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The Scientific-Technological Revolution and Geography

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1. The topic of this symposium comes as a very opportune challenge to geography in view of the current advances in science and technology. Indeed the lively discussions by many outstanding geographers from all over the world on the general problems of development of geography as a science in recent years suggest that our science is now about to enter a new phase in its development.

Without venturing on any systematic survey of the (often convergent) views put forward in these discussions, let us briefly consider the impact of the scientific and technological revolution on geography and some of the resulting consequences. What is actually meant by the scientific-technological revolution? The term itself keeps cropping up both in scientific research papers and in wide-circulation journals. It has acquired a colloquial connotation which tends to obscure its meaning. Its substance and scope are defined rather arbitrarily. When submitted to rigorous semantic analysis, the term does not appear to coincide with its meaning in actual use. The word "revolution" implies a one-time overthrow, an abrupt alteration of the structure of some phenomenon. But when it is used in the expression "scientific-technological revolution" the word acquires a broader meaning. First, revolution is viewed as a continuing process which, once it has started, becomes to some extent autonomous, steadily generates new methods and stimulates the rate of scientific-technological advance at a steadily growing scale. Secondly, the term "scientific-technological revolution" comprises not only accomplishments in science and technology but also—if not primarily—the total body of economic and social changes involved in the rapid development of science and technology and their impact.

The whole gamut of these changes is hard to grasp concisely within one definition, the more so that they are intricately interrelated with one another. Moreover, we must take account of the circumstances that they occur within a context of definite ideologies and value systems which differ from one socio-economic system to another. This explains why we use the term "scientific-technological revolution" in the broad sense here; without developing a concise and more specific definition of the term let us agree to use it to mean the interplay of cascade-type transformations that take place in science and technology as well as those socio-economic, civilizational and environmental changes that are adaptive reactions to the scientific-technological transformations. The reactions, in turn, are interpreted in different ways. One of their essential features, it seems, is that their rate is steadily rising.

The above changes account for the emergence of many new problems of social, economic, cultural and environmental character on a global and regional scale, which force geography to reconsider the role it it may have to fulfill in the world of today and of tomorrow, and to weight its potential possibilities against actual accomplishments.

Thus the impact of the scientific-technological revolution on geography can be analyzed in two aspects:

(1) identifying the new research problems for geography that are caused by the changes in the sphere of reality, and

(2) assessing the changes in the structure of geography as a research discipline and its cognitive function; both the former and the latter are stimulated by the emergence of new research problems and by the development of a new methodological model which creates new possibilities for the advance of science.

2. The two principal problems geography is now facing are: (1) the study of human environment, and and (2) the need for a rational control of the development of spatial systems.

The former of the two problems, though articulated as a traditional domain of geography, has basically changed its character acquiring foremost significance both in public opinion (the ecological crisis) and science; moreover, in its catastrophic and naturalistic variant it became a fundamental component of

various programmes that arbitrarily called for putting a check on technological-social development. At this moment let us point out that the principal problem for science is not so much to impose an all-out ban on the utilization of the inherited forms of the natural environment as to ensure that the new forms and new modes of utilizing the environment should be qualitatively commensurate with the use of existing areas and forms.

Hence it follows that geography should see its task in disclosing and defining the laws that must be obeyed not to violate that commensurability. But in order to give an appropriate and realistic assessment of the gnosiological situation of geography we must furnish it with clear cognitive criteria, and in particular we must admit the view on the dynamic character of man's socio-economic situation and concentrate on problems of the man-specific environment; that is we must study systems whose impact (input - output) is directly connected with the socio-technological biotic structures of the human environment. Because it has up to now tended to focus on the non-specific environment, geography is now incapable of solving the basic problems of the human environment so as to develop itself into a synoptic science about the world and about nature. Emphasis must be laid on the essential role of the socio-economic component, especially of the effect of the social structures that together make up the human environment and which differ from one socio-economic system to another.

The second problem is connected with the first in that the development of rational spatial patterns is the basic approach that geography can adopt for its gnosiological quidelines. It is also in the sphere of space, i.e. in the development of spatial structures, that the relations of man to the surrounding natural system can be most fully developed.

This is also not a new problem; especially in the socialist countries in has long been assigned as a task for geography, but recently in view of the recorded high level of economic advancement and since long-term plans for spatial development had come into use, it has acquired a new dimension. It is also very urgent in the Third World countries whose spatial-economic structures are often blatantly at variance with the current distribution of resources and the productive capacities.

If it is to solve these two research problems, modern geography must somewhat re-orientate its methodological bent so as to impart it a more "active" approach. What is meant here is not so much "applied geography" or "applications of geography" which essentially consist in making practical use of theoretical generalizations but the idea of geography as a science and of the nature of the theoretical constructions it furnishes. A theoretical programme to deal with the question "why are spatial distributions structured as they are?" is in this connection no longer adequate and must be replaced by a new one which would provide a more comprehensive use of approaches and theories of a normative nature.

3. Thus the impact of the scientific-technological revolution on geography involves not only a change in the programme of its problems but also—and above all—a rather radical transformation of its methodological model together with the resulting consequences for both theory and practice. This means that the changes that occured in that model are related to the cognitive aspect of geography and, on the other hand, to its instrumental function.

The development in recent years of new techniques for information collection and processing must be mentioned as the first element of the new methodological model.

The new methods and techniques for use by geographers furnished by what has been termed "the quantitative revolution" involve the use of electronic computers which permit the development and employment of sophisticated mathematical and statistical techniques. It must be stated that although that revolution has already taken place the full use and promotion of all possibilities of computer techniques in geography has barely started.

The advance made in the technologies has opened the phase of automatic cartography. One recent development in this connection is the collection of information through "remote sensing". Remote-sensing devices linked to automatic computing and mapping facilities open further possibilities which must necessarily be utilized for the development of geography and, which, on the other hand, also present a specific challenge. It must be pointed out that the collection of such information (primarily of satellite photos) will be a prerogative of central government agencies, and the scanning and automatic processing of the information demands considerable financial assets (to say nothing about personnel training problems). All that will definitely give an advantage to the better-off nations and, within them, the big research institutes. Thus, there is a real danger of a widening technological gap affecting geography all over the world. To bridge that gap it will be necessary to establish international cooperation as well as found research institutes on a supranational level.

The technological improvements mentioned above in geography's research workshop facilities have a powerful bearing on the development of its methodological structure. On the one hand, they enable the geographer to put his observations on an objective basis and, on the other, they make it easier to formulate empirical generalizations and speed up the testing of theoretical assumptions. Right from the onset of the "quantitative revolution" those improvements were connected with the development of theoretical knowledge in geography and, moreover, with the programme of geography itself as a science which formulates theoretical generalizations.

Another important element of the new methodological model of geography is the growth of a unified structure of geographic knowledge. Due to the improvements in data collection and processing on the one hand and to the need for solutions of the problems generated by the scientific-technological revolution in the man-environment system and for optimizing the development of spatial systems, on the other, the problem of an integral "holistic" approach becomes again of critical importance. In the past during the course of the development of geography the "holistic" approach has gradually been losing ground as a consequence of the rising role of specialization. Although specialization must be credited with having enormously enriched geography and allowed for more penetrating analyses of processes, it added little to the understanding of the world as a whole, as a complex system. The new situation generated by the scientific-technological revolution points to the current need for a "holistic" model, one that would not only grasp the spatial structures of the complex systems existing within industrialized societies but also help to plan socio-economic and civilizational developments within the limits of tolerance imposed by nature. The adoption and implementation of holistic assumptions and of systems methodology open new, far-reaching possibilities to geography as they are on a higher level of generality and furnish a rational foundation for information and for controlling the highly complex systems on a regional and global scale. It is more and more often realized that the multi-parameter problems connected with regional planning, with studies of environmental pollution or resource allocation must be based on a paradigm of systems which secures the best utilization of modern information techniques and mathematical simulation.

The third important element of the new methodological model of geography is that that model has been given a man-oriented (now often termed "humanistic") interpretation. Man-oriented concepts of geography have in fact been put forward before, but in conditions of the scientific-technological revolution that humanistic interpretation acquired a new essential significance as a reaction to the narrowly scientific and technocentric paradigm of science. Such a concept finds its expression above all in a man-oriented or humanistic interpretation of the methodological model of geography. It adopts a rationalist and socially committed attitude of solving problems in which the interest of human beings is for some reason jeopardized. But such problems must be submitted to the most rigorously objective scientific analysis if the solutions they yield are to be fully rational and must also rely on both the knowledge and value systems of the agents concerned. The latter systems are a source of remarkable differences in the way of solving the fundamental problems.

It must be emphasized that in such a concept, the process of value judgement is an integral element in solving the research problem; the researcher is faced with the necessity of choice in all phases of the research procedure and such choices are made in virtue of some system of values, but that system can be employed either deliberately and consistently or unwittingly and accidentally. It is precisely such a deliberate commitment to choosing a definite system of values that is implied in the humanistic interpretation in the solution of a given problem. This leads geography to remodel itself as a commited science, one which pursues a solution of modern and future problems on the strength of a certain valuative reasoning. Such an approach enables geographers to make use of research results in their efforts to solve and overcome socially harmful phenomena.

This process will probably disclose conspicuous differences in the theoretical approaches employed in countries with different socio-economic systems. This will be due to differences in value systems and decision-making that are bound to be explicit in the theoretical constructions. Such a process is likely to prove stimulating to the development of geographic theory in that it may help in eliciting elements indicative of essential differences in the development of various spatial systems in the world.