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SOCIAL ASPECTS OF THE SCIENTIFIC AND TECHNOLOGICAL PROGRESS

From among the immense number of problems relating to social aspects of technological progress, three have been approached in this work: 1) theoretical investigations concerning connections between technology and social life; 2) some social problems of the scientific and technological revolution; 3) the influence of science and technology on man's spiritual life.

THEORETICAL INVESTIGATIONS CONCERNING CONNECTIONS BETWEEN TECHNOLOGY AND SOCIAL LIFE *

The effect of science and technology upon society has in recent years become a much-discussed issue in the world press, if not the most discussed. There are a number of reasons for this interest in the social consequences of technological progress. On the one hand, profound changes in science and technology and accelerated technological development exert an enormous influence upon people in both socialist and capitalist countries. On the other, technological progress under capitalist conditions, like every scientific and technological invention or discovery, leads to the accentuation of capitalist contradictions. And the utilization of science and technology in the military sphere casts an ominous shadow over the world.

Many books and countless articles have been appearing in capitalist countries about the social consequences arising from the use of atomic energy, about the economic, social and moral effects of technological progress as a whole and, particularly, of industrial automation. In the U.S.S.R. — the real aim of building a material and technological basis

* This chapter has been published in *The Evolution of Science Readings from the History of Mankind,* edited by Guy S. Métraux and P. Crouzet. New York 1963, pp. 322—339.

for Communism dictates high speeds and scales of scientific and technological progress, resulting in its growing influence on all economic and social aspects of life. Speaking at the June Plenum (1963), of the Soviet Communist Party Central Committee, N. S. Khrushchev laid emphasis upon the social aspect of technological means. In a socialist society, he said, automation possesses not only economic but also vast social significance. Technological progress changes the character of labour, raises the cultural and technological level of working people, and creates the prerequisites of eliminating the difference between manual and mental labour; with automation, man's role is to direct the automatic equipment and instruments, to set them up, and establish their programs and working conditions.

From the foregoing, the theoretical and practical aspects of investigation into the economic and social consequences of technological progress are clear. In capitalist countries, the heightened role of technology in contemporary society combined with the contradictions its development brings about have made the question of the social consequences of technological progress not only a current topic but a very confused one.

The first and characteristic feature found in most literature written abroad on this subject is the attempt to represent technological advance as the cause of social disorders in modern bourgeois society. Some say that it must be curbed or even halted as something entirely evil. Others hail it and speak of the need to make social relations correspond to the modern technological level, but this is never to be understood in the sense of getting down to rebuilding the whole economic basis of modern bourgeois society, of liquidating private property in the means of production; what they have in mind is some vague capitalist reform that, allegedly, would make it possible to use all the benefits of technological progress to raise man's welfare within the framework of capitalism.

Typical of the views of those who regard technology as hell-born is the Swiss theologian E. Brunner's book *Christianity and Civilization,* in which he says that modern technology means countless millions huddled in huge, soulless cities, a proletariat cut off from Nature, with no real home or friendly neighbours. It means an asphalt culture, monotony, and standardization. These are people, Brunner says whom the machine has freed from the need to think and desire, and who in their turn must serve it at a prescribed speed and in a stereotyped manner. It means unendurable noise and bustle, unemployment and insecurity, the concentration of productive forces, wealth, and prestige in the hands of a few or their monopolization by state bureaucracy. In Brunner's opinion, it also means the rapid standardization of all national cultures and the destruction of their historic roots. We have cited Brunner rather fully because he shows clearly how phenomena

born of modern capitalism, which develops technology in the interests of profit and not of man, are ascribed not to their real author but to technological means in themselves.

Brunner and scientists of like mind have fallen far behind Marx and Engels in their understanding of social phenomena. Marx and Engels gave an even clearer picture of the disastrous results machinery brought to the worker, but at the same time stressed the fact that the cause of the trouble lay not in the machine itself but in its application under capitalist conditions. "There cannot be the slightest doubt — Marx wrote in *Capital* — that machinery as such is not responsible for «setting free» the workman from the means of subsistence... machinery, considered alone, shortens the hours of labour, but, when in the service of capital, lengthens them... in itself it lightens labour, but, when employed by capital, heightens the intensity of labour... in itself it is a victory of man over the forces of Nature, but, in the hands of capital, it makes man the slave of those forces... in itself it increases the wealth of the producers, but, in the hands of capital, makes them paupers..." [1]

The German scientist Alexander Rüstow takes much the same attitude as Brunner. He writes: "The enthusiasm for technological progress so widespread in our day... is assuming the character of a demoniac, soulless religion of deliverance, something in the nature of an unrestrained urge to attain record achievements at all costs. And like every theology, this widespread religion of rationalism, by means of paradox and illusory principle, in the final analysis breaks down intellect" [2].

When manipulating his ideas of an antagonistic society, Rüstow sees only the undesirable aspect of technological development, which undoubtedly exists, but only in capitalist society: the dulling of the worker's intellect, the fanatical profit — seeking by the capitalist to the detriment of others according to the law of capitalist competition, etc. Here once more we find that the contradictions born of technological development under capitalist conditions are ascribed not to a social system whose framework has become too narrow for technological progress, but to this progress in itself.

It is typical that all these writings, with their lack of understanding of the connection between technological and social phenomena, arise to a considerable extent out of the pessimistic literature that tries to represent the crisis of contemporary capitalist society with its military and economic shocks and its unemployment as being a crisis of mankind, literature asserting that modern civilization, culture, and mankind itself are sliding down to inevitable ruin.

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[1] K. Marx, *Capital*. Moscow 1955, vol. I, p. 446.
[2] A. Rüstow, *Kritik des technischen Fortschritts*. "Ordo", vol. IV/1951, p. 384.

A number of scientists in different countries try to penetrate more deeply into the problems arising from scientific and technological progress. But instead of seeking the social and economic roots of these problems, they generally talk about the "lag" of the humanitarian sciences behind technological progress, a "lag" they consider to be the cause of the social, ethical, and ideological conflicts and difficulties caused by scientific and technological advance. One of the most typical representatives of this point of view is the French economist and sociologist Jean Fourastié, whose works are very widely read in France and other European countries. In his *Le grand espoir du XX siècle* he says that:

"Le retard des sciences économiques et sociales sur les sciences de la matière est l'une des causes des malheurs actuels de l'humanité. La technique emporte l'homme vers des horizons imprévus. Placé entre un passé qui lui paraît entièrement périmé et un avenir inconnu, l'homme, privé des traditions, des morales et des religions... et n'ayant pas encore trouvé la philosophie valable pour le nouvel âge, agit au jour le jour, selon les incohérentes sollicitations du court terme. Il a perdu la sécurité et l'efficacité des longs pensers et des fermes propos. Il a perdu la mesure du possible et de l'impossible."

Fourastié considers that *"L'analyse systématique du «progrès technique» sera pour nous le fil d'Ariane qui nous servira de guide pour l'explication de notre temps"* [3].

The well-known German scientist Friedrich Dessauer gives an enthusiastic estimate of technological progress, linking up profound social changes with the use of nuclear energy, the advance of natural science, and technological development:

"Man will have greater knowledge, greater abilities. The far distances are drawing close, the time expended on communication lessens. Men can live longer, be stronger. The number of those who are poor, undernourished, and sick will lessen. Deserts will become cultivated land, steppes will blossom into gardens. All this and more will be «for man», not for one single nation, one state or one continent. Everything that historically divides, that politically sunders, everything that is opposite in humanity is of no importance for natural science and technology. For them, no political colorings exist. They turn their face to all people, not to individual nations and not to warring social forms which are handed down from former days."[4]

As we can see, Dessauer — unlike Fourastié — simply retreats from the task of making the social aspect conform to scientific and technological development. He is not, however, entirely successful in this. Passing on to the technological problems connected with automation, he describes

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[3] J. Fourastié, *Le grand espoir du XX siècle*. Paris 1958, pp. XVII, XIX.
[4] F. Dessauer, *Streit um die Technik*. Frankfurt am Main 1956. Quoting from *The Evolution of Science*, op. cit., p. 325.

the "inflated optimism of the Americans" who claim that now already, and in the future, automation brings benefits to the workers, and also the restrained attitude of Europeans. He refers to the Margate conference attended by 1.100 British and foreign heads of factories, engineers, scientists, and trade-union officials, where it was clearly shown that social conditions do not adapt themselves automatically to scientific and technological possibilities but in a number of cases become a hindrance to the victorious progress of technological innovation.

Representatives of modern Social-Democratic thought have taken up a rather peculiar position on this question. Many of them are quite willing to concede that technology today is outgrowing the economic relations of capitalism, that it can develop succesfully for the benefit of man under socialist relations. But they do not want to take the path of the socialist countries, they offer ideas of the elimination of contradictions between technological means and the social system within the framework of the modern bourgeois state, which in their opinion is even today no longer a class state, but expresses the interests of all strata of society. All this was expressed to a greater or lesser extent at the Münich Congress of the Social-Democratic Party of Germany in 1956.

Professor Karl Schmidt, one of the main speakers, said: "Technological means... radically change our social system, our political forms and in general all forms of human existence". Apprehensions were expressed at the congress that the new technology would be utilized by the monopolists; Heinrich Deist among others spoke of this: "It is necessary — he said — to prevent atomic energy and the possibilities of its use from falling into the hands of private capital".

It would seem that such statements should lead on to a formulation of the purpose of taking the means of production out of the hands of private capital, or developing the new technological means under conditions of socialism. But instead, it led only to a demand to hand over the leadership of society to those forces to whom the future belonged — i.e. to Social-Democracy. This was the spirit that filled the message of greetings from the party leadership to the delegates at the congress, emphasizing that the results of the Second Industrial Revolution could be fruitful only if Social-Democracy stood at the head of society. And this in spite of the fact that there exists tremendous historic experience in the utilization of science and technology in the interests of man under socialist relations.

The Münich Congress of the Social-Democratic Party of Germany did not wish to make use of this experience and adopted a very hazy resolution which gave no real answer to the urgent questions arising from the course of development of modern society. More than that, the trade-union theoreticians of Western Germany are trying to misrepresent the policy of the Communist Party of the Soviet Union on establishing

the material and technological basis of Communism and industrial automation.

Alarm about the social consequences of automation is expressed in the latest works by writers whose aim is a purely scientific and technological exposition of automation, but who nevertheless express their apprehension about its social consequences. One might quote endless examples of the various ideas about the path of social development in view of scientific and technological advance, ranging from appeals to check this advance to assertions that it is this which will save modern capitalism and enable man to enjoy all scientific and technological benefits within the capitalist framework. But this is not the important point; the point is that through all this discordant chorus sober voices are rising with increasing frequency, the voices of more far-sighted investigators.

Capitalism as a social system, they write, has come into a state of irreconcilable contradiction with the level, and still more important — the possibilities — of modern technological development; only socialism as a new and higher social system affords the opportunity to utilize the achievements of science and technology in the interests and for the well-being of man. *Automation and Social Progress*, by the English scientist S. Lilley, is typical in this respect. After drawing a clear picture of the contradictions arising out of automation in a capitalist society and tracing concrete ways for easing these contradictions in respect of Britain, Lilley writes at the end of his book:

"There is no ultimate escape from the fact that capitalism, well though it worked in its time, is not a suitable economic structure for making beneficial use of the advanced techniques of today and the even more advanced techniques of to-morrow. Whatever temporary solutions we may find for present difficulties, these solutions will in turn create further problems. Turn and twist as we may, there is no ultimate way forward except that of changing the whole economic system into a socialist one" [5].

The fate of capitalism under conditions of the technological development and advancing productive forces of modern society finds veiled and peculiar expression in general theoretical discussions on the interaction of technology and social relations. There are several typical trends to be observed. Some claim that social phenomena are the direct result of technological development. Others, on the contrary, assert that social phenomena play the leading role, and technological development arises out of them. Others, again, seek a more intricate connection. Let us examine these three trends in greater detail.

There exists a rather widespread affirmation that social life as

[5] S. Lilley, *Automation and Social Progress*. London 1957. Quoting from *The Evolution of Science*, op. cit., p. 328.

a whole is a function of the development of technology. Such a view is taken by representatives of varied trends, beginning with the technocrats in whose world-outlook the conception of "technological determinism" occupies a key position, and ending with representatives of various scientific circles who deal little with the social aspects of science and technology, but who believe that their development, especially in the long run, has a wholesome effect on mankind. The views of "technological determinism" were very clearly expressed by Leslie White, according to whom:

"Social systems are in a very real sense secondary and subsidiary to technological systems. In fact a social system may be defined realistically as the organized effort of human beings in the use of the instruments of subsistence, offence and defence, and protection. A social system is a function of a technological system... The technology is the independent variable, the social system is the dependent variable. Social systems are therefore determined by systems of technology" [6].

The same opinion is developed by the West German physicist Pascual Jordan — one of the few scientists that frankly declare for the possibility of using atom bombs. As early as 1956, Jordan published his book *The Failed Uprising*, where he had formulated, among others, his conception regarding the decisive role of discoveries and inventions for social and political changes. He illustrates his thought by quoting the example of Liebig's discoveries:

"One can hardly foresee an event of greater importance within the next century than Liebig's discovery of artificial fertilizer. Thanks to artificial fertilizer, and to this alone, it was possible to increase the population of Europe. Liebig's discovery was not a result, but on the contrary a condition of the industrialization of Europe and the foundation of all subsequent social and political changes" [7].

Also belonging to the group of the followers of technological determinism are the scientists, who although not disregarding the social aspects of science and technology, do not reflect upon them very much. A striking example may be offered by the American scientist, George Harrison of the Massachusetts Institute of Technology, who has published his interesting book *What Man Can Be? The Human Side of Sciences*. Harrison's pronouncements are characteristic of the duplicity of this group of thinkers. On the one hand, he looks optimistically at the future, considering that the scientific and technological revolution which is setting in (or which has already done so) will provide happiness to man. On the other hand, he becomes anxious — as other scientists also do — about the fortunes of people and of man, who may be endangered as a consequence of this revolution.

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[6] A. L. White, *The Science of Culture*. New York 1949, p. 365.
[7] P. Jordan, *Der gescheiterte Aufstand*. Frankfurt am Main 1956, pp. 41—42.

Believing deeply in the might of the science, Harrison writes that "Science is coming to determine how much men can eat, how confortable they are, how hard they must work", and he says further: "There is overwhelming evidence that man's scientific achievements with material things can and, because of his nature, will, in the long run, contribute greatly to his spiritual welfare" [8].

Parallel to the defense of technological determinism, and to the attempts to avoid contemplating, in a theoretically deep manner, the social aspects of scientific and technological development, there appear works endeavouring to prove that direct connections between technology and economy on the one hand, and social relations on the other, do not exist. Characteristic from this point of view are the pronouncements of one of the most eminent German philosophers and sociologists, Karl Jaspers, who in his book *Atom Bomb and Mankind's Future* tries to prove that the economic system and the social structure are of no consequence for the development of technology. While admitting Marx's statement about the dominant role of economic phenomena in the life of societies to be of immense importance and to be universally recognized, he asserts that an equally important role is played by the moral factors, no one of the factors,however, being able to determine the social order automatically. At the end Jaspers writes:

"Economy, or any other form it may possess, is not absolute. It is no measuring rod what we are and can become. Economy is probably as necessary as water for an organism, without which the organism would perish. But economy is not everything, just as water does not compose the whole organism. Economy gains meaning only through that for which it exists, and which of course it in itself is not. Economy in itself is permeated by the motives for the sake of which it exists. Therefore, various social orders are possible and exist under an equal technological level" [9].

Here reveals itself a tendency characteristic for western science, the tendency to run away from studying the social aspects of technology under the pretence that the phenomena are complex and that there supposedly exists no possibility to find, in their variety, the leading factors, especially when those are economic factors.

A recently published book *Social, Economic and Technological Change (A Theoretical Approach)* [10] in its particular articles (in French and English) opposes to the technological determinism the "social

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[8] G. Harrison, *What Man Can Be: The Human Side of Sciences.* New York 1956, pp. 1, 18.

[9] K. Jaspers, *Die Atombombe und die Zukunft des Menschen.* München 1958, pp. 238—239.

[10] *Les implications sociales du progrès technique. Changements techniques, économiques et sociaux (étude théorique).* Paris 1959.

determinism" (provided such a definition is acceptable), the social conditioning of technology.

After denouncing the scientists who consider science to be the first cause of the changes in the economic situation, the authors introduce the notion of "aim", and emphasize that it is not the technology which determines such or other social or economic stipulation of aims, but — on the contrary — the social aims as well as the economic theories are determined by the development of technology.

One of the authors of that collective work, Stéphane Bernard, discusses the mutual connections between technology and social relations in his very interesting article *The Critical Analysis of Notions Concerning the Social Conditionings of Technological Progress: "...l'action de la technique sur les phénomènes sociaux* — he writes — *s'accompagne toujours d'une action en retour des phénomènes sociaux sur la technique"*. The author maintains that there exists a close interaction between technical and social phenomena *"en forme de cercle, ou plus exactement de spirale, puisqu'il reste ouvert dans le temps et dans l'espace"*.

This interaction of technological development and society in author's opinion can be expressed as follows: *"...l'une, ascendante, qui va de la technique à la société et qui exprime les changements sociaux en fonction des changements techniques, l'autre, descendante, qui va de la société à la technique et exprime les changements techniques en fonction des changements sociaux"* [11]. It is from such considerations that the author derives the contents and the object of his "sociotechnical investigations".

The article of Wilbert E. Moore of Princeton University entitled *Measurement of Organizational and Institutional Implications of Changes in Productive Technology* deals as well with the interaction of technological and social factors. By stressing the great importance of research on mutual links between those factors, Moore states that "If changes in productive technology have social consequences, they also have social sources. Technological determinism, including the famous conception of «culture lag», may be dismissed simply and categorically as having neither empirical nor theoretical support worth any small fraction of the attention it has been accorded" [12].

Such is the varied picture of judgments on connections of technological progress with economic and social phenomena. It may be seen that the scientists dealing with this problem are correctly perceiving, at the best, only one or another aspect of it. Attributing to technology a decisive significance in the present world, the followers of techno-

[11] Ibid., pp. 33—34.
[12] Ibid., p. 232.

logical determinism lay stress on the immense possibilities given to mankind by science and technology. Since they do not understand the dialectical connections of technology with economic and social relations, their point of view, however, does not make it possible to detect the real and objective character of the mutual links existing between technology and social relations.

Nor do the representatives of social determinism see the dialectical connection between technology and social relations. While stressing rightly on many occasions the social aspects of technology and the influence of social life upon it, while denouncing correctly the representatives of technological determinism, they do not perceive, however, the objective regularities of the development of technology.

The characteristic feature of the numerous pronouncements on the subject of social aspects of technology is their reference to Marx's works. Jaspers, for instance, as mentioned above, after having kowtowed to Marx's theory — then simply rejected it.

The director of the Bureau International de Recherche sur les Implications sociales du Progrès Technique, Georges Balandier, in his interesting preface to the above-quoted book *Social, Economic and Technological Change* also discusses about Marxism, although — to tell the truth — in a very nebulous form: "*...des commentateurs de la théorie marxiste ont-ils été incités à simplifier et déformer cette dernière en la considérant essentiellement comme l'affirmation d'un déterminisme technologique. Ceci nous montre combien la tentation de recourir à un tel et unique mode d'explication des mouvements complexes affectant les sociétés modernes, peut être forte*" [13].

It would be difficult to give a reply to such a critical remark, since it refers to the commentators of Marxism, and among them — as is generally known — there may be also such as give to Marxism a sense opposed to the true one.

The attitude towards Marxism is given a more determined utterance by the authors of another article composing the assemblage in question (H. Th. Chabot, J. A. Ponsioen, J. In't Veld, L. J. Zimmerman, C. A. O. van Nieuwenhuijze, E. A. Campo). They say that the Marxist system "subjects historical events and social institutions themselves to the explanatory process of economic analysis" [14]. The authors seem not to have studied Marx's works, but to refer to Schumpeter's comments; it is to be stated, therefore, that such a general and undetermined formulation of the Marxist system is quite incomprehensible. The English scholars R. Firth, F. J. Fisher and D. G. Mac Rae (from the London School of Economics and Political Science) write in their article *Social*

[13] Ibid., p. VII.
[14] Ibid., p. 5.

Implications of Technological Change as Regards Patterns and Models as follows:

"To Marx technology is nearly always part of the total social structure in time: a partly dependent variable. Like Weber, he regards modern industrial technology as a late consequence rather than a cause of «primary capitalist accumulation». Presumably it cannot be introduced into societies where such accumulation has not taken (or is not taking) place. And yet Marx very frequently — though less than Engels — writes as a technological determinist" [15]. And further to continue: "At least Marx gives us one clue which is, however obvious, important. Innovation requires innovators; a special, sometimes marginal, group or class, able — potentially at least — to influence and/or dominate in their society. Without such a group... a society will remain passive (or be resistant) to technical change and innovation" [16].

We have discussed in detail the various interpretations of the problem of the connections between the social and technological factors, as well as the attempts to utilize Marx's works with a view of explaining those connections. It is to be observed here that Marx's and Engels's approach to technology had, of course, nothing to do with technological determinism. Both of them regarded technology as such, and first of all as an indicator of social relations. This idea was formulated by Marx, at length and precisely, in the first volume of *Capital* where he points out that "the economic epochs differ from each other not by what is being done, but by how it is being done, by help of what instruments of labour". With that, Marx emphasized that "instruments of labour not only supply a standard of the degree of development to which human labour power has attained, but they are also indicators of the social conditions under which the labour is carried out" [17].

Technological progress is considered by Marx as a unity of technological and social factors. He shows how the development of technology conduces to the development of productive forces; how, in consequence of that, the relations of production, the economic relations, and thereupon various ideological relations, as well, are changing; and how, simultaneously, the economic and ideological relations are acting in the inverse direction — upon technology. Marx shows, then, the deep influence of social relations upon technology. Let us examine, for the sake of example, the above mentioned theory deriving the development of technology from the economic and social determination of objectives.

The very notion "determination of objectives" tells us but very little, the conditions engendering them being not defined. It is long ago

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[15] Ibid., p. 287.
[16] Ibid.
[17] K. Marx, op. cit., p. 187.

that Marx examined that question and included the determination of objectives, as a leading force of technological progress, into the explanation of the development of technology. But Marx derives the objectives' determination from the regularities, underlying either formation.

Since the production of surplus value is the basis of the social structure in capitalist conditions, the technological progress, too, is in those conditions connected with the capitalists' aspiration for obtaining surplus value. That is what determines the objectives of capitalists who constitute a class exerting a decisive influence upon the technological progress.

By determining the objectives, the capitalists are not at liberty to give up technological progress: "It is the compelling force of anarchy in social production that turns the limitless perfectibility of machinery under modern industry into a compulsory law by which every individual industrial capitalist must perfect his machinery more and more, under penalty of ruin" [18].

As is obvious from all we said above, the form of Marx's and Engels's conception is based on the fact that they both explain the whole variety of the determination of objectives although it is in the main a concrete expression of economic laws. Marx shows, for instance, how in the United States in view of manpower shortage and of wages being higher than in Europe the capitalists took a special interest in introducing machines into the production plants, or how under the concrete historical conditions in England — the conflict between employers and workers becoming aggravated more and more — the capitalists were developing technology, aiming to make use of it in order to bring the workers to their knees.

"From 1825 onward — Marx writes — almost all the new inventions were the result of collisions between the workers and employers who sought at all costs to depreciate the worker's specialized ability. After each new strike of any importance, there appeared a new machine" [19].

That is above all how the determination of objectives is taking place. There may be quoted, true enough, an infinite number of other objectives connected for different people with different motivations. However the comprehension of the principal line of development depends on the capacity to distinguish the main directions of the determination of objectives, these directions being in the end connected with economic laws of society's development. A correct comprehension of links existing between technological and social factors requires a correct philosophic interpretation of technology itself.

Technology is tools and instruments of labour, developing in the process of social production. Technology is an element of productive

[18] F. Engels, *Anti-Dühring*. Moscow 1957, pp. 257—258.
[19] K. Marx, *The Poverty of Philosophy*. Moscow 2nd ed., p. 157.

forces that in conjunction with the relations of production form the economic base of society. The utilization of nature's laws is the basis of technology, its development, however, and its social effects cannot be understood apart from the relations of production and the laws of social development. Science deals with the possibilities of utilizing nature's laws by means of technology. However, to what purposes, in what direction, at what rate does technology develop, how does it influence man — these and similar questions can be understood only when social conditions of the development of technology are taken into account.

The main deficiency of the theories, widespread in western countries and concerning the connections between technology ad social factors, consists just in that they forget the social conditions of the development of technology and attribute to it properties that ensue from the social conditions of its application.

The first group of social relations, inseparably connected with technology, is constituted by the economic relations of production which not only change in connection with the development of technology and of productive forces as a whole, but also exercise by themselves an influence upon the character, the direction and the rate of the development of technology.

Man is inseparably linked with technology as an active participant of the process of production, as a main element of productive forces, which sets technology in motion. It is therefore evident that changes of technology have a direct influence upon man, upon the character and object of his labour, upon his professional skill and other aspects of his life, but that the direct influence of technology upon man must not be isolated from the social conditions of his life. The same alterations of technology will have a different influence on man in the conditions of socialism and in those of capitalism.

Technology, moreover, affects man not only directly, but also through the development of productive forces. The level of their development determines — as is generally known — the character of man's relation to the means of production, that is to say the form of property. And that is how technology exercises its main influence — through productive forces upon the social relations of man, the form of social relations varying under the influence of the development of productive forces in a revolutionary way in the antagonistic societies, and in an evolutionary way in socialism where the change of the character of technology and the transformations of productive forces lead to the replacement of the state and co-operative form of property by a single communist form.

This aspect of the influence of technology — through productive forces upon the social relations — is to be emphasized not only because the relation to the means of production ranges among the most important

social relations, but also because it is impossible to comprehend the development of technology and its influence on other kinds of social relations when ignoring the prevalent forms of property. There are some other relations that range among the economic relations of production, being the most important group of social relations. The development of technology entails a change of the proportions of social labour and a change — as Marx said — of the social combination of the production process. So there appear new branches of production, the relations between the particular branches get changed, the geographical distribution of production gets altered, technology conduces to an alteration of enterprises as regards their kind and character, and so forth.

But all that finds — so to say — its mirror reflection within the social life and leads not only to the reconstruction of the production apparatus in space and time, but also to an alteration of men's standing, to an alteration of their place in life, to an alteration of the character of their labour and to many other effects, all these changes and more especially their characteristic and concrete marks being comprehensible only with due regard for the main relations of production, within which these changes occur.

The group of economic relations connected with changes of the social combination of the production process is bordered upon by a special group of social relations — relations of men in the process of everyday life. Just as production embraces also consumption, so the economic relations embrace both relations in the production sphere and those in the sphere of everyday life. The man who works at a factory, must restore his forces and have at his disposal conditions indispensable for satisfying his material and spiritual wants. The influence of technology upon that group of relations proves to be somewhat different than the influence exercised upon the relations forming directly at the factory. The profound alterations made by technology in the character of towns, in the transport and in the everyday life — are here of great importance.

The following group of social relations is of an essentially different character. If the economic relations as described above may be called material, forming beyond the human consciousness, the others are ideological, existing in men's consciousness. The last group includes: political relations connected with state activities; juridical relations; men's relations bound up with various forms of ideology — moral, aesthetic ones — as well as with different branches of art.

The influence of the scientific and technological progress upon that group of social relations is of an even more complex character. The foundation of ideological relations is constituted by the class relations developing on a determined economic basis, technology, however, exer-

cises its direct influence not so much on the contents, as on means and forms of ideological relations.

On the other hand, the scientific and technological revolution exerts a powerful, though indirect influence on the contents of ideological social relations, namely through the development of productive forces and relations of production, as well as through development of economy and everyday life. When developing, the production lets enter on to the historical arena new social classes, bearers of a new ideology. It is then that is taking place a destruction or transfiguration of the old tenor of life and old traditions, this finding its reflection within the ideological relations.

What is then the concrete "mechanism" of the influence of technology over economic and social relations? Great publicity has been given to a theory of the American sociologist, W. F. Ogburn. That theory, not long ago critically reviewed in an article by N. I. Osmova [20], can be recapitulated as follows: man lives in a triple environment — a natural, social and technological or technical one. The last of them — the material element of culture — is to be regarded as an independent variable. Under its influence, the non-material environment (economic and political categories and institutions, morals, religion, ideology) is changed.

According to Ogburn's theory, the mechanism concerning the adaptation of social environment to technology functions in the following way: there occurs at first a local adaptation of the life of one or another collective to one or another change in technology, there is also varying one or another social institution. The sum of the transformed conditions gives rise, thereupon, to a new and more sweeping adaptation, and so on. There occurs in fact something like a chain reaction. At any rate, it is technology that gives primitive impulses to changes. Thereupon, technology, together with the sum of changes already realized, gives the second impulse, and a still greater circle of changes gives rise to a third impulse. The theorists of that trend emphasize that the manifold impulses, coming from various sides, become entangled and exert an influence one upon another.

For an outward onlooker, that image is convincing enough. The influence of technology upon all aspects of man's life (for instance at a factory, in agriculture, in transport, in town and village, in the everyday life) is not to be ignored indeed. Once spread, every invention and every innovation affects both particular men and such or other collective bodies. The task facing science, however, consists in that — apart from those phenomena that take place on the surface — the regularities underlying the interaction of technological progress and social

[20] Н. И. Осьмова, *О так называемом «технологическом детерминизме»* (N. I. Osmova, *Concerning «Technological Determinism»*). "Вестник Истории Мировой Культуры" ("Review of the History of World Culture") N. 4/1959.

conditions be revealed, in that the specific character of this interaction be disclosed. In the light of the above-indicated Marxist theory of technology, of its scientific and social basis and of its place amongst the productive forces, the mechanism of the interaction of technological and social factors looks somewhat different. The effect of technological progress upon social conditions can be — as shown above — direct and indirect. But every direct action of technology upon social life depends — as we already emphasized — not only on technology, but also on the social conditions under which man lives. That interaction manifests itself in different ways under different social conditions, and exercises a diverse influence on people and their living conditions.

The main and decisive part is played — as we have just said — not by the direct influence, but by those most profound changes that are occasioned by technology within the productive forces and corresponding relations of production. Such or other production, property and class relations exert, with that, a strong reverse influence on the technological progress.

SOME SOCIAL PROBLEMS OF THE SCIENTIFIC AND TECHNOLOGICAL REVOLUTION

It is usual, when we speak of the scientific and technological revolution, to enumerate its various aspects — the staggering progress made by natural sciences, their merger with technology, automation, electronic equipment, atomic power and its uses, the great leap in the manufacture of synthetic materials, etc., etc. The social impact of all the big and small developments bound up with the scientific and technological revolution merits equal attention, since every development in science, and especially in technology, concerns human communities, tends to alter their condition, their way of living, and the social relations in production, society and the home.

The numerous investigations of the social micro-world, which is in a state of flux under the impact of various scientific and technological developments are therefore highly welcome. But it seems that investigations of this sort would be far more fruitful if the particular were treated in them against the setting of the general, i.e. if the study of the social micro-world went hand in hand with investigations of the social macro-world, inasmuch as the life of every individual, of each cell, is a composite element of large human communities and depends on the general state and development of society as a whole.

It is the fashion these days to draw comparisons between natural and social phenomena. Comparisons, we know, are not proof against error, but very tempting. The first thing that strikes the eye is the indissoluble connection between the phenomena of the micro- and the

macro-worlds. For years the various provinces of natural science appeared to exist independently of each other. Today, this notion is changing rapidly. The amazing world of fundamental particles, their associations and relationships, the world of atoms, was at first viewed by scientists as something quite apart from all the ordinary physical phenomena known to man through direct observation. The previously discovered laws of nature were inapplicable to the new phenomena. Quantum mechanics replaced classical mechanics. New conceptions were called for and developed.

Strange as it may seem, the world's unity is being more and more conclusively demonstrated in our time, when, in effect, we witness the greatest counter-position of the micro- and macro-worlds, and accordingly, of the various objective laws that govern them. The physics of fundamental particles, nuclear physics, knowledge of the structure of the atom, yields a deeper and more accurate understanding of the phenomena transpiring in the visible world, a better understanding of the physics of solids, the age of mountain rocks and the earth, the laws governing the formation of crystals, conductivity and, last but not least, of the life of cells, of living tissue. The modern natural sciences set out from the micro-world and its laws to understand, explain and utilize the world of visible nature in a new way.

Has not the realization grown on us today that the mental and spiritual world of the modern man with all its notions, convictions and infatuations, that the structure of the primary human communities, are indivisibly associated with the social macro-world, with society as a whole, with the change occurring in society under the impact of developments in modern science, technology and the productive forces.

Yet, in comparing natural phenomena with social ones we must also emphasize their distinctive traits. In studying natural phenomena we go from the micro-world to the macro-world. In probing social phenomena it is more correct to go from the changes in modern social life to changes in the life of individuals, families or communities. It is therefore essential first to probe the influence of the scientific and technological revolution on the structure of modern society and then to go on to a study of the indirect (*via* society) and direct influence exerted by the scientific and technological revolution on the individual, his mind, mentality, code of behaviour, and all the other factors considered to be purely personal and individual. The thing to begin with is a general description of the scientific and technological revolution.

It is usual, as I have already observed, when speaking of the scientific and technological revolution, to view the various aspects of it — physics, chemistry, the application of theoretical science to technology, automation, atomic energy, etc., but the prime significance of the various particular scientific and technological discoveries lies in that

their aggregate produces a new and different technology, the system of automatic machines swiftly adaptable to modifications of operating conditions (elastic, pliable, and possessing unlimited sources of power). We do not as yet have such a compounded universal system adapted to different branches of production, but we are fast approaching it.

Let us dwell briefly into the ways and means of its development. To begin with, les us look into the problems of automation. People argue whether automation is a new or an old development. Numerous examples of automation are cited that go back hundreds of years. Yet automation in its present shape is unquestionably an entirely new development. That is easily seen when we compare the old and the new automated machines or automated systems of machines. In the past, there were three-element machines, or systems of machines, i.e., machines consisting of three elements — the activating mechanism, the drive and the generating mechanism. In its incipient stage automation was effected through modifications in the design of the transmission device. This was a simple and incomplete solution, whereby automation could not have wrought any decisive technological progress or changed the functions of man in production.

Today, means of automatic control are, so to speak, self-sufficient. Four-element machines have replaced three-element ones. In their developed form the devices and instruments that constitute the fourth element automatically execute a set cycle of operations and, what is more, maintain the most suitable operating conditions for the cycle. An electronic incoming information, compares the results of the analysis with pre-set criteria, selects (or appropriately modifies) the most desirable programme for the manufacture of products of the desired quality. Devices of this kind are used in research, for economic computing and are being rapidly developed and improved. All this furnishes the clue to the principle underlying the new character of automation.

But there is also this other aspect to the scientific and technological revolution, perhaps less prominent, bound up with the improvement of technology and its adaptation to the requirements of automated production. That is probably the key to the question of how automation will spread, from the technological and economic standpoint, to various branches and transform modern industry as a whole.

When Ford first introduced straight-line automobile assembly methods in 1912, he made a technological advance of incalculable impact. It laid the foundation for mass assembly-line production, without which the development of automation is inconceivable. In the last fifty years straight-line production developed along the principles of flow, unification, standardization and mechanization. These respond perfectly to the challenges of automation. But they have their weak point as well, for they produce mechanical systems that are rigid and inflexible. It is

hard to convert them from producing one product to producing another. This limits their usefulness. Modern technology, in the meantime, lays increasing emphasis on adaptability. Scientific and technological discoveries, new materials and the market demand compel technologists, whether they like it or not, to repattern the mechanical system.

The development of sufficiently flexible forms of mechanical means has been one of the greatest technological advances of the last few decades. In a world of mass production lines, conversion from all-purpose to specialized machine tools with interchangeable power heads was found to be a good way out. The principle of mounting mechanical systems of standard units, though this did not entirely settle the matter, made them more pliable in certain conditions and facilitated conversion to automated production lines. But this applied to certain conditions of mass production only. There is still the widespread small-lot production to cope with. So long as a way is not found to adjust machines and systems of machines to the changing objects of production quickly enough, this vast province of modern technology will not be able to convert to automated machine systems.

What cannot be done in the case of individual enterprises, however, is quite possible within the framework of large scale economic districts or a country as a whole. Unification and standardization of machines, the development of aligned series of machines, and the unification and standardization of the elements of various machines projects the mass production line principle to branches where, it would seem, that principle had no future, blazing the trail for automation. Conversion in mechanical operations from metal cutting to casting, forging and forming, and, last but not least, to chemical production processes which by their very nature respond ideally to the principle of continuity, flow and intensiveness, i.e., to conditions in which automation is most effective, paves the way for automated systems of machines.

But that is not all. Automation does not always wait until technology is ready for it. Often, it helps technology along. Programmed control of machines and systems of machines has a good future. It will make it possible to automate all-purpose machines as well as specialized ones, and subsequently all-purpose systems of machines as well. In the past, adjusting them to new products was a labour-consuming affair, while automated systems with programmed control will reduce adjustment to a simple change of programme. After it is newly programmed, a machine adjusts itself and manufactures new products. Technology and automation develop along one and the same line, helping each other, as it were, and man, as a result, gradually ceases to be the immediate agent of production.

The automated system of machines which is now evolving will be electrically powered. Speaking of electricity, it is not going to play the

passive role of mere power supplier. The most wonderful thing about it is that electricity virtually transforms all branches of technology, from metallurgy and chemistry to mechanics. Electricity is the key technological agent for the conversion to casting, forming and forging. It paves the way for new metals and materials, and promotes chemistry. This is why electrification of production called for by the growing consumption of electric power is a key determinative factor of the technological revolution.

It may be recalled that a series of forecasts has been made in the United States concerning power production in the coming ten to twenty years. The Federal Power Commission bases these forecasts on an average annual growth of power production of 6.75 per cent; the Edison Institute on 7.7 per cent, and the journal "Electric World" on 9 per cent. Accordingly, electric power output is expected to climb to 2,084, 2,795 and 3,184 million kWh by 1980. The 1980 power output in the Soviet Union has been set at 2,700—3,000 million kWh.

With time power production will apparently rise at a still higher rate, and automation and improved technology based on growing power consumption will offer unprecedented opportunities for the growth of labour productivity. Although long-term forecasts are largely hypothetical, they are of considerable interest. American literature infers that by 2050 the 7-hour day's output of a worker will equal a 40-hour week's output by the present-day American worker.

The rapid rise in power consumption poses the question of power resources, renewable and unrenewable, such as gas, oil and coal. According to some specialists the resources of natural gas in the United States will, in the main, be exhausted before the end of this century. Other specialists do not think they will be, but estimate that the oil reserves will be totally consumed. There will still be coal, but its resources are also expected to dwindle. Besides, coal extraction under unfavourable natural conditions and low-quality coal may, it is feared, add to the cost of electric power. The way out lies in the use of new power resources, the power of the sea tides, of geo-thermal, solar and atomic energy.

What is the role of atomic energy in this deep-going historical transformation of production which characterizes the substance of the modern scientific and technological revolution?

Production of electric power through the fission of nuclei of heavy elements has already begun. The first sections of large atomic electric power stations in the Soviet Union, at Voronezh and Beloyarsk, are soon to be completed. The Beloyarsk reactor of 100 MW will, experts believe, have the world's best parameters. The Novo-Voronezh atomic power station is to have aqueous reactors of 210 MW each. It is estimated that atomic power stations with an aggregate electrical rating of 100,000 MW,

working on fast neutron reactors, will consume less than 1,000 tons of natural uranium a year. To produce the same amount of power at ordinary coal-operated power stations would involve 200—300 million tons of coal a year.

A similar search for the most effective ways and means of utilizing the power of fission of the nuclei of heavy elements is under way in other countries as well. But investigations show that today nuclear power engineering swallows up investments double and treble those required in conventional coal and oil power engineering. Many researchers thus come to the conclusion that nuclear power engineering will be applied in the next 20—30 years on a relatively small scale.

Will our generation witness the use of the thermonuclear reaction for peaceful purposes? Just a few years ago it was forecast that it would take a hundred years to learn to apply thermonuclear power for peaceful purposes. Reports made at the Second Geneva Conference on controlled thermonuclear reactions and the progress recorded in this field show, however, that matters will go along much faster than previously assumed. Not long ago it was recorded in the Soviet press that the Soviet scholars have created a stable high-temperature plasma of considerable density with a rather long period of existence.

But at the present stage the old method of electric power generation is still compatible with the incipient technological revolution. The process of mounting power demand is best illustrated by what is today transpiring in the U.S.S.R. The completion of the two world's biggest power stations on the Volga and the building of still bigger hydropower stations in Siberia, the giant power projects based on gas, oil and cheap coal resources, and the utilization of other power sources, indicate that scientific and technological progress will not be held back by a shortage of electric power. Such, in brief, are some of the basic transformations occurring in production. Take the progress made in transport, communications, agriculture, the transformation of nature, and in space exploration, and the picture becomes still more imposing.

The social problems induced by the scientific and technological revolution will have to be solved by ourselves, and not by future generations. What social problems do we imply? The first, basic social problem is to find such social conditions for man's development, such a social system, as would: ensure the rapid development of the scientific and technological revolution, instead of retarding it; ensure the growth of the productive forces and of the material and spiritual wealth of mankind; place all the achievements of science and technology at man's service.

Indeed, what moral problem can there be if the great forces of nature harnessed by man's genius will serve to annihilate people, or if they will be used to contaminate the earth and pave the way to man's degeneration, or if those vast resources that could induce a steep im-

provement of working and living conditions for every individual on earth will be used selfishly, in the interests of privileged groups.

The question of the social system, the social classes and the forces ensuring the proper utilization of scientific and technological achievements is not a novel one. It has cropped up time and again in man's history. In 1957 a book appeared in France by Charles Morazé, the French historian and sociologist, titled *Les Bourgeois conquérants*. The author produces a startling picture of the scientific and technological revolution of the XVIIIth and early XIXth centuries. In portraying the social forces which furthered the advancement of science and technology, he makes the very trenchant observation that the European bourgeoisie conquered not because they were bourgeois or European, but because they were better able than anyone else to extract advantages from the technological aspects produced by progressive science.

Science and progress, he writes, elected the European bourgeois for all of 150 years. Science and progress do indeed elect those that serve them better. At the time of the industrial and technological revolution of the XVIIIth and early XIXth centuries, the question of the most serviceable social system and class was solved on a historical plane. The system was capitalism, and the bourgeoisie was the class.

This settled the question of the social conditions and forces through which the scientific and technological revolution of the XVIIIth and early XIXth centuries was effected. What, then, will be the social consequences and conditions of its development in our time? One may establish the common factors and the distinctions in the development of the two scientific and technological revolutions. The current revolution, like that of the XVIIIth and early XIXth centuries, calls for new social conditions, new social forces that would best utilize the possibilities it presents for the development of the productive forces of society.

But there is also a very great difference between the social conditions of the two revolutions. The social force that promoted the development of mankind in the XVIIIth and XIXth centuries did not link up the first scientific and technological revolution with moral factors. Yet today mankind associates such a revolution not only with the growth of the productive forces, but with progress that would serve all men, would ensure their material and spiritual wealth and further their spiritual, moral and physical improvement.

Mankind will not entrust the achievements of science and technology to social classes and forces that might use them for new wars or the extermination of people. Capitalism and the capitalist class which, according to the British scientist S. Lilley [21], had to good advantage promoted the development of production in the preceding stages, is

[21] S. Lilley, op. cit.

obviously unfit for the current scientific and technological revolution, both from the standpoint of material production and from the moral standpoint. This is probably best illustrated by the example of the United States, the most developed capitalist country. The scientific and technological revolution of our time, even in its early stages, has given rise to greater unemployment there, and has, mildly speaking, created an unstable situation, curtailed use of production plant and lowered the rate of economic development.

Scientists of different countries and schools are often of one mind about the present social system of capitalism being unsuitable for the realization of the potential of the current scientific and technological revolution. They differ only over the trend and character of the changes called for in social conditions. The works of Professor Lewis Mumford, that distinguished American scholar, may serve as an illustration. In his book *In the Name of Sanity* [22] Professor Mumford holds forth on the social conflict induced by technological development. Machines increasingly take the place of men, the author notes, and men themselves are tolerated only to the extent that they take on the attributes of machines, free from passion and emotion indifferent to values. It is to be deplored that Professor Mumford does not define the social causes of these phenomena. He offers but one solution for the social conflict — a sensible control of the rates of automation and modernization.

In his other book entitled *The Transformation of Man* [23], Professor Mumford portrays the various stages in the development of mankind: early man, archaic man, civilized man, and axial man (these four stages comprise the period of "Old World man"). This is followed by the "New World man" stage. Mumford believes that mankind is today on the threshold of a new transformation. He sees two alternatives. The first is to follow the "Post-historic man" trend (towards technocracy in which man is reduced to the status of a machine). The other is the development of a world culture and "One World man". Mumford believes that the coexistence of communist and capitalist states is a prerequisite for this stage. "One World man" must embrace both the depths of the subconscious and the summits of the conscious, purposeful activities. This ideal, as Professor Mumford thinks, is fairly close to the notion of the "completely developed individual" postulated by Karl Marx.

I am not at the moment concerned with the historical conception set forth by Mumford, though it is undoubtedly of considerable interest. What I should like to do is dwell on the prospects facing mankind in the light of the scientific and technological revolution and on the ways and means whereby the ideal of a harmoniously developed "One World man" may be attained.

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[22] L. Mumford, *In the Name of Sanity*. London 1954.
[23] L. Mumford, *The Transformation of Man*. London 1957.

In Mumford's opinion, "One World man" will materialize through the conscious self-transformation of mankind based on the common urge towards the ideal of a new world. I do not wish to belittle the factor of self-improvement and of a conscious aspiration towards self-transformation, yet the contradiction which Mumford analysed in his book *In the Name of Sanity* and the one-sided evolution in the direction of stark rationalism, is no more than an upshot of the social conditions of capitalism. This is why the achievement of a harmoniously developed society should be associated with socialism, that new stage in the development of mankind. It is a stage that comes when all peoples perform the transformation of their economic and, subsequently, political and ideological life on their own, without any outside interference. I believe, therefore, that it is essential to popularize not only the ideals of that new society, but also the specific ways of building it.

In *The Transformation of Man* Mumford writes that the transition to a "One World" society will occur in a world where communist and capitalist states coexist. He thinks that the communist states will tend to accept "the flexibility and diversity of a mixed system of production as a means of increasing efficiency, will tend to become responsive to popular control and more open to the give-and-take procedures of democracy". Mumford is of the opinion that the capitalist regimes have already accepted many of the ideal features of communism. Here is how he sums it up: "Instead of maintaining their ideological purity, each regime, seeking a dynamic equilibrium, will tend to take on more of the diversified attributes of living systems" [24]. We are convinced that man's progress is bound up not only with the improvement of the outdated capitalist system (appeals for improvement merely create an illusion), but with the transformation of that system into the new and higher socialist and communist system. For this, the means of production must be transferred into the possession of the people. All economic and political institutions will, like the ideology, also undergo a transformation upon this groundwork.

As to the socialist systems, these are dynamic and burgeoning systems which are continuously improving their economic and political institutions under the impact of the scientific and technological revolution, ensuring an increasingly broader democracy in social affairs and creating material and spiritual conditions for the harmonious all-round development of the individual in the direction formulated in the new Programme of the Communist Party of the Soviet Union. This does not mean that the Soviet Union will not adopt anything from the life of capitalist society. The peoples of the two systems have a vested interest in the greatest possible development of economic, scientific, technological

[24] Ibid., pp. 213—214.

and cultural contacts, for these are beneficial to both systems. The practicability and necessity of these contacts is all the greater in view of the problems that arise over the peaceful use of the achievements of the scientific and technological revolution.

These contacts, this collaboration in the fields of science, technology and culture do not mean, however, that the socialist countries will renounce their ideology. The communist ideology is strictly scientific and based on the objective laws governing social development. On the other hand, it is the very medium that facilitates the all-round development of the individual, in which, as Professor Mumford aptly observes, man must consciously perceive his history, embracing both the depths of the subconscious and the summits of conscious, purposeful activity. One may agree or disagree with Lewis Mumford's concepts but one cannot in either case deny that Mumford depicts not only the prospects of the social and moral development of society under the impact of the scientific and technological revolution, but also the trends leading to a new social pattern.

There are many other evaluations of the social and moral consequences stemming from the scientific and technological revolution. We think it will be worth while to deal at greater length with one of them, that of Professor Jacques Ellul, the French scientist, inasmuch as it reflects an outlook rather popular in the West. In his book *La technique* and in the supplementary notes which he presented for the conference held by the *Encyclopaedia Britannica* and the U.S. Centre for the Study of Democratic Institutions at Santa Barbara, California, on March 11—16, 1962, Professor Ellul gives a very pessimistic portrayal of the possible consequences of the scientific and technological revolution [25].

Professor Ellul made a selective survey of what scientists think society will be like in the year 2000 under the effects of scientific and technological progress. Here is what his survey produced: voyages to the Moon will be commonplaces, as well as inhabited artificial satellites; all food will be completely synthetic; the world population will be four times the present figure, and will be stabilized; in the opinion of Professor Muller [26], whom Ellul quotes, there will be artificial insemination, with the reproductive cells in question being preferentially those of the most valuable dead individuals and this method will be utilized universally, because if one country were to adopt it while the others did not, that country would attain incontestable superiority; the metallurgy of seawater and ordinary rocks will yield necessary metals; diseases and food shortages will vanish; problems of energy production

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[25] J. Ellul, *La technique. L'enjeu du siècle.* Paris 1954. J. Ellul, *The Technological Order.* "Technology and Culture", N. 4/1962.

[26] H. J. Muller, *Out of the Night. A Biologist View of the Future.* London 1936.

will have been resolved; knowledge will be accumulated in special "electronic banks" and transmitted directly to the human nervous system, eliminating the need for reading and studying piles of useless information, and the need for attention or effort; human affects and thoughts will be shaped and reshaped at will, pre-established collective decisions and wishes will be artificially produced, and homogeneous social units will be constituted out of aggregates of individuals.

Professor Ellul unfortunately seems to accept these features as unconditional upshots of scientific development in the future society. But he is critical of scientists who visualize the state of science and technology in the future society, and go on to project the social and moral pillars of that society. Whenever our scientists describe the "golden age" in any way other than scientific, Ellul says, they emit a quantity of down-at-heel platitudes. Scientists, he says, speak of the triumph of peace, liberty and reason, and of eliminating cultural lag. But, he asks, what culture do they imply? Scientists, he says, speak of conquering outer space. But for what purpose?

Summing up his considerations about the ability of scientists to foresee the social and moral consequences of scientific and technological progress, Ellul arrives at the conclusion that the scientists are capable of no more than the vainest platitudes as soon as they stray from their specialities. "None of our savants — he says — ever poses the question of the end of all their marvels. The «wherefore» is passed resolutely by" [27].

The most natural reply to that question from the standpoint of our contemporaries would be: "For the sake of happiness". Unfortunately, however, that is entirely ruled out, says Ellul. One of the best known specialists in diseases of the nervous system, he avers, pointed out that we will be able to modify man's emotions, desires and thoughts. Specialists point out that a conviction or an impression of happiness may be produced without any real cause of it, and without any material substratum for it. The "golden age" man, Ellul writes, will be capable of "happiness" amidst the worst privations; why do we need extraordinary comforts, hygiene, or knowledge if we can be made happy by fairly simple manipulations upon our nervous system? The last meager motif for technological development thus vanishes into thin air.

The picture of the "golden age" drawn by Professor Ellul is bound to outrage the feelings of every progressive-minded person — just as it goes against the grain of Ellul himself. The point is not whether science and technology will be able to provide solutions for the above problems but whether humanity will consent to be turned into

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[27] Unpublished report of Professor Ellul presented at the conference in Santa Barbara, USA 1962.

guinea-pigs, which are at present used to prove the possibility of achieving the impression of happiness. But, according to Ellul, the solution of these issues is out of man's reach; technology, produced by man, in the course of its development becomes independent of man and advances in keeping with its own inherent laws. Man becomes a helpless servant to technology, which allegedly reflects a social system corresponding to it — that of dictatorship.

It would certainly be wrong to ignore certain objective tendencies involved in technological progress with which men are bound to reckon. Scientific and technological progress shatters the traditional forms of production and life. An integrated production apparatus with an automated system of machinery is coming to replace individual enterprises, and territorial and national combinations. Each of its elements develops only as a part of the whole. It calls for stringent proportions and is based on an explicit division of labour and the logical connection between the various elements of production and the available manpower. In this environment technological progress predicates a realization of its achievements under a special plan, and newly-arising scientific and technological problems require a large-scale concentration of effort in the most important directions.

An integrated pattern of life arises, consistent with this transition to an integrated system of production. Modern transport facilities shorten distances between people. The telephone, radio and television promote mutual understanding, etc. Yet it is impossible to regard social life as stemming from technology alone. In our opinion, the social and economic development of mankind will guide scientific and technological progress along a totally different channel. The development of the socialist economic system shows that the centralism objectively produced by scientific and technological progress may be combined with continuously advancing democracy and genuinely popular rule. This system is not a figment. It has materialized in the process of the development and improvement of the socialist state. The name it was given is democratic centralism. Democratic centralism is founded on the transfer of means of production from private ownership into the hands of the people and on the establishment of a state representing popular rule.

Professor Ellul stresses with regret that there is only one solution to all these questions. Dictatorships will have to be set up, which will promote the fullest possible development of technology, and will concurrently cope with the difficulties arising from the progress of science and technology. What is more, Ellul also envisages the harshest of dictatorships of the future, Ellul visualizes a technocracy. That this will be a dictatorship of test tubes rather than of hobnailed boots does not detract from its nature, and from its dictatorial purport, he stresses.

To begin with, let us dwell on the conceptions. Dictatorship is coercion of some over others. But there are different kinds of dictatorships. Some are dictatorships of the minority over the majority. The fascist states were states where the most reactionary monopoly-capital groups maintained a dictatorship to suppress the majority of the population in the country concerned, or to enslave peoples of other countries enlisting certain sections of their people to their side by bribery — a dictatorship against their own people and the peoples of other countries. But there is also the dictatorship of the majority over a negligible minority, exemplified by the dictatorship of the proletariat and effected by the proletarian state after the revolution with regard to the routed but resisting former ruling classes and other insignificantly small social groups that sided with the defeated classes.

Professor Ellul overlooks yet another essential distinction between the dictatorship of a minority and the dictatorship of a majority. In the first case, the old social classes resist the objective course of social development and seek to retain their dominance at any price, to turn back the progressive advance of history in spite of the objective course of development and the interests of the nations. In the second case, the new social forces, and above all the proletariat, establish a social order furthering the progress of human society. The new social system resorts to violence, to dictatorship, solely because it is compelled to do so by the resistance of the deposed classes, and renounces dictatorship as a form of statehood after it succeeds in transforming society upon the new socialist basis. The experience of the Soviet Union is a striking illustration. After socialist relations had won out for good there, the country replaced the dictatorship of the proletariat as state power with a socialist state of the whole people, and has on the strength of objective laws of social development set itself the task of ensuring in communist conditions a rise from socialist statehood to communist public self-government.

Professor Ellul, in the meantime, refers not to an ordinary form of dictatorship, but to the dictatorship of a technocratic state. That kind of dictatorship may emerge as one of the forms of the dictatorship of monopoly capital, the dictatorship of the minority with regard to the majority. In that event the machinery of that dictatorship combines not only the political levers of coercion with respect to the majority; science and technology become a means for it to achieve the dictatorship, and to retain and consolidate it. A dictatorship of that sort will not, as Ellul puts it picturesquely, replace the dictatorship of the hobnailed boot with a test-tube dictatorship. It will combine all the forms of dictatorship to make the most of the achievements of science and technology not in the interests of the material and spiritual development of every individual, but in those of the monopoly groups. In these

circumstances it is possible to expect the artificial breeding of men with pre-established physiological and mental properties, the fixation of population dimensions to conform with the requirements of the ruling dictatorship, and the control of man's mental processes by methods and preparations inducing the desired physiological or mental conditions in human beings.

A technocratic dictatorship is liable to arise in a capitalist environment, where people are divided into the scientific and technological elite and the rest of society to execute the will of the elite, and education develops to no more than the extent required by the interests of production and by the life of the given society. Socialist society, on the other hand, is overcoming the distinctions between town and country, between the elite and the other members of society. It offers an opportunity to all of getting a higher education, of developing one's creative abilities in the chosen field. This, too, is not a figment but the living experience of the U.S.S.R. Before the Revolution 2 per thousand of the population in the country had a higher or a specialized secondary education. In 1959 the respective figures rose to 64, including 18 persons with higher education. In future all who wish to do so, as we have said above, may get the education they require to devote themselves to creative pursuits for which they have the strongest inclination.

In considering the essence of the transition to new society, Professor Ellul poses a number of allegedly insoluble questions. He asks, how will the transition to his "golden age" occur socially, politically, morally and humanly? How will the prodigious economic problems, such as unemployment, be solved? How to make the human race refrain from begetting children by the natural method? How to make the human race abandon the traditional modes of nutrition? What to do with the 1,500 million persons who today live from agriculture? How to distribute the population equably over the surface of the earth? And how to accomplish the disappearance of the national cultures?

These allegedly insoluble questions are actually solved in the process of the transformation of society along socialist lines. Solutions are not arbitrarily made up; they are borne out by the practical experience of socialist construction, by a profoundly scientific programme of the building of Communism (true enough, this programme covers not all of 40 years but only the next 20).

Professor Ellul wonders how the transition to the "golden age" will occur socially, politically, morally and humanly. Socially it will be effected through transition to society where the exploitation of one individual by another will be abolished; the means of production in this society will be owned not by individuals but by society as a whole; wars will be excluded. Ellul is aware of the possibility of such transition, but he apparently does not believe in it. He is possibly repelled by the

errors made in the transition along these lines and stemming from the personality cult, and by the hardships it entails. Moreover, he apparently let himself be influenced by active anti-socialist propaganda in which the opponents of the new society indulge. But then, Ellul is a member of the French Resistance and a scholar, and he is too well versed in history not to know that any deep-going social changes involve errors and hardships. He cannot fail to see that the Communist Party of the Soviet Union has subjected to drastic criticism the errors committed, in front of the whole world, while taking the necessary measures to overcome the consequences of these errors.

Politically, these questions are solved (as stated above) in the course of the transition, from the dictatorship of the majority over the minority, to a socialist state of the people, and subsequently to the elimination of all political institutions and the establishment of communist public self-government. This, too, is not an empty declaration; the directed processes of political transformation in socialist society are taking place in real life and can be observed in the process of building Communism.

In the moral sphere, development will be clearly traceable on the basis of studying both the documents of the C.P.S.U. and the real phenomena of life in the socialist countries. At the basis of the moral transformation of society are lofty moral ideals evolved by humanity's finest minds over the centuries; they rest on the moral codes common to all humanity, whose purport is summarized in the ideas of humanism. Humanity's supreme moral ideals, developed by its finest representatives and handed down from one generation to another may be transformed into basic and universal norms of behaviour in a society based on new principles; in the future they will no longer have to be protected by legal codes.

On the human plane, the aim is to give every man a fitting place in the new society. Arduous, labour-consuming processes, already curtailed, will be gradually eliminated; the people's material welfare will continue to rise on an ever increasing scale. Science and technology are changing the character of production and labour; under socialism, they provide for eliminating the gap between mental and manual work, between work in agriculture and in industry. Leisure will continue to increase, and, in the words of Marx, it will be used "for loftier activities", involving science and the all-round spiritual and aesthetic development of the individual, in the course of which the spiritual potentialities of man will be increasingly tapped. This, too, is not appointless dream but an actual phenomenon prompted by the tenor of life and education in the new society.

Another question listed by Professor Ellul is that of how the prodigious economic problems, such as unemployment, are to be solved.

This problem is successfully tackled in the U.S.S.R. and in the other socialist countries unhampered by the contradiction between the social character of production and the private character of appropriation. Thus, the U.S.S.R. has accomplished the first stage in the technological revolution. With the use of new technology, labour, productivity in industry increased, over the period of 1913—1961, approximately 11.9 times over; yet this failed to give rise to unemployment, due to the rapid development of the national economy, the shortening of working hours (from 9.9 to 6.93 hours), the growing share of labour in public services. According to the development plans for the next 20 years, the U.S.S.R. may even have difficulties caused by scarcity of labour power. This calls for speeding up technological progress and automation — in contrast to the appeals of many scientists in the capitalist countries to slow down this progress.

A few words about the question of how humanity as a whole should be forced to refrain from begetting children by the natural method and accept a radical transformation of its traditional modes of nutrition. This question is in itself indicative of an uncritical approach to the pronouncements made by certain scientists, who are carried away by research in their particular fields and are inclined both to over-estimate the possibilities of the realization of scientific discoveries made in particular fields, and to solve the question regardless of its social aspects.

Professor Ellul further asks how a milliard and a half persons who today live from agriculture should be located. Speaking of the total elimination of agriculture in connection with a switch to synthetic food is another instance of how scientists working in a particular field are carried away by their research. Mankind will not only learn to produce synthetically the simplest foods — mostly to be used by animals; it will also transform agriculture and thus receive an increasing quantity of high-grade agricultural produce. Gigantic projects to irrigate dry lands are already under way in the U.S.S.R. It is planned to divert the waters of the Northern rivers flowing into the Arctic Ocean, to the desert areas. Plant physiology, on the basis of the new achievements of physics and chemistry, will open up vast prospects to humanity from the point of view of improvement of the methods of receiving agricultural produce and raising its quality. There is hardly any reason to expect that in future people will stop using the foods which Nature, transformed by them, will yield bountifully.

How shall people be distributed equably over the earth's surface is another seemingly insoluble problem mentioned by Ellul. Here again one has to reckon with the new social conditions under which people will live. We know from history about the mass movements of people,

attracted by the prospect of acquiring wealth, to isolated, inclement areas rich in gold or other mineral wealth. In the new social conditions there are new stimuli at work. Millions of Soviet people have left their native towns and villages and, undismayed by the prospect of facing difficulties, have moved to the new farmlands, to the construction sites of new towns and industrial enterprises in the vast expanses of Siberia. In future, too, there will be strong-willed, courageous individuals attracted by new surroundings and unafraid of difficulties. The problem of a more equable distribution of people will be also successfully resolved.

In outlining the society of the future, Professor Ellul seems to have overlooked the fact that under socialism, in the environment of a continuously greater democratization of society, mounting cultural and technical standards, the development of the state into a socialist state of the whole people and its subsequent transformation into bodies of public communist self-government, people will not only be educated but also raised in the finest traditions evolved in man's history. The education and the way of living in a society based on lofty moral principles will afford every individual an opportunity for the maximum spiritual development founded on the principles of moral purity and physical perfection.

People of that mould will not submit to being used as guinea-pigs and will not tolerate projects that science may produce reflecting upon their lives, physiology and mentality. In socialist society people will themselves decide their future, and themselves effect and utilize the advantages of science and technology in their own interests. It is difficult now to picture many aspects of man's future life; there is no doubt, however, that the collective mind of humanity, the all-round education, the moral level of men, their physical perfection will allow them to find a correct solution of all problems provided that — let us emphasize — the culture and education favour the manifestation of that collective mind.

When talking about the social consequences of the scientific and technological revolution, it would be wrong to regard the scientific and technological progress as an independent variable, and the social life as a dependent one. The socioeconomic conditions can not only impede, but also to a great degree favour the scientific and technological progress. The Soviet Union is a striking example of that. Owing to the victory of socialist relations not only was — in the course of one generation's life — the scientific-technological lag overcome, but also immense achievements attained in the development of science and technology. After all, it is the Soviet Union that paves the way in Cosmos. The flights of Soviet cosmonauts constitute the best illustration of the possibilities inherent in the new social relations. Demonstrating

the possibilities of Soviet science and technology, they open a new stage in the life of our planet and infinitely widen man's possibilities. It is not yet possible even fully to imagine at present their consequences for mankind.

INFLUENCE OF SCIENCE AND TECHNOLOGY UPON THE SPIRITUAL LIFE OF MAN

In this paragraph we are going to discuss in greater detail the influence of the scientific and technological revolution upon man's spiritual life, and in particular upon his mind. There have appeared recently a great many books and articles dealing with this problem to some extent or other. Very characteristic in this respect is the book of the West German physicist, W. Heitler, entitled *Man and Scientific Cognition*. Here the author set the task to himself to follow and to investigate the influence of science upon the life of man, and on his way of thinking in particular.

He tells that there have been worked out specific ways of cognition based on causality and the application of statistical methods. These ways that initially arise within the exact sciences, get transferred afterwards into the scope of something quite different, as for instance into the domain of interhuman relations. The author emphasizes that the abstract scientific thinking based on causality and statistical methods is also for natural science of limited importance, as it does not reveal the whole depth of the meaning of the world. *"Wir drücken das so aus* — writes Heitler — *dass wir sagten, die Physik beschreibt den kausal--quantitativen Aspekt der Welt, eine Art Projektionsbild auf eine kausal-quantitative Ebene, aber sicher kein vollständiges Bild"* [28]. While criticizing the mechanistic world outlook, the author puts a mark of equality between it and philosophical materialism.

Where is Professor Heitler right, and where is he not? He is right in that the contemporary scientist is not satisfied with the specific methods worked out by natural science for examining one or another aspect of reality, in that he needs a more profound theory of knowledge. But he is not right when putting the mark of equality between the vulgarly mechanistic approach to cognition, and the philosophical materialism. The materialist theory of knowledge does reply, in fact, to the questions put by Heitler, by defending the positions of determinism, that is causality, and regarding scientific abstraction and statistical regularity as elements of scientific knowledge.

Reducing higher forms of matter's movement to the lower ones, as

[28] W. Heitler, *Der Mensch und die naturwissenschaftliche Erkenntnis*. Braunschweig 1961, p. 71.

for instance vital activities of living organisms to physical and chemical processes, or social processes to the biological ones, is alien to philosophical materialism. It would be strange to reduce the whole of the riches of man's spiritual life to mere physiological processes taking place in human organisms only because definite psycho-physiological processes correspond to every manifestation of spiritual life. We reach here those recommendations that are being given by Heitler for the domains that lie *"jenseits der Abgrenzung"* [29], i.e. for phenomena more complex than the physical and chemical ones, and — first of all — for man's social and spiritual life. He means determinism to be here supplemented by teleology. While talking about investigation of life he writes:

"Wir sind zu dem Schluss gekommen, dass Teleologie als Ergänzung zur Kausalität in der Biologie eine wichtige Rolle spielen muss — was nicht heissen soll, dass beide Prinzipien zusammen (Teleologie und Kausalität) genügen werden, um den lebenden Körper völlig zu verstehen" [30]. He further stresses that the application of physical and chemical laws is not sufficient for examining biological phenomena.

The author accomplishes here the act of substituting one problem for another one; the problem of reducing the research methods in biology exclusively to physical and chemical laws for the problem of the possibility of applying the causal and statistical method to the solution of biological problems. Laws of physics and chemistry may be applied in biology, too, but they cannot suffice here, while causal and statistical methods, on the contrary, ought to be applied for examining purely biological processes.

The purposefulness in the development of biological life is a fact that is denied by none. Firstly, however, this purposefulness is not an absolute one, and — secondly — the comparative purposefulness in the structure and in the life of organisms can be perfectly explained from the position of causality by Darwin's natural selection theory. Thus, remaining within the bounds of causality, and applying statistical methods, and others, it is possible to investigate biological processes without reducing them to mere physics and chemistry, and revealing their qualitative differences and the specific character of the progress of biology.

The same can be said of social life. Causal and statistical methods may and are to be applied as well in examining social life, but this does not mean that social life can either be reduced to laws of biology, or — all the more — explained by physical and chemical processes taking place in man. One of the specific features of social life lies in the fact that man's activity is characterized by purposefulness, but this

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[29] Ibid.
[30] Ibid., pp. 72—73.

purposefulness, too, is explained by the objective conditions of man's existence, and first of all by the material conditions of social life. Putting forward teleology on a par with causality did not lead to and is not going to lead to anything else but theology.

The problem of the influence exerted by the development of science upon the mind is now acquiring a wider meaning in connexion with the development of cybernetical devices and those methodological problems that arise when considering the importance and the prospects of cybernetics. There are being put, in fact, more concretely the same methodological problems we studied previously, the question being not so much of the degree of applying methods developed in the domain of mathematics, physics, chemistry to researches in biology, psychology, social life, as of the possibility of reducing biological and social life processes to the processes taking place in cybernetical devices.

Some foundations for such a conception of the problem were given by Norbert Wiener in particular. "It is my thesis — he wrote — that the physical functioning of the living individual and the operation of some of the newer communication machines are precisely parallel in their analogous attempts to control entropy through feed-back" [31].

While developing this idea, Professor Wiener points out that "both of them have sensory receptors..." [32]. In fact, we have to do here with the idea that computors — just like the living beings — are in possession of sense organs. And if the cybernetical devices have sense organs at their disposal, they consequently have also sensations and feelings. It is with caution, in truth, that Professor Wiener is talking about emotional phenomena with reference to automatic devices. He says, namely, that a computor may have them or not have [33].

Some authors attribute to cybernetical devices the possession of not only unconditional reflexes, but also of conditional ones, usually referring to "Shannon's mouse" that gets over to the exit of a labyrinth swifter the second time than the first one. Some of the Western researchers (W. Ross Ashby, D. M. Mac Kay) even maintain that the electronical computors do think [34].

The most typical way of proving the cardinal sameness of cybernetical devices and of living beings is the following reasoning: in cybernetics, a computor is defined as a system which is able to perform activities directed to a defined purpose. A living being accords with this definition. So living beings, and man in particular, are computors in this meaning.

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[31] N. Wiener, *The Human Use of Human Beings. Cybernetics and Society.* New York 1956, p. 26.

[32] Ibid.

[33] Ibid., p. 162.

[34] Compare their articles in a collective book *Automata Studies.* Princeton 1956.

Man is the most perfect of all cybernetical devices hitherto known, at whose design the program is genetically introduced.

Developing such theses, the adherents of the fundamental sameness of cybernetical devices and living beings state that there are no doubts whatsoever that the whole of the activities of human organism is but the functioning of a mechanism, subordinate in all of its parts to the same laws of mathematics, physics, and chemistry, as some device or other. Thence conclusions are being drawn that there is no fundamental border line between computors, thinking and not thinking, creating and not creating, that there are no obstacles to artificially creating living organisms, as there are no fundamental differences between "artifical" and "natural" ways of their creation. The whole problem consists in raising their organization to the proper degree.

Where lies the methodological mistake of such consideration? One accepts here the general notion of a cybernetical device as a system capable of performing actions directed to a determined purpose — and since this notion is general, man can be included under it, and so the whole of man's manifold activity can be explained by mathematical, physical, and chemical laws. Every scientific notion, however, should comprise not only general characteristics, but also those specific ones that are peculiar to a given object or phenomenon, and distinguish it from others. It is only in such circumstances that scientific examination of the manifold objects and phenomena is possible.

The second factor — which has already been considered by us — is the inadmissibility of reducing phenomena, the ones to the others. Phenomena of life are subject to laws of mathematics, physics, and chemistry. But at the same time they are subordinate to their own laws. It is besides very characteristic that adherents of the sameness of cybernetical devices and of living beings do not even need to mention biological laws when explaining the action of those beings. With an approach like that, social laws of moulding and developing of man will not be necessary for explaining his activity.

We do know that man is born helpless, that there is only one feature distinguishing him from higher animals — his ability to assimilate and to develop human culture in a social environment. There are known cases when man developed outside society. He was then not only devoid of such human features as for instance speech, but even did not keep an upright posture, showing a tendency toward moving on all fours. It is therefore very difficult to imagine, even in fancy, how it would be possible to create artificially man gifted with all human features, since those features arise in him while he lives in society, and owing to society.

More fruitful seem to be comparisons of cybernetical devices and of human brains worked out by scientists, who deal more strictly with

this matter on the basis of scientific achievements and who reveal not only what is common to electronic computors and human brains but also what is specific for the brain of man. Most interesting in this respect is the work of Dennis Gabor, Professor of Applied Electron Physics at the Imperial College of Science and Technology in the University of London [35]. Estimating an electronic computor he calls it intelligent, but he points out at the same time that devices copying such operations as would be taken — when occurring in the living beings — for a manifestation of reason, are regarded by him as intelligent.

Talking about electronic forecast computors the author stresses that the question here is not of predictions in relation to statistical prognoses concerning regular processes, but of predictions within a large class of stochastic processes of but a partially regular character. Computors for forecasting, and, in general, universal computors capable of learning, do work by making choice of the least squares of the error, i.e. the difference between the real value and the forecasted one.

The author also talks about those games in which man can be beaten by a computor not only because the latter has an infinite patience and infallible memory, but also because it is devoid of illusions. At the same time, however, he points out that the level of a computor's intellect is below the scientific one. A computor — he writes — is able to foresee the track of the movement of a ball, but it never would manage to formulate the laws of dynamics. The action of a computor is indeed complex, but it always remains on the same logical level. The computor is never able to elaborate abstract notions. Gabor says that contemporary electronic computors are "learned idiots", and surpass the best mathematicians with regard to deductive arithmetical operations, they are, however, not capable of induction and abstraction. They are not able, as thinking live beings are, to organize themselves in order to get adapted on a large scale to the situation, distributing economically their experiences and elaborating their own regularities with a view to act in new situations on the basis of previous associations.

Talking about the prospects of creating cybernetical devices similar to the human brain, the author points out that there will appear immense quantitative obstacles in the way. Firstly, the human brain comprises about 10^{10} neurons, this number being superior to that of electronic relays existing in the world today. Secondly, the previous naive attempts to design a brain proved to be so poorly economical that there arises the question whether we would not be using a huge quantity of devices to the only purpose that the computor distinguish colours (black or white) on a checkerboard. Gabor writes that as long as we shall not have made an enormous step in diminishing the size of logical elements,

[35] Compare: "Encounter", N. 15/1960.

which might take us outside the range of electronics, and as long as we shall not have learnt to imitate evaluating thinking, we cannot even dream of creating something akin to an artificial universal brain capable of competing with the human brain, constituting a wonder of economical organisation.

It is interesting to see that many Western scientists, who do not stand on Marxist positions, are correctly defining the differences between cybernetical devices and man. Thus A. P. Lassey is considering the problem whether computors are able to think, and he shows that from the viewpoint of theory — without going into the technical details — there is no fundamental difference between what man is able to perform, and what a robot, but that the fundamental difference consists in the mutual relation between the Conscious and the Unconscious [36]. The robot is devoid of feeling. The author is of the opinion that the fundamental difference between a computor and man does not lie in what they are able to perform (as is commonly believed) but in what they can feel and experience.

Speaking about the influence of science's progress on thinking we only lingered upon some of the problems involved. But these problems can be set and analysed against a wider background, connected with man's spiritual life and his culture. The progress in science and technology vehemently raises the importance of the abstract scientific conception of the world, and consequently changes the relation between such a conception and the sensuous feeling connected with art.

Quite recently a lecture by Charles Percy Snow *The Two Cultures and the Scientific Revolution* [37] became famous; it was repeatedly published and provoked numerous responses. Professor Snow, uniting in his own self a scientist and a writer, regards science — otherwise than many West European scientists do — as a type of culture opposed to affective types of culture. Snow talks about the ever increasing chasm between these two types of culture, and about the menace of the fall of the contemporary — i.e. bourgeois — society as a result of that chasm. In his book *The Search* — this being a tale about scientists that was published for the first time in 1934, and appeared in a new edition in 1960 with the author's preface — Professor Snow writes that we live between two cultures, that barely are in touch with each other: the traditional unscientific culture and the growing scientific one. They are strikingly different not only as regards the intellectual approach, but to an even greater extent as regards mental climate and moral

[36] A. P. Lassey, *Men and Robots.* "The Philosophical Quarterly", N. 38/1960, pp. 61—72.

[37] C. P. Snow, *The Two Cultures and the Scientific Revolution.* 6th ed., New York 1960.

positions. These differences come out not only in the United States and Great Britain, but also in the whole of the Western World [38].

The responses to Professor Snow's prelection show that he firmly seized the important social processes in the development of man's spiritual life. Thus for instance at the conference devoted to the 400th anniversary of Francis Bacon's birth and held on the 13th October, 1961, Professor R. M. Mac Iver in his report [39] pointed out while speaking of Professor Snow's lecture that the chasm between the two cultures (art and science) is a misfortune for society. But neither Professor Snow, nor other Western authors see the fundamental reason of the chasm between science and art, between natural science and social sciences. They do not see the real ways to fight it either. Professor Snow explains it — at least as regards Great Britain — by the specialism of education existing there, as well as by the lack of mutual understanding between the representatives of intellectual culture (scientists) and the representatives of the emotional one (artists). The way to overcome this division is seen by Professor Snow in a reasonable education.

The Perpetual Secretary of the French Academy of Sciences, Louis de Broglie, in his article *Scientific Culture and the Shaping of Men to Come* stresses — similarly to Professor Snow — that science and its application have been for some years past gaining constantly in importance for the development of men's culture, and that in the teaching programmes the subjects of general education aiming at shaping the intellectual and moral face of man, are being ousted by science. "*L'étude des sciences et de leurs applications à tous les niveaux exerce évidemment les esprits à bien raisonner et à être précis. Elle conduit à contracter des habitudes de travail et de persévérance, à acquérir des qualités d'honnêteté et de sincérité intellectuelles. Elle rattache celui qui s'y adonne à un grand effort collectif de progrès dans le domaine des idées et dans celui de l'action. L'enseignement scientifique est donc loin d'être dépourvu de valeur intellectuelle et morale*" [40].

But the author also points out the dark sides of the problem. Science and technology, strictly keeping to their positions, are bent on examining the material world, the concrete. That is why they induce man to abstract of all that constitutes the riches of man's inner intellectual life, of moral and emotional life. Like Snow, de Broglie is of the opinion that the chasm between the two types of culture ought to be and can be overcome by training, and in particular by teaching, at least in primary school, of literature, psychology, ethics and history. The

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[38] C. P. Snow, *The Search*. New York 1960, p. XVII.

[39] R. M. Mac Iver, *Science as a Social Phenomenon*. "The American Philosophical Society Proceedings", vol. 105, N. 5, p. 504.

[40] L. de Broglie, *La culture scientifique et la formation des hommes de demain*. "Nouvelles Littéraires", N. 1766/1961, p. 1.

author also proclaims the necessity of introducing "human" factors to the purely rational or utilitarian science, that is of introducing into education certain notions from the history of science, notions about ways of the development of scientific thought, as well as about those synthetical views that bear — as he puts it — the not exact name of *"philosophie des sciences"* [41].

There are also other opinions concerning the problems put forward by Professor Snow. Thus, for instance, G. A. Lundberg, Professor of Sociology at Washington University, explains the catastrophic chasm between the two cultures defined by Snow: "The current controversy about science versus the humanities and the arts — he writes — is, as we shall see, quite absurd. The assumption seems to be that the advancement of science must be at the expense of the other intellectual, artistic, and religious pursuits of man. This is a preposterous assumption... Actually, the advancement of science can only free, stimulate, and advance also the arts" [42].

The critics — he writes further — are protesting against the abstract, depersonalized character of scientific methods. They demand ties with nature through medium of feelings. The mystery of the world's structure, however, attracted man evermore. Should the critics be afraid that science will reveal those mysteries and that by this token man will be deprived of aesthetic pleasures, it can be answered with the statement of Veblen: "The net result of scientific investigation is to make two questions grow where one grew before" [43]. Some contend that, for instance, knowledge of the life of plants deprives the botanist of the aesthetic pleasure arising from contemplating flowers. Ask a musician, however — writes Lundberg — whether he is of the opinion that devoting himself to the theory of music hinders him from enjoying music, and "he is likely to go to the other extreme and assure you that without these studies you can't really enjoy" music [44].

In closing his work, Lundberg puts the question anew "whether science can save us", and he replies: "Yes, but we must not expect physical science to solve social problems. We cannot expect penicillin to solve the employer-employee struggle, nor can we expect better electric lamps to illumine darkened intellects and emotions. We cannot expect atomic fission to reveal the nature of the social atom and the manner of its control. If we want results in improved human relations, we must direct our research to the solution of these problems" [45].

We have reviewed but an inconsiderable part of problems that arise in the way of man's spiritual life in connexion with the development of

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[41] Ibid., p. 5.
[42] G. A. Lundberg, *Can Science Save Us?* 2nd ed., New York 1961, pp. 16—17.
[43] Ibid., pp. 97—98.
[44] Ibid., pp. 98—99.
[45] Ibid., p. 134.

science and technology. We saw how the swift development of science and its ever newer discoveries lead the scientist and every thinking individual directly to methodological problems. The more swiftly modern science develops, the more profound will be its influence upon the development of thought and the more extended will be man's possibilities of cognizing the world and himself.

The correct comprehension of science's philosophical foundations, however, is the necessary condition to this end. A profound meaning has been preserved in Lenin's directive made in *Materialism and Empiriocriticism* that the immense achievements of science and the most recent discoveries in physics cannot be contained within the old mechanistic notions, which up to this date are being identified by many Western scientists with philosophical materialism. The way out of the situation lies in a conscious transition of scientists onto positions of materialist philosophy. Marxist-Leninist philosophy makes possible the analysis of all new phenomena, even the most unusual from the viewpoint of old notions.

But the development of science and the methodological questions engendered by it transcend the bounds of science's methodology and pose, as well, methodological problems as to the study and comprehension of social phenomena. The problem of two cultures — the scientific and the non-scientific one — that has been raised by Snow, can not be, of course, resolved by the means of perfecting education and training methods only, although they must not be underestimated. The mutual understanding between men of scientific culture and men of non-scientific one can be secured, as it is shown by experiences of the Soviet Union, by educating the intelligentsia in the spirit of service to the people, and by subordinating all efforts to the development of a harmonious society. Science and technology are becoming ever stronger factors of social life and their reasonable utilization in the interest of man and of the growth of his material and spiritual riches demands a large-scale and well directed programme of action.

Such a programme is in the Soviet Union the programme of the building of Communism, that also determines the directions of the development of science and of art as well as the conditions of a harmonious development of personality.