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SUSTAINABLE DEVELOPMENT:

NATURAL AND SCIENTIFIC PRINCIPLES

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PREFACE FOR THE TEACHER

> I am not interested to know who takes laws or makes profitable international *deals* — *because I am able to write a textbook.*
>
> P.Samuelson

1. What is this book for?

The epigraph given here imposes a high responsibility on us. Thus, before starting this book we asked ourselves, "What books or works would we like to be guided by?"

Why did this question arise? It is very simple. A textbook is one of few documents that reflect scientific outlook. That is why we feel so highly responsible to the generations and generations of specialists — citizens of the society to come.

While spending years and years mastering sciences we discovered that those subjects and courses that helped us, young as we were, fill the gap of links between belief, knowledge, understanding and ability to produce really working systems made most vivid impression on us and proved to be of real use.

Nowadays everyone needs to overcome these gaps, but it is students who need it most of all and we would like to help them.

We decided to write this book in hope to share the admiration that we used to feel when we were younger and that we still feel for works helping to realize the Unity of all parts of thinking — unity of belief, knowledge, understanding and ability to do. It is those works that constitute the backbone of our book.

Generally speaking we expect students using our book to discover new creative prospects and opportunities of practical use.

We grew up in most amazing and not trivial time when incompatibles were combined; when historical background of the country, its present and future were disintegrating and tangling into a knot of contradictions that most often was beyond understanding. The impossible seemed to become possible and real opportunities were razing like card houses. People **trusted** to words and were constructing *a common house* having only "phantom" knowledge, without any "drawings" of this house and real tools for constructing.

Now we know that it is impossible to build a house without a substantial project. The house may fall down.

It isn't enough to believe, to know and understand — you must also be able to do.

To be able to do is to be able to design and realize the project of a future system which you don't have yet but need to have to survive and create conditions for development

However, you can't design a project unless you **believe** it's real and **know** and **understand** how to design it.

The history of mankind saw many global and local crises, conflicts and wars. However, none of those has ever *brought our civilization to the verge of extinction and the issue of the Earth's limited dimensions* required professional experts able to project future development.

In the absence of a consistent unified theory the existing notion that some countries are steadily developing may probably cause the same strategic mistakes in the choice of the way of development.

There are two spacetime prospects to determine the choice:

1. The Earth is a closed system and the only place to live in. This postulate implies the limits of development which, in their turn, give rise to genocidal ideas (one of these is that only one "golden" billion of people is worthy of living on the earth).

2. The Earth is an open system and everything living on it is a cosmic phenomenon. This postulate implies sustainable development not only on the Earth but also in Space.

As there is no room for mistake, it is most important to understand: "What is the essence of the system we live in? How does its development sustain itself?"

These are the key questions. They are very exciting for everyone and very intriguing for the students as they are closely connected with the place we occupy in this system.

These questions we studied in the book "The nature—society—man system: sustainable development" published together with Pobisk G. Kuznetsov.

He is gone but his creative spirit is alive and we try to convey it to our successors. Many ideas and postulates from that book have become the foundation for the given textbook and served as its guiding star.

We would like the creative spirit of scientific research to help educate people who are able and who realize their ability to make the impossible possible.

In the preface to the book we gave an example from our personal experience.

We were destined to start our scientific career in the 50-ies with the "earthly" problems of geology. The next 40 years we spent doing research, development and organizing some complicated systems.

One of us was devising the Global information system that connected space with the atmosphere and the Earth (the "GEOS" system).

The other provided the scientific supervision of the development of life support systems for people in space.

The third one was creating a complex of dynamic models to control sustainable development of social-economic systems.

The problems and systems seem to be completely different. What was in common between them?

Every time before starting work we faced one and the same situation when it was considered impossible:

1) to devise a system to explore the relationship between cosmic and earthly processes:

2) to devise a system of life support for people working not only on the earth but also in space;

3) to devise a system to control the processes of sustainable social-economic development conforming to the laws of nature.

Nevertheless, provided these systems have been devised, what used to be impossible becomes possible.

Now what is the process of turning the impossible into possible?

This process is called creation.

As an example of creative work here we mentioned devising a certain type of systems but there is not a single type of reasonable human activities that is not creative.

The process of searching for, taking and realizing the solutions of various environmental, economical, financial, social, legal, political and other sorts of problems **is a creative process.**

This process bears its inner logic and that logic provides transition from the impossible to possible.

Studying that logic suggested the idea that the process of "research" and the process of "construction" of various systems are just two different terms to denote a unified integral process of **projecting the future** world.

Naturally, it is a very serious problem. It is impossible to work it out without well-qualified personnel. There is an infinite variety of careers for the students to choose from.

Now a few comments on how we understand the target of projecting.

The target of projecting is to make certain changes in the constituent parts of the environment so that the **world** as a whole would be sustainable.

In philosophy this principle runs like this: **"everything changes and stays unchanged".**

In mathematics this principle is called transforming of partial coordinate systems with invariant.

Various aspects or parts of the world — are partial coordinate systems, and the world as a whole and its fundamental laws — are invariants (i.e. rules of sustainability). The process of searching for and implementing of necessary changes is a creative process of transforming of partial coordinate systems with invariant. These transformations cause changes in the parts but the whole stays as it was and keeps on **working** actively.

The whole book is to survey this process.

We make it obvious for the students that this process originates from **ideas**, and its target is to turn the idea into a working construction that will give the society new opportunities to satisfy its demands both current and future ones.

Using numerous examples from various fields — philosophy, mathematics, physics, chemistry, biology, ecology, economics, finance, politics — we explain to the student that **creative process** is the process of **conservation of development** that has been being demonstrated to us by **all the history of mankind.**

We give students an opportunity to understand that before admitting the necessity to implement an idea it is necessary to

estimate its reasonability in terms of its **contribution into growth of opportunities** for both a part and the whole.

We explain that in case this estimation cannot be practically done it will take longer to materialize these ideas which will result in slowing down the growth of possibilities of the society as a whole, and, hence, the satisfaction of demands of its members. We show to the student how to do it.

Of course, in every particular society (or community) it is done in a different way.

However, the society that is able to use ideas occurring in the mind of an individual to increase the possibilities for the society in general and using the increase of possibilities of the society as a whole to form the individual who is able to generate new ideas — **will be the fastest to increase its possibilities.**

It is a key principle in the theory of sustainable development that is valid for any society whatever its political background and dominating form of ownership are.

Meanwhile it should be pointed out that it would be totally wrong and discrediting the very idea of sustainable development to consider the sustainable development of the society without taking into account the fundamental laws of nature. Why are we so categorical? Anyone had plenty of chances to be convinced of the truth of this assumption.

Thus, when devising the global communication system "GEOS" we had to process a lot of data of satellite observation of physical fields of the Earth. The results of the survey revealed the relationship between the self-organization of the Earth and outer control of Cosmos. The Earth is an open wave dynamic system and there are reasons to consider this system to be "an Ideal Machine" that works in accordance with the universal laws of nature.

When developing systems of life support for people working in space we had to devise a machine which will enable a man "to live and work well" without breaking the laws of nature.

When developing a variety of systems of control of social and economic processes we realized that all sorts of critical and conflict situations result from disagreement of decisions and programmes with laws of nature.

Thus, to provide a sustainable development it is necessary the decisions taken in various fields should comply with the dynamics and natural laws.

Throughout our book we keep explaining to students how to do it.

People of different professions are distinguished by their unique outlook and thus answer these questions in their own way.

A philosopher, a mathematician, a physicist, a biologist, an ecologist, an economist, an engineer, a sociologist, a lawyer, a politician — representatives of different professions have their own outlook, their theories, their methods.

It all should be learnt and it is taught to students. The summands of this sum are so miscellaneous that they hardly ever subject to adding. A student has a "jigsaw" idea about the world and does not have any integral working construction.

On the other hand, today's numerous extremely complicated environmental, economical, social, legal and other sorts of problems equire clear understanding of what they have in common **that makes them closer and connects various** subject fields being present in every discipline whatever it is called.

One queer fish can ask so many questions that a thousand of wise men will fail to answer them. Nevertheless, as a philosopher put it, the answer to questions left without answer is the questions asked in a different way.

That is why the question as to **what should be done and how it should be done** to develop steadily **is put in a different way: what should be measured and in what way it should be measured** in the system nature—society—man in order **to retain the development of the whole system.**

This is the major question. That is why it is to this or that extent considered in every chapter: in philosophy, mathematics, physics, economics, finance, politics.

Why we reckon this question to be the most important one. N.Kuzansky seems to have put the idea into words very well back in the 15th century: "**The intelligent** man is the measuring man".

It might appear to be one of the reasons for the World Business Council for Sustainable Development to adopt the following motto: "All that can be measured can be achieved. And all that can be achieved is measurable." There is hardly anything to add to it.

Having studied this book, the student will acquire not a sum but a system of basic scientific knowledge and awareness of **what and how it should be measured** to devise a working construction in any branch of practical activity.

As a basic system of values in the book we use the so-called LT—system of Bartini — an outstanding scientist and aircraft designer whom Sergei P.Korolev considered to be his teacher. In this system all known physical parameters are expressed through integer (positive and negative) degrees of length and time that allows the possibility to see the world **differently.**

Students closely study this system and we expect them to enjoy its amazing beauty and transparency.

One of the serious benefits of the system is that (like in Mendeleyev's table) in a very illustrative and standard way you can

represent all known laws of nature in it and, moreover, see all "blank" spots awaiting for new discoveries.

In general there can be as many laws of nature as there are physical quantities. However, of all known quantities we use power as a basic one and show that like a rod it is piercing the whole system remaining invariant. We are going to explain this idea.

Why the power and not any other quantity? Let's say mass, for example?

The choice of the power is not accidental. It is determined by serious arguments that are to be considered practically in every chapter of the book. Let's consider several illustrative arguments.

Firstly, "why not mass?" The point is that J. Maxwell's idea of the dimensionality of mass being its volume with angular acceleration is wonderfully realized in the LT—system of Bartini. The justification of this idea can be found in the chapter "Physics". It means that in reality we deal with various space objects varying in time. "What of that?" you may ask. No hurry.

Secondly, being most common at present, power is in the "apex" of hierarchy of quantities in the LT—system. Theoretically, using standard rules any quantity can be derived from the power.

Thirdly, the law of conservation of power that was discovered by Lagrange in 1788 and confirmed by J. Maxwell in 1855 is extremely important when open systems covering all known phenomena of Life, social life included, are considered. Here is an "everyday life" example.

One may look for a decision, commit these or those actions, utter or write these or those words, **not having spent a single cent,** a single copeck.

However, you can't commit a single action or pronounce a single word **without spending time and energy.**

The amount of energy in unit of time is power.

Power is the possibility to act in time or capacity for work in unit of time.

A famous economist of the XIX century Alfred Marshall believed that "Economics study normal vital activity of the human society". A well-known in this country American economist Gregory Mankiw from Harvard University, the USA, reckons that at the end of the XX century "the definition of economics given by A. Marshall is still valid".

That means that modern economics studies normal vital activity.

And what if the activity of society is not normal?

The world scientific community admitted the global system being in a system crisis. Apparently, one can't call this state normal. Hence, it is not the subject of economics?

Then the subject of what science is the abnormal vital activity?

It will not be discussed what normal and abnormal vital activity is, but it should be noted that the preliminary study of this issue showed that normal and extraordinary vital activity differ like balanced and unbalanced relationship of society and nature do.

The answer to the question seems to be obvious.

The science that studies the disagreement between society and nature is ecology.

But it is not that simple.

A closer study of the issue revealed that the relationship normal / abnormal cannot be considered without taking a Man into account. There appears a triad: nature—society—man. Three types of connections are obviously present here:

1. society — nature;
2. society — man;
3. man — nature.

The first and the third types of connections are subjects of ecology. The second one is the subject of humanities (not only economics). But then another question arises: what science studies interconnection and interaction in the system nature—society—man?

That is how the problem of synthesis of sciences and humanities arises. The essence of this problem is commensurable relations between natural and social processes (spiritual ones included).

This issue arouses heightened interest of students. A lot of questions are asked and there are no answers to them not only in the textbooks on ecology.

At one of the lectures a student asked a tricky question inspired by the approach to estimation of a human life given by Gregory Mankiw in his "Principles of Economics".*

The question asked by the student was like follows, "Please, say how much Ptolemy would agree to pay for the life of the beloved Kopernik."

Students are cheerful people and whenever they are offered theoretical recommendations that have nothing to do with reality they treat them with a sense of humour.

It should be pointed out that every science as well as every theory has its limits. These limits are determined by the language and basic principles of the given science. The problem is that an infinite variety of professional languages makes it extremely difficult to perceive and understand the unity of the whole system that very negatively affects the students' knowledge.

When estimating the cost of a human life G. Mankiw proceeds from a very simple everyday assumption: "How much would you agree to pay for your life or for the life of your beloved?" And answers — approximately $10 mln.

Our book could be of a certain assistance in this not very easy matter. We aspired to show that an interdisciplinary language barrier is being overcome when relations between basic principles and concepts of sciences and humanities are established.

In the course of the book we have been showing how to do it.

To be able to do is to be able to measure.

In the book we explain and show how to express basic concepts and principles of sciences, technical sciences and humanities using steadily measurable quantities thus making it easier for the students to master basics of the nature—society—man system.

A student needs to know that beyond measuring relations between natural and social processes it is impossible to justify a single large-scale project because there are no such projects beyond these relations.

Projecting sustainable development — is first and foremost a creative process in the course of which it is becoming clear what and how to measure so that social and natural systems would work **normally**, i.e. like an integral unity.

This seems to be of a definite assistance for the economics.

How to connect different and sometimes contrary views on one and the same world we live in? We need a method. Not simply a set of political, economic or military means and various devices but a scientific method practically verified.

The method is to provide rules of compliance between particular coordinate systems (or particular views) and a set of fundamental laws verified by practice and not dependent on particular views. It is still more important in such a complicated modern world.

The method is to provide us a possibility to make changes in the system, i.e. to pass from one particular system of coordinates

(view) to another one keeping the whole system able to work even though the structure of the system may change.

Why does the method need to have such properties?

The answer is quite easy.

Because this is how the fundamental laws of nature work.

Here is the simplest example. When a body is moving in the space its coordinates are changing but the moving object stays the same. Let us see another example. There exist various frames of reference. When recount from one system into another is being done the standards are changing (the point of reference is different), the system of quantities staying the same. Here is the third example. In the social system the manufactured products keep on being distributed or redistributed. The names of these products are changing. The shares of distribution are changing. Some subjects of relations get more and others — less. Why?

Economists answer the question in a very simple way: "There is only one pie and many mouths".

It is not very conspicuous that whatever the way the "parts of the pie" may change, the equality of the full power at the input and the sum of the power put out and the power lost at the output **always stays unchanged.**

It follows from the law of conservation of power.

It follows from this law that any change of the power which was put out (free) is compensated by some change of the lost (bound) power. These changes are controlled by the full power of the system.

A student must know, understand and be able to use mechanisms of functioning of laws of nature in projecting particular systems. We would like to help him in it.

To this end much attention is paid in this book to the system of laws of nature and mechanisms of their functioning in various aspects of social life. Essentially, the first and the second parts of this

book are devoted to this problem. On studying them a student will get an idea about laws of nature: what they are and how they are organized and how they work.

Our aim is to give a complete interpretation of the scientific bases of the nature—society—man system, as well as to explain the essence of the theory and method of projecting in a most simple and constructive way so that people of any specialization would be able to understand it.

We would like to assure the reader that *there is an opportunity not only to adequately interpret the social-natural world around us but also to purposefully change it without breaking any fundamental laws of nature and, on the contrary, actively using them.*

We are absolutely sure that any future specialist must know, understand and be able to use opportunities discovered by the science for transition to sustainable development of the society in indissoluble connection with the environment of the Man.

Education is the key factor, the lack of which makes this transition impossible.

We are also certain that the care of the generations living about the generations to come means helping to educate people who are able and who realize their ability to create for people's benefit, for the sake of life on the Earth.

The target of the higher education is to give a student an opportunity to make a well-qualified *specialist*, to teach him to *feel responsible for the fate of the country.*

Studying the scientific foundations of projecting sustainable development in the nature—society—man system serves to this purpose.

The textbook we offer is *the first in the home and international practice. We feel privileged and deeply responsible.*

2. What are the distinguishing features of the book?

We would like to point out only two distinguishing features:

a) *Transparent and concise* presentation.

b) *Focus on the student.*

a. Transparency and conciseness.

Obviously, this book may be useful and accessible for a wide variety of readers provided it is clear and concise. Even though it looks imposing, in fact, it is thousands of pages thinner than a combination of traditional textbooks on philosophy, mathematics, physics, chemistry, biology, ecology, economics, finance, technology, law. Only basic principles of the nature—society—man system are conveyed in the book, the essence of logics and method of projecting to provide sustainable development, i.e. something that traditional textbooks lack.

The principles stated in the book make up a rod "fastening together" various subject fields into an integral system. Thus, their clear presentation can make it much simpler to study some extremely complicated problems in philosophy, mathematics, physics, economics, politics. Moreover, knowledge and understanding of these principles allows a possibility to see *commeasurable relations* between fundamental cocepts of sciences, technical sciences and humanities.

Lack of **quantities** that would bind principles and notions of sciences and humanities into a unified system in traditional textbooks seems to be an essential factor that slows down the synthesis of the science, hampers integral perception of the world, prevents creation of effective projects of development of social-economic-ecological systems that in the end affects our living standards.

Transparent and universal quantities that are used in the book made it possible to present material in a concise and most distinct

way. If you look through the book you will see a great deal of pictures and schemes illustrating the assumptions, making them clearer and more obvious.

We intended to create such a course of theory of projecting sustainable development that *a student specializing in any subject would like to read it and then to re-read and realize what has been read.*

We value the time of the reader. That is why one of the universal quantities in the nature—society—man system is time in its numerous manifestations.

b. Focus on the student.

Trying to make the book readable and clear for students of any specialization we *had to understand* what remains unclear for the student in traditional courses of lectures and after that *to decide* what is to be given first.

The survey of a big variety of textbooks on philosophy, natural sciences, mathematics, physics, economics, ecology, law, politics revealed that one of the most important reasons preventing a student from mastering the material is *the impossibility to compare and commeasure* principles and concepts given in sciences and humanities. For example, how to compare such fundamental principles as the law of conservation of energy and the law of correspondence of demand and offer in economics? And how to compare the principles of evolution of wild nature and the law of competition? And how to compare laws of nature and acts of law? How to compare quantities admitted in sciences with quantities admitted in economics, politics, sociology?

It is obvious the relation should exist but it has not been made apparent in any textbook. The student is being confused and can find no answer. Our desire to help the student is only natural.

The principal difference of the book offered to your attention in comparison with all other books is that it is supposed to help a student in his ambition not only to know something but also to understand what has been read.

It is essential for the student as far as without this understanding one cannot make a qualified specialist.

We believe that this course will make it easier for a student to understand what is going on in the real world.

3. How the book works

While thinking over the structure of the book we realized that clear and student-focused narration requires *student-friendly arrangement of the material.*

Our book comprises all the necessary levels and elements of scientific knowledge about projecting sustainable development in the nature—society—man system. It consists of the Introduction to the problem, two major parts including 19 chapters and 3 appendices.

Introduction to the problem.

Part I: Outlook.

Part II: Theory.

Appendix: Glossary. Programme of the course. References.

To give a teacher an idea how the material is arranged let's scan the chapters.

Introduction to the problem. Essentially, it gives an overview of the problem and its priority. Here one can find preliminary definitions of sustainable development approved by the 42nd Session of the UN General Assembly in 1987. The essence of the problem is stated basing on seven key questions that reveal difficulties the world has faced on its way to sustainable development. Various examples are given to prove that it would be extremely difficult to solve it without deep scientific work. Factors that influence sustainable

development in a negative or a positive way are pointed out. The definition of the object and method of projecting sustainable development in the nature—society—man system is closely studied.

Part I. The outlook. Starts with the definitions of the basic notions used in Part I to make it easier for the students to find their way through the material which follows.

Chapter I. The essence of scientific outlook. Explains what scientific outlook means. It is supposed to explain it to the students that the essence of scientific outlook is to enable to differentiate between imaginable "phantoms" and real processes. Relationship between scientific outlook and ordinary outlook is shown. The conditions are pointed out under which the conclusions of scientific outlook become generally compulsory for everyone. We study the question what knowledge and scientific knowledge are. Their common features and differences are shown. A special emphasis is put on the requirements of provability and measurability of knowledge. We offer some basic preliminary notions of logics of projecting sustainable development as well of the existence of a universal foundation and quantity of knowledge. conditions necessary for development of scientific knowledge are described. Some conclusions based on the questions discussed are made.

Chapter II. The essence and system of scientific knowledge. We study very important questions that help students understand how to catch knowledge out of the "sea"; how to distinguish scientific knowledge from knowledge; how to determine relationship between miscellaneous knowledge presented by sciences and humanities. Consequences of breaking the relationship between the elements of knowledge are specially analyzed. We study what breaking of the relationship is usually caused by.

Chapter III. Sustainable development as a problem of synthesis of scientific knowledge about nature—society—man system. It is clearly and definitely explained to the student that despite the unity of the world it is disintegrated in our mind into "pieces" by the Tower of Babel of professional languages that handicap understanding of the essence of problems in the nature—society—man system. The problematic field is carefully studied. The essence of the problem of synthesis of scientific knowledge is proved to be in the incommensurability of quantities used in particular sciences. We show what the problem originated in and also give a survey of scientific heritage beginning with N.Kuzansky's works (XV century).

Chapter IV. The philosophical essence of the problem. The two logics of philosophy are explained. Explanation of the essence of the idea of "atomic theory" and the idea of development are given. Examples are presented to illustrate the notions of Chaos and Order. The process of transition from "atomic theory" to the idea of Development is considered. The connection of mathematic axioms with dialectic logic is revealed. The essence of the mathematic world and the world of animated nature is explained. The notions of quantity, quality and measure are introduced.

Chapter V. The essence of the problem in the foundations of mathematics. Questions that are absolutely essential for the students are considered. Why did the mankind create mathematics? Why is mathematics based on axioms? How could it be explained that knowledge of mathematics does not guarantee ability to use it in projecting particular systems? What key idea made it possible for us to come closer to the modern level of understanding of mathematics? All the questions are considered in terms of the essence of the

problem discussed and examples are given to make it easier for the student to grasp the core of the matter.

Chapter VI. The essence of the problem in terms of natural sciences. Key questions generating the physical essence of the problem as it was understood by the Russian cosmism school representatives are explained to the students in a clear and simple way. V.I.Vernadsky's definitions of empiric generalizations. E.Bauer's principle of sustainable non-equilibrium as a basic principle of natural phenomena is formulated. The question of possibility to derive natural phenomena from the second law of thermodynamics is discussed. The student is encouraged to acquire the notion of quantity in physics basing on the examples from satellite observations of interrelation of the Earth with the cosmic fluxes proving that the Earth works like an "ideal machine".

Chapter VII. The humane essence of the problem. One of the core problems is discussed in this chapter that provokes the greatest number of students' questions: Does any objective law of historic development of the mankind exist? Various ways to solve this question are suggested. The notion of formation as the clue to understanding of the birth of the new is considered. The notion of creative work as an act of creating the future is discussed. Sustainable development as a generalizing idea of creation is considered. The definition of projectology of sustainable development as logic of projecting changes in the nature—society—man system is suggested. The distinguishing features of speciality are analyzed.

Part II. Theory.

Just like Part I it starts with explanation of basic notions. They include the definitions of scientific theory, applied scientific theory,

structure of applied theory, requirements to theory, stages of construction of applied theory.

Chapter IX. Physics. Key principles and notions are clearly explained without which it is impossible to discuss the problem. R.Bartini's space—time system is presented. Notions of energy and power are considered. Power projections (forms) are shown. The notions of free and bound energy are referred to in order to illustrate the given definition. Relation between the notions of temperature and entropy is considered. The law of conservation of power is formulated. Basing on this notion equilibrium and non-equilibrium systems, dissipative and non-dissipative processes are considered. The mechanism of sustainable equilibrium and the mechanism of unsteady equilibrium are discussed. The definition of development is given.

Chapter X. Chemistry. The following key notions are explained to the student: photochemical transformations, photoeffect, captivated emission, forms of manifestation of photons, forms of photon-molecule relation, heating effect and chemical reaction, resonance of frequency, energy of activation. In order to help students we pay special attention only to the notions that build bridges from physics and chemistry to biology.

Chapter 11. Biology. Only primary notions are discussed without which it is extremely difficult for the student to understand what is common and what is fundamentally different in living and abiotic nature. The notion of metabolism in living and abiotic nature is given a special consideration. The fundamental difference is pointed out. The forced character of the process is explained. The alternative "Order-Chaos" or "free-bound power" is considered. We

formulate the generalized conclusions and postulates: the postulate of existence, the postulate of conservation, the postulate of change.

Chapter XII. Global evolution. Students are given an opportunity to watch the process of evolution of life forms on the Earth from a bird's eye view (as V.I.Vernadsky put it), to notice its wave tendency in general. The fundamental difference between global and local evolution processes is considered. Various mechanisms of evolution are discussed: growth (natural selection), acceleration of development (competition), bifurcation. Distinguishing features and basic parameters characterizing the main line of global evolution.

Chapter XIII. Man. Basing on the questions that most commonly arise some primary notions and principles are suggested to the student. Why does nature need a man? What are the borders of survival? How does a "device" work that provides the "appropriate" behaviour? What is the first necessity? How did speech appear? What is the essence of the first labour act: quantities. The elementary scheme of manufacturing cycle is considered. The essence of mechanism of thinking and development.

Chapter XIV. Mankind. In this chapter statements and mechanisms of operation of a number of laws are discussed in a most constructive and intelligible way: law of economy of time, law of increase of good power. The following notions are closely discussed: sustainable development, unsteady development. To provoke a discussion students are asked to explain why people exist whose interests and aims are contrary to the society's needs in general.

Chapter XV. Technologies. This chapter is saturated with examples. But it is not the main advantage of it. A student gets an

opportunity to imagine an "ideal machine" which is called a spaceship "Earth". The student being a crewmember of the spaceship learns about its appearance. He also learns the call sign of his ship. What is still more important the student will be suggested a generalized *mechanism of work* of the ship. He will see that practically all the elements were studied in the previous chapters and, thus, it will be easier for him to grasp the ideas of the general classifier of technologies. This classifier will be closely studied and illustrated by explicit examples.

Chapter XVI. Ecology. The student gets an opportunity to get acquainted with a definite way of interpreting the relationship and interaction in the nature—society—man system. The student is interested not only in verbal and full of formulas definitions but also *figurative* that is geometric expression of the system. That is why students are offered two models represented both in formulas and in the form of data-flow schemes. The models of integral estimate of dynamics of interaction in the nature—society—man system are implied. In this chapter we show that it is possible to represent various notions from ecology, economics, sociology, technology in a measurable form. It is demonstrated that processes of different character can be commensurable and it is possible to identify their relationship. The quantity of power (in ecology this notion is interpreted as productivity of the resource) is shown to be the most general one.

Chapter XVII. Economics. Primary notions are considered: cost and productivity. Their relations and quantities are shown. "Creative work" as a factor of sustainable economic development is analyzed. The following notions are discussed: potential possibility, real possibility, economic possibility. Procedures of their change are demonstrated. Interaction of economic laws and possibility of their

representation using measurable values is shown. The notion of investment effectiveness and its relation with sustainable development is discussed.

Chapter XVIII. Finance. Students are very much interested in what is the relation between money and energy quantities. That is why this relation is discussed in the chapter. The sustainable maintenance of cash flows is shown to be the quantity of good power. The sustainable maintenance allows to provide a fundamental mechanism to secure investments from risks of inefficient management. The notion of risk is considered to be a quantity of possible losses of the investor due to inefficient management. Rating that takes into account risks. Economic sanctions. Promotion of effective management of development. Possible consequences of putting into effect the mechanism to secure investments using sustainable security of assets.

Chapter XIX. Politics. Students are often interested to know how power, money and ideas relate. They want to know about the gold reserves. They are worried by instability of securing of financial market. And, finally, they want to know what all these questions have to do with sustainable development. We demonstrate that sustainable development must be a political objective of any society whatever its political background or forms of proprietorship may be. This assumption is abundantly illustrated by historical facts. We show the causes of critical periods in history. Their connection with wars. We demonstrate how politics influences the sustainable development. The problem of responsibility for sustainable development of mankind is considered. Theoretical questions of law and conflicts are discussed. Typology of purposes and a variety of interests are suggested.

Part III. Method.

This part of the book is to introduce the method. Thus, it starts with basic concepts.

In Appendix I you can find Glossary of some terms, concepts and quotations.

In Appendix II there is a concise Reference list that includes the names of the authors whose works were used in the scientific data base of the nature—society—man system.

In Appendix III the programme of the discipline is specified: scientific foundations of projecting sustainable development in the nature—society—man system. Finally, you can find a reference list of the literature used and the Word about the Teacher — P.G.Kuznetsov.

4. How the book helps the student

The aim of our book is to help students learn and understand the scientific basis of designing sustainable development in the nature—society—man system.

To achieve this aim we follow a definite plan using a thoroughly chosen set of facilities.

4.1. Contents of the book has logics of its own:
The first part (the introduction to the problem included) Outlook — it is first and foremost an answer to the questions **why and what for** we should measure. The second part — Theory — is an answer to the question **what and how** to measure. We expect this logic to prove successful and able to make the material easier to understand.

4.2. Contents of every part of the book:
Has the beginning and the end connected with each other. Every chapter starts with a list of definitions of basic concepts. At the end of the chapter we reproduce this list of basic concepts.

Has a common "rod" piercing all the chapters. It is constituted by the basic concepts expressed in sustainable quantities.

4.3. Contents of the chapter. Every chapter starts with the plan of the material in order to help students get an idea about the contents of the chapter they are going to study. The plan comprises a number of key questions (usually not more than 7-8). The key assumptions and notions are usually emphasized by bold type that improves understanding. Moreover, practically all basic principles and assumptions of the book are illustrated by schemes, graphs and tables. There is a conclusion and a short resume at the end of every chapter to remind students of the basic assumptions of the material studied. These conclusions may be very useful for the student when preparing for the exams. The conclusions are followed by a list of basic notions considered in the chapter.

4.4. Questions for revision and discussion. Every chapter ends with questions for revision of the basic assumptions. Students can use these questions to check their knowledge of the theme. The database of the "Dubna" University should be used for checking the answers. Teachers can use these questions for homework and as starting points for discussion of the theme in class.

4.5. Tasks. Every chapter is followed by tasks for the students and a recommended list of literature to be used in order to find answers to the questions that may arise while studying the material. Practically all the books are accessible for students and are kept in the archive of the database of "nature—society—man system": sustainable development. These sources can making learning easier.

PREFACE FOR THE STUDENT

> *We borrow capital of nature from the generations to come not even intending and having no possibility to return the debt. They may curse us for our wastefulness but will never get us to return the capital. We behave in this way because there is no one to make us pay the debts. Future generations do not vote, they do not have either political or financial power but they can dispute our decisions.*
>
> G.Ch.Bruntland.

Why must students start studying the scientific foundations of designing sustainable development in the nature—society—man system?

This question seems to have been brilliantly answered back in 1986 by the Chairman of the International Committee on environment and development the Prime Minister of Norway G.Ch.Bruntland and that is why we have chose her quotation to be an epigraph.

We suppose this quotation to be not only still urgent but also of even greater importance. The debt is increasing and there are no guarantees that in the nearest future it will stop getting bigger. No one is eager to be the debtor of their children. However, the one thing is to want and the other — to be able to. To be able **to do something** important in real life one must **know and understand** at least the foundations of the nature—society—man system.

The one who is moving will come to the end.
Good luck to you, dear students!

We would like to bless you with the words of the Great Leibnitz:
Any creative activity is a non-entropy activity and this is what makes you happy.