SCIENCE IN A GLOBAL AND A REGIONAL APPROACH

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In the present paper I shall discuss the character, functioning and changes of science in a global and a regional dimension in the framework of the concept of science as a socio-cognitive system. I shall consider the following issues:

1) the concept of science as a socio-cognitive system,
2) the global dimension of science, and
3) the regional dimension of science.

1. SCIENCE AS A SOCIO-COGNITIVE SYSTEM

It is my opinion that science is not only a cognitive pursuit, but also a mode of social action and its product shaped by communities of researchers in a specific social environment. Hence, I propose to discuss science as a socio-cognitive system.

A socio-cognitive system, as any real system, is characterised by: a) its composition, or a set of components or parts of the system, b) its surroundings, or a set of objects which are not components of the system, but with which it is linked, and c) its structure, which is a set of links or interactions that hold among the system components, and between the system and its surroundings.

The **composition** of a socio-cognitive system embraces two kinds of elements: 1) the group of researchers engaged in scientific activity, and 2) the products of this activity, or scientific knowledge.

The **surroundings** of a socio-cognitive system embrace the social environment, i.e. the social system whose component is the research group, and the technical-cultural environment, i.e. means and facilities necessary to pursue science.

The **structure** of a socio-cognitive system covers internal and external relations. Internal relations assume the forms of scientific knowledge, communication, and criticism of results. External relations holding between the socio-cognitive system and its surroundings, mainly the social environment, embrace on the one hand the impact of society, or better economic and political factors, on scientific activity, and on the other, the impact of science on the economy, polity and culture.

A socio-cognitive system is a subsystem of society, or strictly speaking, its culture. In a systems approach, society is seen as the most complex social system composed of a variety of subsystems and operating at several levels of complexity: global, regional and local. Each society, however, consists of three main subsystems as its indispensable components: economic, political and cultural. These subsystems are manifestations of activities of members of the society which involve their surrounding reality.

However, science as a social subsystem displays a considerable degree of autonomy in its activity with regard to other social subsystems. The autonomy springs from its distinct aims (cognition of facts and regularities), means (research methods and techniques), and results (scientific knowledge), as well as from its institutional and organisational distinctness. The growing interdependence between the development of science and technology, however, makes science increasingly dependent on the economy and politics, which tend to exercise an ever greater influence on the scope of its research problems.

Science as a socio-cognitive system operates at two basic levels of complexity: 1) global, i.e. world science, and 2) regional. The latter can be further subdivided into: 2a) a national level, e.g. Polish science, and 2b) a sub-national level, i.e. one formed by scientific centres, scientific islands, etc. (cf. Chojnicki, Czyż 1992, 1994). Interregional scientific systems can also be distinguished, e.g. the 'Archipelago Europe' (Hilpert 1992).

This characterisation needs to be complemented with a discussion of the science - technology relation. This dichotomy can be elucidated as follows. If we presuppose science to perform three basic functions, that is, cognitive, utilitarian and practical, then we can distinguish, respectively: 1) basic science, 2) applied science, and 3) technological science. The relations that hold among them can be described, after Bunge (1983: 215), in the following words: "(...) basic science, applied science and technology have commonalities as well as differences. All three share essentially the same world view, mathematics, and the scientific method. (...) They differ mainly in their *aims:* that of basic science is to understand the world in terms of patterns; that of applied research is to use this understanding to make further inquiries that may prove practically useful; and that of technology is to control and change reality through the design of artificial systems and plans of action based on scientific knowledge". This shows that the notion of science can be understood broadly enough to embrace technological science as well.

Let us now pass on to the presentation of main aspects of science in its global and regional dimensions.

2. The Global Dimension of Science

In its global dimension, science is considered as a whole worldwide socio-cognitive system. Within it, the universal character of scientific activity and its organisational-institutional forms develop. Thus, what evolves in the global dimension includes:

1) standards of scientific research and its results,

2) the internal structure of science in the form of scientific disciplines,

3) the organisational and institutional structure of science, and

4) systems of scientific information and criticism.

Re 1) The creation of standards of scientific research and its results is the foundation of the universal character of scientific knowledge. It takes place within the whole of science, although with reference to its particular branches or disciplines. It is a complex process of the formation of opinions of science people during which research methods and techniques as well as criteria of result evaluation are being worked out. Naturally, they change with the advance of science. There is, however, no consensus on the philosophical principles according to which these elements are interpreted. The result is a variety of philosophical orientations adopted as basic assumptions.

It is also debatable whether those principles are common to the natural and social sciences. In social science international universality is more of a programme than a fact. A good example is the discrepancies among historians in their evaluations of conflicts between nations.

Re 2) Another process that occurs in the global dimension is the differentiation of science through the emergence of new disciplines. It is within their frameworks that scientific criteria gain substance and progress is made through the formulation of new scientific problems and their solution using appropriate research methods and techniques.

The process of the differentiation of science and the emergence of new scientific disciplines is connected, on the one hand, with the broadening scope of reference of science, and on the other, with the growing specialisation of research competence. Its consequences are also organisational: separate institutional forms develop to accommodate research and academic activities within a given discipline.

Re 3) In the global dimension, organisational and institutional structures of science assume two main forms: 1) professional requirements that researchers and academic teachers have to meet (academic degrees and titles), and 2) a system of institutions where research activities and academic education are being pursued (schools and their faculties, institutes, departments, scientific committees).

An important role in the shaping of scientific activity is played by international organisations and agencies which promote and co-ordinate research activities.

Re 4) The development of the international circulation of scientific information is the principal instrument of making science universal and creating an integrated body of scientific knowledge. This circulation system is made of scientific journals and book series of an international range, as well as international scientific congresses and conferences. They have also become centres of scientific criticism and communication of results, as well as creating a uniform body of knowledge as a collective product. This system, however, works mainly in natural science, and to a lesser degree in social and technological science. The results of technological science are often kept secret owing to their innovative character. The international circulation of scientific information has been mostly monopolised by Anglo-Saxon scientific centres and journals, which makes those centres privileged.

A new medium has recently joined the international system of data circulation, namely computer networks. They accelerate and expand communication, producing a uniform worldwide information system.

3. The Regional Dimension of Science

The regional dimension of science is defined by relationships holding between science and the state as a social supersystem which contains as one of its components the socio-cognitive system of science. The distinction of the state as the main social supersystem of science is justified by its nature and role in the territorial organisation of social life and social activity. The state is the main self-organising territorial social supersystem which integrates, regulates and controls all kinds of activity (economic, political and cultural), hence also scientific activity.

The relations between science and the state give a concrete shape to

dependences holding between science and society. They are interactive in nature: science influences society, its culture, economy and politics, and society affects science. I shall restrict myself mainly to the other kind of influence.

Within a state, scientific activity differs from area to area. Thus, two levels might be distinguished: national and sub-national. The sub-national, or regional level in a narrower sense, consists of various scientific activity centres as elementary socio-cognitive systems (cf. Chojnicki, Czyż 1992).

To consider the impact of the state on scientific activity, on which I am going to focus, it is necessary to define: 1) the character of the scientific policy of the state, and 2) the character and role of the national and sub-national dimensions of scientific policy.

3.1. The character of scientific policy

The tremendous impact that science exerts on culture and economy today makes it an important means that the state can use to achieve its economic and political goals. Hence the role of scientific policy as the principal manifestation, and also a tool, of the state's influence on the nature and development of scientific activity (cf. Kukliński 1994).

The state scientific activity can be 1) interventionist, or 2) non-interventionist.

A **non-interventionist** policy leaves science mainly to private initiative or social organisations. It is implemented through action rather than programmes, and is tacit rather than explicit. Public institutions, especially government and official projects, have little effect on the shape of scientific activity. Research is carried out mainly at private universities and institutes, and financed by foundations and industry. The state only finances huge projects of a clearly public nature (military matters, the natural environment, cities).

An **interventionist** policy, in turn, rests on the state's active involvement in the shaping of scientific activity through government institutions and big public projects which it finances. The influence the state can wield depends crucially on its goals and role. Two types of science planning and management can be distinguished here: 1) authoritarian and 2) democratic (cf. Bunge 1983: 248).

Authoritarian planning and management fully regulate and shape the whole of the socio-cognitive system of science through central government institutions. The control covers both aims and means of scientific activity, including the character of scientific community, the content of scientific thought, and the scope of research in the framework of the official ideology. This leads to the monopolisation of scholarly life and to giving preference to low-level studies. Naturally, in practice there are several levels of authoritarian planning and management, but their results are usually similar: a low level of exploratory prowess and innovativeness.

Democratic planning and management is characterised by freedom of research and an equilibrium between various centres influencing scientific activity. To achieve it, it is necessary to reconcile the interests of science itself with those of the consumers of its results. While an essential element of this approach is the necessity to finance science from public, especially government, resources, there is no authoritarian imposition of closed projects, and research is permitted to develop on a competitive basis. Naturally, the research must accommodate social needs, and the mechanisms of social scholarly life should include the possibility of their public presentation, confrontation and recognition (Chojnicki 1990).

3.2. The national and the sub-national dimension of scientific policy

The distinction of the regional aspect of scientific development entails the definition of the character and role of the regional dimension of scientific policy as a totality of means regulating and promoting the development of science in a regional approach. Hence, two dimensions should be distinguished in scientific policy: national and sub-national, or the level of sub-national regions.

In the **national** dimension, scientific policy embraces the regulation and shaping of scientific activity by central state institutions from the point of view of global interests of society and the state, while maintaining the cognitive and practical goals of the development of science and scientific progress.

However, experience shows that in the implementation of scientific policy, especially in countries at a less advanced level of economic development, preference is given to technological 'interest' over cognitive one. This manifests itself in the dominance of financing of technological progress, and hence of applied and technological science. The justification offered rests on the claim that the results of basic research have a global nature and are more readily accessible within the international system of scientific information. It should be emphasised, however, that technological progress depends heavily on basic research, and that there are development chains linking basic science, applied science and technology.

Hence, it is necessary to develop basic science, without which advances in technological research are impossible. The danger of a one-sided development of scientific activity, viz. gearing it to purely technological purposes, lies in the fact that it may erode the internal regulators of the development of science, its cognitive aims, and the freedom of choice of research alternatives. Setting concrete targets makes science susceptible to all kinds of webs of interests and political strategies, not necessarily development-oriented.

This is closely connected with the issue of steering of scientific development. Directing research at concrete targets irrespective of their cognitive values must seem a worthwhile improvement cutting the costs of science to any scientific policy interested only in those targets. This may lead to a sort of wasteful management in science. In turn, competitiveness as such may enhance conformity to the power system and serve to promote particular interests, thus losing its function in strategic development.

The aims and instruments of scientific policy can assume a variety of forms. Kukliński (1994: 244) suggests adopting the following as the fundamental goals of Polish scientific policy: "a) improving the competitiveness of Polish science at the global scale, and b) strengthening Polish science as a factor involved in the process of the transformation of the country, society and economy", and incorporating the discussion about scientific policy into a broadly understood strategy of Poland's development.

To achieve those goals, several conditions have to be satisfied, the most important of which include: 1) ensuring a suitable level of financing, 2) selective promotion of research directions, 3) utilising research results, and 4) introducing institutional and organisational changes. Let me quote my earlier comment on this matter (Chojnicki, Czyż 1994).

Re 1) The drastically low financial outlays for science in Poland, which over the last three years varied between 1.3% and 1.1% of national income distributed, reduce science to a mere survival level and bring about a sort of depreciation of scientific staff and their outflow abroad. This makes progress impossible in those basic studies of an experimental nature which depend on expensive apparatuses, as well as in technological research. Such a situation leads to Poland's increased technological dependence and purchase of still more licences, while weakening the position and role of its science in making practical activities more efficient.

Re 2) A selective promotion of research directions is a must in the face of the existing financial limitations. However, it imposes serious restrictions on the development of science, which is a system of connected vessels of a kind, and as such requires a reasonably balanced development. This holds especially for relations between basic sciences on the one hand and applied and technological sciences on the other.

The selection of specific research directions cannot be made by central state institutions because, as the experience of the previous period demonstrates, it leads to promoting mostly technological research of little innovativeness. The choice must be made under conditions allowing scientific bodies to put forward research projects and to evaluate them.

At the same time, however, the selection of research directions, especially those of a technological nature, should be in agreement with the directions of economic development, and particularly with the restructuring of production.

Re 3) For the results of scientific research, especially state-of-the-art technologies, to be used effectively, it is necessary to create appropriate socio-economic and organisational conditions. What I mean are not merely some organisational changes such as the setting up of information centres, but first and foremost fitting technological progress in with the restructuring and practices of industrial enterprises so as to make them take suitable steps themselves.

Re 4) Institutional and organisational changes in the system of science are important factors in improving the effectiveness of scientific activity. Its financing from state funds has already been reorganised, with the State Committee for Scientific Research set up to handle the matter. Transforming basic research units, i.e. the institutions of the Polish Academy of Sciences, as well as higher schools, into self-governing and self-supporting bodies is not possible at present, or in the nearest future. It would require them to adjust to the rules of the market game, and would depend on the emergence of a market for scientific products and for higher-school graduates.

With the above as a background, let us consider some problems and dilemmas of the sub-national dimension of scientific policy.

The **sub-national** dimension of scientific policy rests on the acceptance of scientific centres as independent agents of scientific policy, and on the acknowledgement of their role and character in the development of science. Both scientists and scientific institutions tend to be located in places which are centres of scientific activity and which offer several benefits, like scientific co-operation, the use of technical and information bases, as well as interactions and links with the economies of the particular regions of the country.

In the sub-national dimension, scientific policy influences spatial differences in scientific activity by promoting particular scientific centres on the basis of their research potential in specific disciplines and their

creative scientific programmes. It also deals with various sources (central and local) of financing. It should consider the interests of the particular regions of the country as well, and encourage regional patterns of innovation and co-operation with the economy.

The major aspects of the sub-national dimension of scientific policy can be tentatively taken to embrace:

1) the impact of the character of scientific centres on the effectiveness of scientific activity, and

2) the role of scientific centres as places generating technological and organisational innovation.

Re 1) The promotion of scientific activity has to take into consideration the impact of the character of scientific centres on the effectiveness of scientific activity. This requires the introduction of a specific regional coefficient in the evaluation of scientific programmes, i.e. carrying out research in a specified scientific centre. What I have in mind here are primarily complex, finalisation-type programmes. In this way the broader environment of scientific research could be taken into account, namely equipment, scientific information, and co-operation. This, in turn, should be conducive to the specialisation of the centres and the formation of scientific schools, but in the conditions of competition. Within the centres themselves it may reinforce internal links and indicate particularly creative institutions around which scientific activity tends to crystallise.

Re 2) Apart from their science-creating role, scientific centres are places generating technological and organisational innovation in the surrounding area.

At the scale of sub-national regions, those scientific actions should be promoted which condition or support their social, economic and civilisation development. Despite the open character of scientific activity, the regional and local links between science and the economy tend to influence production profiles and the economic effectiveness of regions of a country ever more strongly. The activity includes: the training of highly-qualified scientific staff, consulting, the creation of technological and scientific information centres, firms implementing research achievements, technological parks, industrial incubators, etc. Simultaneously this activity opens up new possibilities of financing science from sources outside the state.

At the **international** scale, specific scientific centres could collaborate with major centres of innovation and technological progress which are European or world 'islands of innovation'. This concept of Hilpert's (1992) and his studies show the role of such collaboration for innovation processes.

Taking into consideration the sub-national dimension of scientific policy in Poland makes it necessary to devise a new strategy of the development of science accommodating this aspect of scientific activity, and to create such legal and fiscal mechanisms which would stimulate the diversified development of scientific centres and the use of their research potentials in the economic and civilisation development of regions of a country. The legal and fiscal regulations to be introduced should encourage the financing of research and development projects from sources other than central ones.

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