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Ways of thinking and the unification of science

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Scientific disciplines can usually be distinguished by three aspects: purpose, domain, and approach. In each aspect, there is a problem that science is confronted with. With purpose, the relationship of theory and practice is addressed and the question arises of how mediation between what is and what ought to be, between theories and technologies may be possible. With domain, the relationship between theory and reality is entangled and, thus, there is the problem of hypotheses becoming theories and theories becoming deeper. With approach, the theory-method relationship is in question, as is whether or not observations form the basis on which theories are built. The fundamental problems of science are embedded one in another.

It can be said that a discipline embodies a certain way of thinking, meaning the way it tries to come to terms with the problems. On the one hand, there is a naturalistic way of thinking which is characteristic of natural science disciplines. This way of thinking holds that induction is possible, leading from observations to hypotheses, that verification is possible leading from hypotheses to theories and that guidelines for action can be derived from describing facts. On the other hand, there are two kinds of culturalistic thinking, anthropomorphism and dualism, both of which start from the predominance of attitudes that prove theories fallible which, in turn, prove observations but relative.

The crux of the problem is that neither way of thinking enables humanity to master global challenges or to bring the emerging world-society onto a sustainable path. A theory of evolutionary systems, unifying various self-organization research findings, has to select a way of thinking that imparts philosophical reflection. Only in this way can the gap between the so-called "hard" and "soft" sciences be bridged.

Keywords: two cultures; naturalism; culturalism; global challenges; positivism

1. Introduction

The impressions made by the atom bomb, industrial and agricultural catastrophes, hunger, suffering and death in the poor parts of the world, have raised consciousness of the destructive and fallible nature of the human technosphere, the fragile and finite nature of the human ecosphere, and the unsettled, unbalanced nature of the human sociosphere. It should be a part of general knowledge to realize that the existence of such global problems can endanger the material reproduction of today's society.

Assuming that these problems have an anthropogenous origin in the use of technical, natural and human resources of social systems, human efforts to solve them (or at least produce a strategy for dealing with them) are purposeful, and so should be supported by contributions from science. Thus it has become an

important criterion of academic activity to evaluate the effectiveness of such attempts to overcome these challenges.

As it is in the nature of the challenges facing the social system to be complex and global, they have to be approached in a similarly complex and global fashion. The split into disciplines which are both alien and deaf to each other is an obstacle for consistent comprehension, which takes into consideration as many of the manifold aspects as are necessary in order to take measures to reach the desired goals without being frustrated by undesired effects. The urge, however, to transcend the borders of the disciplines, the trend towards transdisciplinarity, and the search for a base of understanding between the domains of science, has been growing.

The bridging of the gap between the two so-called cultures of natural and social sciences is an item on the agenda. Idealistic constructs should be measured by their ability to communicate and integrate, and by how far they can generalize the diverse contexts of the world and comprehend complexity.

After centuries of dominance of the analytical ratio, i.e. the modern, Western-controlled (natural) sciences, with their irrational reverse side (metaphysics, mythology, mysticism – the means of expression for everything that mechanistic philosophy put last), the time seems to have come for a paradigm change in academic thinking, as far as a synthetic overall view. This integrative view of what can be perceived by human intelligence does not have to, indeed should not, be a return to the pre-modern vision in the form of speculative natural philosophy, as it was in the Antique period. Rather, it can and must be put together with the results obtained from disciplinary research, as if in the form of a historical movement, which spirals upwards from the abstract to the concrete.

2. Fundamental problems of science

Every scientific activity, regardless of the field being investigated, has to contend with three problems, namely substantiation of the methodology, reality contents, and practical applicability of the theoretical findings.

This becomes clear when a broad scientific term is used as a basis, which does not restrict vision to the context of justification and criticism of scientific knowledge, but rather extends it to the discovery and use or exploitation contexts of knowledge (Fig. 1).

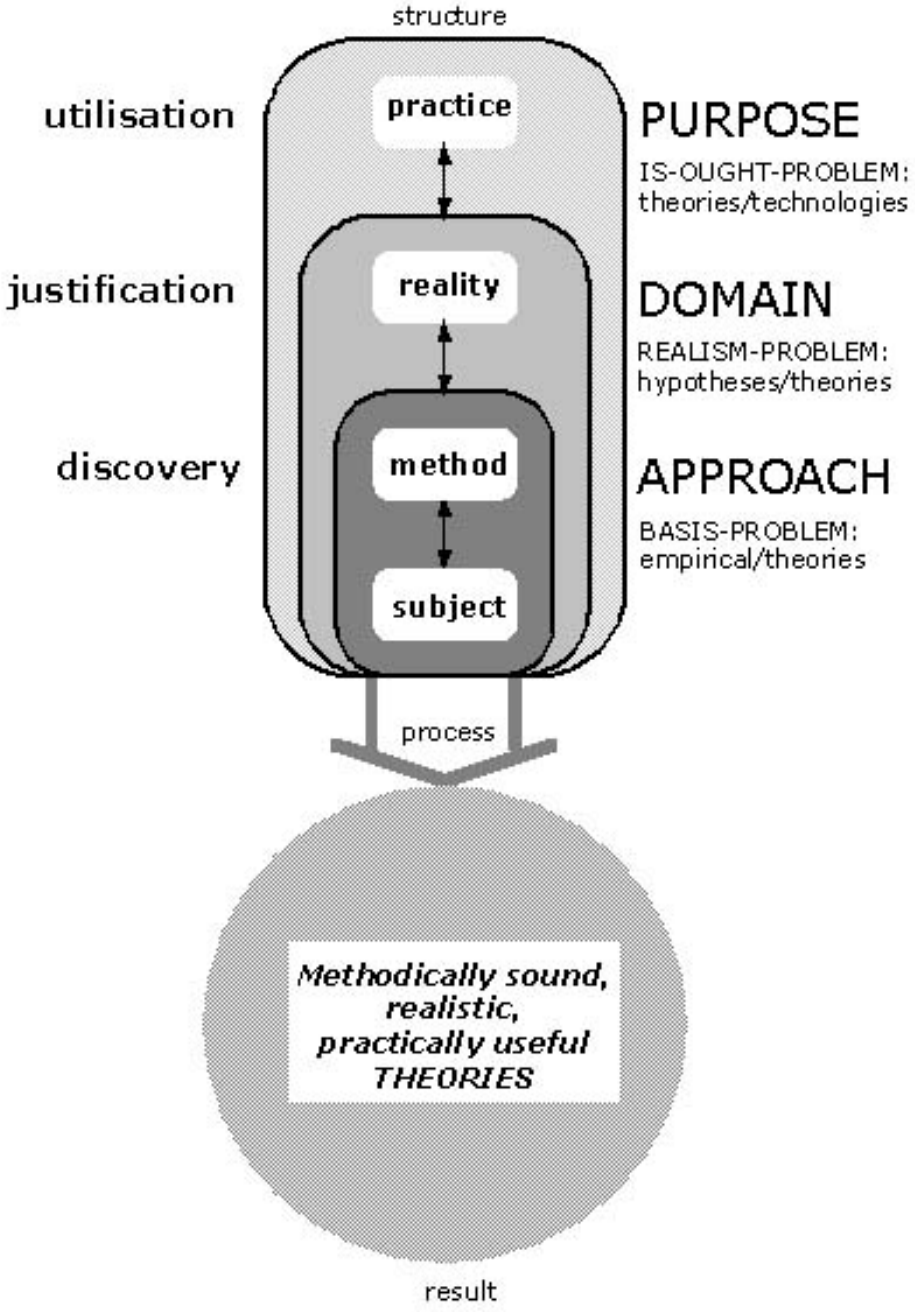

Fig. 1: Science – structure, process, and results

In this broad scientific term, science is an activity whose result (theoretical knowledge, empirically based, formed from hypothesis by experiment and in some way capable of technical exploitation) is not totally independent from the activity which caused it. Like every activity, it radiates from its subject. This is not abruptly active, but on some path or another, it is not directed towards itself, but rather at some person or thing, and not without purpose, but rather to meet some challenge arising from practical experience. In other words, there is firstly a certain means, of which the subject of the activity makes use, which is capable of scientific cognition and thinking (cognitive methods); secondly, an object towards which the activity of the subject orients itself (the cognitive object); and thirdly a specific purpose, for whose sake the subject – as opposed to the object of the activity – becomes active, namely the cognitive interest.

We may then expound the problems of what the access is that the scientific activity takes, what is made into the activity's object, and what the task is that the activity is left to do. The aspects are so imbedded in each other here, that the relationship of the subject and the method is the innermost, the relationship of subject and method on the one hand, and the reality on the other is the next in line, and the relationship between the subject-method-reality relation and practice is the outermost (see again Fig. 1).

In the case of scientific access, the method under discussion is that which should authenticate the scientific experience. Here we are in particular concerned with the relation of theoretical knowledge to empirical

knowledge, and therefore whether and in what sense of the first it can be said that it is based on the second. This may be called the "basis problem" of science.

Regarding the object of science, it must be asked how far scientific representation catches an objective reality that exists outside and independently of the scientific cognition process. In particular, it is crucial how theoretical knowledge as opposed to hypothetical, can be qualified as more realistic and adequate. This may be known as the "realism problem."

The task of science becomes noticeable where scientific directions are required for practical action. In the center of this activity is in particular the transformation from theoretical to technological knowledge, whereby the theory tends to express specialist knowledge, the technology embodies rather values and norms. This can be called the "is – ought" problem.

These questions will now be answered in different ways. The attitude to one problem suggests the attitude to another.

3. The positivist way of thinking

The ubiquitous thinking, which cements thought into bulkheads, is the positivistic (Hofkirchner 1986). It can be seen most clearly in the deep cleft between two cultures of natural/technical sciences on the one hand, and all other academic fields on the other (C.P. Snow 1995). This difference, which unfortunately still exists today, goes back to the 19th-century Neukantianism of south-west Germany, which divided the "nomothetic," i.e. law-seeking, explanatory sciences from the apparently "idiographic," i.e. descriptive but non-explaining sciences (Windelband 1907, Rickert 1913). Whilst the definition of strictly scientific criteria on the one hand creates a space in which the treatment of phenomena is in accordance with the prescribed criteria, on the other hand it allows a vacuum to appear, in which things not meeting the criteria are allowed, and a sort of anarchy reigns.

This way of thinking may express itself in two ways. Firstly, there is the naturalistic way, in which an attempt is made to force everything into the confines of precise sciences, headed by the mathematical sciences. Secondly, there is the culturalist way, dominated by the humanities and social sciences. This can itself be seen in two different ways. The first involves the anthropomorphistic reversal of naturalism, whereby the monopoly of the natural sciences is replaced by one of social sciences and humanities; in the second, the sovereignty of the natural sciences is not contended, as long as there is reciprocal recognition of social and human academic fields, which may be described as bi-cultural thinking in the narrow sense.

3.1. The "hard science" stance

Naturalism in science consists therefore of the exclusive use of methods belonging to the arsenal of the natural sciences, of considering all objects as if they were natural, and intending to make all these subject to technical manipulation.

The approach that it chooses takes place via a methodology, whose normal denotation as empiric-deductive makes one forget that it normally proceeds inductively. The emphasis is put on experiments in which things can be measured, and deductive-nomologic explanations, which allow mathematical modeling, and which fit these observations. In this respect, theories seem to rest upon observations.

The objects of the investigations are not only the natural contexts of the respective object area, but also it is assumed that the object in one way or another disappears in these natural contexts so that it can be explained (and predicted) according to them. Fitting explanations (and predictions) then appear to verify the underlying hypotheses. To this extent, a transition from unconfirmed or poorly confirmed hypotheses to better-confirmed theories is suggested.

The purpose of the results obtained lies in the unscrupulous, nondeliberate realization of everything that seems possible in the light of these results. In this respect there is no barrier to be overcome between the *is* and the *ought*, or between the theory and the technology. The dynamics of science appear to force technological progress forward.

In these three dimensions, the naturalistic philosophy is guilty of a mistake. It makes absolute what is valid for the area of natural sciences, in that it makes solely valid things that are also valid for the field of social sciences, and in doing so overlooks the peculiarities of this field. It thus reduces the specifics of social sciences to that which is found in natural science.

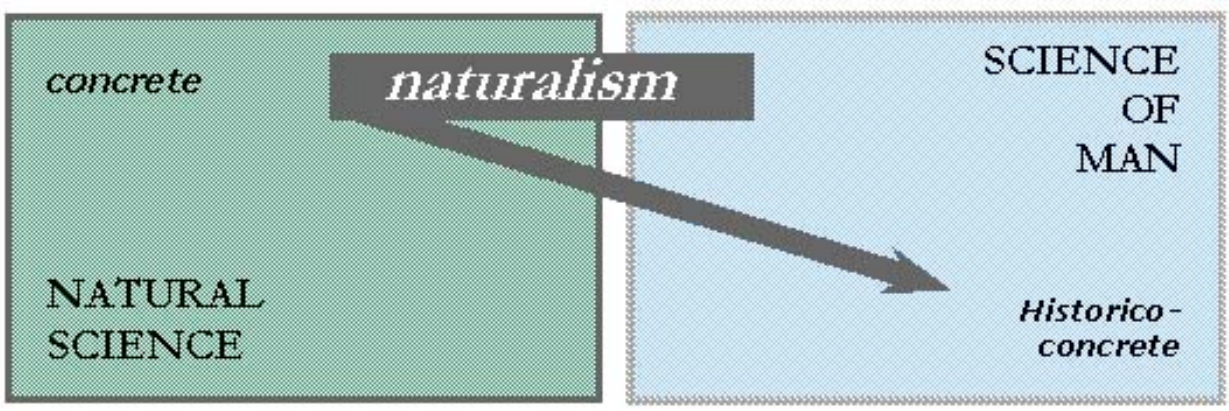

Fig. 2: Naturalism

3.2. The "soft science" stance

The culturalism in science concerns itself with using methods of social sciences and humanities, sees in the object of cognition a genuinely human, i.e. intellectual, social, societal and cultural, phenomenon, and regards its task as paying tribute to the specific conditions of humanity in academic works.

The approach differs from naturalism in that the perspective of the observer, be it an individual or collective, is from inside, not outside. As a result, all observations are relative. What is seen cannot be explained by reference to objective regularities, but has to be understood by the respective subject. Either the claim to validity of this cognitive relativism is raised in an anthropomorphistic sense for any domain, including areas where natural-science methods are applied, or it is reserved in a dualistic sense for a specific and limited area of science, outside of which naturalistic methodology can be used.

Not only the methods of cognition, but also the objects themselves appear to be so strongly influenced by humans no theories can be formed without consideration of this circumstance. Thus the theories are fallible, because their truth depends on the inclusion of the human factor. Here too there is the variant of anthropomorphism, which declares the entire observable world to be the sphere of human influence, and the variant of dualism, which allows room for the existence of an area of the world which is not human-controlled.

Culturalism sees its purpose in life as warning of the creeping danger of humanity being silenced, and insists on a standpoint of the inalienable right to human autonomy. In accordance with this, there is no such thing as value-free science, but rather values are the starting point, pivot and crux of all science. The difference between anthropomorphism and dualism depends on whether the *ought* dominates the *is*, or remains neutral relative to a part of the *is*.

Both anthropomorphism and dualism must admit to mistakes, too. Anthropomorphism states (quite unlike naturalism) that whatever applies to the fields of human and social sciences, also applies to the fields of natural science, thereby stating that something is the case where it is not. In the process it extrapolates the specifics of social sciences to the field of natural sciences (Fig. 3). The two-cultures-philosophy separates absolutely the respective case in each of the two fields, and postulates its exclusive validity for that particular area. In doing so it ignores the fact that social and natural sciences do have common areas (Fig. 4).

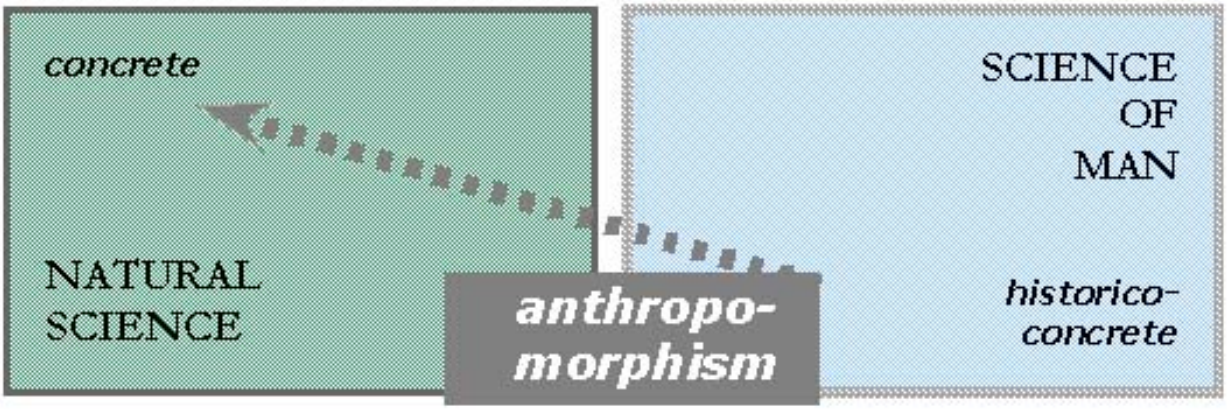

Fig. 3: Anthropomorphism

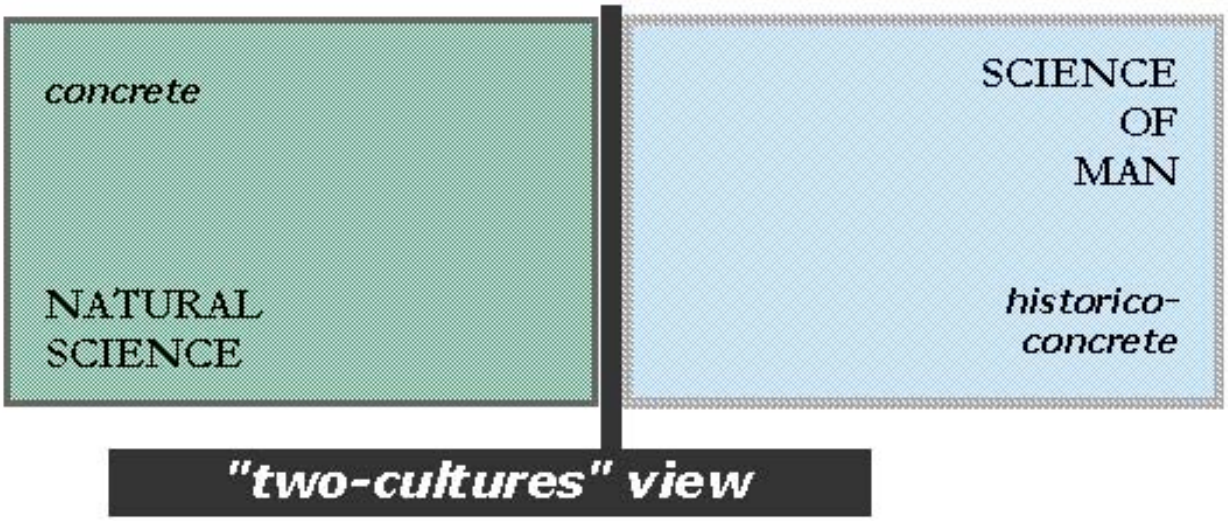

Fig. 4: Two-cultures view

4. A unifying perspective

Opposing the positivistic view is a philosophy that mediates the relationship of individual disciplines to another, and that of the social sciences to the natural sciences, by including philosophical considerations, which allow the common features of the individual areas to remain, without blotting out their individual character; likewise they allow the individual characters to remain without blotting out the common features (Fig. 5). This way of thinking sees both the differences and the similarities simultaneously, so that no exclusion of one by the other arises. The differences that separate the two sides are based on their similarities that unite them and are reflected by the philosophy. It is only via philosophical efforts that the concrete of the natural sciences and the historico-concrete of the human sciences, respectively, are generalized before they are specified again, leading to the historico-concrete and the concrete, respectively. Thus direct conclusions and also mutual exclusions, i.e. everything which leads to making absolute, can be avoided.

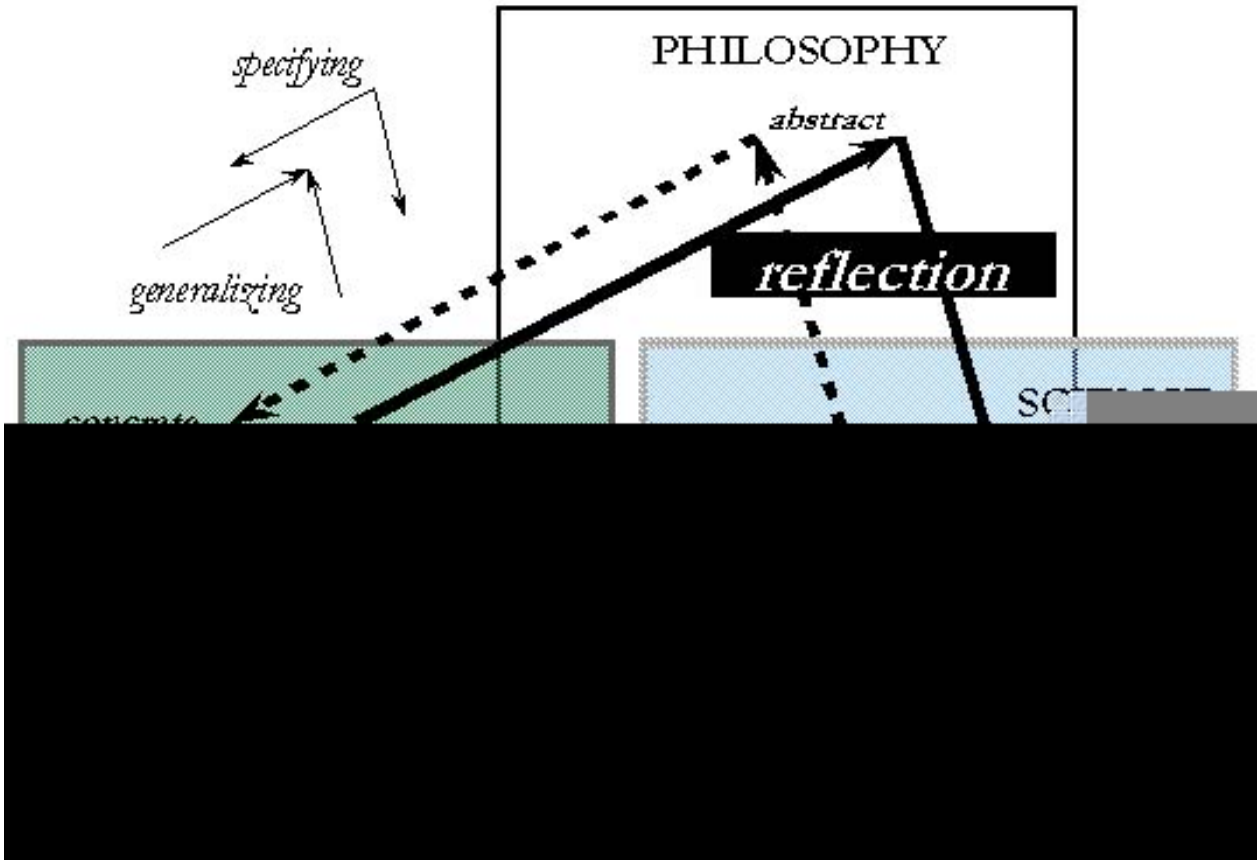

Fig. 5: Reflection

Naturalism and culturalism have shown themselves to be very extremist positions regarding application of methods, fundamental views of the object being considered, and the values used in their practice. It is therefore not surprising that the extreme position of the one side causes an equal and opposite position on the other side, a sort of positive discrimination to counteract the respective exaggerations and neglects of the opposing position, so that both sides can be taken as the two sides of a coin. An alternative would be to consider the unity of the sciences, a mediation attempt by philosophy, with the following characteristics. Firstly, it sees methods of natural sciences and methods of human sciences as instantiations of a unified scientific methodology; secondly, it sees any object in terms of its natural and societal relations as belonging to a single, coherent reality; thirdly, the technological applicability of the scientific results obtained are inspired and induced by a practice that provides common and general interest in the production of conditions that were mutual, and would increase the self-determination of a growing number of members of society, whom scientific and technical progress is supposed to benefit.

4.1. The thesis of the unity of methods

In contrast to the view imposed by naturalism, it is not unscientific to get by without experimental or mathematical methods; in contrast to the anthropomorphistic globalization of cultural thinking, explanations of natural science are not merely a misunderstood variety of traditional understanding in the humanities; and in contrast to the dualistic culturalism, it is not sensible to divide the applicability of scientific methods along the line dictated by the differentiation of nomothetic and idiographic. Both the naturalistic and culturalistic philosophies are concerned with the description of events and the comprehension of their arising, be this in the form of explanation, prediction or understanding. Such comprehension is achieved when a demonstration of those conditions succeeds, to which a participatory role can be attributed at the onset of the events. Sometimes, such conditions may constrain to precisely one case. The onset of events is then a sequence, which happens out of necessity. What happens out of necessity must of course be possible. Other times, the conditions may constrain to a number of cases. The sequence of events is then a process that happens randomly, but which would be made impossible in the absence of the conditions. The appropriate conditions may thus be described as necessary conditions, which create the possibility of all conceivable cases. Both times, the role of the conditions is a constraining yet enabling one.

The unity of the methods can thus be seen in the fact that comprehension is always sought. One could

speak of the understanding of the existence of a phenomenon, if the possibility of its existence has been sorted out, and of explanation and prediction if in addition to the understanding and the derivation of the possibility of existence, the derivation of the reality of existence is successful. The dividing line between "exact" methods and methods of "soft" science is thus a relative one.

The means by which the comprehension is reached, be it understanding, explanation or prediction, is a theory that always rests upon empirical methodology, in as much as the conditions are only described empirically. The theory cannot however be derived by formal-logical means from the empirical descriptions. The jump from empirical methodology to theory is one which cannot be made without a flash of inspiration.

4.2. The thesis of the unity of reality

The thesis of the unity of the methods is closely related to the theory of the unity of reality. It is clear that the application of methods is dependent on the object field; if there are clear causal relations in the object field, it is promising when the cognitive methods look for them, whereas if there are not, the cognitive methods must be satisfied with proof of incompletely determining causes. The results of research into self-organization make clear that there is now movement in the dividing line previously drawn by sciences between systems of the first object field and those of the second. In any event, the first object field is made up of mechanical systems which represent a subset of all real-world systems. Put more precisely, they are systems at or near the point of thermodynamic and chemical equilibrium. In the case of systems that are far removed from such equilibrium (i.e. in which they are exposed to fields where the unequal distribution of free-energy flux density has exceeded a critical value), the well-known phenomena of self-organization appear, namely the spontaneous building of order from fluctuations, by the dissipation of entropy. These cases include an essential incompleteness of the determination of the events, in order that the creation of really new events can occur.

The unity of reality can thus be seen in that the world is full of systems. These may be differentiated according to how far they are from thermodynamic and chemical equilibrium. Incomplete determinism means the recognition of the existence of more flexible causal relations, as well as the rigid mechanical cause-and-effect relations. This owes its existence to the fact that self-organizing systems are not completely fixed in their movement. This can be seen in the alternatives with which they are constantly faced, and in view of which the systems are left to make a choice themselves. Evolution arises through the system movements' engaging of one another, and their development paths. A yet-to-be-developed theory of evolutionary systems will make clear the reality as the totality of systems which arose from each other, influence one another, and remain in a state of development. From this viewpoint of system evolution, the world may be understood as system of systems which organizes itself, i.e. created itself, and continues to develop, under its own steam. The systems have subordinate subsystems and are themselves components of higher systems. Together they form a layered structure in which the systems that arose in later stages of the evolution process are found on higher levels, the older systems on lower levels. The higher levels of the systems rest on the lower ones both processally and structurally; the lower ones open up the possibilities of further development on the same level, and, when the carrying-out of system-specific functions reaches its limits, the higher organization of the systems on the next level, which may or may not be realizable by the systems. The lower development levels form quasi-potential preliminary stages for higher development, but do stipulate the precise details.

Human systems are nothing other than self-organizing systems that observe other self-organizing systems and create theories as to their mode of action. These theories receive feedback from the observed self-organizing systems themselves, and thus come increasingly closer to correspondence with what they are supposed to represent. Thus hypotheses are upgraded to theories, whilst theories are, in light of better theories, downgraded to only partially valid hypotheses.

4.3. The thesis of the unity of practice

The thesis of the unity of reality is itself closely related to the thesis of the unity of practice. The recognition of the world as an overall context of varyingly differentiated evolutionary systems, which are nonetheless subject to the same laws as regards the essential features, is a precondition for the ability to intervene in the happenings of the world, to change the world in such a way that it is preserved. Neither predefined material constraint as in naturalism (or ideal values from anthropomorphism), nor arbitrary definitions as in dualism, should be accepted. Norms are to be left where they arise, namely in the societal process of living, and where they are oriented towards good and pleasant things (whereby what is evaluated as a good and pleasant life varies within a historically changing band width), but they are not to be removed from their roots. Securing a good and pleasant life in a cultural sense always means, above all, securing survival in an

elementary physical sense.

The unity of practice arises, with respect to the influencing of the technosphere, ecosphere and sociosphere, totally from the search for a way out beyond the impractical, ideal-typical alternatives of continuing the path taken or turning back. On the one hand, carrying on along the same path cannot make itself plausible (in the way that a simple increase in science and technology with the same economic drives and political framework conditions could bring about a qualitatively changed situation), if the present situation is in debt to a lower quantity of the same development. In this conservative variant, continuity is made absolute and the necessity or possibility of a jump in quality is denied. Either the solving of global problems is seen as something with which, in the framework of the modern age, can be coped with, without needing any modifications of civilization's development, or the existing situation is attributed with a problem-solving capacity on a vastly different scale, because obstacles are not recognized. In neither case is there a need for action. On the other hand, the call for a U-turn would throw the baby out with the bathwater if it proposed something radically different here and now, without consideration of development so far. It believes it would have to do without any modern science or technology, just as it would have to forego modern economy and politics. This radically utopian form of socio-political guidelines makes discontinuity absolute, and denies the possibility or necessity of the continuation of certain relationship structures in societal development, it dualises the bad reality and desired good to the point that every possible course of action becomes superfluous. In addition to these two alternatives, there is a way out that stresses the possibility and necessity of both discontinuity and continuity in the scientific-technical development which is enclosed in the societal one. A leap in quality is demanded, which stops present quality in its role as the dominant quality, but keeps it as a quality which is now dominated, and enhances the status of some of its features insofar as they prove ready for development under the dominance of the new quality.

Unity in practice means that we are, as the acting subject, always in situations in which we have to decide for or against carrying out particular actions. As a basis for decisions we require knowledge, but decisions cannot be made with knowledge alone. The *is* has within it the possibility of being the *ought*, the theory has the possibility of being technology. However, technology is not the automatic realization of theoretical cognition, even if this is gained in view of solving a specific problem. Humanity must today make a conscious decision between the continuation of its existence and a game with destiny. Whether the scientific results are obtained in such a way that the technical applications that rest upon them serve the general good, is left to the discussion of the effects and preventative shaping of scientific and technical development.

References

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