NASA TECHNICAL TRANSLATION NASA TT F-13,963

THE TREND OF SPACE PROGRESS

A. D. Ursul

Translation of: "Kosmicheskaya Ustremlennost' Progressa," Priroda, No. 7, July 1970, pp. 8-14

(NASA-TT-F-13963) THE TREND OF SPACE PROGRESS A.D. Ursul (Techtran Corp.) Mar. 1972 21 p CSCL 05D

N72-18989

Unclas
G3/34 19808

FAC (NASA CR OR TMX OR AD NUMBER) (CATEGORY)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D. C. MARCH 1972

Reproduced by
NATIONAL TECHNICAL INFORMATION SERVICE
U S Department of Commerce
Springfield VA 22151

THE TREND OF SPACE PROGRESS

A. D. Ursul

ABSTRACT. The author points to a major change in the outlook of mankind toward his surroundings (and which is still going on, which had its origin in the overturn of the geocentric theory of the Universe by Copernicus). From this he progresses to discussion of what he terms "cosmization" of science and of manufacturing activity, and he considers a matrix of possible situations which may be encountered at times, involving the inter-relationship of subject, object, and conditions of observation. His basic outlook appears to be that his phenomenon of cosmization is a natural outgrowth of man's appreciation of the universe about him. Furthermore, situations in which the subject, object of observation, and conditions of observation (one or more) will be extra-terrestrial will steadily increase; he envisions, for example, such situations as conducting extended studies of objects or phenomena from points outside our own earth, or perhaps even exchange of information with extraterrestrial civilizations. Naturally, these are merely touched upon.

While much of the material is philosophical and abstract in nature, he does not retreat from his view that the day of a purely geocentric approach to science, life and manufacturing is gone, never to return; and he touches on the effect that space exploration has already had on items of manufacture and on the types of jobs which have been created.

Arkadiy Dmitrievich Ursul, Professor in the Department of Philosophy, Moscow State Pedagogical Institute imeni, V. I. Lenin. He deals mainly with philosophical questions of coping with the cosmos and of cybernetics. His principal monographs are: Osvoyeniye Kosmosa (Filosofsko-Metodologicheskiye Problemy) [The Conquest of Space (Philosophical-Methodological Problems)], Moscow, 1967; Priroda Informatsii: Filosofskiy Ocherk (The Nature of Information: a philosophical Essay), Moscow, 1968. /8*

---

*Numbers in the margin indicate pagination in the foreign text.

The revolutionary upheaval in astronomy which was achieved by Copernicus exerted a magical action on the growth of science. This discovery, as Engels has already noted, marked the beginning of the process which we now call the "information explosion." From the moment of the rejection of geocentrism, wrote Engels, "the growth of science moved by giant steps, accelerating, so to speak, proportionally to the square of the distance in time from its starting point, as if wanting to show the world that, with reference to the movement of the higher type of organic matter, human endeavor, a law operates which is opposite to the law for movement of inorganic matter."[1]

What sort of principles led to such an acceleration of the tempo in growth in science?

These principles are usually connected with the origin and development of capatalistic production, reduction in the influence of religion, and growth of effective media for propagating knowledge. It is hardly possible to take exception to these reasons of a social type; without doubt they have played their role in the accelerated development of science, but nevertheless such an explanation will not enable one to answer the question of why Engels dates the beginning of accelerated accumulation of scientific information precisely from the discovery of Copernicus.

Was this fortuitous? Did Engels consider the rejection of astronomical geocentrism to be simply a great discovery, or did he far-sightedly see in it something in principle? In fact, the onset of the accelerated growth in science could be quite possibly connected up exclusively with the appearance of the social causes mentioned. Nevertheless, knowing these causes, Engels assigns a decisive importance to the rejection of geocentrism.

In our view, such a connection between the onset of the accelerated accumulation of knowledge and the decisive rejection of geocentrism is explainable if one attempts to examine it against the background of the tendency of development in science which is now called cosmization.

---

[1]K. Marx and F. Engels, Papers, Vol. 20, pp. 509.

What Cosmization is

This term first appeared in philosophical works. The creation of a new concept was not at all a whim of scholars; they devised it to designate an important process in the development of science which is taking place independently of the will or wish of any man. And now the idea of "cosmization" is used not only by philosophers, but by cosmonauts, naturalists, and scientists in many other specialties. However, we are not concerned with the term "cosmization," (it is possibly not entirely harmonious), but with the idea itself, the content of this idea.

In fact, we encounter the first philosophical interpretation of the cosmization problem in the works of Engels. In his scientific work, K. E. Tsiolkovskiy started from the cosmic point of view on the development of mankind, and exactly this cosmic trend of the scientist led to an understanding of the role of the rocket as a means of leaving the bounds of our planet and also to a number of other very fruitful ideas associated with mastering the cosmos. A cosmic trend of thought was organically inherent in V. I. Vernadskiy[2] /9 who increasingly propagandized the cosmic view in science (especially in natural science). Together with these scientists' names, one could also point out many others who have clearly seen the narrowness of the traditional world--concept based on ordinary terrestrial canons.

Cosmization consists in the fact, that in conscious human activity, regardless of whether it is displayed in a scientific, manufacturing, or other social effort, factors and features are beginning to penetrate ever more persistently which are associated with the cosmos. Obviously the action of the cosmos (and primarily the Sun) existed from the time when society began, but from this it still does not follow that human activity should be considered as cosmicized from the very start. Although solar energy has been used directly or in "bound" form (coal, petroleum, fossil fuels, etc.), people did not suspect that they had to do with forces which were cosmic in nature.

---

[2] I. I. Mochalov. "Problems of Cosmization of Science in the Work of V. I. Vernadskiy," "Voprosy Filosofii," No. 1, 1968.

The beginning of cosmization, in our opinion, should be considered the time when the need of a cosmic point of view was realized, and the need, because of this, to consciously utilize cosmic factors. And this, undoubtedly, is possible only if the cosmos is represented not as a simple continuation of terrestrial phenomena and conditions, but as something different from these. Menawhile, the geocentric point of view was widely disseminated for a long time, in spite of the fact that heliocentric hypotheses were expressed even before the new era. The Aristotelian-Ptolemaic geocentric world system, allocating a central position to the Earth, considered all the rest as a "continuation" of terrestrial conditions; the non-earthly was explained by purely earthly means. The heliocentric system of Aristarchus of Samos broke with the usual views on the hegemony of the Earth in the Universe, and allocated to the cosmos the place which belonged to it by right. But we well know the dramatic fate of this concept which lay in oblivion for two thousand years -- until it was discovered anew by Copernicus.

Such an unfortunate fate of the heliocentric concept, of course, cannot be fully explained by the action of religious ideology or church interference. Most probably the role of religion came down more to maintaining the geocentric idea than to shaping developing knowledge. The preference which men gave to the geocentric world system is explained, as we see it, primarily by the features of the development of knowledge itself.

One should bear in mind the stepwise character of the growth of human knowledge, particularly in regard to space and time. "Man", indicated V. I. Lenin, "cannot take in -- reflect -- depict -- the nature of all completely; he can only constantly approach it, by creating abstractions, ideas, laws, a scientific picture of the world, etc."[3]

Since man has had to do primarily with purely terrestrial conditions and processes, then on encountering unknown processes or objects he has naturally explained them starting from concepts and ideas which are habitual to him. He has stated the non-earthly by the earthly, and has not invented new hypotheses. He has extrapolated the habitual, the terrestrial, to all the rest,

---

[3]V. I. Lenin, Complete Collected Works, Vol. 29, pp. 164.

and in this picture of the nature of the cosmos he has noticed no more than a simple extension of the earth. Hegel has already noted this: "The Sun serves the planet, as in general the Sun, Moon, comets, and stars are only conditions of the Earth."[4] This same thought found expression in the work of Engels, who advanced the idea, valuable for gnoseology, of a center of knowledge, which, for us for a long time, was the Earth.

In this sense Engels spoke of geocentric physics, chemistry, biology, meteorology, etc., and thought that "these sciences lose nothing from the statement that they have force only for the Earth and therefore are only relative. If we earnestly demand a science lacking a center, then we thereby stop the movement of any science."[5]

Geocentrism as a method of knowledge has been inherent to the whole complex /10
of science, according to Engels. Therefore, overcoming geocentrism, which began in astronomy, has also included the other sciences, successively including mechanics and physics, then chemistry and other natural sciences. But overcoming geocentrism in astronomy and in the other natural sciences bore a qualitatively different character. If a false concept was rejected in astronomy, then the other natural sciences (which basically studied terrestrial phenomena) overcame geocentrism by passing to a knowledge of the processes which take place not only on our planet, but also outside its boundaries.

Objects of nature are the subject of natural science. But nature -- up to the moment of conscious rejection of geocentrism in science -- was considered exclusively as the Earth, as terrestrial processes and conditions; speaking more briefly, this was a period of explicit (or implicit) identification of all nature with the Earth. And, although the ancient Greek philosophers willingly used the word "cosmos" as a synonym for nature, this was a geocentric-mythological cosmos, and not at all the cosmos as it came to be represented to man after the first decisive challenge to geocentrism hurled by Copernicus. In fact, before Copernicus, all three concepts -- cosmos, Earth, and nature -- were not adequately contrasted, were not differentiated one from another. A

[4]Hegel, Works, Vol. 2, Moscow-Leningrad (1934), pp. 138.
[5]K. Marx and F. Engels, Works, Vol. 2, pp. 554.

breakdown of understanding of nature into terrestrial and nonterrestrial, that is, the cosmos, was the basis of a future -- henceforth even conscious -- cosmization of natural sciences, an evidence of the really dialectic nature of the growth of knowledge.

And so the old understanding of nature, which was practically reducible only to the nature of the earth, was split into two concepts which reflected the objective differences of the Earth and cosmos in a single nature. Later on, the process of analysis of nature led to the discovery of a very important contradiction in the growth of science -- a contradiction between terrestrial and cosmic, which became a powerful source of accelerated progress in science and which opened up limitless prospects of its further growth. The contradiction between the terrestrial and the cosmic in science is a reflection of the interaction of such opposites as the Earth and the cosmos. But in the unity and the "struggle" between the terrestrial and the cosmic, the winner proves to be the cosmic, every time.

This victorious procession of the cosmic in the growth of our knowledge of nature has come to be called the cosmization of science. And this very cosmization has served as one of the decisive reasons for the exponential build-up in scientific knowledge.

Apparently, the rate of growth in science would not have proved so swift if our thinking had been restricted to a narrow world of geocentric "common sense". The cosmos, as reflected in human knowledge, became a powerful driving force in science which causes an acceleration proportional to the mass of knowledge already accumulated.

Cosmization of Human Practice

The fact that the cosmization of science began earlier than the conscious cosmization of manufacturing turns out to be a consequence of the cosmization of science, and science enters here as a direct productive force. However, this line of movement from science to production is only one of the aspects of the interaction between science and practice, of a relationship where practice enters as a first basis, purpose, and criterion of the truth of scientific

knowledge. Only by considering the evolution of human practice can one understand why, and on what basis, the cosmization of science is taking place.

For a long time human practice bore a purely terrestrial, geocentric character: this was caused historically by the fact that mankind arose right here on Earth. An exchange of matter and energy took place between human society and nature; in the course of work, information obtained by people continuously increased. The subjects, work means, and the information obtained by people continuously increased. The subjects, work means, and the information obtained by society, as well as social man himself, proved to be products of the natural growth of the planet, and were the corresponding reflection of the specifics of terrestrial objects and conditions. This reflection showed up, too, in the features of human practice: people transformed the surrounding nature by proceeding from a knowledge of its laws and taking account of the peculiarities of the surrounding medium. A direct change of the nature of the earthly sphere by man, the transformation of material objects, was the kernel of that form of practice on which the knowledge of the pre-Copernican period was based. In other words, the geocentrism of the practical bonds between man and nature caused the geocentrism of science.

The overcoming of routine geocentrism of thought by science undoubtedly took place under the influence of the needs of practice, which had already ceased to satisfy purely terrestrial objectives and conditions, included among them, matter, energy, and information. Initially it proved necessary to include in the sphere of practical human activity not matter, nor energy, but information about the cosmos, for that which existed already could not satisfy developing mankind. The discovery of Copernicus in essence made available this information about the structure of the cosmos and moreover raised the question of the need to corroborate it in practice. The truth of the world system of Copernicus was then confirmed practically by astronomical observations and by other discoverers (Kepler, Galileo, Newton, etc), although in these cases practice did not enter as the action of mankind on nature, which, as a rule, took place in the study of purely terrestrial phenomena. Overcoming

geocentrism proved to be connected with a broader understanding of practice, for, as V. I. Lenin has indicated,[6] "in practice, which serves us as a criterion in the theory of knowledge, one must include also the practice of astronomical observations, discoveries, etc."

Further overcoming of purely geocentric concepts (before the era of mastery of the cosmos) was associated mainly with astronomy and the form of human practice corresponding with it. For a long time, astronomy was a purely observational science and therefore the first nongeocentric form of practice was also connected with observation. Observation, however, bore the character of a one-sided (informational) connection between the subject of knowledge and the object. The subject could not change the object of its observation, could not use its energy or matter in manufactured objects (excluding, to some extent, the Sun). Moreover, obtaining information from the cosmos was also insufficient, since the atmosphere of the Earth, distances of celestial objects, and other factors interfered; all these, taken together, caused a need to go over to the following form of nongeocentric practice, associated already with the growth of cosmonautics.

However, even before this moment the reproduction and utilization of a number of processes in the manufacturing sphere had begun which were not specific to terrestrial but to cosmic nature - for example, nuclear reactions, powerful magnetic fields, plasma states of matter, super-low and super-high temperatures and pressures, etc. Such a trend in growth of cosmization in manufacturing led to a still greater stimulation of cosmization in science.

Further cosmization of human practice proved to be connected with the growth of rocket-cosmic technology as a transport medium for exit into the cosmos. Thanks to this technology alone, mankind has acquired the possibility of continuously increasing action on extraterrestrial nature, as a result of which a new form of nongeocentric practice appeared. While previously the action of man on nature, as has already been mentioned, bore a specially geocentric character, penetration into cosmic space created material

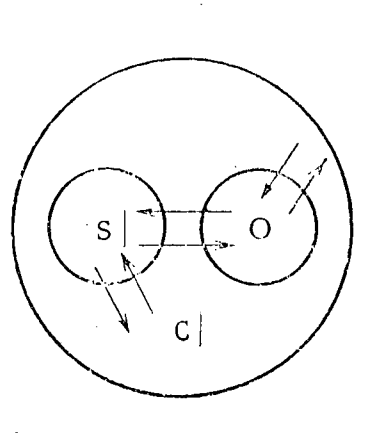
---

[6] V. I. Lenin, Complete Collected Works, Vol. 18, pp. 143.

conditions for action on cosmic objects and processes, these being not only in an informational, but also in a matter-energy aspect.

On the basis of utilization of cosmic technology, systems arose for satellite communication, satellite navigation, geodesic and meterological satellites, etc. As a matter of fact, this is cosmization of very important branches of manufacture, a new cosmic means for solving mature national economic problems which could either not be solved or were solved uneconomically by traditional means. Moreover, the growth of rocket-cosmic technology and systems for maintaining life in the cosmos has led to the situation that movement from cosmic branches of industry to ordinary terrestrial branches /11 began. In the course of only five years after the launching of the first earth satellite, more than three thousand completely new forms of production appeared, stimulated by cosmic research. Among these are new power sources, electronic devices, fuel reservoirs, plastics, alloys, materials which are stable to high temperatures, pressures, or corrosion, etc. In connection with mastering the cosmos, hundreds of new professions have appeared, the growth of these continuing at a rapid rate. All these facts indicate cosmization of manufacturing activity, an expansion of the forms and directions of non-geocentric practice.

Growth of cosmicized production in the future will lead to involvement of a raw-material basis for cosmic objects and energy for cosmic processes in the sphere of interaction of society and nature, and to the origin, not of cosmicized, but inherently cosmic production. Elements of such production already are emerging on artificial earth satellites (welding, assembly, etc.), and then will appear even on the Moon. In the future, cosmic production will attain such a growth that terrestrial industry probably will turn out to be only one of the insignificant foci of human activity in the Universe.



Basic Cognitive Relationship. S) Subject of knowledge; O) Object of knowledge; C) Conditions of knowledge. Interconnections and mutual effects of parts of the cognitive relationship are shown by arrows.

It is quite clear that the developing cosmization of production serves as the material basis on which further broad cosmization of science leans and will lean. The appearance of cosmicized production and its forerunner, rocket--cosmic technology, opens up before science vast growth horizons, and gives new means for an accelerated and, in principle, limitless knowledge of the world. As Academician G. I. Petrov has correctly noted, the main thing consists in, "that man should acquire a new means of learning about the surrounding world, a new instrument for scientific research. He can change the whole course of human history."[7]

Entry into the cosmic era indicates that a radical revolution is taking place in the history of society, that there is not, and cannot be, a return to geocentrism as a form of societal practice and knowledge. By force of its material needs, mankind is obliged to rise on the cosmization route, to discard the thousand-year-old chains of geocentrism, and to lay out the difficult route into the limitless spaces of the universe.

Cosmization of the Cognitive Relationship

Cosmization is not a partial process which embraces some limited sphere of human activity: it is common and necessary movement which is gradually

[7]G. I. Petrov: Kosmicheskiye Issledovaniya v SSSR (USSR Space Research), Moscow, "Znanie" Press, pp. 8, 1970.

embracing all regions of societal labor. However, consideration of this process as a whole is not the theme of the present article: of more interest to us is the cosmization of science, and primarily in what direction it is developing, to which we shall devote our attention.

Obviously the trends in cosmization which arose historically were subject to some mechanism which is latent in the cognitive process itself. Knowledge enters as the interaction of subject and object. By subject is understood not the individual taken separately (let us say, some scientist), but all society on a definitive state of development as considered from the aspect of its cognitive and practical activity. In the theory of knowledge we term objects those subjects and phenomena of objective reality which, at a given moment of time, are involved in the sphere of the theoretical and practical activity of man. However, a study of the problem of cosmization of science on the basis of the subject -- object relationship alone would give us such simple structures that they would do little to elucidate the essence of this problem. The structure of the cosmization of science is revealed more fully only in the case where we add to subject and object a third competent member -- the conditions of knowledge. It is clear that neither the subject nor the object is isolated from the medium surrounding them, and this latter also exerts an action on the cognitive process. Thus, a complete cognitive relationship appears already as not two- but three-component, and includes not only the subject and object, but also the conditions of knowledge; that is, what does not enter into either the subject nor the object of knowledge. To fully, and completely isolate the object and subject of knowledge from the effect of conditions is impossible in principle. The well-known, recently deceased French scientist, L. Brillouin, has called attention to this.[8] He convincingly shows that the physicist, the astronomer, the geologist, or any other scientist attempts, in his work, to isolate the object studied from external conditions (otherwise, knowledge would be impossible), but in principle it is impossible to achieve this. However, here it is not the natural-scientific aspect of the effect of conditions on the object of knowledge that interests us, but the gnoseological specifics

---

[8]L. Brillouin: Nauchnaya Neopredelennost' (Scientific Indeterminacy and Information), Moscow, "Mir" Press, (1966).

of the interaction of earth and cosmos (as the conditions of knowledge, sphere of action of the usbject, and the location of the object) on the whole cognitive process. So we consider (see Figure on page 10) the cognitive relationship: subject (S); object (O); and conditions of knowledge (C). The effect of the inter-relationship: earth (E) -- cosmos (K) shows up in the fact that the conditions of knowledge can be both terrestrial and also cosmic; the object of knowledge can also be either a terrestrial or a cosmic phenomenon. Finally, the subject (society), while being on the Earth, nevertheless is also cosmicized and emerges into the cosmos. /12

Cosmization of the cognitive relationship is associated with the interaction of all the previously considered components. In principle, a rather complex picture is obtained here, since each such component is cosmicized in very different aspects and directions, and is, in turn, in diverse specific connections with the other components. However, from all this diversity one can separate out the basic directions and forms of cosmization of the cognitive relationship (that is, the relationship of subject, object and conditions of knowledge), as a result of which, of course, we shall simplify the real state of affairs, but we shall gain in the other, since we shall obtain an easily visible structure of the cosmization of science.

TABLE 1. STRUCTURE OF COSMIZATION OF SCIENCE

Cosmization of Science before Era of Mastery of the Cosmos.	1	ES	EC
	2	ES	KC
	3	ES	EC
	4	ES	KC
Cosmization of Science in Era of Mastery of the Cosmos.	5	K_1S	EC
	6	K_1S	KC
	7	K_1S	E_1C
	8	K_1S	KC

See next page for explanations of abbreviations.

Legend of Table 1.

E = Terrestrial; K = Cosmic; K_1 = Being Cosmicized; S = Subject; O = Object; C = Conditions. Letter combinations have following meanings: ES - Terrestrial Subject; KO - Cosmic Object; KC - Cosmic Conditions, etc.

On the basis of the foregoing, now by purely formal means we are able to construct the following relatively simple table (see Table 1).

Such a rectangular table, made up of elements of an arbitrary nature, in mathematics is called a matrix. It is necessary that all identical symbols (signs) in the table should have one and the same meaning. This condition is not always fulfilled in our case; therefore we further stipulate those cases where the table is transformed into a matrix.

We shall attempt further to explain how it is possible to consider the lines in the table obtained as trends, one way or another, in the cosmization of science, associated with astronautical and astronomical stages of knowledge of the universe.

Cosmization of Science Before the Era of Mastery of the Universe

Let us start with the first half of the table (lines 1-4). It turns out that this half basically characterizes the astronomical stages of the cosmization of science - that is, the basic cognitive situations which were observed before the launching of the first artificial earth satellite.

1. The first line of the table depicts the cognitive situation in natural science which initially arose and then became traditional: a terrestrial subject studies a terrestrial object under terrestrial conditions. This is a very important and moreover typically geocentric case of human connections with nature, which was absolutized for a long time.

2. The second line can be interpreted as a study of the effect of cosmic conditions on terrestrial objects. This, for example, is the effect of sunspots on the magnetic and electrical fields of the Earth, on its atmosphere, etc.

3. The above-mentioned examples of the effect of extra-terrestrial factors on terrestrial objects are mainly associated with physical fields and radiations. However, cosmic matter in the form of meteorites and meteor

particles penetrates the atmosphere of the Earth, and even reaches the surface of the planet. Knowledge of such phenomena is generalized by the third line of the cosmization table.

Meteorites were apparently the only large "visitors" from the cosmos (which penetrated to the earth by natural means) that were available to science before this time. Running somewhat ahead, we note that the onset of practical cosmonautics opened up boundless possibilities in this direction. Now we no longer rely on the "kindness" of the cosmos, for we can actively redirect the cosmic objects that interest us directly to the Earth. The first step has already been made: precious lots of "lunar rocks" have been delivered to the earth and are being studied. And although this trend will develop even further with progress in cosmonautics, one should not think that a large part of the cosmic matter must be sent to the Earth, or must be studied here of necessity. In the future it will prove more expedient to study cosmic objects directly in the cosmos, about which we will say more later.

TABLE 2. STRUCTURE OF SELENIZATION OF SCIENCE

1	ES	EO	SelC
2	ES	SelO	EC
3	ES	SelO	SelC
4	Sel_1S	EO	EC
5	Sel_1S	EO	SelC
6	Sel_1S	SelO	E_1C
7	Sel_1S	SelO	SelC

Z = Terrestrial; sel = selene sel = Being Selenized; S = Subject; O = Object; C = Conditions. Lines indicate following: 1) Study of effect of Moon on terrestrial conditions; 2) Study of lunar matter on Earth; 3) Observations of Moon from Earth; 4) Observation of phenomena on Earth by cosmonauts from Moon; 5) Study of selenized terrestrial objects directly on the Moon; 6) Study of possibilities for long-term residence of man on Moon; 7) Functioning of scientific laboratories on the Moon, which have been set up to study its nature.

Perhaps one should also assign to this same trend of cosmization of natural /13
science the simulation of a number of processes and conditions whose originals in their natural form exist principally in the cosmos. Now cosmic phenomena are reproduced artificially (are simulated) on the Earth; for example, high vacuums are generated, powerful radiation or magnetic fields, plasma states of matter, or the like. However, by no means all cosmic processes or parts of them can be reproduced under terrestrial conditions; therefore, the cosmization natural science is terribly interested in the escape of the scientist from the bounds of Earth and its atmosphere, and his approach to interesting objects of knowledge.

4. The following trend in cosmization of science is characterized by the fourth line of the table: this is the classic cognitive situation which is peculiar to astronomy and the complexes of sciences associated with it before the era of mastery of the cosmos - the study of cosmic objects under cosmic conditions by a terrestrial subject. This trend in cosmization was fundamental before flights into the cosmos; it even turned out to be historically the earliest, for the origin of the turn in science toward the cosmos is dated by the revolutionary discovery made by Copernicus in astronomy.

Thus we have considered the first half of the table, which in some degree formalizes the stage of cosmization associated with terrestrial and astronomical means of knowing the world. This half of the table (if one rejects the last note to the third line) characterizes the most important trends in cosmization of natural science before the era of mastery of the cosmos.

The transition from the astronomical stage of cosmization to the astronautic sharply intensifies the movement of scientific knowledge away from geocentrism. Society, as a subject of knowledge using only terrestrial or astronomical techniques, has only limited possibilities of knowing nature. However, the appearance of new forms of practical interaction of society and nature in the form of rocket-cosmic technology sharply increases the cognitive possibilities of mankind.

The Cosmization of Science and Astronautics

While the first half of the table of trends in cosmization is characterized by cognitive situations with a terrestrial subject (ES), the lower part gives four elements with a cosmicized subject (K_1S), which means a departure of the cosmonaut-scientist (or device) past the limits of terrestrial conditions. It is precisely this feature which is creating new trends in the cosmization of science.

5. One of these is symbolized by the fifth line of the table, in which the following cognitive situation is formalized: a cosmicized subject studies a terrestrial object under terrestrial conditions. For example, the scientist-cosmonauts can study terrestrial objects either from artificial orbiting stations or from natural celestial bodies. The use of artificial Earth staellites offers the possibility of considerably improving short-term and long-term weather forecasts; of measuring land, sea, and atmospheric temperatures; of photographing cloud cover; and of following snow and ice formations, precipitation zones, hurricane formation, etc. A single long-term weather forecast using satellites permits the U.S.A. to save 2.5 billion dollars per year. Moreover, each year 700 million dollars are saved which were spent in making maps; now the same work can be done using satellite photography. However, staellites are necessary not only to meteorology and geodesy, but also to the whole complex of Earth sciences. Thus, infrared satellite photography assists in detecting foci of disease in forests, the composition of soil, sources of water, migration of fish, etc. Thanks to astronautical means of knowledge, terrestrial phenomena have come to be studied on a global scale, which was either impossible or greatly hindered before the launching of cosmic devices.

6. The next trend in cosmization of science is associated with the study by a cosmicized subject has become rather common in connection with the launching of Earth satellites, interplanetary automatic stations, and manned spacecraft. In fact, to successfully master extra-terrestrial space, it is necessary to know how the cosmos will act upon terrestrial objects (under the conditions of cosmic flight) borne by a rocket beyond terrestrial limits

This is undoubtedly one of the main trends in cosmization of science, tied in with the contemporary stage of mastery of the Universe. The cosmos is characterized by a complete vacuum, powerful radiations, weightlessness, meteroic particles, etc. Under these conditions, terrestrial objects behave differently than under earthly conditions. And this affects the solution of technical and medico-biological problems on space flights, for one is obliged to solve problems of lubrication, welding, heat-transfer, use of liquids and gases, life preservation and safety of living beings, construction of cosmic bases, manufacturing organization, etc. differently from on Earth. Moreover, one must also study the effect of cosmic flight factors (overload, noise, vibration, micro-climate, etc.) on technical devices, materials, animals, and man.

7. The seventh line of the table is concerned with a cosmicized subject studying a cosmic subject under terrestrial conditions. This reminds one of the cognitive situation formalized in the third line (ES-KO-EC), but with the difference that the subject of the knowledge is already in the cosmos. Here one has in mind particularly a study of extra-terrestrial objects which interact with the Earth, from the cosmos. Moreover, in the process of mastering the cosmos, the problem arises of creating conditions which are close to terrestrial ones directly in the cosmos, which is necessary for extended residence of man outside the limits of his native planet. Therefore the task arises of studying the possibilities of creating such conditions on cosmic objects (let us say, on the Moon, Mars, or Mercury, etc.) and of investigating their interactions with cosmic phenomena.[9] /14

Another picture may also be presented, where there will be as cosmic subject, not our civilization but another cosmic civilization, which transmits its scientific information to inhabitants of the Earth and observes its effect. Up till now we have spoken only of terrestrial man gradually leaving the bounds of his planet; that is, of the cosmization of the subject of knowledge

[9]Here the symbol "E" is interpreted otherwise than in the other elements of the table. All these divergences from a single value of the symbols indicate the complexity of the process of formalizing the cosmization of science, for formalization always encompasses only part of the content of the phenomenon being studied.

in a completely definite direction. But, as a matter of fact, in connection with mastery of the cosmos, understanding the subject of knowledge as man earthly in origin, in the future (possibly still very far off) will not satisfy the cosmicizing theory of knowledge. The traditional subject of knowledge (human society) in perspective will emerge as a part, a subsystem of a more general image system; the subject of knowledge of some hypothetical whole, of the entire social growth stage in the universe.

8. As concerns the eighth line, here we do not encounter any "terrestrial" symbol. A cosmicized subject studies a cosmic object under cosmic conditions. However, the sign K_1 can be interpreted in this case as a cosmic subject, bearing in mind the other cosmic civilizations which also comprehend the world and in this sense are a subject differing from terrestrial man in the theoretical-cognitive aspect which interests us. Here this value of the symbol K_1 can be inserted into the other elements of the first column of the second half of the table.

Since, in this case, all the E and K symbols will be used in one and the same meaning, the table may be considered as a matrix wherein the letters can be replaced by numbers (for example, the elements with the letter K are replaced by 1; and the elements with the letter E, by 0). The eighth line characterizes the ideal to which final rejection of geocentrism leads: from "being cosmicized," science is converted completely to cosmic. But this does not at all mean the cessation of the cosmization process - in fact, it is necessary to surmount other centers of knowledge, to go over, according to the expression of H. Shapley, from geocentrism to galactocentrism, and, in the future far removed from us, to discard even this last "centrism".

Naturally, the cosmization structure considered characterizes only the contemporary stage of the inter-relation of society and the cosmos, and in the future should be replaced by another. If the table suggested here (the matrix) for cosmization characterizes mainly the overcoming of geocentrism, then corresponding tables (matrixes) can be constructed too for other centers of knowledge, where the Earth will be replaced, say, by Venus, the Sun, etc. Finally, using cosmization tables (matrixes) one can study some definite directions in cosmization, for example, selenization (the effect of studying

the Moon on science - see Table 2), aresization (the effect of Mars), and the like. One must construct as many of such tables (matrixes) as there are centers of knowledge (for example, planets). To take into account the effect of study of all planets on earthly science, one must already consider rather complex cosmization structures.

At the present time, such sciences have appeared as cosmic physics, cosmic chemistry, astrogeology, astrogeography, cosmic geodesy, cosmic meteorology, cosmic biology, etc. Although they still appear as additions to their terrestrial predecessors, their appearance indicates the main route of scientific progress - the route of cosmization. Contemporary natural science is not satisfied by purely terrestrial contemplation and is entering into the era of its "cosmic being".

The outstanding attainments of cosmonautics are shifting the interest of contemporary science (especially natural science) more and more strongly in the direction of cosmic problems. A characteristic evolution in the thought style of naturalists is occurring, a transition from geocentrism to cosmic world understanding. Simultaneously with the process of rejecting geocentrism for concrete sciences, a reorganization of natural-scientific thought is taking place, and cosmic motives are penetrating into all spheres of the theoretical mastery of the world.

The cosmization of thought reflects an objectively occurring cosmization of living, it reflects the interaction of geocentric and cosmic opposites on the logical level of scientific knowledge. A deep and thorough-going study of this specific and important feature of contemporary natural-scientific thought and discovering its role in constructing scientific theories makes up one of the urgent problems of Marxist-Leninist philosophy.

REFERENCES

1. Gagarin, Yu. A. and V. I. Lebedev, "Man's Conquest of the Moon," *Voprosy Filosofii*, No. 3, 1966.
2. Petrovich, G. V., "The Assault on the Universe," *Vestnik Akad. Nauk SSSR*, No. 4, 1966.
3. Ursul, A. D., "Conquest of Space and Progress in Production," *Voprosy Filosofii*, No. 3, 1964.
4. Faddeyev, Ye. T.: "Features of Modern Natural Science (An Experiment in Philosophical Analysis), in the collection: *Zemlya vo Vselennoy* (The Earth in the Universe). Moscow, "Mysl" Press, 1964.
5. Faddeyev, Ye. T.: "Man and the Universe," *Kommunist*, No. 3, 1966.

Translated for the National Aeronautics and Space Administration under contract No. NASw-2037 by Techtran Corporation, P. O. Box 729, Glen Burnie, Maryland, 21061, translator: J. K. Lawson Jr., Ph.D.