Integrative Explorations of the Creative Mind

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Edited by

Leonid Dorfman, Pavel Machotka and Vladimir Petrov

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STUDIES OF CREATIVITY AND FUTURE PARADIGMATIC CHANGES IN HUMAN SCIENCES (INSTEAD OF A PREFACE)

Dear colleagues!

As far as both my co-editors entrusted me to write something like an introduction to the given issue—I would be frank: the forthcoming lines express primarily my own, 'intrinsic,' *personal feelings* concerning some methodological problems both of science and the humanities. In addition, for me personally, it became impossible to escape some 'lyrical constituents,' and I decided not to fight against this temptation: really, a book about *creativity* would be too dry and boring without some emotional motives!

Sincerely, the main idea which has troubled me during the last two or three decades of my life, is the following: I suspect that the moment is close—when CREATIVITY will become the *key point* not only for the entire system of our knowledge—but also for *our entire lives*! However, it's a pity, researchers are not ready to meet this moment, so we can miss due opportunities. Moreover, possibly the entire course of our future history may occur very far from its optimal trajectory—or it may be pernicious. Hence, we should make every effort to escape such false ways and to bend our steps towards due direction.

That is why the given quasi-preface does not describe the forthcoming chapters (each of them narrates their content autonomously). These lines are devoted mainly to problems which are absent in the given issue (or presented only partly)—but are necessary for further development both of the science of creativity and the entirety of humanitarian knowledge, as well as the entirety of life! So, we will start from these 'high and noble' matters.

Paradigmatic changes in human sciences: what will we study and how?

> If you have lost your wrist-watch somewhere in the park—it is better to look for it under the lantern: there is more light.
> —*A proverb widespread among researchers, which reflects the existing 'strategy' of choosing topics for investigations.*

After the above 'high-flown' passage, it seems difficult to turn to concrete problems of the *science of creativity*. Nevertheless, my standpoint consists namely in the necessity to proceed from certain 'high-level matters,' i.e., to "construe the house beginning from the roof"—in order afterwards to deduce logically the regularities of lower levels, as well as to come to various empirical data—which would confirm these regularities.

The cornerstones of my standpoint are connected with the so-called 'systemic-informational approach' (which is described, e.g., in the monograph: Golitsyn, G. A., & Petrov, V. M. [1995] *Information and creation: Integrating the 'two cultures'.*' Basel; Boston; Berlin: Birkhauser Verlag). Meanwhile, it is not obligatory to follow the logic of this approach—it would be possible to base the consideration on some other cornerstones, or even simply on 'usual commonsense': the results will be almost the same!

Our initial 'high matter' is nothing other than rather obvious and trivial fact: all our *Cultural Universe*—from our language to various agricultural and industrial instruments—was established due to *achievements of the creative mind*! [Besides, it is not mere phrase: recently it was shown that even our everyday three-dimensional perceptual space exists because of the regularities of our psychic activity—as far as we possess an attitude to economize the mental resources needed to keep information about the environment; and exactly three-dimensionality happens to be the most economic version of information storage!] So, our *moral duty* is to pay maximal attention to *studies of creativity*—it is the principal *source of* all our *mental wealth* (and hence, also our material one).

However, many *menaces* to our well-being—and moreover, to our very existence—also appeared *due to the creative mind*: we mean, first of all, the probability of a world nuclear war capable of destroying, for ever, all our civilization, together with its creators, and even together with the memory of them! It is the second motive causing our *moral importance* for due orientation of investigations in the field of creativity: really, both brilliant scientific inventions and the menace of the disappearance of the entirety of civilization—are fruits of creative activity!

Besides, not so long ago, just before the 16ᵗʰ International Congress of the International Association of Empirical Aesthetics—IAEA, which was held in New York in 2000, our late colleague Prof. Vladimir Koshkin (eminent Ukrainian physicist, aesthetician, and poet) proposed to devote one of the sections of this Congress to problems of the menace of war. It's a pity, we were too short-minded and we didn't hear his appeal; so, Vladimir was refused. First of all, I was guilty because at that time I was a Vice-President of the IAEA; hence, possibly I should have been more insistent when it came to decision making; besides, Vladimir was a close friend of our family. But only now the links between these rather 'remote matters' become more or less clear, and just now some attempts appear in this field, e.g., trying to consider the so-called 'aesthetic harmony' in international relations—instead of war.

What are the *motives* usually determining the choice of *problems for scientific investigations*? As a rule, this choice is dictated either by a customer—if one exists—or simply by the researcher's inquisitiveness, which in turn, may depend on various socio-cultural (psychological), conditions, primarily the so-called Zeitgeist. Meanwhile, now the situation has become so serious, that it seems impossible to farm out the investigations capable of *influencing upon any creative innovations*. Hence, it is necessary to clear up: which *problems* should be of *prime importance* for the contemporary situation in human sciences?

These actual problems are determined by *two circumstances*:

—firstly, by the *importance* of different problems for further development of the given field of knowledge—in our case, we mean the *entire sphere of human sciences*, as well as the entire social practice;

—secondly, by the opportunity to come *immediately* to some *results*, seeming to be more or less '*snazzy' for the professional scientific community* (it is an analogue of the above mentioned 'place under the lantern' in which it is recommended to look for the wrist-watch).

Of course, we should take into account both circumstances—in order to come to the *features of a predictable future paradigm* in human sciences. It would be better to analyze the zone of '*overlapping*' of both requirements (circumstances).

The first ('eternal') requirement is evident (at least, proceeding from the observations concerning several previous centuries). It is nothing else but the necessity to *overcome the splitting* of the entirety of contemporary knowledge (as well as all our mental life) into two parts—once upon a time C. P. Snow designated this problem as the contraposition of '*two cultures*,' their core being science and art (together with religion). The discrepancy between these two cultures became felt rather sharply

especially in the second half of the 20ᵗʰ century (i.e., when the epoch of brilliant achievements in the technical sphere were compared with rather modest results in the humanities). That is why an idea appeared: to apply the *methods of the exact and natural sciences* in humanitarian investigations, and now appropriate studies have been put forth. These studies realize the *growth of an integrative constituent* in the massif of humanitarian investigations.

As for the second ('current') requirement, which can be ascribed to 'actual reality,' the researchers should be focused primarily on *wave-like processes* taking place in all branches of 'scientific prose'—such a name was introduced by Colin Martindale for various branches of scientific publications (see his monograph *The clockwork muse: The predictability of artistic change*, NY: Basic Books, 1990). In his studies—as well as in some other ones (e.g., works by Sergey Maslov)—it was shown that the *researchers' attitudes* reveal *pulsation*, with the full duration of cycles about 48-50 years: regular, periodical alteration of two 'polar' styles of thinking, meaning the 'analytic' style vs the 'synthetic' one, or dominating left-hemisphericity vs prevailing right-hemisphericity, and so on. These cycles were measured in psychology, linguistics, and literary studies. Recently analogous cycles were observed in cultural studies of the 20ᵗʰ century: periodical alteration of 'analytic' directions (formalism and structuralism) and 'synthetic' ones (existentialism and post-structuralism), which penetrate the humanitarian sphere.

Now we see the final lap of the previous 25-year wave (of synthetic, right-hemispheric style of thinking) and the *transition to a new paradigm* (of analytic, left-hemispheric stylistic coloring). So, exactly in the near future we should expect the arrival of a *great paradigmatic change* in human sciences. Besides, namely now other important '*switches*' are taking place—the foremost of which is the transition of most countries from a 'resource-oriented' phase of development to an 'information-oriented' one.

Taking into account that *creativity* constitutes the *core* of any kind of *innovations*—the *science of creativity* should also experience in the nearest future an appropriate *paradigmatic shift* characterized at least by *two features*:

1) The *beginning of the new steep paradigmatic change* in human sciences falls in the 2010-2020s, coinciding with the new wave in the entire socio-psychological sphere.

2) The next stage of human sciences—including the science of creativity—will possess *integrative coloring*, being oriented on general,

high-level regularities, with *analytic constituents* and *inter-disciplinary studies* having a weighty role.

For me personally, the latter conclusion seems to be not threatening: I came to cultural studies (and related matters)—after two decades devoted to natural sciences (experimental physics). Besides, my official work in physics was accompanied with 'non-official' creativity (sometimes together with my friends) in literature and painting. However, for 'traditional' humanitarian scholars, the conclusion concerning the 'inevitable transition' to an integrative phase, may seem frightening. But please, don't be afraid: usually the mastering of 'extraneous' fields is rather easy, if a person has no methodological prejudices.

Further we will come to some other non-trivial features inherent to the predictable nearest future of humanitarian knowledge, including the science of creativity.

In the forest of creative regularities: traces of external (social) influences

> I sit in a wood and stare
> Up at untroubled branches
> Locked together and staunch as
> Though girders of the air…
> —*C. Day Lewis, Transitional poem (1929)*

First of all, we should consider the very *status of theory*, meaning 'social prestige' and place of theoretical investigations in the contemporary socio-psychological sphere—as well as in its various branches. Recently most investigators usually followed an 'inductive' strategy, proceeding from empirical observations, which are gradually generalized—in order to come to 'high levels.' Such a situation was typical for the overwhelming majority of investigations, especially in human sciences. Only in contemporary theoretical physics do we deal with a quite opposite, deductive strategy, consisting in mathematical unfolding of a system of initial postulates, which comes to regularities of empirical reality.

Nevertheless, in recent decades the situation has started to change—even in rather 'archaic' branches of humanitarian knowledge. (Thus, one of the pioneers of such innovative efforts in the field of psychology, was the German A. Golitsyn, who founded the above mentioned 'systemic-informational approach.') And we should expect the arrival of a new *higher status of theory* in all human sciences.

For me personally, a quite analogous process of steep growth of the status of theory, took place literally before my eyes: the 'switch'—just

after 1945—was caused by the invention of the A-bomb. For commonsense, this event marked the end of the era of dominating empirical knowledge! Really, the very idea of 'critical mass' could not come as a result of any step-by-step, gradual process—but only as a product of theoretical prediction. Various echoes of this event started to penetrate different branches of our entire socio-psychological life.

Besides, the inclination to such a paradigmatic feature, can be illustrated with *two phenomena*—though both are only *indirect evidence* in favor of the 'theoretical impact' discussed. The first phenomenon is the fact that now sometimes certain experiments in natural sciences are simply *substituted by* model *calculations*: they are not so expensive. The second phenomenon deals immediately with *creativity*: recently the whole direction of art appeared—the so-called '*Constructive Conceptualism*' (now its examples exist in painting, poetry, and prose). In each work of art belonging to this direction, the *aesthetic structure* exhibited is *accompanied with theoretical text* which explains the psychological mechanism(s) of its sensual perception. Due to such 'duality,' both principal constituents of human mentality: 'immediate thinking' and theoretical reflexion—occur "glued together"; so, their contraposition (known under the name of conflict between left- and right-hemisphericity, or sensual and conceptual constituents of thinking) occurs partly weakened. [Apropos, some paintings belonging to this new direction of art, were exhibited in September 1997 in Perm—during the International Symposium '*Art and Emotions*' organized by the Perm State Institute of Art and Culture.]

Another important feature dealing with 'outer influences' upon creative activity, is nothing else than the *very sharp inhomogeneity of statistical distributions* inherent to most processes in this sphere, and this feature will show steep growth in the nearest future. [My own chapter in the given issue is devoted namely to such 'sharp statistical distributions' revealing themselves in rather large diapason of scales: from the 'harmonious mental life' of personality—to the 'global harmony of international relations.']

This rather substantial peculiarity is caused by the *type of a feedback* in the chain which connects personal '*products of creativity*' with further life of 'producing elements,' i.e., with the "*fate of creators of innovations*." As it is well known, any feedback can be either *negative or positive*. Many processes in the sphere of living matter are based namely on *positive feedback*: success generates new success. For instance, let certain objects or subjects (i.e., elements constituting the system) show high results at the given stage of the system's development. Then at the next stage, exactly

these objects (or subjects) will also show the highest results (it is the so-called Biblical 'Matthew's principle'). Thus, it seems natural that for a researcher who wrote 10 articles during a year, it would be easier next year to write more articles than for a researcher who wrote only 2 articles. Such positive feedback is opposed by negative feedback typical for non-living matter, as well as for human non-creative activity; its statistics were once upon a time analyzed by Hans Eysenck—as the phenomenon of 'regression to the mean.'

Because of such positive feedback, the fates of creative persons (or their eminence) occur subdued to the statistics of the so-called '*hyperbolic law*'—regularity relating to 'stable non-Gaussian distributions' known under the names of Zipf, Pareto, Lotka, Mandelbrot and so forth. (Apropos, my own chapter in the given issue—is devoted exactly to different faces of such hyperbolic distributions.) This '*quantitative*' (at first sight) *peculiarity* possesses rather substantial '*qualitative*' *consequences*—in particular, resulting in very large social roles of some 'top persons' (leading 'personages' in each creative sphere). For instance, according to Martindale's data (as well as other numerous publications), usually about 50% of the 'entire glory' of a certain epoch of each national school (in poetry, music, painting, etc.) falls on the 'first person' (e.g., Mozart or Beethoven in German-Austrian musical life). So, perhaps the 'obligatory essence' of this regularity means that the heart of the matter is hidden not in definite 'genius qualities' of a certain 'key person'—but in the *objective necessity* of the arrival of such a person (as well as persons possessing several other leading positions). Hence, the '*free will*' of two or three such 'top creative personages' appears capable of bending the steps of the whole national creative sphere!

The ethical consequence of this regularity is a very high *moral responsibility* of such key people—for the entire *trajectory of the given sphere of creativity*. And perhaps, this regularity can be taken into account in cultural politics—when construing scales for '*progressive' taxes*: the percentage would depend both on random ('avalanche-like') constituents in the functioning of mass media, and the 'quality' of artistic production.

Some other *general systemic regularities* caused by social mechanisms, are waiting for their detailed investigations, promising to come to non-trivial results. [In former times, in the USSR existed a special 'instruction on secrecy' for scientific editions, where it was written that a set of non-secret results is capable of carrying valuable, practically significant secret information; perhaps, a quite analogous situation takes place in the sphere of creative regularities?—Is it a joke?] Thus, practically, the data concerning the *phenomenon of 'rara avis'* may seem

very interesting: some genius innovations (especially in the sphere of arts) were introduced by 'strange persons' sharply differing from other creative personages. This phenomenon should be taken into account in the practice of cultural politics.

Out of the diversity of such partial regularities, those ones seem to be of prime importance, which relate to the above-mentioned problems:

3) The high role of a conceptual, *theoretical constituent* in creative activity;

4) The high role of *personal peculiarities* of leading persons in each creative field.

In the "thicket" of creative fruits: again on moral factors

At last, we *should* turn to the final *results* of creative processes, i.e., *innovations*: their *impacts on the culture*—in a broad meaning of this term (e.g., according to Yury Lotman's definition of 'culture as a system of non-genetic information accumulated and processed by various human collectives'). These 'creative impacts' are important both for the creative personality—and the social reality. So, the *internal* processes and appropriate *self-estimations* occur adjacent to the *external*, *social estimations* of impacts received; hence, *two* quite evident general *systemic motives* should be taken into account:

a) all estimations of creative processes and their results, are to be based primarily on certain *criteria* functioning at the *higher level*, i.e., the role of the given culture in a certain broader system (e.g., the global civilization);

b) naturally, the above estimations may *depend on the model* used for their analysis, so sometimes the estimations may occur even diametrically opposite.

As far as we intrude in a zone which is vague and non-traditional for 'genuine scientific' investigations, we should resort to the help of such 'indirect means and devices' as examples, parallels, and hints, requiring the reader's own efforts in the analysis.

Thus, the first (*a*) motive becomes clear if we would estimate, e.g., the innovative efforts aimed at creating the A-bomb, which were realized in the 1940s, in parallel in Nazi Germany, the U.S.A., and USSR. Evidently, we should estimate negatively all achievements of German physicists: in case of their success, it would be simply a nightmare (though for most German physicists it would be a giant success! But hopefully our consideration is realized at the higher level!). Meanwhile, no doubt, efforts of participants of the American 'Manhattan Project' deserve positive estimation. However, when doing such estimating, we have implicitly

involved motives ascribed to the dependence of the model used (*b*). [Moreover, the situation of the successful invention of the A-bomb—in due time, i.e., outstripping the Manhattan Project—made by Soviet physicists, remains unclear: its estimation depends on the model scenario of possible military events.]

Our other example of model dependence, deals with the very *nature of giftedness*. Thus, in the framework of a model which proceeds from the concept of primarily *genetic determination* of high creative results, these ones can be estimated as something like '*private or family wealth*.' On the contrary, in the framework of an 'opposite' model, which treats giftedness as a result of the purely *random combination* of genes—their lucky statistical coincidence would be considered either as a '*personal merit*' or a '*gift of Fate*'? Each of these versions entails its own *consequences* (logical, cultural, social, economic, etc.).

Sincerely, the first time, when I became practically involved in the field of such ethical problems, coincided with studies of such specific kinds of 'collective creativity' as construing the myth about "features of women's attractiveness." Here also ethical problems arise: for instance, whether the beautiful appearance of the given fair lady belongs to her—or to the social reality, which uses these 'distinctive features' simply for the purposes of social stratification? Moreover, the very life of a subject (especially a creative one)—does it entail his/her 'ownership'?

Finally, there exists an aspect which seems to be almost fantastic: it is possible, in principle, to '*construe*' a certain '*ideal*' (optimal) *socio-psychological structure* which would stimulate *maximal creative activity* in a given society. It means, first of all, building a special *social hierarchy*—either in addition to existing social hierarchies, or perhaps, substituting some of them. This new hierarchy would provide perspectives of development (psychological, cultural, technological, etc.) which are impossible in the framework of existing socio-psychological structures: something reminiscent of those ones described by Herman Hesse. They should substitute (at least partly) existing structures, including so-called 'democratic' ones (and sometimes, in many cases ochlocratic ones)—and they can be named '*meritocratic' social structures*.

For me, such a project is not at all fantastic or utopian: once upon a time, I was engaged in the field of cultural politics, and I know the real possibilities of various social programs which are capable of realizing recommendations of such researchers as Lawrence Harrison and Yu. N. Harari, as well as recommendations of the Club of Rome (2018) concerning creating a principally new worldview. A social project oriented

on maximization of creativity, may be so effective, that it would be compared even with the above mentioned 'Manhattan Project'!

So, among possible new concrete directions of studies devoted to creativity, we should single out the following ones:

5) investigations aimed at *ethical aspects* of creative processes;

6) construing *social structures* providing *maximization of creative abilities*.

<div align="center">*   *   *</div>

Of course, the above half a dozen features (1—6) which would be hopefully inherent to the future paradigm in human sciences, including their core—investigations of creativity—do not exhaust the spectrum of prospective studies. Some attempts in these directions, are presented in the given issue. As well, some other ones will be undoubtedly realized in the nearest future!

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PART I.

INTEGRATIVE APPROACHES TO CREATIVITY

CHAPTER ONE

COLLECTIVE CREATION OF HARMONY: TWO INFORMATIONAL MODELS BASED ON 'POWER LAW'

VLADIMIR PETROV

Abstract

In the framework of the systemic-informational approach, the 'power law' (statistical distribution, also known under the names Zipf, Pareto, Lotka, and others) is deduced, with special attention to the role of the resource deficit. On the basis of this law, two models are derived and proved empirically, relating to such kinds of 'collective mental life' as assimilation of the system of culture, and optimal distribution of military expenses of different countries of the globe. Each model provides various measurements, as well as practical applications in sociological and psychological measurements, including the needs of social and cultural politics, as well as international ones.

Key words: creativity, system, information, culture, art, science, power law, entropy, personality, measurements, mentality, indices of activeness, cultural politics, harmony, international relations.

The logical line of the given text is almost Kantian: it would be shown that various kinds of human 'collective mental processes' are subdued to the so-called '*power law*,' as if this law was simply 'looking for places' which would be 'ideal' for its 'due applications.' We shall show that this *statistical regularity* is much more important than it is accepted to think, and it opens great perspectives of *practical applications*. Though the 'ideal constituent' of our narration is 'genuinely mathematical,' its 'material constituent' would deal with quite concrete kinds of *mental processes* named '*collective creativity*.'

The very fact of 'collective thinking' is well known, its scales varying across a wide range. The simplest version of 'collectivism' in creativity,

deals with *two persons* united to come to certain achievements in a definite field of activity: artistic, or scientific, or political, and so on. Examples of such 'joint creative process' are numerous: Marx and Engels in the sphere of political life of the 19ᵗʰ century, Il'f and Petrov in Soviet prose, the brothers Goncour in French in the 19ᵗʰ century, Stanislavsky and Nemirovich-Danchenko in Russian and Soviet theatrical life, Komar and Melamid in Soviet painting (and afterwards in America), Sun Yat-sen and Chiang Kai-shek in Chinese political life. [The author remembers his recent visit in Taipei: a double portrait exhibited in the Mausoleum— profiles of these two political leaders, during their meeting and talk in a railway wagon.]

More *expanded 'creative collectives'* are also known. In each case the effectiveness of uniting seems to be caused by a certain '*common creative climate*' which is functioning within such a 'community.' Exactly this 'climate' is the main '*collective author*' of all creative innovations. Sometimes such a 'climate' becomes inherent in the life of a local literary circle—as it was in the medieval French town of Arras (it was a miracle— several poets created a circle, which was functioning during many decades—see Ocheret, 2008), or in the intellectual life of Paris in the 1920s, when modern American literature was born. Apropos, in the Moscow of the 1960s-80s, the author of these lines participated in one such 'literary community' (the traces of its activity see, e.g., in Melamid & Petrov, 2016a, 2016b). The *most expanded 'creative collective'* is observed in the case of *language*: usually it is produced due to the efforts of many thousands or millions of 'co-authors.'

Naturally, the more expanded the 'creative collective'—the more chance to observe its appropriate statistical regularities, including the 'power law.' We shall describe its application in *two models*, each dealing with numerous 'co-authors' and besides, each being important for needs of social practice.

<p style="text-align:center">*   *   *</p>

The ***first model*** deals with the behavior of personality in the world of culture. It presupposes *creation* of new cultural values, as well as *assimilation* of existing ones. Both kinds of activity are tightly interwoven, and they are influenced by numerous participants ('co-authors') of the cultural process. These two kinds of processes relate to various fields of activity, being inherent to science, art, techniques, religion, political life, and so forth.

The contemporary stage of humanitarian investigations—together with the practice of social and cultural politics—came to the necessity of possessing instruments capable of *measuring* quantitatively the process of the person's *assimilation of some systems*—ethical, political, scientific, artistic, *etc*. For instance, recent works by Lawrence Harrison (1992, 2013) proclaim a great *impact of culture* onto the entire social life, including the economic prosperity of the society. However, in order to provide practical realization of this concept in concrete countries (or regions), it is necessary to build, at least, a *general model of cultural assimilation*, i.e., mastering, by the subject, a certain *system of elements*, which are at the disposal of the society. Then, on the basis of appropriate sociological investigation, it would be possible to derive an *optimal strategy of social and cultural politics*: to improve the life of the country (region), by *influencing the mentality* of its population.

Another 'challenge of practice' relates to the so-called '*program approach*' in the field of cultural politics (see, e.g., Fokht-Babushkin, 1982, 1987). One of the models derived in the framework of this approach, dealt with planning the *long-term expansion of 'artistic consumption'* realized by the population. In order to determine the 'aims' of such expansion—meaning 'desirable scales' of contacts with various kinds of art—it was proposed to divide all the population of the country (or a region) subdued to the procedure of planning, into 20-30 social groups. Within each group, certain '*outstripping*' members were proposed to be singled out (on the basis of a sociological investigation), serving as 'reference points' for all the members of the group. [Exactly the scales of cultural 'consumption' of these persons should be used when calculating the 'aims' in the framework of this approach.] To choose 'outstripping persons,' it is necessary to *aggregate* indicators evidencing *different aspects* of the person's *socio-psychological 'image'*—such as his/her labor activity, parameters of mentality (including, e.g., his/her system of knowledge, aesthetic development, *etc.*). Hence, it is necessary to have a *model of personal cultural assimilation*, with the core of this model containing certain *indices*, which would permit to *estimate quantitatively* the '*integral quality*' of each subject involved in the investigation: whether he/she can be treated as an 'outstripping person.'

In the framework of the **second model**, we deal with quite the opposite scale—the model embraces all the planet: here '*co-authors*' creating the state of the system, are *all countries of the world*. We should proceed from the problem which might seem to be '*strange*' for researchers focused on concrete international matters, conflicts, wars, *etc*. (Though statistical approaches to such matters possess certain traditions—see, e.g., Richardson,

1960.) In reality, this problem is not 'strange'—it is the *key point* of the contemporary world, especially in the light of the recent conclusions of the *Club of Rome*, who proclaimed the necessity to create a *new worldview* for the globe (von Weizsaeker and Wijkman, 2018).

Within this model, the principal problem is nothing other than to build an *optimal structure of international relations*, which would be advantageous for the entire global system. Exactly such a structure can be used as a kind of '*reference point*' when deciding many concrete current problems of international relations. Really, the structure which would be advantageous for the globe, would be effective also for most of its constituents, i.e., countries of the world. [Of course, appropriate 'recommended directions' of further development should be treated only as one of the sources for practical decisions.]

So, the models proposed below, relate to different stages of investigations, meaning their readiness for practical application. Both models contain the '*power law*' as its core, and both were derived in the framework of the '*systemic-informational approach*.' That is why it seems reasonable to proceed from the foundations of this approach.

1. Theoretical foundations: maximization of 'mutual information'

The systemic-informational approach is rather universal; it integrates sciences and the humanities, embracing various fields of human activity: from semantic and phonetic structures of all existing languages—to creative peculiarities of talented and genius painters and composers (see, e.g., Golitsyn, 2000; Golitsyn & Petrov, 1995, 2005; Petrov & Locher, 2011; Petrov, 2017). Moreover, now some perspectives appeared relating to the so-called 'General Informational Theory of Miracles' (GITM) pretending to solve an 'insoluble task'—to predict the appearance, in the future, of some quite unique, very rare objects or events, which cannot be forecasted by traditional statistical methods.

The given paper deals only with some *particular applications* of this approach, though rather important ones. It seems reasonable to start from its foundations.

Previously (see, e.g., Golitsyn & Petrov, 1995) a principle was formulated which permits to explain many facts and regularities of *behavior and evolution* of various kinds of *adaptive systems*—biological, sociological, technical, *etc*. It is the so-called ***principle of the information maximum*** (the details of our narration see in: Golitsyn & Petrov, 1997):

$$I\,(X,R) = \Sigma p(x)\,\Sigma p(r/x)\,log[p(r/x)\,/\,p(r)] = H(R) - H(R/X) = max, \qquad (1)$$
$$\quad x \qquad r$$

where *x*—conditions of the environment; *r*—responses (traits, features) of the system; *p(x)*, *p(r)*—probabilities of *x* and *r*; *p(r/x)*—conditional probability of *r* when *x* occurred; *H(R)*—unconditional entropy of responses; and *H(R/X)*—conditional entropy of responses.

This principle means: the system aspires to choose such a response *r* which provides the maximum information about a given stimulus *x*. In other words, the '***mutual information***' between the system and its environment, should be *maximized*.

An example: a certain person makes an interlinear translation of a certain text from Russian into English. Here the stimuli *X* are Russian words, the responses *R*—their English equivalents, *H(X)*—the variety of the Russian vocabulary, *H(R)*—the variety of the given person's English vocabulary, *H(R/X)*—inexactness of the translation, *etc*. The craftsmanship of the translator (degree of 'adaptation' to his profession) is characterized by the amount of mutual information *I(X,R) = H(R)—H(R/X)*, where *H(R)* characterizes variety and *H(R/X)* inexactness of the translated text. Apropos, the concept of 'mutual information' put forth after the studies of Robert Fano (1951).

In the case of biological objects, mutual information characterizes the 'fitness' of the organism for the environment. Usually for the well adapted organism, this information is so large that the biologist looking at the traits of the organism, can say much about the conditions of its environment. So, a well adapted organism is a very 'transparent' channel of information: looking at the output of it, we can see what is happening at the input. Quite similar is the situation in cases of other kinds of objects (they might be worms, animals, societies, languages, kinds of art, and so forth).

Though of the system's 'desire' to ***maximize the mutual information*** mentioned, as a rule, there exist some *restrictions* which prevent the system from reaching the absolute (unconditional) maximum of information. The system has to be satisfied with the *conditional maximum*. A very general and typical condition is the restriction of the *average resource E(X,R)*:

$$\Sigma\,p(x,r)\,e(x,r) = E(X,R), \qquad\qquad\qquad (2)$$
$$\quad x,r$$

where *e(x,r)* is a resource expense in the state (*x,r*).

The resource might be energy (in physics), substance (in chemistry), the number of talented persons (in cultural studies), and so on. If there are several restrictions, we must write several expressions as in (2). And of course, we must also take into account the condition concerning probabilities:

$$\Sigma_{x,r} \; p(x,r) = 1. \tag{3}$$

Equations (1), (2), and (3) can be joined by means of the Lagrange multipliers λ and β and be presented in the form:

$$L = I(X,R) - \lambda\Sigma p(x,r) - \beta E(X,R) = H(R) - H(R/X) - \beta E(X,R) = max. \tag{4}$$

A physical sense of the multiplier β is a *deficit of resources*. So in thermodynamics $\beta=1/T$ where T is an absolute temperature—the average energy of one degree of freedom. The less energy the system has, the more β. In other cases β may be a deficit of space, time, power, *etc*. The higher the deficit, the higher the weight β and the significance of the corresponding resource in the total sum. If the deficit of the resource E is absent then β is equal to zero and the corresponding item in the total sum can be omitted.

As far as formula (4) contains *three free items*, the principle of the information maximum describes *three principal tendencies* inherent to the behavior and development of any system:

A. *Expansion*, aspiration to increase the number and the variety of the system's responses $H(R)$. This tendency is often called 'search behavior.'

B. *Idealization*—aspiration to improve the '*exactness*' of the system's responses, i.e., to decrease the entropy of the errors $H(R/X)$. Such behavior is directed towards the maintenance and the stabilization of essential parameters of the system, which provide a self-identification of the system, the preservation of the system as such; in other words, this tendency permits the system to survive, so this tendency is sometimes named 'conservative behavior.'

C. The third principal tendency is the *economy of resources*. As soon as this item in equation (4) contains *two constituents* which are multiplied, this tendency can be realized by *two ways*: on the one hand, by the *choice of situations* (x,r) with minimal resource expense $e(x,r)$, on the other hand—by the aspiration to *decrease the deficit* of resource β, i.e., to increase the resource supply.

There exist various versions both of separate functioning of these tendencies and their combinations, which take place in different conditions. Thus, if resource *E* is energy and items *H(R)* and *H(R/X)* are fixed, we come to such a particular case of the information maximum principle, the *principle of the economy of energy*. This economy becomes of prime importance also, when the resource deficiency *β* is too large and the last item in (4) predominates over the others.

Our further narration will deal with certain partial cases realizing the general model described. In principle, we have, at our disposal, more than 30 partial models, each dealing with various phenomena characterized by its specific conditions. Apropos, for some regularities, deduced within most of such partial models, there exist other approaches coming to analogous results. Nevertheless, the 'main pathos' of our systemic-informational approach, is the possibility to deduce all partial regularities—proceeding from the main, 'root model.' Exactly this will be our forthcoming deduction of the power law—from the principle of the information maximum—though of existence of various other ('parallel') paths capable of coming to the same regularity. That is why we will not 'branch off' to other approaches (including, e.g., those which are based on Bayesian logic) coming to the regularities to be discussed below.

In general, the systemic-informational approach permits us to realize a famous program which was proposed by Leonhard Euler (1707-1783): to deduce, using purely logical (i.e., mathematical) means, the entire set of regularities—both of the physical and mental worlds—proceeding from the only "principle of optimality." Now this rather ambitious program seems to be fulfilled (see also Levich, 2010), at least in application to some fields of physics, as well as to the entire system of mental and cultural phenomena (Petrov, 2017). To add a 'brick' to this totality of regularities is a 'super-goal' of the given text.

2. Some most important partial cases: principle of the entropy maximum, restricted resource, and power law

If the response is always adequate to the reaction, then item *H(R/X)* in expression (4) is zero and we come to the well known '*principle of the entropy* ("self-information") *maximum*.' This principle describes a tendency to increase the number and the variety of the system's responses *H(R)*.

At first, the principle of the entropy maximum was formulated in physics. But now it is broadly applied to many areas of reality (including human activity) such as economics, linguistics, sociology, *etc.* The modern

usage of this principle is based on works by Jaynes (1957) who considered informational entropy to be a subjective measure of our lack of knowledge. His principle of the entropy maximum is a generalization of the famous principle of 'equirandomization of probable events': if we know nothing about variable *r*, we must suppose that all values of this variable have the same probabilities: *p(r) = const*. But this result can be deduced from the principle of the entropy maximum in the particular case of the absence of any supplement *restrictions*. It was normal to generalize this principle in the case where such restrictions were present.

A general trend based on entropy, as well as motives of resource restrictions, can be retraced in the field of theoretical studies dealing with roots of power law. Firstly, the growing interest in information theory led to involving entropy in most models—see, e.g., Petrov & Yablonsky, 1980; Newman, 2005. Secondly, the important role of resource limitations started to be taken into account—see Visser, 2013. Thus, Lozinsky (1970) when calculating the subject's efforts needed to assimilate certain elements (e.g., when cultural assimilating), proceeded from the mean value of the resource spent per one element. Nevertheless, previously the resource expenses were not combined with entropy; such combining was realized by the systemic-informational approach.

Let's concretize the role of the resource available for the system in question.

If we know anything about the restrictions of variable *r* (such as the average of *r*, the variance of *r*, *etc.*), we can obtain a more realistic probability distribution, through adding these restrictions, as supplement conditions, to the ***principle of the entropy maximum***. A very general and typical form of restriction occurs when a summary or mean quantity of resources is fixed:

$$\Sigma_r \, p(r) \, e(r) = E(R). \tag{5}$$

The principle of the entropy maximum can be described as follows: if *r* is an accidental variable and there are some statistical restrictions on any function of this variable, then the probabilities *p(r)* can be obtained from the condition

$$H(R) = -\Sigma_r \, p(r) \, \log p(r) = max, \tag{6}$$

taking into account the condition (5).

We must also take into account that the sum of the probabilities must be equal to 1:

$$\Sigma_r \, p(r) = 1. \tag{7}$$

Equations (5), (6) and (7) can be joined by means of the Lagrange multipliers λ and β:

$$L = H(R) - \lambda \, \Sigma_r \, p(r) - \beta E(R) = max. \tag{8}$$

Let us look at some consequences of this principle. One can see that optimal distribution of probabilities *p(r)* exists which provides the maximum of the Lagrangian *L(R)*, i.e., the maximum of entropy under the given restrictions (5), (7). Let us find partial derivative of *L* in respect to any probability *p(r)* and bring it down to zero:

$$\partial L/\partial p(r){=}\partial[-\Sigma_r p(r) \, log \, p(r){-}\lambda\Sigma_r p(r){-}\beta\Sigma_r p(r) \, e(r)]/\partial p(r){=}{-}log \, p(r){-}1{-}\lambda{-}\beta \, e(r){=}0. \tag{9}$$

Or

$$log \, p(r) = -1 - \lambda - \beta \, e(r). \tag{10}$$

Then the *optimal probability* distribution *p(r)* is

$$p(r) = exp \, [-1{-}\lambda - \beta \, e(r)] = exp \, (-1-\lambda) \, exp \, [-\beta \, e(r)] = C \, exp \, [-\beta \, e(r)], \tag{11}$$

where $C = exp \, (-1-\lambda)$ plays the role of normalization factor.

We can see from (11): the more *e(r)*, the less *p(r)*. For example, let *e(r)* be the resource expense which is necessary to achieve state *r*. Then (11) means: the higher the resource expense—the lower the probability of the corresponding state *r*. If the resource expense is infinite, *e(r)* = ∞, then *p(r)* is zero, i.e., the state *r* is unattainable. For instance, if we have a 'potential well' with infinitely high walls, then the probability distribution is concentrated inside the well and probabilities will be zero outside the well.

Now let us pay attention to the role of the multiplier *β* which characterizes a *deficit of resource*. The more *β*—the closer the distribution *p(r)* is concentrated around zero, the higher the unevenness of distribution, the lower the entropy of responses *H(R)*. [The entropy is maximal when

the probability distribution is even.] In other words, a deficit of resources leads to a decreasing variety in the responses of the system. The inverse value *1/β* can be interpreted as '*activeness*' of the system. For example, in physics the temperature of the system plays the role of a measure of activeness. The more the deficit of resources, the less the activeness of the system.

One of the consequences of the principle of the entropy maximum is the famous **power law** (see, e.g., Zipf, 1949; Newman, 2005). Versions of this regularity are often known under the names Pareto, Lotka, Zipf, Mandelbrot and so forth; they became objects of numerous investigations, both theoretical and empirical, relating to different fields. [The most fundamental and interesting of these investigations was realized by Newman (2005). The early stage of our works in this field relates to the 1970s: Petrov & Yablonsky, 1980, 2013.] Various details of such distributions were analyzed. However, now we should dwell upon a rather important aspect: the connection of the distribution in question—with the degree of the deficit of resource *β*.

The heart of the matter is a *peculiar mechanism* which is inherent to many kinds of *human behavior*—so this regularity was called by the great statistician M.G. Kendall the '*natural law for social sciences*.' (Meanwhile, this mechanism is typical also for many other spheres— especially those ones, where the effect of progressive development takes place. It is opposed to the statistical mechanism of 'regression to the mean,' which causes stagnation of the system or even its decay.) This peculiar mechanism is nothing else than *positive feedback* in the chain connecting the *intensity* of a certain activity with its *results*.

Really, very often the more experience somebody has in executing any activity, the easier it becomes to create a new act. For instance, the more papers *r* that have been written by a scientist—the easier it becomes for him to write one more paper. In other words, the resource expense on a new paper is inversely proportional to the number of papers written: the link between the increment of the resource expense *de* and the total experience *r* is

$$de = dr \, / \, r. \tag{12}$$

Integrating this expression, substituting the result obtained in (11), and turning to logarithmic coordinates, we come to the expression:

$$log \, p(r) = log \, C - \beta \, log \, r, \tag{13}$$

i.e., a *linear function* with a negative slope. (Later we shall use this linear dependence.)

Figure 1-1 shows two curves corresponding to this regularity, with different values of *β*. Two 'behavioral properties' of such curves are illustrated:

—the more resource expense *e(r)* needed to function at the given level—the less probability *p(r)* at this level;

—the more the deficit of resource *β*—the more the slope of the curve *p(r)*, it becomes steeper; a little later, exactly the value of this coefficient will be used as an ***index*** needed for sociological and psychological measurements.
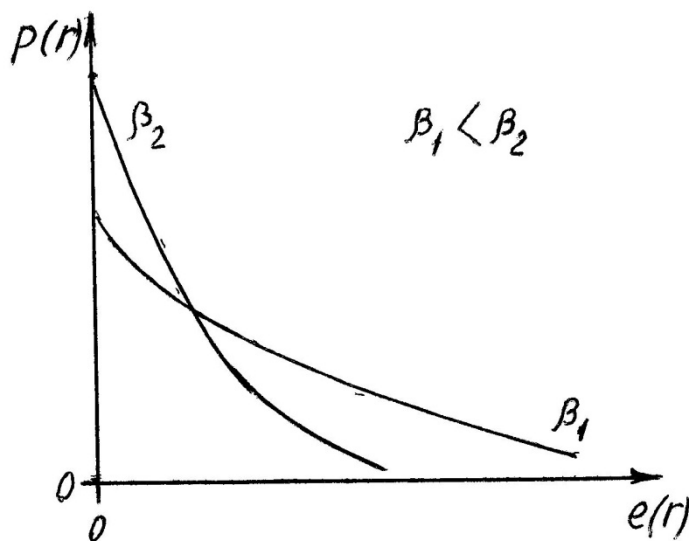

Figure 1-1. Dependence of the probability of response *p(r)* on resource expense *e(r)* and the deficit of resources *β*

So, power law is the ***optimal distribution*** of the system's states—from the point of view of the entropy maximum, under condition (12). It reflects the degree of diversity of the distribution of the system's states caused by definite resource restrictions. So, such optimal distribution may be characterized as carrying a certain ***harmony*** inherent to the system's structure.

3. First model for concrete system—aesthetic sphere: primary elements and their relations

> Bloomin' idol made o'mud—
> Wot they called the Great Gawd Budd…
> —*Rudyard Kipling, Mandalay*

Let's construe a *deductive model* for a concrete system which is assimilated by a subject, i.e., a model which should be based on certain abstract postulates, but after its derivation, the model should be constructively used in concrete psychological and sociological measurements. To build such a model, it seems reasonable, first of all, to divide the whole system to be assimilated, into certain *primary elements*.

The model below is applicable to many spheres. For instance, this model was applied to study the subject's moral potential, his/her cultural development, musical development, *etc.* In the given paper, we shall illustrate our narration with materials concerning literature and *literary development* of a subject.

The problem of selecting empirical evidence of aesthetic development, as well as its possible aggregating in a certain 'index', was an absolutely insoluble task for Russian researchers during several decades. I remember appropriate discussions of the 1970s-80s in Moscow (at the State Institute for Art Studies, where I worked for 36 years): what indicators should be chosen to judge the so-called 'aesthetic potential' of personality? Some 'thinkers' tried to resort to the help of 'achievements of the Soviet aesthetic school'—but couldn't come to constructive results. Some ladies lifted both their hands and eyes—to the ceiling, trying to find the solution in its numerous cracks, and so on… Nevertheless, none of them seemed capable of accepting the model described below: it seemed to be too complicated for their comprehension, though in reality (for persons without anti-mathematical prejudices) it is very easy!

The primary elements of the system subdued to assimilation, may include, for instance:

*) Different kinds of knowledge relating to literature, writers, poets, *etc.*, e.g.: '*Lord Byron was an English poet of the nineteenth century,*' '*Paul Valéry followed poetic tradition founded by Stéphane Mallarmé,*' and so on. Such elements provide a subject with some means to orient himself/herself in the sphere of literature.

**) Various kinds of knowledge about concrete literary works: their authors, motives, contents, personages, *etc.*, e.g.: '*The novel* The Moonstone *was written by Wilkie Collins,*" '*Lenina was one of the main heroes in the novel* Brave New World *by Aldous Huxley.*' Such elements

are also useful for a subject, to orient himself/herself in the sphere of literature. [Besides, sometimes such elements may become the 'end in itself' for cultural (literary) 'consumption' realized by a subject—for instance, if he/she is interested mainly in concrete information about facts described in literary works.

***) Habits of perception of literary works, ability to decode their 'languages,' *etc*., for example, to distinguish between poetical works, belonging to different stylistic directions, and therefore to 'decode' these works in due manner. Such elements provide a subject with some 'keys' for assimilation (perception) of many other elements; so they are necessary for due assimilation of the entire system. Apropos, sometimes such elements themselves can play towards the 'final aims' of cultural (literary) development of a personality—for instance, when prestige behavior is of prime importance for a subject, so that he/she needs definite habits of literary perception to enhance his/her social status.

****) Notions about some general features of the surroundings, and first of all about certain 'patterns' ("keys") assisting the subject to form a sensual relation in regards to these features, about emotional experience in 'typical situations,' *etc.* Through such elements, a subject gets a kind of a 'key' to decode various concrete situations which he/she observes, sometimes like a 'recipe' for feelings, e.g., a feeling of 'proud solitude' quite analogous to feelings of definite personages of Ernest Hemingway's prose. Such elements serve to 'harmonize' the mental life of a subject, to enrich its emotional aspect. [Moreover, different subjects which have assimilated the same element, experience the same (more or less) effect of catharsis, and such common effects stimulate different subjects to have certain common features of dispositions, understanding the surroundings, sense of life, and so forth. In other words, the personality becomes more 'socialized.']

We will not continue the description of concrete types of possible elements. What is of most importance for our further consideration—is neither the concrete nature of these elements, nor their functions in relation to concrete subjects—but *interrelations within a system* of such elements. We shall try to find some *general regularities* within a system of elements which functions in a certain culture. [Our further consideration will be illustrated mainly with relatively simple elements relating to knowledge about some facts from the sphere of literature. This is done in order to simplify the description; meanwhile, all the considerations below are valid for numerous other kinds of elements, including very delicate stylistic hues, profound motives, and even non-verbalized ones! Besides, each element is supposed either to be assimilated by the given person—or not