TWO ARCHETYPES IN THE PSYCHOLOGY OF MAN

Izrail Moiseevich Gelfard

This lecture is important to me. I am very grateful for the opportunity and privilege of giving it, especially since it is one of the few occasions in which my lecture is not a professional one in either mathematics or biology. Such an occasion has occurred only two or three times in my life—and this is the second time I am giving a talk in Kyoto—a city which I like so much and which made a deep impression on me when I was here a half year ago.

Perhaps Kyoto materializes the statement of one of the clever philosophers, who said that one of the important features of Japanese culture is that it absorbs new things while not forgetting or discarding the old.

I don't think I am going to tell you anything new. But this lecture has become a pretext for me to think over and write down certain ideas, and to express more clearly some of my thoughts, which I have been carrying around with me for many years. These thoughts have accompanied me in my work in mathematics, cell biology, neurophysiology and in an important domain which has different names: artificial intelligence, system analysis, informatics, cognitology, and many other words about which I cannot tell you their exact meaning, nor the difference, if any, among them. Perhaps the most significant of my works in such areas are my old papers with my friend Zeitlin who died prematurely in the field, let us say cybernetics; and my works with doctors in the last 10 to 15 years, every time working on specific medical problems in which we tried, while solving these problems, to help doctors.

The reason I have the courage to speak about these things is that the structural approach and principles which we developed during our investigations in such different areas as in the mechanisms of the cyclical movements of cats and mollusks and in our experimental work in cell biology were very similar; and, of course, this is not by chance. It seems as if there are some general principles which are common to most quite different living systems. It is hard to find these principles of living systems because it

would be like sitting in a dark room and thinking about the basis of existence. We must, therefore, try to extract these principles from investigations of real systems. In thinking about these questions I would like to work backwards—to start from the end, from the things which I clearly have understood recently while preparing this talk.

I think that there are two archetypes which have been built into man from the very beginning. And these two archetypes constitute a duality which is caused by the contradictions between them. In the psychology of man and society, I would call this contradiction the opposition of two notions—cleverness and wisdom.

In the first archetype, man is regarded as a higher achievement in the evolution of living organisms—the "crowning glory of creation." This notion is widely spread and is materializing thanks to the remarkable successes of technology, biology, physics and so on. The life expectancy of the average man has increased. There is today the possibility of feeding many more people than in the past. In addition, it is fantastic to have the possibilities of communicating by car between the most distant places (also, by fax, satellites), and this unstoppable and unavoidable step-by-step movement, or progress, strongly reinforces and encourages the belief in many people that this understanding (or intellect) of man is unique. Technological and scientific progress is the proof that man is the crowning glory of creation.

In the second archetype, man is a part of all living nature and cannot separate himself from it. And even if he could, it would only be temporarily, and then only with the understanding of the limits of such a separation. Perhaps this is the point which constitutes the difference between cleverness and wisdom. We know so little about living systems that it is hopeless from our understanding of small isolated parts, even though these parts may be very remarkable (for example, the genetic code), that we can guess or speculate about the whole picture.

We are accustomed to admiring even worshipping the powerfulness of man's intellect and identify this with the first archetype. But let me inject a word of doubt about the uniqueness of this first approach. One small example: the spread of genetic diseases depends on marriages between people with close genotypes, close relatives. Our understanding of this became possible because of the remarkable development of genetics, the genetic code, and so on. But I do not know what to admire more—the remarkable achievements of the man who many thousands of years ago formulated the

very complicated rules for marriage without knowledge of genetics but only with general intuition. These rules of marriages were such that they followed the rules of genetics and, as far as I know, there were practically no mistakes in them from the point of view of modern genetics. And we can go on to give an unlimited number of such examples. Of course, this example illustrates that this is not the first archetype. To have formulated these rules for marriage, wisdom was essential, although to be sure, the intellect was also necessary—but the intellect of a sensible man.

There are many such examples because the development of human culture, science and so on is connected with the interaction between these two archetypes. A proper understanding of harmonious evolution depends on our understanding of these two archetypes and of the interaction (or proper relation) between them. There must be a balance and any violation of this balance—in either direction—can lead to pathological development in a human being or in society itself.

The imbalance in the first type—that is, in the direction of the "crowning glory" approach—could be given many different names, but one of the clearest, yet perhaps too narrow an interpretation, is the word "technocrat" and the notion of "technocracy." It can also be called the "mathematical approach" to every living system, the priority of the mathematical model over the real system, whether it is in economics, or in the treatment of patients, or in behaviorism in psychology.

As a reaction against this, another kind of extreme has developed: that is, a rejection of progress altogether, or the claim that progress is harmful—a reflection of the justified concerns of many people about the excesses and extremes of technocracy. I would like to say that as a mathematician, I have thought for a long time that this duality has its limitations because, at first glance, it would apprear that mathematics is typical of the first archetype. But this would represent the point of view of a mole. From the standpoint of an eagle, mathematics clearly belongs to the second archetype as well. Perhaps the development of this thought is very attractive and could merit a separate talk because now there is a renaissance in mathematics and it is time to lift ourselves up and see how both of these tendencies are expressed and how they have affected the development of mathematics in the second half of the 19th and first part of the 20th century. It would be even more useful 10-15 years from now because mathematics will be significantly different from what it is today, and for the reasons which I will relate to

you shortly.

Globalization

One of the most characteristic features of our modern world is this extraordinary globalization which makes many local problems worldwide. The development of technology and the so-called exact sciences, which was begun long ago, has resulted in incredible successes in many fields. Cars, planes, all kinds of telecommunications have sharply reduced our subjective notions about the dimensions of our planet, and have practically converted our world into a unified system in which all the parts are equally dependent. But we cannot say this globalization has affected the spiritual side of human life in the same way. As a result there is an imbalance between logical, technocratic development (the first archetype), and the development of the spiritual side of life (the second archetype), and this imbalance is growing; it is increasing to the point where it has begun to threaten the existence of mankind itself.

It may be that one of the reasons for this increasing imbalance is precisely the fact that the development of the first archetype—that is, technology—has served as the basis for globalization. Language, for example, as it relates to the first archetype, has become uniform. The words for automobile, TV, airplane, telegraph and so on have become international. However, the language of concepts, which is the language of the second archetype, has remained quite disconnected and stagnant. Also, we have not developed the means of expressing fundamental human values through language. To put it very simply, we have not learned to communicate fundamental human values on a global scale. And the consequences of this disproportionate development of globalization presents us with a frightening danger—technology moving in one unified global direction while the expression of human values that we all share remains undeveloped.

As I have just stated, modern technology has transformed the world into a unified system. The production of food and supplies of energy have increased immeasurably. But we must ask ourselves—is at least one of the “eternal” problems we face solved? After all, everything in the living world (in the world of living organisms) is interconnected. Developments in biology, for example, the discovery of antibiotics, have permitted us to solve the problem of venereal diseases. And this, together with the

emergence of the industry of birth control, has lead to the so-called sexual revolution. But apart from bacteria, there are also viruses. I am not implying that God punished mankind with AIDS, but there is a formidable danger standing right in front of us which we carelessly and recklessly underestimate.

I am reminded of a cartoon in a newspaper showing a man walking in the street. Thoughts are floating in his head: “early to bed, early to rise—jogging in the morning—smoking and alcohol are bad for one's health…” And meanwhile, from the 30th floor of a building, a steel box is about to fall on his head.

Now let us change the time scale a bit and suppose that the steel box will take 15-20 years to fall on him. This will replicate how the modern world works. The latent period during which the AIDS virus develops is about 5-7 years, not one day. We are not able to evaluate psychologically, to grasp this timespan of latent development, with the result that all of us and all governments are behaving in a criminal and careless fashion.

I have singled out AIDS as one example. It may very well be that in order to solve the problem of AIDS, along with other profound problems, we will be required to have a unified approach with respect to both the first and the second archetype.

Another matter I want to touch upon here concerns the aggressiveness of human beings. Man has made such incredible progress that disputes and other disagreements between nations have reached new proportions; now all societies warring with one another possess enough resources to annihilate not only one another but all of mankind as well. There are two aspects to this problem, which, of course, everyone understands. First of all, developments in physics and technology generally have by far overshadowed cultural developments. Secondly, human beings remain apathetic and lethargic (lazy) when it comes to reducing the aggressiveness of either an individual or a group. It becomes the moral responsibility of the scientist, faced with the lethargic nature of human beings, to do his best—to aspire beyond receiving prizes and medals—to do his best and delve into an investigation of the deep psychological structures of the individual human being as well as into human societies. And in matters relating to this investigation, the technocratic touch is especially dangerous.

By the way, when we study psychology, the question naturally arises: can that domain called science really reveal the deep nature of the human psyche, or should our investigations in psychology only be set down in literary form? In some limited sense

the works of Dostoevsky may be considered as such.

The global problems I have just mentioned, as well as others, are so important for mankind that we will be compelled to seek solutions to them. And in order to do so, we must understand one another, (we must learn to speak a common language), without which mankind will perish. At this point we come to the question of the language of communications.

Adequate Language

One of the important notions is the notion of adequate language. We have spoken previously about the existence of two archetypes, about the dualism caused by the existence of these two archetypes and about the undesirability and inadmissibility of restricting ourselves by either of these two archetypes. One should not think that the contradictions between these two archetypes can be eliminated by artificial means. These are two different ways of perceiving the world; they have been built into man from the very beginning and they are obliged to coexist. Adequate language can help them to coexist.

There are two reasons, in my opinion, why the existence of adequate language is necessary. One of them is that globalization, mentioned earlier, causes many different parts of the world which have many different traditions, cultures, and so on to interact and to communicate with one another. And if there is no, what I call adequate language, the misunderstandings which arise are dangerous. The other reason is that this, let us say, contradiction exists not only between different parts of the world or between different groups of people, but between the two archetypes themselves, and the second archetype will be suppressed because the first archetype has many more capabilities. Of course, no adequate language will unify both of these archetypes which are the two sides of man, but adequate language, at least, gives them the possibility of interacting and communicating.

In my lecture I will try to explain a bit about the notion of adequate language. We often do not think about the absence of language which adequately describes some situation. For example, often an article that is logical and without apparent contradictions is very persuasive. History gives us many examples of this use of logic and persuasive charm for evil purposes. And in such cases we easily forget that we were

persuaded by incorrect or inadequate language.

I will illustrate this by giving a very elementary parody. Among the stories about Baron Munchausen, there is one about a hunting dog. The Baron tells us that the dog was so good at hunting that even when it died, he had a jacket made from its skin, and during a chase, this jacket propelled him towards the hunted animal. And while approaching the animal, the buttons fell off the jacket and shot down the animal. "You can see for yourself," the Baron said to his listener, "there is not a single button left on the jacket."

Logic works perfectly well once mankind has developed adequate language. But logic is helpless if it has to develop this adequate language. The development of such language is not a logical procedure. And certainly, common sense is involved. Just as a good doctor in the treatment of his patient cannot substitute a model of a brain for a real brain, or a model of the heart and nervous system for a real heart and nervous system, so too, in the development of adequate language, we must use common sense. There are, however, many areas in which substitution can take place. The mistake we make is that we have omitted the notion of adequate language—and this is a defect in modern technocratic thinking.

Going back to my work with doctors, I have come to realize that a mathematician is compelled to understand and to sense those medical things that he is investigating in order to talk to the doctor in the language which he understands so that together they can work and formulate basic concepts. At least these concepts in some limited way may really serve as the basis for the future logical framework and its experimental verification.

We have come to the necessity of developing the system of using questionnaires which give us an adequate description of every individual patient. And we have developed this special method of developing these questionnaires. These questionnaires must satisfy two conditions: (1) they must be concise (conciseness is a necessary condition for adequate language); (2) they must give—as much as possible—a broad and adequate picture of the patient.

In the process of developing these questionnaires and the verification of their adequacy (using a comparatively large number of patients), we formulate the words (the concepts) which then became the basis of adequate language in this particular case. The

composition of this questionnaire, as it relates to the narrow area of diseases, took a lot of time, at least several years.

For more details on this subject I would like to refer you to the book *Outlines on the Joint Works of Doctors and Mathematicians,* Moscow, 1989, which was written by myself in collaboration with B.I. Rosenfeld and M.A. Shifrin.

I would like to add that this difficult and thoughtful work would have been impossible for me without the enthusiasm and dedication of a small group of my friends and students.

As for the formulation of adequate logic, there must be a language which does not impoverish the real situation.

It is terrible that in our technocratic age we do not doubt the initial basic principles. But when these principles become the basis for constructing either a trivial or finely developed model, then the model is viewed as a complete substitute for the natural phenomenon itself. And the better the model, the worse it becomes for its applications. Indeed, the pressure of snatching "initial principles" will lead us to use the model well beyond the possibilities of its application.

By developing adequate language we can, to some degree, overcome the contradiction between the two archetypes. With the help of adequate language, all the main (even intuitive) notions of the second archetype, can be transformed into the object of further logical analysis. At the very least, it will be possible to understand the role and the value of matters which are available for this analysis under a unified approach not only of the first, but above all, of the second, archetype. What is significant here is that thanks to adequate language, logical constructions become intuitively and artistically understandable. The result is—and this is even more important—that adequate language itself has the possibility of verifying whether or not these logical constructions have been used beyond the limits of their suitability.

Adequate Language in Mathematics.

If we direct our attention now to the history of science, then perhaps Euclidean geometry serves as one of the most beautiful and wonderful examples of adequate language. Indeed, people always had to deal with the problem of building the model for demonstrating the spatial relationships of our world. Some time before Euclid this was

done in the following way: a picture was drawn with the inscription—"*Look*." The language of Euclidean geometry has been in existence for some 2,000 years and it has become so essential that all school textbooks are written in this language which is adequate for this formulated problem, notably, the understanding of the spatial relationships of our world. We have to rigorously distinguish between the axioms of Euclid and what we understand today of modern axiomatic geometry (due to Hilbert and others).

For example, Euclid has an axiom which, from the point of view of modern mathematics, does not make sense. "A point is an object which has neither length nor width." Now, from the point of view of adequate language, (for example, our rules, those which we have developed while working with doctors) this axiom is clarified; the concept of point must be explained to another person in such a way that he understands exactly what you are talking about, that is, in a way that makes the same image emerge for both of you when discussing this notion.

One of the fundamental works was one by Hilbert in which he showed, from the point of view of modern logic and mathematics, how to purify the axioms of Euclid and make our understanding of them very precise. He got rid of whatever did not make sense (from the point of view of modern logic, for example, the axiom given above) and constructed the axiom so that it became practically flawless. Axiomatic geometry was placed into a logical, non-contradictory framework. This has been invaluable in our approach to computers. It is even possible to say that from such a point of view the paper of Hilbert can serve as a predecessor for papers on computers, because in every instance he wrote formal laws, which if desirable, could be fed into a computer.

According to Hilbert, anything could be called a point, a plane or a space as long as the axioms concerning their connections are satisfied. This has been a great achievement for science. You can call a point a plane, a plane a point (in projective geometry) which explains the duality. But this is quite a different problem from the problem of the structure of geometry.

For the main things, Euclidean geometry is relatively sufficient even today. I say this on the basis of my 50 years of experience in teaching. School textbooks on geometry suffer from many defects as far as formal logic goes: not everything is proved, and there are no precise criteria for distinguishing facts which require proofs from facts

that do not. But thanks to adequate language, the following occurs—and I can hardly explain it. When you ask several students “how can you give a rigorous proof?” then all the answers coming from quite different parts of the country will more or less coincide. This is the result of some gentlemanly agreement which is reproducible from person to person and does not “depend on the hospital” as we would say when we are working in medicine.

Of course, after the student has learned the geometry of Euclid, we would have to go to the next level if we wanted to train him as a mathematician; that is, for him to understand geometry as a logical, non-contradictory system. By the way, this next level is also in some sense the level of the modern programmer, who, up until now, uses only precise data for the computer. The main task here is to find a way to have adequate language to express the intuitive feeling for the surrounding space and living in this space, and to make a correspondence between this intuitive feeling with the structures of geometry.

Let us also note that in the mathematics of the 20th century, adequate language is very often obtained through the axiomatic approach. Prior to the 20th century, the axiomatic approach was a real event and used only in a few cases, for fundamental things (such as in geometry, axioms for the group, and so on), but today, as we have said, we are accustomed to using this axiomatic approach quite often. One small example here. The ingenious mathematician Grothendieck used the notion of trace in algebraic geometry. But instead of constructing formulas for the trace, he presented a system of axioms.

A few final remarks on this matter. Mathematics has become increasingly necessary in the development of physics, mechanics and so on. And the language of mathematics for the field of physics has become more and more adequate. It is quite understandable why a lot of mathematicians are attracted to connecting mathematics with biology, psychology, economics, sociology, and so on; this is because in their subconscious, they understand that mathematics can also be useful in the development of these other disciplines. Mathematical language is, of course, adequate for the techniques of physics and so on, but a word of caution is necessary: it is absolutely dangerous to insist everything have a mathematical structure. The experience of a good mathematician in those domains mentioned before—biology and all the rest—is very

important, but with the condition that the mathematician have common sense, together with an understanding and feeling for the domains to which he is applying mathematics. For example, take the case of putting together (constructing) a portrait of a criminal. We can ask some adequate questions, after which we can draw and even recognize the person. And this is clearly a much better way to proceed than trying to take the coordinates of the person's whole head.

Structuralization

Another important notion is that of structuralization and structural approach. In the notion of structural approach, the elementary level is the structural unit—the monad. There are different words for structural units. In neurophysiology, this notion was introduced by the remarkable Russian N.A. Bernstein and developed by Zeitlin and myself under the name “synergy.” In cell biology, the typical example of the structural unit is the cell, or in neurophysiology, a group of cells which are responsible for movement. For example, the set of neurons in the spinal cord which is responsible for locomotion, scratching and other cyclic movements. It is interesting to remark that in a mollusk called a sea angel, only a few tens of neurons (from 20 to 60) are responsible for the cyclical movements, while for a cat performing the same movements, a huge number of neurons are required. Yet, in both cases the scheme (or system) of interaction of these neurons is the same. I would like to refer you to the book of Yu.I.Arshavsky, I.M.Gelfand, G.N. Orlovsky entitled *Cerebellum and Rhythmical Movements,* Springer-Verlag, Studies of The Brain Function, Vol.13, 1984.

The structural units must satisfy three conditions:

(1) the inner structure of the structural unit is much more complicated than the way in which it interacts with the outside world;

(2) a part of a structural unit is not a structural unit;

(3a) the principle of reduction: the parts of the structural units which do not function are eliminated, as for example, in the process of evolution; or alternatively,

(3b) the principle of abundance; the nonfunctioning parts of the structural unit manage to find a job within the structural unit

There are many interesting examples of types 1,2,3a and 1,2,3b in biology, sociology and so on. In the example of a cell, conditions 1 and 2 are fulfilled because the inner

structure of a cell is much more elaborate than its way of interacting with other cells; and (2) part of a cell is not a cell. Now if we speak about (3a) and (3b), it is interesting to compare how the same structural unit is relized in both invertebrates and vertebrates.

It is very interesting to see the difference between the principle of reduction (3a) used in the case of invertebrates, where a priori every element has a given structure, and the principle of abundance (3b) for vertebrates, For verte brates, which have the principle of abundance, you have the condition that every element of the structural unit tries to have a job; this permits some function which has not been foreseen. In this principle of abundance, 3b, maybe there is the hint of the second archetype.

Permit me the following analogy to illustrate what I have just said. Let us imagine a group has been formed to solve some well-posed problem in which all the principles are known: the problem of improving a new model for a car. In this case all the members of the group must have a precise task and everyone performs some definite function. And now, let us also imagine that there is a group which must solve another kind of problem, a problem that is vague and not well posed. For example, to have a new type of computer which will work on completely different principles. In this case the principle of abundance is absolutely necessary. And the members of this group must be active, talented people; and each person will have to find his own job (3b). From this group we can wait for and expect unpredictable solutions.

The Responsibility of Mathematicians

The first responsibility of the mathematician is to use his experience in mathematics, especially the mathematics of the 20th century, to broaden the possibilities of constructing adequate language for different parts of science and society. And the first step, as I said before, is to find the language and structure for living systems—different aspects of biology, economics, psychology and so on. I am an optimist and believe that in this still very backward area much will be done, especially in this age of computers. The dissemination of computers will slowly but surely change the psychology of mathematicians, and help them to go towards non-formalized living systems.

But, it may be that the more serious responsibility lay, as I have already said, in resisting the dangerous and careless usage of exact mathematical and logical systems

outside of their suitability. For lack of time, I have not gone into detail here, but I want to say once more, that in the first drafts of my talk, this was perhaps one of the most important points. There were many examples of this, and maybe there should be a special lecture about this because who, but a mathematician, can help to diminish the dangers of the senseless usage of mathematics in our technological age.

What New Things will Come from Mathematics?

I want to mention two of them. The first new thing is a very old one and has been on the backburner of mathematics—it is combinatorics. And the second thing is that there must be a radical change in our notion of space in connection with quantum gravitation and so on.

Adequate Language for Global Problems

I have already explained how long it took to develop adequate language for concrete problems in medicine. Maybe I lack the courage to insist on finding adequate language or languages for global problems. But the globalization of all human problems makes it absolutely necessary to develop such languages that can be applied to different social structures. From my experience I understand how infinitely difficult a task this is. The only thing I know is that there are some important words in this language—words like “conscience,” the absolute value of human life, respect for spiritual values, respect for nature, and the refusal to use aggression as a means of solving human global problems. But without such adequate language, we cannot solve any of the problems of the modern world. And without adequate language, we cannot understand the duality of the two archetypes on which depends the harmonious balance of society, science, and culture.

About Japanese Culture

I understand the ideals of the Kyoto Prize of the Inamori Foundation are very close to the thoughts which I tried very had to explain, using my own experience, in this talk.