process of education and upbringing.

We will now examine, through the example of a general school, the changes that can help solve in practice the problem of raising labour productivity.

From this point of view, the theoretical and practical work in the field of the scientific organisation of pedagogical labour (SOPL), today being carried out in many areas of the Soviet Union, is deserving of close attention.[32] In the schools of Kislovodsk, for example, experimental research has been carried on for a number of years by I. P. Rachenko. The introduction of only a few elements of SOPL resulted, over three years (1962-1965), in a reduction in the average amount of the teacher's working time by approximately 10 per cent. In connection with this, the time expended by teachers in raising their qualifications increased by almost 60 per cent, or by 125 hours a year. At the same time, the rate of progress of students in the schools of Kislovodsk in the same period of time rose by 2 per cent, and the number of students receiving marks of "4" (Good) and "5" (Excellent) increased 1.5 times.[33]

The results of research carried out in the Ukraine show that simply by giving the teacher work in 3-4 parallel classes, the average time spent preparing lessons is reduced by 1.5-2 times. Moreover, during a lesson about 30 per cent of the time is ordinarily spent unproductively. Reduction of these losses not only raises the efficiency of lessons, but also reduces the time spent on remedial work.[34]

Raising the productivity of the teacher's labour has so far been achieved basically through improving traditional methods and forms of instruction. However, if improvements

are made within the framework of the traditional organisational forms of the instructional process and on the old material-technical base, there are only very limited reserves from which to make improvements. At best, the teacher's working time can be reduced by 30 per cent, but most often only by 10-15 per cent. And the success or lack of same in introducing SOPL is greatly dependent on the personal qualities of the school administration, qualities that are not always those required. It is necessary, of course, to thoroughly exploit the possibilities for improving the organisation of the teacher's labour within traditional forms, but at the same time it is essential to search for more fundamental ways to solve this problem.

Over the last hundred years the productivity of labour in the realm of material production has increased by 1,400 per cent, while in the sphere of non-material production it has only increased by 120 per cent.[35] It has grown especially slowly in education. The school's "forms of production" are at a pre-industrial level, notes the Swedish pedagogue Torsten Husén. Knowledge is transmitted and skills are developed basically as was the case 50 or 100 years ago, despite all the progressive intentions in the area of updating methods and rationalising the instructional process.

Although measuring the productivity of labour is methodologically very difficult and is quite problematical, it is nevertheless possible to state quite definitely that labour in the realm of education is, in an economic sense, subject to the regularities and factors that act in all other areas of human activity. "But the productive power of labour," remarked Marx, "is raised, above all, by *a greater division of labour*, by a more universal introduction and continual improvement of *machinery*." [36]

It is apparent that pedagogical labour is, in principle, in this respect no exception. However, its division, for a number of reasons, has changed little as compared to with last century or even the Middle Ages. Introducing technical equipment in this area of activity, in view of its exceptional complexity, has until recently been impossible. Only the scientific-technological revolution opens new prospects in this regard.

3. THE REVOLUTION IN EDUCATION. ELECTRONIC MACHINES

There are in schools today no few new technical aids to instruction. However, while in industry the cost of machines and equipment has long since surpassed the cost of buildings, in schools the expenditures on instructional equipment are extremely modest. At a time when, in the realm of material production, technical devices are applied on an increasing scale to replace or supplement the human work force, in schools new technical equipment remains an alien body that does not blend into the work process. The basic tools of pedagogical labour — blackboard and chalk — are scarcely distinguishable from the wax tablets and sticks used five thousand years ago.

The scientific-technological revolution not only makes qualitatively new demands on the process of education, it also provides for their satisfaction instruments so powerful that only yesterday they seemed completely fantastic. Educational television, for example, raises the labour productivity of lecturers several times and at the same time embraces auditoria thousands of kilometres apart. The experience of the Tyumen Industrial Institute and the Novosibirsk Institute of Electrical Engineering shows that modern technical equipment provides, too, feedback between teachers and students no less effective than that where there is direct contact. Scholars are today raising the question of creating a large circuit of Siberian educational television.

However, electronic teaching systems have the most importance in improving the process of instruction. They are now in the toddling stage and, like any revolutionary innovation, meet an extremely contradictory reception from specialists. Some scholars, especially in the United States, believe that computers (electronic and digital) will be able in the immediate future to replace teachers, and that they will carry out all the teacher's functions more cheaply and many times more efficiently. In the opinion of Robert S. Harnack, the whole complex of factors that define a teaching situation is a system that can be programmed and translated into computer language.[37] Other authorities rate the potential of electronic machines much more modestly. The Director of Claire College at Cambridge, Eric Ashby, for example, feels that programmed instruction, at

least at today's level, encourages only those answers that agree with the programme and therefore the sceptic, the other-minded, any person who has an original mind, will neither be stimulated by such instruction nor satisfied by it. And the creation of ideal machines that could discuss with students, could argue, etc., is connected with understanding how the human brain codes information, and we will in all probability understand this process only in the very distant future.

Moreover, the assimilation of knowledge is conditioned not only by perfection of the algorithms of instruction, but also by the force of the emotional experience in the process of apprehending new material, an experience that depends to a great extent on the personal charm of the teacher, on the teacher's attitude to the subject that he teaches. Authorities consider direct rapport between teacher and student the only way to develop such abilities as intuition, rich imagination, ability to rework information by means of analogies rather than through deductive reasoning.

Education consists not only in enriching the memory with a store of knowledge, but also in the development of the ability to imagine, to create, to perceive reality aesthetically. "We are proud," wrote the teacher I. Balnykov, "that we can make the student see in clouds a recepticle of electricity. But one mustn't complain if, on the way to cognition of this, he loses the ability to see in clouds as well brilliant caravels in a blue sea." [38] We should add: education can be called valuable only when it develops both of these abilities. And this, again, depends overwhelmingly on the teacher.

We may even assume that all the technical and economic difficulties in creating the necessary quantity of sufficiently modern electronic teaching machines will be overcome in the immediate future. But it is still necessary to nourish in all pupils, especially among children and adolescents, a conscientious attitude to study, the desire to learn, without which even the best teaching machines will be dead capital. As teachers observe, the question "how to teach" is in practice often overshadowed by the question "how to make one study". In all probability, it is impossible to solve this problem without an intelligent teacher who loves his profession and the subject he teaches. The teacher who can be replaced

with a machine deserves it, says the Director of the Research Centre at the University of Pittsburg, Robert Glaser.

Some pedagogues are generally sceptical of the possibility of instruction with the aid of computers. They believe that the scrupulous precision of machines will kill students' initiative, will nourish in them soulless formalism, and the teacher will be turned into a simple button-pusher. It is said, too, that machines will produce an awful standardisation of education and unemployment among teachers.

One should stress that, under capitalism, these apprehensions are not groundless. Major corporations there really do aspire to use machines to standardise education, to subordinate it even more completely to the interests of capital and to increase their control. At the same time, teachers note with alarm that monopolies ever more insistently force on schools expensive, often untried equipment whether or not it is useful in the educational process. It is even possible that the introduction of computers, like automation in industry, will give rise to unemployment among teachers.

In socialist society, there are no classes or social groups that could aspire to use new education equipment in their own narrow, egoistical interests, to the detriment of the working masses. Pedagogical labour is directed to the thorough development of the students' personality. Insofar as this field of activity is limitless and insofar as it is in fact the harmonious development of everyone's personality that is the supreme goal of our society, the labour of the total teacher, no matter how productive and great its volume, will in practice never be superfluous. Moreover, the growing complexity of production and social life requires for education and upbringing ever more qualified specialists and makes ever more unacceptable the ideal of the primacy of family upbringing. This means that, in the foreseeable future, no increase in the efficiency of the teacher's labour will reduce the need of socialist society for teachers.

Real dangers in introducing electronic machines into the educational process, thus, do in fact exist, but they are connected not with the technology itself, but with the capitalist mode of its use. As for the negative attitude to teaching

machines in principle on the part of some scholars and pedagogues (we should note that this is often simply disguised by sensible arguments), it is conservative and even reactionary, though not surprising, for in the field of education inventions and innovations always meet with opposition. It is known, for example, that even the great thinker and teacher of antiquity, Socrates, was hostile to the invention of writing, supposing that this would force people to neglect memory and that written speech is worse than the oral for giving the sense of one's utterances. So Professor Patrick Suppes is absolutely right when, criticising "opponents in principle" of teaching machines, he says that just as a book cannot suppress the initiative of a serious student, so a computer will not oppress but bring the student to a broader expanse of knowledge.[39]

Instruction is not only the process of transmitting information from teacher to student. It is simultaneously a socio-psychological process of mutual intellectual influence of teacher and student, a process in which situations arise that are complex and, at times, fraught with conflict. The teacher must be able to guide the psychological climate of the audience so that it aids as much as possible the assimilation of the material. On the strength of this alone, the teacher, even with the best teaching machines at hand, will never become superfluous in the educational process. On the contrary, the machine, assuming in full formal control over the assimilation of knowledge, will allow the teacher to switch to informal, psychological control and direction of the learning process. The teaching machine, even in the future, will never be able fully to replace the teacher. However, machines can handle many of his functions, and more successfully than the most experienced teacher under present conditions. The teaching machine in the hands of a teacher able to use it will become a powerful new tool of labour, a tool that will relieve the teacher of a multitude of uncreative, monotonous work and will free time for more delicate and important pedagogical activity, for self-education, and it will in the future allow the efficiency of pedagogical labour to be raised many times over.

At the same time, one must recognise that the widespread use of teaching machines in practical pedagogical work is fraught with great difficulties and many unresolved problems.

Programmed instruction in schools is still going through its initial stage and is most often carried out either without machines or with the simplest teaching machines, functioning as "coach" and "examiner". Technically, machines of this type and the majority of programmes are still very imperfect.

Many organisations in the USSR are studying, both theoretically and experimentally, the problem of utilising computers in the educational process. Great difficulties have been encountered in this research. It has been established that all of the existing digital computers fail at present to implement many goals of instruction. To raise the effectiveness of using machines in the pedagogical process, a number of problems must be solved, the chief of which are: the elaboration of appropriate mathematical principles; elaboration and practical testing of different instructional programmes in order to find the most effective and, above all, adaptable programmes that will ensure individualisation in the instruction of every student when there are a great number of students; the elaboration of the principles for designing and creating devices for effective contact between the trainee and the machine, equipment including individual panels and devices linking them with the computer.

There are a number of difficulties in the solution of all these problems, and neither theoretically nor in practice is the way to overcome them sufficiently clear. The development and application of modern educational hardware is still going on slowly.

However, the positive results already obtained justify an optimistic forecast. For example, experimental research carried out in the Ryazan and Rostov regions shows that even programmed instruction based on the application of comparatively simple technical equipment, though it requires some extra expenditures, greatly eases the teacher's work and raises its efficiency.[40]

In the Soviet Union recently, no few models of automated teaching systems have been developed, including some that use various digital computers, which have completely justified themselves in practice, getting high marks from specialists. Among these one can name the Akkord automated classes, Lastochka teaching machines, Sibiryak, Ala-Too and others.

Very effective teaching systems have likewise been set up abroad (for example, PLATO at Illinois State University).[41] Study of world-wide experience shows that difficulties in this area can in fact be surmounted and that perhaps even in the immediate future technical and pedagogical solutions will be found that will make possible widespread introduction of electronic teaching machines in our academic institutions. Moreover, in evaluating the potential of teaching machines one must have in mind not so much what has already been achieved as the outlook for the future. The efficiency of computers has been increasing unusually rapidly: 10 times in every seven years since 1946. Consequently, the potential of the machine from the point of view of its use in the pedagogical process is growing rapidly, too.

Another obstacle on the way to using electronic machines in general schools is their high cost. According to some calculations, in the United States, the cost of instructing one student with the aid of a computer for one hour may in the near future be reduced to $ .25-.27. Other authorities consider these figures unreal, since they do not include collateral expenses; they doubt that it will be possible in the near future to reduce the cost for one hour for one peson to $ 1.50. One can argue about specific figures, but the general tendency to a rapid reduction in the cost of machine time is obvious.

It is machines that can help solve the problem of raising the level of secondary education in rural areas (especially in schools far from major population centres), where, as has been noted, the level of education is at present much lower than in cities. Computer centres for instruction can embrace enormous regions, for computer terminals can be hundreds and thousands of kilometers from the digital computer. The more so, as Soviet scholars under the guidance of Academician V. M. Glushkov have already developed a method that allows the exchange of information between automated control systems and computer centres through standard telephone cables.

Thus, if we view the problem of teaching machines as the method of dialectical materialism requires, dynamically, it has to be recognised not only that such machines have extraordinary long-range prospects, but also that the whole future of

education is connected with them. While rejecting the idea that electronic teaching machines are the universal means for solving all pedagogical problems, one must at the same time conclude that *the introduction of computers in the educational process will without a doubt produce a revolution no less profound than did the invention of the alphabet.* "The era of the widespread application of electronic teaching machines is approaching," write A. I. Berg and B. V. Biryukov, "machines following teaching programmes devised by experienced teachers, machines able to ensure group and individual, classroom and correspondence instruction. Electronic teaching machines, able to adapt to the real potential and needs of students, will over the course of the next few decades change the whole process of personnel training."[42] The introduction of teaching machines, which has already begun, is one of the most important aspects of the revolution in education.

The question of automating education touches not only on the process of instruction per se. There is also a broad field for the application of computers to planning, accounting and managing the system of education. The Institute of Cybernetics of the Academy of Sciences of the Ukrainian SSR, for example, annually uses computers to calculate investment allotments for the construction of new schools and to determine where new schools are to be built and the scale of construction. Almost one hundred different parameters and characteristics of the schools are included in the calculations. Moreover, forecasts of the school-age population and the number of classes are made for the next decade.

At the Tomsk Polytechnical Institute, an automated system to be used in educational management is being successfully developed. One of the first sub-systems of the Automated Control System, a sub-system that is already being put in use, analyses quantitatively the functioning of universities. A set of programmes has been developed for computer processing of information from almost all the higher educational establishments of the country.

Computers have been used very effectively in automating and optimising the procedures for acceptance of applicants for higher educational establishments. In the Moscow Institute of Economics and Statistics, for example, the Abiturient

system, based on the Minsk-22 digital computer, has been in operation for several years. The system does the following: compilation of summaries and reports, control over exams, issuing various forms on applications, recommendations on the order in which people should be accepted, preparation of orders for enrolment in the Institute, assigning students to various academic groups, etc. Of great interest in this connection is the development of methods that allow determination, on the basis of some formal indices, of applicants most likely to succeed in the Institute.[43]

Since 1971, computers have been successfully used in the Institute for taking in entrance exams. The machine, issuing examination papers to every applicant, has the same impartial attitude to every examinee, and this makes for ideally equal conditions for all and makes equal demands on everyone. As a result, a calm, businesslike atmosphere reigns in the Institute, greatly easing the work of the examiners. Checking answers on 500 papers takes, for example, a little more than two hours. And while before 30 persons were on the examining board for mathematics and 20 for physics, the corresponding figures are now 6 and 3. Examinations in the human disciplines are at present conducted in the usual fashion, but even here the use of machines is in prospect.

In the not too distant future, the present system of entrance exams will probably seem anachronistic. Use of computers in teaching provides continual control over the assimilation of material being taught and makes many exams superfluous.

Teaching machines in schools help solve, too, an important problem with regard to content. In the present curriculum, questions of the polytechnisation of education are connected chiefly with traditional machines. Machines of the new type, born of the scientific-technological revolution, machines that gather and process information necessary in the process of production, remain at present to a great extent outside the limits of the school curriculum. Yet today's schoolchildren will have to live and work in a world where computers will be an ordinary, universally applied tool. In this connection, it is very important to familiarise children as quickly as possible with technology of this sort. Electronic machines must today be viewed not only as a means of instruction used by teachers, but

also as a *working instrument* used by schoolchildren, an instrument that helps them acquire polytechnical training and labour skills. Children now studying in school will work in a time when the factory foreman, and perhaps even the skilled worker, will have to work daily with automated machines.

The introduction of computers into the field of education is an objective, inevitable process. However, this process is not spontaneous. Its success depends to a great extent on a correct evaluation of the significance of this matter. One must keep in mind that both the efficiency of schooling and the cost of the technology needed for mass instruction of students will much depend on whether the development of programmed instruction and modern technology will proceed in a spontaneous, amateurish fashion, at the initiative of a small group of enthusiasts, whose energies and resources are terribly dispersed, or whether this affair will be organised today on a national scale, with the purpose of creating in the shortest time a system of centres for machine teaching throughout the country.

The problem of introducing automated teaching machines into the process of instruction is not even connected so much with the machines themselves as with, first, the training of personnel able to provide the requisite mathematical programming and personnel able to service the teaching machines; and second, with the creation of a demand for teaching machines. Already today, it is necessary to prepare, both professionally and psychologically, teachers and students at teachers colleges to use these systems in pedagogical practice. It will be much more difficult to make up for lost time here than in the area of designing, building and organising the mass production of teaching machines.

So the problem of teaching machines must be solved systematically, with all aspects closely conjoined. It must, too, not be viewed in isolation, but in the totality of all the other emerging, revolutionary changes in the field of education: renovation of the content of education, optimisation of the flow of information taught by devising adaptable curricula, introduction of new forms for organising teaching and study, a fuller utilisation of the potential for teaching very young children, etc. Introducing teaching machines will make new

demands, too, on teaching facilities, on the rational distribution of academic institutions. The problem of creating and utilising electronic teaching machines must be worked out by combined research groups consisting of teachers, cyberneticians, economists, psychologists, sociologists, engineers, designers, architects and, of course, representatives of the specific academic disciplines in which electronic technology will be applied.

4. THE REVOLUTION IN EDUCATION. OPTIMISING THE FLOW OF INFORMATION

One of the primary reasons for unjustifiably great expectations and for scepticism with regard to teaching machines is connected with the fact that the problem is usually viewed in isolation from other problems and goals of education. "Optimists" see only the, in fact, unlimited (in principle) potential of the computer as such, forgetting the many unsolved psychological and pedagogical problems of the educational process. "Pessimists" would adjust technical means of instruction that are new in principle to old forms and methods of organising the educational process.

Revolutionary changes in the equipment used in teaching—the shift from blackboard and chalk to electronic machines—require a revolution, too, in methods of instruction. Changes in the latter area are, it is apparent, tied above all to optimising the flow of academic information on the basis of modern achievements in experimental psychology, physiology, the theory of information and cybernetics.

The decisive factor in the process of instruction is not the machine itself, but the programme and its relation to the objective logic of the educational process. Of course, successful utilisation of programmes depends much on the perfection and technical potential of the machines. However, despite all this, as the Soviet scholar N. F. Talyzina writes, machines are only a means, and one completely described by the programme, which reflects the specific features of the educational process.

The electronic machine helps to collect and process statistical information concerning the course and results of instruction,

provides for simultaneous instruction of a large number of students and permits the implementation of various teaching algorithms. It makes possible highly individualised, adaptive instruction. At the same time, the computer should be considered only one of the elements of the instructional system, an element with which the teacher can control the cognitive activity of students with programmes of varying complexity.

The basic function of the programme is to optimise the flow of information to the student. Devising programmes is an extraordinarily complex problem. "...The teaching process," writes N. F. Talyzina, "cannot be analysed in its cybernetic aspect without taking into account the specific (psychopedagogical) features of this process. And in turn, specialists in the field of psychology and pedagogy cannot develop the psychological and pedagogical bases of directing the teaching process without a certain knowledge of cybernetics."[44] We meet here one of the problems that requires for its resolution teachers of a new type, able to approach teaching from non-traditional points of view, to study it as an information process that can be formulated and described with quite definite algorithms.

Assimilation of the material taught is connected with a complex of subjective factors: the student's abilities, his attitude to the subject being studied, his general emotional frame, personal experience, etc. It also depends on the logical interconnection and consistency of what is being imparted, on the frequency of repetition and many other factors. The student will inevitably assimilate only a part of all the information directed at him, the rest will either not be understood or will be lost, i.e., forgotten. At the same time, all teaching material has objective informational characteristics, the use of which can optimise the transmission of material so that every student can assimilate the maximum (within his own individual potential) volume of information in a minimum amount of time.

Methods for organising the flow of information have until now to a great extent developed spontaneously. Content, volume and time distribution have been established without a strict scientific basis and without quantitative calculations. The

question of how close the flow of information is to the optimum simply has not come up before. Today, when the information explosion threatens to overwhelm both students and teachers, it has been put on the agenda by life itself.

In this respect, the research of R. G. Kuklin is very interesting. Using data from contemporary didactics, cybernetics and psychology, Kuklin has produced an original theoretical analysis of the problem of optimising the flow of information in education, has proposed a specific method for its practical solution using as an example the teaching of foreign languages and has conducted appropriate experiments. The first results obtained are promising. For example, it turns out that the existing level of knowledge of a foreign language among students can be reached after approximately 300 hours instead of the presently allotted 1,200-1,400 hours, that is, about 4-5 times faster.[45]

However, many "buts" immediately arise. First, students' abilities are not identical. So when the flow of academic information is optimised, some will inevitably move far ahead in assimilating material, while others will lag behind. This difference can be removed through "branched programming", but only in part. The problem of individualising the process of education immediately becomes acute. The new approach does not fit the traditional forms of the single-class system. Second, in the approach proposed the necessary degree of individualisation can be achieved without the automation of the teacher's labour if the teacher works with 3-5 students (given audio-visual aids). Third, if the teacher applied this method even to such small groups, he must nevertheless greatly intensify his work and spend about twice as much time as usual preparing lessons, because continual control must be exercised over the progress of each student, and the students' work must be corrected and directed toward the "optimum path" for studying the subject. True, this work can be significantly eased by using appropriate programmed manuals for teachers.

This is quite possibly one of the reasons why, despite the obvious positive results and high marks from specialists, Kuklin's method has not been at all widely applied even when teachers work with small (e.g., graduate student) groups of 4-5

students. This example shows that the introduction of the new is difficult not only because it is necessary to surmount the force of habit and tradition, but also because at first glance purely "technical", didactic, problems often require for their practical resolution a more general, a broader sociological, economic and socio-psychological approach.

Taking all these circumstances into account, R. G. Kuklin is careful to recommend his method only for individualised instruction in foreign languages for the present. But it may be of much broader application. It is quite possible that analogous optimisation of the flow of information will be no less (and possibly even more) effective in other disciplines, and not only for individualised instruction. For this, it will be necessary, of course, to develop new forms of organising the teaching process, forms substantially different from traditional ones.

The results of a very interesting experiment which has been conducted since 1968 at the Perm Polytechnical Institute support this conclusion. In order to optimise the teaching process there, so-called cyclical schedules were introduced. Essentially, they consist in concentrating the most time-consuming disciplines (mathematics, physics, strength of materials, thermodynamics, etc.) into a 4-6-week period. In this time a student does a term's worth of work in one subject. Examinations follow. Cycled disciplines are combined with socio-political disciplines, drafting, a foreign language and physical education, which follow the usual schedule and are interrupted for 2-3 days during exams. Thus the student's time is apportioned, during a definite period he specialises in one science. The rapid increase of material leads, in a chain reaction, to making order out of it. The amount of time needed to grasp the material is reduced many times. The examination session as such is abolished, and exams, which occur throughout the term, become an ordinary part of the teaching process. The relative brevity of the cycle allows all the material presented to be retained in the memory, and constant engagement in one science makes exams a matter of no great difficulty, free of excessive strain.

During the experiment, the rate of passing marks rose to 95-100 per cent in the cycled disciplines (mathematics, physics, strength of materials) and to 80-85 per cent in the rest. "The

rate of absence was sharply reduced. Independent work became more uniform over the whole term, answers at exams showed greater depth and were more substantive," write Y. Ivankin and N. Kuzmin, heads of the Department of Mechanical Engineering at this Institute.[46]

In the given case, optimisation of the flow of information was effected for the students as a whole. This can be viewed as the first stage in the process of optimisation. On it, one can build the second stage—optimisation of the flow of information with respect to the individual capacities of each student. One may assume that a sharp rise in the efficiency of instruction would be achieved. However, this requires the most careful experimental verification.

The experience of V. F. Shatalov, a teacher of mathematics and physics in Donetsk, also speaks of the enormous unexploited potential for intensifying the schooling process. Critically reviewing all the elements of a lesson, he found a way to test daily every student in his class for knowledge of the material gone through, so that no student had any gaps in his knowledge. He found empirically the amount of new material that the children could master without losing interest in the lesson. In effect, he was able without the use of technical aids significantly to increase the stability of the feedback between teacher and students and to find a way to direct the flow of academic information within limits close to the optimum.

As a result, there were "miraculous" changes: all the students began to experience a feeling of satisfaction and joy from study itself, and the need to give a bad mark disappeared. An ordinary class, the progress of which had before only been modest, completed the curriculum in physics and mathematics of the 8th, 9th and 10th grades in two years instead of three. Representatives of scientific institutions from Kiev and Moscow examined most "meticulously" Shatalov's pupils. And here are the marks that these ninth-grades received for 8th-10th-grade work: in mathematics, 21 received "excellent", 8—"good", 3—"satisfactory"; in physics, 19—"excellent", 12—"good", 2—"satisfactory". And grades went up in other subjects, too. One year after the beginning of the experiment, 16 got only "good" and "excellent", and by the end of the 9th

grade, there were three who received "excellent" in all subjects.[47]

Electronic teaching machines open broad prospects for optimising the flow of information in education. They make the realisation of this idea on a wide scale not only possible, but even necessary. On the one hand, these machines make it economically and technically feasible consistently to put into effect the requirement of an individualised approach to each student and to relieve teachers of the need to orient the teaching process to the "average" student. On the other hand, the theoretical and methodological analysis of the problem of optimising the flow of academic information makes it possible to increase greatly the pedagogical effect of the technical means of instruction. It is also, apparently, a good basis for devising experimental machine teaching programmes that automatically adapt to the abilities and level of preparation of each student.

Using teaching machines to optimise the flow of information will raise the efficiency of pedagogical labour several times over, which in itself will mean a revolution in the ways and means of teaching.

Use of even the simplest teaching machines makes acute the problem of changing the traditional organisation of teaching. Some authors express the apprehension that, given programmed instruction, the secondary school class or the student group in a higher educational establishment, as a unit, as a collective, will disintegrate, that the individualisation of instruction will lead to an end of student interaction and to an ignoring of the collective nature of students' labour.[48]

Genuinely socialist collectivism has nothing in common with the aspiration to shape everyone to the same mould, with primitive levelling and stereotyping of the individual. To the contrary, collectivism is for us valued precisely to the extent that it is a sine qua non for the fullest development of every individual. The goal of the academic collective is that each member attain the best results possible in mastering knowledge. Individualised instruction will most effectively meet this goal. Consequently, it does not contradict, but furthers collectivism.

Many pedagogues object categorically to the passage of students through courses at different rates. But is it right to hold back the progress of the more prepared and capable students because the less capable need more time to assimilate the material? This is not only incorrect, but goes against the interests of the individual and of the collective and society as a whole. If the traditional single-class instruction in schools and the lecture and group system in higher educational establishments are restrictive and hamper the increase of teacher and student productivity, then life will demand that we find new and more flexible ways to organise the educational process and nourish collectivism among students.

Optimisation of the flow of academic information by using electronic machines is so revolutionary an innovation that it cannot fully reveal its potential without substantial changes in other elements of the educational system and in its organisational structure. On the other hand, it is just this innovation that creates favourable conditions for progressive changes in all the other elements. Such changes become not only possible, but absolutely essential.

5. THE REVOLUTION IN EDUCATION. NEW FORMS OF THE DIVISION AND COORDINATION OF PEDAGOGICAL LABOUR

Use of machines in any sphere of human activity improves the organisation and division of labour. "Labour," wrote Marx, "is organised, is divided differently according to the instruments it disposes over." [49] At the same time, the division of labour is a relatively independent factor in the growth of labour productivity.

The conservatism of education is most apparent in the incredible stability of the forms of organising the educational process and of the division of pedagogical labour, forms that, despite the most profound changes in the system of human knowledge, have over the last hundred years not undergone any substantial change.

Even in "pre-machine" education, it is possible to better organise the division and coordination of pedagogical labour

than is the case today. But, until recently, progress in this direction has been quite insignificant.

If we make a small detour into history, we see that in antiquity one and the same mentor could successfully teach the art of public speaking and the art of war, gymnastics and mathematics, could organise and educate his students, providing them with harmonious (for the standards of their time) development. And instruction was individual in nature.

The increasing complexity of social life in the Middle Ages meant that reading, writing and the fundamentals of science had to be taught to many more people than before. The single-class system of instruction, a system born in monastery schools and formalised in the 16th-17th centuries, was the response to this social demand. It allowed for a multiple increase in the productivity of the teacher's labour and was, apparently, an important factor in the brilliant flight of the human spirit that was the Renaissance—a fact that has not yet been adequately evaluated by historians. But the "teacher of all subjects" remained the basic figure for a long time yet.

As scientific knowledge accumulated and social goals changed so, too, did the types of schools and the functions of the teacher. In the era of capitalism, the socially necessary volume of knowledge imparted in schools grew so much that it became necessary to divide pedagogical labour more thoroughly. So in a comparatively short time, secondary schools everywhere switched from a system of "one teacher of all subjects" to "one teacher for each subject".

By the end of the 18th-middle of the 19th centuries, the system of dividing pedagogical labour that we use today had taken shape. The development of the system of human knowledge objectively demands concentrating the efforts of specialists in ever narrower fields. This affects the teacher, too. But the teacher must not only broaden his knowledge in the subject taught, he must also be competent in areas far removed from his own. One should hardly be alarmed by the lack of competence of a research biologist in the field of art. But with respect to the teacher of biology, such alarm is fully justified.

So, first, the requirement that the teacher have a broad education is not just a part of the general demand that every individual have a harmonious development, which is our social

ideal, but is required of the teacher as a professional. The objective basis for this is the fact that the teacher functions today, at a minimum, in two roles: the role of teacher and the role of educator. However closely connected these roles, however closely intertwined as to their ultimate goal, they are two different professional roles, each of which has specific tasks, methods and means for carrying them out, demands special knowledge and skills, special time, special preparation, etc. This contradiction is tied to the inadequate division of the teacher's labour *by speciality*.

Second, the production functions of the teacher as organiser of the process of instruction are such that they fall into a multiplicity of functions, both fundamental and auxiliary, for example, preparing visual aids, checking the student's work, etc. The teacher today must carry out both fundamental and auxiliary functions because he does not have aids and lab assistants. This is tied to the inadequate division of pedagogical labour *by duty*.

Third, teachers have different levels of education, different seniority, different professional experience, different abilities, etc., but they carry out identical functions. In practice, in carrying out these identical functions in some cases there is a certain surplus of skill, there is a sort of waste of the specialist's knowledge and experience, in other cases—there is a lack of skill, when the necessary result is not completely achieved. These difficulties are tied to the absence in the teaching profession of a division of labour *by skill*.

Let us return to the first division of labour—by speciality. At present, there is in the school a division into two types of labour: between teachers of elementary school, where one teacher teaches all subjects, and teachers of secondary school, where different teachers work in different subjects. The institution of subject teachers that has taken root in the secondary school is gradually taking shape in the elementary school, too. The labour of the subject teacher is recognised as an independent speciality. At the same time, even here there are unexploited possibilities for the further division and coordination of pedagogical labour.

School No. 10 in Novosibirsk is known for the fact that its students get a good education and succeed in enroling in higher educational establishments where the competition among applicants is great. Yet the working time of the teachers in this school is close to the general norm—41 hours per week. These results have been attained chiefly by increasing the division of pedagogical labour. Specialised teaching in groups in the same grade is carried out not only in senior, but also in junior grades.

Numerous experimental attempts to raise the efficiency of instruction by further division and coordination of pedagogical labour are being undertaken in other cities, too. For example, in the schools of Moscow and Donetsk, the job of senior teacher, responsible for the teaching of a given subject in school, was introduced as was the post of senior form-master, who heads a relatively autonomous school sub-system, sections of parallel classes. In the junior classes, besides appointing from among the teachers a chairman of the committee on methods, a senior councellor is also appointed.

To obtain the needed results in the perfection of the system of division and coordination of pedagogical labour, it is necessary, taking into account teaching experience from all over the world, to reject a number of outmoded views. For example, if rigid forms of the single-class system of instruction are done away with, then a lecture organisation (at first, in the senior classes) will allow the better teachers to work simultaneously with 150-200 students. This will raise the productivity of pedagogical labour 5-6 times and will not only help raise the quality of teaching (since all students will be taught by the most skilled and talented teachers) but will also ensure that graduates of schools are better adapted to the college system. The lecture form for senior classes has already been successfully employed in School No. 10 in Novosibirsk, in the physico-mathematical school, and many other schools. At the same time, organising lecture sequences will free the teachers' time for an individual approach to students during other work. Teachers who are as yet inadequately skilled and cannot handle a large audience will effectively apply their talents to directing laboratory work, grading notebooks, and organising extra-curricular activity. A number of difficulties stand in the way of the practical implementation of such organisational forms, but the results of some experiments carried out in

recent years in the USSR and elsewhere speak of the great future of work in this direction.

The teacher deficit in the United States and the poor preparation of students in public schools have forced American teachers to look intensively for a solution to the conundrum: How to improve education despite the pressing lack of teachers? One such investigation in the area of new organisational forms for pedagogical labour was conducted by J. Lloyd Trump in more than 100 junior and senior high schools in the period since 1956. Not all of the conclusions of the American educators are indisputable, and many of their practical proposals are unacceptable to us. Yet the experience with this new organisation of teaching is quite interesting.

In the experimental school, the teachers were divided into full-time teachers working with 150 children, instructional assistants who may work part-time, and highly skilled consultants. As a result, the teaching staff was reduced by 37.5 per cent and annual expenditures on staff reduced by 2,000 dollars.[50]

Experiments in elementary schools with team-teaching—teams of 3-8 teachers working with groups of 75-240 students—also merit attention. In the team there is a leader, the senior teacher. In addition, during the working day an assistant provides help. In two large teams, there is also a teaching aid, who works quarter-time. Pay for the teachers in the team is differentiated according to functions performed. The organisers of the experiment have concluded that team teaching creates conditions for closer cooperation among teachers and for better use of the abilities and knowledge of each individual teacher.[51]

It must be stressed that some teachers react quite negatively to innovations of this sort. Many are convinced that, no matter what the other conditions, one must always try to keep the number of students in a class down to 25-40. This conception, quite rational in its time, rests on the strength of a tradition more than 1,000 years old and has today become something of a fetish. It hampers a fresh evaluation of the possibilities and prospects that are opened to pedagogics by the scientific-technical revolution.

A sharp rise in the productivity of pedagogical labour by the

simultaneous teaching of large numbers of students is possible, too, in physical education. For example, the physical education teacher at Novosibirsk Vocational School No. 10, I. G. Skachkov conducts classes for 100-150 students at a time. This allows him to conduct classes in physical training for all students every day. It is important to stress that the new form of the lesson is organically connected with its new content. Skachkov does not follow the usual programmes. He does not teach complex exercises on gymnastics apparatus. His lesson is 30 minutes of pre-programmed movements, running, etc. Skachkov bases his system on the scientifically determined amount of motion necessary for the normal physical development of adolescents; his lessons are conducted in the open in any weather, at every time of year. The length of the lesson has been reduced by one-third. However, while the intensity of the average lesson in physical education is 30-35 per cent, using the new method it reaches 85-90 per cent. The new method allows all students without exception to be physically and emotionally active during the lesson.

Skachkov did not try to "fix up" or improve the existing method of instruction, but chose a new and original course. As a result, his students have, in all anthropometric indices, far surpassed their peers who participate in the usual physical education classes. Moreover, they are almost never sick, and miss class 10 times less often than before. This system of physical training has been positively reflected in the rate of progress, conduct, and external appearance of the students.

In connection with the scientific-technological revolution and the acceleration of social progress, the task of upbringing has become much more complex. It is no coincidence that the time teachers devote to such work has grown over the last four decades by about 1.5-2 times. Society today demands an ever more educated and intelligent teacher. It expects that the teacher will not only arm the younger generation with solid knowledge and will develop a communist outlook among pupils, but will also successfully carry out many other functions. In particular, the School Statute envisages that the teacher must care for maintaining the health of students, must study their individual peculiarities and living conditions, maintain contact with parents and the public, and disseminate

pedagogical knowledge. If the teacher is a form master—and the overwhelming majority of teachers are—he must, in cooperation with other teachers, with the pioneer group and the Komsomol group, conduct moral education in the class entrusted to him; he must obtain a uniformity of pedagogical demands on the part of school and family; he must maintain contact with parents, with the teachers of extended day groups, with advisory councils for family and school at enterprises; he must, if necessary, ensure timely academic help to students; he must provide documentation on the class; he must provide data on the students' progress, attendance and conduct; he must watch over the state of the students' report books; he must take measures to fortify the students' health; he must organise their socially useful labour. Moreover, the teacher may be required to supervise the subject laboratories, workshops or experimental gardens.

Considering that, with a load close to the normal, the teacher spends more than 40 hours a week on preparing and giving lessons alone, one can imagine how difficult it is for him to meet fully the demands that life makes upon him. The question has been raised in the literature as to whether the subject teacher is able to cope with the total volume of work required to run the class. This duty usually takes up 11-15 hours per week, and a large part of the necessary work is left unfinished at that.

The question of whether it is time to institute in schools the post of teacher-counsellor, entrusting him with much of the extra-class and extra-curricular work presently performed by subject teachers, has come to a head. Many investigators of the problems of the school in other countries, too, are inclined to conclude that such measures are necessary.[52]

The theoretical and experimental resolution of this problem is much obstructed by some pedagogues' incorrect, undialectical view of the thesis of the indivisibility of the functions of teaching and upbringing. In fact, teaching and upbringing are part of a unity that, however, is a unity of opposites, a unity that unfolds into a contradiction as the process of teaching and upbringing develops and becomes more complex. This contradiction has come to such a point today that the traditional understanding of the unity of these elements—as the necessity

for every teacher to engage in all aspects of the process of teaching and upbringing—has become outmoded.

A teacher overloaded with numerous extra-class and extra-curricular duties is not always able adequately to prepare lessons. So he is often only a retranslator of academic information, does not elicit "feedback", and as a result the moral effect of the lessons is often quite insubstantial. On the other hand, clubs, discussion groups and lectures on themes abstracted from the curriculum, amateur artistic work and other such measures are often handled in the schools in an unskilled way, formally, and so neither interest the students nor teach them anything. Thus occurs, in fact, the split between the functions of upbringing and teaching, a split leading to a sharp reduction of the effectiveness of the whole pedagogical process.

To ensure a good moral effect, the teacher today must concentrate entirely on preparing and giving lessons. He must develop himself much more than was necessary twenty or thirty years ago, so that he is not just a *source of knowledge*, but also a *source of interest* for children. By the same token, choir, dance and other circles, lectures on art, on socio-political themes, etc. should be conducted by specialists and at a high level of professionalism.

The dialectic of the teaching-upbringing process is such that fully to reunite the functions of teaching and upbringing, to ensure their *unity*, it is necessary today to further *divide* the labour of pedagogues. The problem of introducing in schools the post of teacher-counsellors requires, of course, special study. In particular, there is a need for scientifically grounding the questions of the duties of such persons, their interaction with other teachers, their number, etc. Nevertheless, this problem has already come to a head and awaits prompt theoretical and practical resolution.

Now, with respect to division of labour *by duty*. At present, there are in the school system three basic positions: principal, director of studies and teacher. The position of teacher is at the base of the hierarchy—there are no lower positions. If we compare the nomenclature of positions in the school system with the nomenclature of the positions, let us say, in public health, one sees immediately that the base of the medical

hierarchy is held not by the doctor, but by the nurse, that is, a representative of the so-called "middle echelon". This middle echelon in the system of public health is very large and still growing. In the area of education, such a "middle echelon" is for all practical purposes lacking, if we leave aside the one or two lab assistants found in a large school. The question of what functions it is legitimate for the teacher to devolve upon the lab assistant — preparation of teaching aids, checking notebooks or remedial work with students — requires, again, special study.

Finally, division of the teacher's labour *by skill*. The example of material and cultural production shows that differentiation of functions cannot be reduced to division of labour by speciality, but includes also division according to level of skill. For example, there are six categories of fitters, three of chauffeurs, three of doctors, in the higher school there are the categories of assistant, senior instructor, docent and professor. Down to 1972, there was no such differentiation among teachers, though there are objective gradations in skill: there is the experienced teacher and the young, beginning teacher. In accordance with a resolution by the Central Committee of the CPSU and the Council of Ministers of the USSR, teachers after certification are now given the titles "senior teacher" and "teacher-methodologist". A number of socialist countries have had good results from certification and the establishment of categories of skill for teachers.[53]

The need to differentiate skills is a result not only of the different qualifications of teachers, but also of the breaking-up of the production process into functions of varying degrees of complexity. For example, the assistant and the professor perform functions of different degrees of complexity that are a part of the single process of instruction, and this is confirmed formally in the differentiation of the rights to perform one or another kind of work. In the instructional process in the secondary school, too, functions of varying degrees of complexity can be isolated and assigned to teachers with different qualifications. For example, the organisation of lectures for the senior classes can be entrusted to the most skilled teachers (senior teachers and teacher-methodologists).

The introduction of certified levels of skill, given corresponding differences in pay, will give teachers the prospect of

advancement inside their profession and by the same token additional stimuli for raising their skill and pedagogical craftsmanship. The simple increase of seniority, as the work of I. P. Rachenko shows, often is in inverse ratio to the increase in skill.[54] It is possible that teachers who turn out to be of little ability, will, feeling a lack of prospects for advancement, seek another outlet for their energies.

The establishment of objective and sufficiently clear criteria for measuring and rating the quality of pedagogical labour is an extremely intricate task, but, in principle, one that can be met. Considering the real urgency of this task, one may suppose that it will attract the attention of many researchers in the next few years.

Without a doubt, the questions of further differentiating and coordinating pedagogical labour are not settled. On the contrary, it is extremely necessary that they be discussed. However, the very fact that at a time when there have been changes in the system of human knowledge greater in the last hundred years than in the whole history of human civilisation, when society's demand for quality education and upbringing has grown immeasurably, there have been no essential changes in the division of labour in the school, forces us to raise the question: is not this system in need of fundamental changes? This question is becoming especially acute because of the prospective improvements in the process of teaching and upbringing that are being opened by the application of modern, technical ways and means of instruction.

For example, the relativity of the unity of the functions of instruction and upbringing, a unity that encompasses their differences, is becoming especially apparent in connection with the introduction of electronic machines into the area of education. It is above all the instructional aspect that yields to automation, while the aspects of upbringing proper, both within the class and outside, remain as before connected with the teacher's personality. It follows that those pedagogues whose primary function is instruction should be the first to master machines.

Optimising the flow of academic information, which optimisation is based on the massive application of electronic machines, will require a flexible combination of lecture, group

and individual forms of organising the instructional process. It also gives rise to the need for further specialisation of pedagogical functions. In teaching collectives, completely new specialities will appear: engineers and technicians, specialists in electronic and teaching machines, teachers trained in programming, mathematical programmers, operators, etc.

In this regard, many of the new forms of the division and coordination of the labour of teachers and students, forms that have so far been applied experimentally, will become absolutely necessary if the enormous potential for raising the effectiveness of instruction, a potential embodied in electronic machines and methods for optimising the flow of academic information, is to be realised. A revolution in the *technology* of education demands corresponding changes in the *organisation of the labour* of teachers.

Naturally, only in sufficiently large teaching collectives are there possibilities for dividing and coordinating pedagogical labour. In large schools it is easier to solve the problem of acquiring and exploiting modern technical means of instruction, it is easier to organise optional courses and to vary and enrich the content of extra-curricular work. So in modern conditions the question of *concentrating the school* comes up with special force.

In cities, it is, apparently, necessary to focus on large schools suited for two or more thousand students at a time. However, there is among teachers an opinion that such schools are not warranted. This view apparently stems from the fact that, in large experimental schools, the forms of division, coordination, organisation and remuneration of labour are the same as of old. But the advantage of large schools becomes apparent only when the organisation and remuneration of labour are changed.

Concentration of the school cannot be reduced to simple enlargement. It is necessary to develop inter-school cooperation, to improve the administration of the entire system of public education. Average and small urban schools located in a single district can be joined into large academic combines administered by a council of directors and general director. Such combines may be justified, too, in rural areas. The problem of concentrating the rural school is especially acute

today. The existing state of enormous dispersion of material-technical and financial resources and, most important, of pedagogical personnel in rural areas is extremely non-rational in social, pedagogical and economic terms. The cost of instruction per pupil in small schools is several times greater than in large schools. At the same time, small schools as a rule cope with educational tasks more poorly. They are responsible for the bulk of students who are poorly prepared, fail, and drop out. Bringing the number of students up to the required norm, which is achieved by enlarging the school, is always justified not only from the economic but also from the pedagogical point of view.

Concentrating the school is a very complex sociological problem, which must be solved in conjunction with long-range economic plans and in coordination with plans for the development of enterprises and population centres. Study of empirical materials allows us at this point to draw two important conclusions: first, the scientific-technological revolution demands a great acceleration in the process of concentrating the school; second, the rate of concentrating the rural school must surpass the rate of industrial concentration and enlargement of settlements. Today, a good school is an important factor in holding on to personnel in industrial and agricultural enterprises and is consequently an important factor in these enterprises' production achievements, too.

6. THE REVOLUTION IN EDUCATION. INSTRUCTION AT AN EARLIER AGE

From the point of view of the future of education, one of the most important problems today is that of beginning education at an earlier age.

The question should be put thus: how will the pedagogical process as a whole change if instruction begins not at 6-7 years of age, but significantly earlier? There is reason to believe that we have in this respect squandered enormous, unexploited reserves for raising the efficiency of the whole system of education. Moreover, it is being asked in pedagogical circles whether instruction should be begun at six years of age.

Because the volume of knowledge that children should obtain in school is continually growing, many teachers posit the need to lengthen the period of instruction in secondary school. But as has been noted above, the need for such a prolongation is not settled. If in fact it does turn out to be necessary to do this, then the question is at which end years should be added: at the top or at the bottom? Advocates of prolonging instruction "at the top" object to beginning education at six years, citing the fact that conditions in kindergarten are much more favourable for the child's development than conditions in school. They also point to the fact that if a year of education is added at the end, it will help bridge the gap between the end of school and being drafted into the army. What can be said in this regard?

First, in resolving the question of instruction from six years of age (and especially if we speak of an even earlier beginning), we must not use present-day primary schools and kindergartens as our point of departure. Classes for six-year olds (and even more so for five-year olds) should be a *qualitatively new institution of teaching and upbringing*, in which *the best features of kindergarten and school are synthesised*.

The advantage of bridging the gap between the end of school and service in the army is only imaginary. In fact, it would be a significant detriment to the strained labour resources of the country, for it would take from production a significant portion of young people. One should scarcely complain about this so-called gap. It is a good thing that young people enter the army with production experience and hardened by labour.

The principal argument of those who would extend education by adding years at the end is that, from the point of view of the effectiveness of instruction, a year at the end is supposedly much more useful than a year at the beginning. But this assertion is based on the most general ideas of ordinary consciousness and has no theoretical foundation.

From the point of view of modern science, age-linked mental development cannot be viewed as a unidirectional and uncontradictory process of the enrichment and increase of mental powers. It would be an error, writes the Soviet educator N. S. Leites, to think that as the child grows older the

conditions for the development of his faculties become more favourable. "It is known that the child's brain is especially subject to the influence of his environment and that the development of many qualities is much easier among children than among adults.... It should be noted that, however strange at first glance, some aspects of the child's psyche are not constant, but are connected chiefly with a specific stage of development."[55] There is every reason to suppose that addition of a year of instruction "from below", that is, beginning with six-year olds, would be much more useful from the point of view of the child's mental development than the addition of a year "at the top".

The idea that the period of early childhood (up to 5 years) is in a certain sense of exceptionally decisive importance for subsequent physical and spiritual development of personality has been expressed more than once. Recalling his early childhood, Lev Tolstoi wrote: "Wasn't it then that I acquired everything by which I live now, and acquired so much so quickly that I haven't gained a hundredth of it in the rest of my life? It is but a single step from the five-year old child to me."[56]

If we imagine a human life as a single day, the American scholar Arnold Gesell has said, then the period from one to four years is only an hour, but the greater part of our development occurs in this hour.[57] Many Soviet pedagogues share this idea.[58] Nevertheless, this idea is usually understood only as a methaphorical, emotionally pointed phrase that need not be taken in its literal sense.

In recent years, however, these paradoxical assertions have suddenly found ever surer footing because of the plentiful stream of new experimental data flowing from a number of different countries. Generalising the results of research conducted by the World Health Organisation, Anthony Barnett, for example, writes: "The important period was found to be the first five years."[59] Investigators are increasingly convinced that the pre-school period is of decisive importance in shaping personality and developing the intellect. And some of them arrive at a conclusion not at all similar to accepted conceptions, that these processes depend in great part, if not chiefly, on the child's life from six months to one and a half years. At any rate, there are now at hand the results of an

experiment in which children received the greatest portion of developmental instruction from one-half to one and a half years—and 90 per cent were honours students in the first grade. The Director of the Estonian Scientific Research Institute of Pedagogics, Osvald Nilson, feels that for this reason one is "reparing" the personality in school more than shaping it.

Many foreign teachers and psychologists engaged in exploring the reasons for the differences in individuals' intellectual levels have come to similar conclusions. For example, scholars at Harvard University working under the direction of Professor White have become convinced, on the basis of many years of research, that something important, something that determines the child's further intellectual development, occurs between ten months and a year and a half. It turns out that in the shaping of the child's intellect, it is extremely important *how* the mother smiles at him, *how* she talks with him, whether she shares his agitation and stimulates his mental activity. The director of a clinic for children with nervous disorders in New York, Peter Neubauer, argues that the bases of mental health are formed in early childhood. A mother's love and tenderness in the period from birth to three years, in Neubauer's opinion, conditions to a significant degree the further course of development.

In 1964, Professor Benjamin Bloom (University of Chicago) noted that 50 per cent of man's intellectual capacity is formed in the first four years of life, and that up to the fourth year the mind of a child is extraordinarily receptive of external influence, while this capacity continually declines thereafter. Bloom feels that the "measurable intelligence" of the 17-year old can with 50 per cent probability be predicted in the fifth year. In other words, an "impoverished" environment in the first four or five years of life can have more serious consequences than the deprivation of opportunities for development in the next 12 years. And the more drawn out this early "impoverished" period, the more difficult to repair the loss.

Teaching and bringing up the child in his first five years is an extraordinarily intricate and delicate process, which must be conducted with a view to the individual psyche of each child. At present, psychologists and pedagogues optimise this process only by chance.

The British specialist in the biochemistry of the brain, S. Rose, has concluded that the growth and development of the brain occurs to a significant extent after birth, in the first few months and years of life. In this period, when only a comparatively small number of new cells are formed, a much more important process goes on—the formation of an enormous number of new connections between the cells. Anything that obstructs this may hinder the development of the brain and intellect. In childhood, writes Rose, new connections in the brain are formed through the growth of cells, the development of new cellular processes and of new synaptic nodes. However, as soon as the brain is fully developed, it loses to a great extent the ability to form new connections. So with the passage of time it becomes ever more difficult for man to learn.

It is early yet to speak of any strict theory of age-linked development of the intellect, but enough factual material has already been accumulated for it to be quite obvious, first, that the individual's intellectual potential is enormously dependent on how effectively his spiritual development was stimulated in the period of early childhood, and, second, that it is difficult or even impossible to fully compensate later for any deficit in developmental instruction at this period.

It would seem that one can draw practical conclusions from this. "We are in the habit of considering the first grade as the beginning of all beginnings," writes A. Khripkova, Vice-President of the Academy of Pedagogical Sciences of the USSR. "But in fact the personality (and health, too) of the child begins to form long before he enters school." [60] Unfortunately, until now the opinion has been widely held that up to three years the child is psychologically so primitive an entity that no special knowledge is needed to rear him. In any case, it is felt that in pre-school institutions, especially nursery schools, nurses as well as aides without special education can successfully cope with the tasks of training children.

The potential for development at a later stage in childhood is inadequately exploited, too. Instruction in reading and writing begins in the first grade, i.e., at seven years of age, yet the age

best suited for mastering these skills is 4.5-5 years. A teacher from Volgograd S. Semin, on the basis of his own interesting experience, has come to the conclusion that, given a certain method of instruction, it is possible and necessary to begin teaching reading and counting at an even earlier age — one to two years. "...At this age," he writes, "commitment to memory is more spontaneous and productive than at a later age. Not to use this feature of the child's psychological development is simply foolish and inefficient." [61]

Comparisons of the results of research conducted by D. N. Uznadze in 1928 and M. I. Zarandiya in 1967 on the level of generalisation and definition of concepts by pre-schoolers show convincingly that the mental capacities of contemporary five-year olds in this respect surpass the mental capacities of seven-year olds of 1928. According to the data of the Scientific Research Institute of Pre-School Upbringing of the Academy of Pedagogical Sciences of the USSR, 64 per cent of urban children can read when they enter school, 96 per cent know numbers, 89 per cent can count to ten. For some towns and regions, and also for children who attend kindergartens, these figures are still higher.

Since the 1964/65 school year there has been conducted in Daghestan an extensive experiment to learn whether contemporary six-year-olds can assimilate material previously studied by seven-year olds. The results already allow a positive answer to this question.[62]

On the basis of all these facts, one can assert, first, that, given an increase in the period of schooling, it is more useful to extend the period by beginning earlier. Second, it is useful to begin teaching children at six years of age even if the total length of schooling remains as before. This will be reflected positively in the quality of the whole school programme.

One must consider, too, the practical experience of world pedagogics. In many countries, practical steps are being taken to begin education from earliest childhood. Naturally, in such cases the content, forms and methods of instruction must be different in principle than those used in school today. Early education must, without fail, be directed by specialists with the highest qualifications.

It is quite possible that the native potential for mental development that man has at a pre-school age is, among the overwhelming majority of people, used only to a slight extent. As a result of this, society loses irretrievably a considerable part of its intellectual potential. Conversely, a fuller use of those capacities for the development of the intellect that are present in early childhood (up to 5 years of age) would make possible a sharp rise in this potential, would greatly increase the number of capable, gifted and talented people, of whom in the era of the scientific-technological revolution there is a pronounced dearth.

In June of 1972, in the Section of Didactics of the Scientific Research Institute of General Pedagogics of the Academy of Pedagogical Sciences of the USSR, a conference on "The Development of Creative Ability — a Most Important Problem of Our Time" was presided over by M. N. Skatkin, Corresponding Member of this Academy. The conference drew up detailed recommendations. It was stressed that there is an increasing amount of data testifying to the exceptional role of early childhood, when children are especially receptive to assimilating different aspects of social culture.

An interesting attempt to study this question by way of a "family experiment" was undertaken by the Nikitin couple. Their children (there are eight children in the family) are taught from earliest childhood to play not only with toys, but also to handle genuine adult equipment, to use sports equipment. The Nikitins have a detailed system for early instruction in reading, writing, and counting, based on very original games that stimulate thinking. Children from the age of two and three learn to read as they play, at the age of three and a half they can count.

The experiment in the Nikitin family is being conducted to verify a hypothesis that is interesting but usually only talked of. The executive and the creative faculties, writes B. P. Nikitin in his *Hypothesis on the Origin of the Creative Abilities*, develop along lines that are different in principle: the first along a curve asymptotically approaching a certain limit, the second — exponentially. The first do not vary significantly among different people (they are the objective basis for establishing work norms). The second can differ by many orders of magnitude, and the reason for this is that most people do not

receive enough external stimuli for the development of the creative faculties in the period of early childhood, which is most favourable for their development. As a result, there is an irreversible extinction of the potential effectively to develop faculties, an extinction which, though not absolute, is very difficult to overcome.

The idea that it is necessary to begin the child's education early is increasingly widespread. "Millions of children are being irreparably damaged by our failure to stimulate them intellectually during their crucial years—from birth to five. Millions of others," writes the American teacher Maya Pines, "are being held back from their true potential. Our severest educational problems could be largely solved if we started early enough." [63]

The renowned Japanese musician and teacher, Shinichi Suzuki, who has worked a lot with children of from three to six years and has achieved amazing results in developing their musical abilities, has concluded that everyone has talent, but far from all have conditions favourable for its development. "All human beings are born with great potentialities," he says. "We must investigate methods through which all children can develop their talents. In a way, this may be more important than the investigation of atomic power." [64]

Intensive experiments in this direction are being conducted at the present time in the United States, West Germany and Japan. Special schools have been set up, the fundamental goal of which is to develop abilities among children beginning from two years of age. In the United States, there is also an experiment in goal-directed training of babies from 3 to 12 months, an experiment being carried out through the efforts of specially trained teachers, who will help mothers raise children at home.[65]

It should also be noted that the movement for earlier instruction must everywhere overcome great opposition. On the one hand, attempts by progressive teachers and democratic forces to take practical steps under capitalism, steps to improve the living conditions of pre-school children from the poorest families, to organise their upbringing through special programmes for development, in order to compensate for their material and spiritual deprivation, meet with the strong

opposition of admitted reactionaries, who strive to strengthen and reinforce social and cultural inequality in society. On the other hand, many teachers and scholars, insistently adhering to traditional views, oppose the idea of early education.

Quite often, a negative attitude to early education is justified by references to the fact that it supposedly contradicts biologically established laws of the development of the human organism. In reality, such assertions are no more justified than assertions to the opposite effect. "To what extent environmental stimulation can influence brain maturation or organisation," writes J. M. Tanner, "is not clear.... The way in which we teach children, and the times at which we teach them various things, must be governed by the manner of growth of their nervous systems. Evidently sequences of development exist; but we have no answer to the all-important question of what happens to the cell assemblies if we attempt to teach something too soon; or conversely if we delay teaching something too long, so that a new neural organisation may be starved of exercise." [66]

Many foreign specialists oppose in principle any programmes for teaching children in the pre-school period, feeling that the children are still too small to think, or that at that age "learning is for them as unpleasant as being forced to drink castor oil". "Until six years, children aren't ready for study," some teachers say. It is truer to say, notes Maya Pines: "The teacher isn't ready to teach them."

The opinion is often met that to teach children before they are six is to deprive them of the joy of childhood, etc. This is not without foundation, and quite justified if early education is understood to be simply a mechanical shift of school curricula down the age scale. Early education can be successful only when all elements, without exception, in the educational system are transformed in accordance with the child's potential at a given age. It must be carried out on a qualitatively new basis and with methods different in principle from those used in school. These new methods must be based not on compulsion, but on the child's heightened curiosity at an early age, and also on the use of the play factor in the process of instruction. The most difficult thing in this affair is to find the optimal system of exercising pedagogical influence for each

age group and, even more, for each individual child — taking his genotype and psyche into account.

Experiments in the field of early education must be comprehensive, they must take into account the continuity of content, forms and methods of instruction in the various elements of the educational system — nursery school, kindergarten, primary school, secondary school and university. Otherwise, the most brilliant achievements in pre-school education may be effaced and nullified at subsequent stages.

It is obvious that the importance of an educational institution, its social significance, grows in proportion to its height in the hierarchy of the educational system. It is a matter of course that the most educated and erudite pedagogues work in institutes of higher education, the less educated in kindergartens and primary schools. But the early age demands personnel no less qualified.

One of the most, if not the most, important changes that the revolution in education is bringing is the introduction of elements of education beginning with two-year olds, and possibly even among younger children. It is possible that the greatest untapped reserves for raising the productivity of labour in the realm of education are connected with a fuller accounting of age-linked potential, and that the most effective way to optimise the flow of educational information lies in just this direction.

Research on the problem of early education and the potential of early childhood is quite difficult not only because of its complex and multi-faceted character, but also because decades are needed to verify hypotheses. The resolution of this problem, however, can be substantially speeded up by careful study, including statistical analysis, of the empirical material already accumulated by pedagogical science throughout the world.

Early education and upbringing organised on scientific bases will permit a sharp rise in society's intellectual potential, a great increase in the younger generation's creative abilities, and this, as Academician P. L. Kapitsa has said, is a fundamental goal, on the meeting of which may depend the future of our civilisation, not only in one country, but on a global scale.[67]

CONCLUSION

A LOOK AT THE FUTURE

Under contemporary conditions, production, education and science develop as a single system. However, in the process of its evolution, education has lagged considerably behind science and production, which have since the middle of the 20th century entered a profoundly revolutionary phase. The ensuing contradiction can be resolved only through a corresponding revolution in education.

Under capitalism, class antagonisms are superimposed on this contradiction; hence, the entire bourgeois system of education is experiencing a most profound crisis. Under socialism, on the contrary, social relations aid the rapid surmounting of this contradiction and a rise in public education to a qualitatively new level that corresponds to the requirements of the modern era.

Education has been turned into one of the most important sectors in the historic competition between two opposing social systems, a sector where socialism shows in practice its pre-eminence, its vitality, its right to the future. As in everything, here, too, success is obtained in accute and tense struggle.

Both socialist and capitalist countries, seeing the need for profound changes in the content of education in correspondence with the objective needs of the scientific-technological revolution, are forced to examine critically the traditional forms of the process of education and upbringing, to search intensively for new more efficient ways to organise instruction and for new methods of teaching. The systems of education

are faced with the task of sharply raising the productivity of pedagogical labour, a task that must be met in practice through a revolution in education.

The basic tendencies in the revolution in education are: actualisation of the content of education, introduction of electronic teaching machines, optimisation of the flow of information, introduction of forms of division and coordination of pedagogical labour that are new in principle and are connected with the concentration of the school, and a transition to education from early childhood (and perhaps infancy).

Despite their enormous significance, none of these tendencies can develop in isolation, unconnected with the others. Therefore, the problem of a revolution in education must in theory and practice be resolved as a complex, integral whole, with a view to mutual coordination of all these tendencies. Otherwise only partial solutions of limited import are possible; each will be an improvement of details in the system, but not a fundamental revolution and not a resolution of the contradiction that has arisen between traditional education and the new demands of the scientific-technological revolution.

For example, optimising the flow of information can be done first by rationalising the division of school subjects over the school year and during the school day by improving the organisational forms of the study process. On this level, optimisation is realised with regard to the potential and abilities of large groups of students. The second level of optimising the flow of information is carried out with respect to the potential and ability of the individual student. This is an immeasurably more complex task that can be met on a large scale only with electronic teaching machines and programmes devised by cyberneticians and experienced psychologists and teachers working with them. Finally, the third level is reached when the flow of information is adjusted to the abilities of the individual student in relation to his age (a problem that is practically unstudied but fraught with possibilities). So there is a single, three-stage, intensified process of optimising the flow of information, a process that, in all probability, can raise the efficiency of instruction to fantastic levels.

Thorough theoretical and experimental analysis of all these problems is of paramount importance from the point of view of raising the efficiency with which the educational system as a whole functions and, consequently, also from the point of view of securing the leading place for socialism in the on-going scientific-technological revolution.

One must keep in mind in all this that the best programme and miracle-machines, the best forms of organisation and methods of instruction, the best school buildings and equipment, as is true of any other innovation in the educational process, will succeed only if the principal factor in the process of education and upbringing—*the teacher*—is fully prepared in a professional, socio-economic and moral sense.

Yet, often, valuable innovations do not justify themselves and are compromised precisely because this factor is underestimated. We must recall the old idea of Plato and Hegel that we pay more attention to selecting the masters who sew our clothing than to selecting masters who raise our children. In devising an educational strategy, it is very important to devise measures to ensure a constant flow of the best forces into the pedagogical field and to make it possible for them to realise their creative potential in full. In this respect, it is especially urgent that we analyse the problems of improving professional selection, training and the further planned elevation of the teacher's status to a social height that will allow him to cope with those new tasks that the scientific-technological revolution has thrust upon him.

One may suppose that there will be quite substantial structural changes in the system of education in the USSR over the next few decades.

The stage of pre-school education (and upbringing) will, probably, consist of a ramified network of appropriate children's institutions and an institute of instructors, pre-school teachers and psychologists, who will give systematic and skilled aid to families. This stage will cover children of the corresponding age and will be a very important, inseparable element of the whole educational system. The development of polytechnisation and the combining of education and industrial labour in the general secondary school, on the one hand, and the development of general secondary education into a system

of vocational training, on the other hand, will lead objectively to the convergence of these two sub-systems.

The system of specialised secondary education now fulfills two functions: preparing middle-echelon specialists and highly skilled workers. In the future, apparently, the role of technicums in training the most skilled workers will grow. All of this will lead to the convergence and integration of all forms of secondary education. Higher education, too, will continue to develop. At the same time, the rapid development of graduate studies and different courses for raising qualifications among those who have graduated from higher educational establishments will lead to another stage—"post university" education.

The objective conditions of the modern world make the boundary between education, production and science ever more mobile and relative. In connection with the fact that the scientific-technological revolution forces everybody throughout his life to raise his qualifications or to change professions several times, a new demand is made of education as a social mechanism—to ensure an increase in the level of every individual's general education throughout his working life, i.e., a demand for *continued education*. Different ways to raise qualifications are ever more broadly distributed in the national economy. This means that the modern system of production is increasingly becoming a system for constant training of personnel.

On the other hand, college students, in order not to enter science and production with half-outdated knowledge, must continually participate in scientific research, in designing, in introducing and exploiting the latest technology. These demands have to a certain extent already been taken into account in the work of a number of institutions of higher education. Such an approach fully justifies itself in practice, and it is to be expected that in the near future it will be widely applied. Combining study with practical work, with production and science, is increasing in scale in schools, technicums and institutions of higher education. The educational system is to an ever greater degree becoming simultaneously a system of production (not only of personnel, but also of material and cultural wealth for society). As a result of the scientific-technological revolution, there will take place an *integration of two major spheres of human activity: production and studies*.

The contradiction between the mushrooming volume of socially necessary pedagogical labour and the real ability of the total pedagogue to do all he should in instruction and testing assimilation of knowledge can be resolved through use of automatic and electronic machines, but tutoring proper cannot be automated. The most perfected technology and the best methods of instruction can never of themselves meet the goals of upbringing. An individual can be raised to lofty demands only through live human intercourse. The modern scientific-technological revolution, which has caused a sharp expansion in the scale and a growth in the complexity of the process of teaching and upbringing has engendered a demand for a significant increase in the volume of the total teacher's live labour.

There is an acute need, and a real possibility, to involve ever more of the public in this. The further reduction of working time and the increase of free time will make for greater possibilities in this area. And such work is no "sacrifice" of time and effort by those who voluntarily take on themselves pedagogical responsibilities. Pedagogical activity develops and ennobles those engaged in it and is to a certain degree their own reward.

The work of upbringing is a two-sided process, in the course of which both parties undergo positive changes. Consequently, the question is how to turn the upbringing of the younger generation into the affair of all members of society as quickly as possible.

Moreover, as the experience of leading Soviet schools shows, it is possible more widely to bring in scholars, engineers, doctors, cultural workers, foremost workers and collective farmers for lessons and lectures, for work connected with the school curriculum and with its extension. "Talk of a lack of teachers in cities is mistaken. For work in schools," notes Academician M. A. Lavrentiev, "one can mobilise, on a part-time, paid basis, the whole technological-engineering intelligentsia. Teaching has great significance: it is a school for managers, a school for organisers...." [68]

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