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Commentary

Higher-Level and Horizontal Interdisciplinarity

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It is well known that most of the topical problems of our times cannot be addressed in clean disciplinary separations or total disciplinary make-up, but they are only successfully to be addressed in interdisciplinary or transdisciplinary or even supra-disciplinary manner. For instance, ecological problems are not just natural science questions, but of course they are not only cultural or social humanities problem areas either. In the overriding and comprehensive problems of our society and age we encounter a complex of not only internal interaction and interconnection if not mashing of the prospective disciplinary areas. We need more abstract plus disciplinary methods, disciplines and technologies, so to speak generalized operational techniques in order to get a more formal or abstract or methodological perspective. This is even true for the humanities in the narrow sense. It is quite obvious that in the last decades the techniques of information processing, electronic data-retrieval and processing as well as other information techniques have penetrated also the humanities. We deal here generally with information or, to be more precise, interpreted information as well as processes and results of interpretations. Using a rather technical methodological term since 1978 I proposed to talk, as we saw, of "interpretation constructs" [1] or "scheme-interpretation" [2]. In referring to rather artificial and/or abstract "objects" of description I would list them as "interpretata" or even "schematisata", i.e. the results of schematisations or interpretation processes (qua the activation of schemes) amounting to be looked at as a "higher order", if rather "refined material", of the sciences and humanities as well as the relevant information processing disciplines.

This is certainly true for the representation of realisations and materialisations as well as the symbolisation in information-disciplines, information systems etc. Here we see ever-extending information networks, systems of interconnections embedded in other systems like a Russian doll gaining more and more relevance across traditional disciplinary perspectives. Using computers is of course a main feature in any area of scientific presentation and systematisation, but also in production and operations research and control as well as in administration and social organisation. All these trends are aspects of a rather comprehensive information and systems rationalisation in the highly industrialized societies, which can be dubbed now systems-technological societies in the information and systems technological age. These information and systems technologies characteristically would cross, overlap, or reach beyond traditional disciplinary borders and limits. They do not only intersect, but also interconnect and override traditional separations between areas and disciplines amounting to a new interdisciplinary frontier of information technological and to systems expanding processes, phenomena and transdisciplinary interactions and interconnections of whatever sort. One may speak of a systems technological or systems-technogenic interdisciplinarity. The sharp separations between and by disciplines are not anymore to be neatly upheld, if not just for operative, methodological or methodical reasons. This certainly leads to respective challenges on the side of scientific methodologists and philosophers of science on the one hand, but also of social scientists, social philosophers and moral philosophers on the other. We all know the problems resulting from the handling of documentation systems, the retrieving of data, the almost unlimited possibility of combining data with respect to data protection problems and "Big data", respective legislations etc. Some even fear that we are on the brink of or already living in a sort of "computerocracy". That seems to be the fate and development of mass societies which apparently cannot be stopped anymore or scarcely be legally checked. This is certainly true since the last decades with respect to the world-wide information systems like the Internet, World

Wide Web and other means of data retrieval and access. It leads to hardly solvable questions of moral responsibility for the private and "Big" data for the stored or manipulated. Responsibility cannot be allocated or assigned to a respective one and only bearer anymore. It seems that human responsibility for consequences and developments in comprehensively interconnected and complex information systems can neither ethically nor legally be borne by a person or individual any longer nor by a rather vague and almost unlimited set of agents or groups. These questions are at the moment far from any possible idea of a solution. We don't know how an operative, practically applicable, ethics and/or legislation and executive jurisprudence regarding the world wide information systems will look like.

In a sense, we are of course responsible for abiding by what I call a "concrete" or "practical humanity" [3,4] and the respecting of that idea in the world wide communicating and trafficking with information and in our typically rather remote indirect contacts with partners and addresses of our actions and their far reaching consequences. Questions of the tradition and development of "concrete humaneness" through moral philosophies and humanities are in charge. To say the least, it cannot be the case that the problem areas and disciplines in these overriding fields of worldwide interconnections can be neatly separated from each other. The most important problems of our society as well as life in general do not encounter in a pigeonhole-like separation of individual disciplines. In addition, disciplines cannot be operated rather independently of one another, but they all have to accept the interdisciplinary challenge generally outlined. This is also and all the more true for the humanities. The interconnections of systems in our systems-technological age require the application and development of abstract procedures and generalisations as, but not only by, formal and functional perspectives of representation. Across disciplinary description and processing as well as practical action portfolios in handling objects, processes, systems and the respective interconnections between them this operational approach is growing evermore important. This can be called "interdisciplinary" in a true sense. It is now a necessity to go "interdisciplinary" and supra-disciplinary if not even multi-disciplinary. This can only be addressed in a rather general form by going methodological, formal and informational at the same time. This means that also a practice-oriented and reality-prone methodology has to be developed, i.e. an epistemology that can take up these requirements and the interdisciplinary constitution and interconnection of the problem areas in order to consider all these phenomena in a proportional perspective.

It is true that indeed tendencies of a sort of autonomy or independence of systems operations and systems are notably being in danger of developing a systems technocracy and/or rather "computerocracy". Both can only be counterbalanced by a cross-disciplinary delimitation, control and safety regulation as well as risk-minimisation reaching beyond any single-disciplinary onesidedness. Therefore, beyond the extant teamwork of different specialists and experts from different disciplinary schools and approaches we need also so-called generalists developing and applying abstract methodologies, methodical and operational approaches that can be used in rather different areas. This is even true also for the so-called "specialists for the universal", the "universalists" (like philosophers and methodologists) approaching the problems of societal aims and social values as well as the epistemological and methodological basics of the respective disciplines and their interrelationships.

This interdisciplinary constitution and the interconnection problems are confronted in the intersection area of many classical disciplines. These problems are only to be addressed across and beyond the single disciplines. There is a necessity to develop interdisciplinary and supra-disciplinary approaches - in practice and also from a higher level methodological perspective. Classical single disciplines are as a rule overcharged by the cross-disciplinary phenomena, processes and problems of an interarea type. The multiplicity of disciplinary perspectives and the incompatibility of many judgements by the experts from a single disciplinary perspective would typically lead towards important organisational and methodological problems going beyond the mentioned pigeonhole separation of the respective disciplines. This is especially true for the traditional humanities with their once fashionable distinction between the alleged "two cultures" of the "natural" versus the "Geisteswissenschaften", or historical disciplines.

For instance, there are a series of examples from new research areas being ex ante in a certain sense interdisciplinary - like, e.g. environmental research or science of science - not to mention again the two branches of rather behaviorist and humanistic psychology. Wein-

gart [5] has called science of science a "multidisciplinary aggregate science". The research areas of this disciplines are history of science, sociology of science, economy of science, psychology of science, organisation theory of science, methodology of planning, parts of political science and, of course, philosophy of science ("Wissenschaftstheorie", including scientific methodology and also different philosophical approaches like social philosophy). They deal with a lot of values and ideas, methods (or a methodology) that scientists of science would analyse. As yet there seems to be obviously no direct possibility to develop a truly interdisciplinary theory - therefore the term "aggregate science".

How is it possible to differentiate different disciplines and types of disciplinarity and interdisciplinarity from one another? (See the following two diagrams).

Typical differentiations of the disciplines according to their:

1. Objects and fields or areas
2. Methods and arsenals of methods
3. Interest(s) of knowledge" ("Erkenntnisinteressen", Habermas)
4. "Theories and their systematic interconnections and networks"
5. "Theories and their historical interconnections and developments" (Krüger)
6. The relationship of theory and practice
7. Substantial(ity) vs. operational(ity) and formality of theories (Bunge)
8. System-holism vs. specificity of domains
9. Apriori or analytic formality of methods vs. empiricism
10. Explaining and systematising patterns (e.g. descriptive vs. explanatory, historical vs. systematising)
11. Cognitive orientation and normativity (descriptive vs. normative disciplines)
12. "Fictionality" (virtual realities, "cyber worlds", e.g. the so-called "second life") and secondary reality (social "validity or "Geltung") vs. "primary reality".

The disciplines are traditionally distinguished with respect to these criteria or markers.

Very important to my mind is the difference between substantial and operative theories [6] where the latter ones concern formal procedures, operations, program- and model-making. Substantive theories would be, e.g. gravitation theories after Newton or Einstein. Operative theories would be for instance information theory, mathematical game theory or general formal procedures and analytic instruments which can be applied in very different sciences. Information technological and information-theoretical approaches are obviously operative theories and importantly applied in interdisciplinary research. Formal theories do of course elaborate formal ideal-language concepts like special mathematical theories, e.g. fractal geometry and chaos theory.

An important differentiation is also the fashionable but usually rather dogmatized polarity between patterns of explanation and other systematizing or generalizing theories on the one side and rather descriptive historical approaches of the so-called "understanding" ("verstehende") disciplines on the other. It does not make much sense any more to defend a sharp dichotonomy contrasting these ap-

proaches in a total and exclusive manner. Rather, we need a differentiating combination and approach of dealing with both of them. Many respective research areas may require such an overriding and comprehensive approach, e.g., the both psychologies as well as disciplines like paleo-anthropology, descriptive geography on the side of the natural sciences or linguistic theories and semi-lattices in the formal theories of linguistic.

A rather necessary distinction to be much more appreciated is the distinction between cognitive (descriptive) and normative disciplines. Cognitive- descriptive disciplines are certainly the only extant ones in the natural sciences proper, whereas, e.g. jurisprudence has to be largely taken as a normative discipline[1].

An important difference seems also to be the distinction between real and material objects vs. fictional or soci(et)al objects. The latter are by definition produced by human invention, norming, rule-based and linguistic or language- structuring and categorizing of a social provenance (This has to be addressed in connection with the extant "realistic interpretations" and fictive, socially and culturally produced interpretations in the narrow sense).

All these perspectives - particularly those explicitly mentioned as important - lead to different types of interdisciplinarity which are listed in the following.

Types of interdisciplinarity

1. Interdisciplinary co-operation in more or less well-defined practical projects (e.g. GIS in geosciences).
2. Interdisciplinary research areas (like, e.g. satellite geodesy).
3. Multi-Disciplinary "aggregated" field of research (e.g. ecology research).
4. Permanent "multi-disciplinary aggregate science" [5].
5. Genuine "interdiscipline" (like physical chemistry or biochemistry).
6. "Multi-discipline" resulting from/relying on multi-disciplinary theoretical cooperation and practical integration (e.g. molecular-biological, chemical & physical gene-technology).
7. Abstract generalized interdisciplinary systems theories (e.g. General Systems Theory [7]).
8. Mathematical theories of abstract and complex dynamical systems (e.g. deterministic or probabilistic, fractal geometry, chaos theory, network- and connectionist approaches etc.).
9. Statistical information-technological "Big Data" analyses
10. Supra-disciplinary abstract structure-analytic and operational disciplines (e.g. operations research in management and economics).

[1]Although there are descriptive and cognitive parts and derivations as well as knowledge perspectives that are also important here leading to what can be called nowadays a supplementation of jurisprudence by some modern sciences like sociology, neuroscience, bio- and gene-technology and traditionally, psychology and criminology as auxiliary disciplines. These auxiliary disciplines have a much more important stance nowadays for the legal disciplines.

11. Methodological supra-discipline(s) (as e.g. philosophy of science and science of science and methodologically oriented history of technoscience).

12. Philosophical epistemology as meta-disciplinary approach (e.g. methodological scheme-interpretationism, see above).

Some remarks regarding the diagrams and types of interdisciplinarity are in order:

- Ad 1. The simple cooperation of projects in interdisciplinary research co-operations are certainly the practically most important sort of interdisciplinary teamwork by experts of different orientations (like in city planning or any environmental research dealing with natural and human-made and manipulated systems.) This is yet a rather lose not systematic or theoretically interconnected cooperation or aggregation of experts' work and contributions of the respective planning or development program(s).

- Ad 2. There are bi-disciplinary aggregations or cooperative networks, within a research project, obtaining between two disciplines, e.g. between architecture and sociology in city-planning.

- Ad 3. More generally, a respective multi-disciplinary cooperation of projects within a large field, as, e.g. in environmental research, a kind of "gathering" enterprise between different input disciplines - perhaps becoming

- Ad 4. A "multi-disciplinary aggregate science" (Weingart's science of science).

- Ad. 5. From aggregative cooperation one has to distinguish a genuine specific interdiscipline as, e.g., molecular biology or biochemistry or, more traditionally, physical chemistry or biochemistry.

- Ad. 6. Multi-disciplines are the systematic integration of more than just two disciplines (as the combination of molecular biology, biochemistry & physical experimenting, say in gene-technology)

- Ad 7. Then there are the generalized interdisciplinary disciplines of a formal or model-based mathematical character as for instance generalized systems theory like the one called "General Systems Theory" (after Bertalanffy).

- Ad. 8. The purely formal and abstract mathematical theories of, e.g. complex dynamic systems nowadays, are notably involved in progressive developments in dealing with systems of deterministic chaos or fractal geometry within these approaches[2].

- Ad. 9. Statistical AI analyses like Big Data research technologies are currently booming in applied computer science/technology.

- Ad. 10. Supra-disciplinary applied structural and operations disciplines as are to be found in economics in the form of the so-called operations research are pretty old. Meanwhile also mathematical game theory has a notable impact in the economic field.

- Ad. 11. There are methodological-meta-theoretical supra-disciplines of a higher level like traditional philosophy of science or also a higher-level approach to science research ("Wissenschaftsforschung") on a more conceptual basis - including a generally systematized history of science.

- Ad. 12. Finally we have to mention and further develop and systematize the philosophical and epistemological-methodological meta-theoretical field of debates of the respective systems connections and the whole set of the disciplines. That should be accomplished under a specific holistic or higher level-methodological perspective (as, e.g. offered by "methodological interpretationism" or "scheme-constructionism" [2,8-10]).

[2]There are not as yet stochastic or probabilistic chaos theories or models beside some sketchy applications and economic approaches to a chaos-theoretical interpretation of social sciences and humanities which would be indeed be rather probabilistic instead of the extant deterministic ones.

Indeed, these all these different possibilities and aspects or types of interdisciplinarity are useful, because, e.g. pure "gathering disciplines" loosely covering a practical field of research in a complex interaction of different scientific approaches just bound together by practical requirements are quite another thing than an "interdiscipline" like physical chemistry or a mathematical operative theory.

For all these aspects however, we have to require that the involved scientists have to have for this a certain kind of secondary competence in the neighbouring respective science or discipline. Lastly, it is obvious that the philosopher of science who wants to systematically deal with methodical and methodological problems of biology should be somehow up to date in biology proper. He or she need not be a productive researcher in biology, but should be able comprehensively to evaluate the present state of the art. Yet, secondary competence would also be required for study programs in philosophy of science and methodology of "technosciences" (Ihde). Such plural or many-sided competencies would mean to delve into different or diverse sciences involved which is possible for an individual only in a very limited measure. Again, the development of the more general systems competences as mentioned is called for - especially of those abstract and formal methods of the generalists and even deeper rooted capabilities of the so-called "universalists". Beyond the extant specific disciplinary orientations they provide necessary conditions for being able to provide valuable research work, analyse and discuss overriding problems of values and norm systems etc. The relatively best solution conceivable is of course not the one result springing from an alleged "encyclopedic" brain of just one universalist, but usually a cooperative production and cooperation within and by a teamwork of scientists from different provenances.

Heckhausen ([11], 135) wrote that in the humanities research in any case is essentially interdisciplinary oriented, because everything is historicised, and one has in the last analysis always but different text bases. Yet, the research method would be rather uniformly the same. I think that this is not true anymore today. However, it is true that the stronger the contacts, historical traditions etc. are involved in the approaches, the more often will this aspect of the contributions by different disciplines become relevant. In the humanities and social sciences there is today a requirement of an especially high interdisciplinary challenge and qualification.

My experience in a technical university was that interdisciplinary teaching and education has notably to emphasize practice-orientation, problem specificity and practical projects like case studies. It is certainly the best way if the latter examples are involved or integrated within the framework of practical research projects or in a limited thematic field of operation. I regularly used to offer interdisciplinary seminars together with the experts of the respective other fields and disciplines in mathematics, natural and social sciences and technology. However, that cooperation has to be not only occasionally offered together with experts but should possibly be institutionalized in regular continuity of communication or "mutual penetration" even if sometimes in debate confrontation. It should be problem and project-oriented. Topical case studies like environmental projects and problems or the climate crisis would be ideal. This indeed presupposes a certain kind of secondary competence, at least a sort of a deep-rooted readiness to try to understand or learn to understand the terminology of the other disciplines and to get into real touch and discussion with the disciplinary experts. However, one would thereby presuppose implicitly that something like a common practice-oriented perspective or basis of methods or even a common methodology of the sciences, i.e. of the philosophy or methodology of science or "technoscience" would somehow exist, if on a higher meta-theoretical level. Beyond that there should also be a common perspective regarding what one can call the "methodology of actions", i.e. the acting researcher and rules of checks, controls as well as moral values of research (like objectivity). This would imply that there are overriding (inter-departmental, i.e. "interfakultativ"[3] and interdisciplinary) approaches or "interdisciplinary institutes" focused on the respective problems field relying on such interdisciplinary perspectives.

[3]In our former school of Social Sciences and Humanities and the so-called "Karlsruhe School of Philosophy of Technology" (Mitcham) the students were offered some additional qualifications of that kind notably from a sociological or multimedia as well as information-theoretical and intercultural perspective. As yet, philosophy of science perspectives proper were and still are lacking a bit.

It seems necessary to draw some short theoretical consequences from the sketched problem situation. I would like to do this by critically reviewing the implications for social and human sciences under the perspective regarding the traditional separatism of methods between atural sciences and humanities and our social sciences[4]. This is another contrast which is not incompatible with an overriding methodological viewpoint, say, from a higher level meta-theoretical approach of methodological provenance which might be relevant of most of the sciences and their theoretical schematisations as well as on this abstract level also for some systematisations as they are also to be found in the social sciences and even in the humanities of historical categorizations.

Indeed, the traditional dichotomies are not only misunderstood but also too rough and superficial to be possibly refined to give an adequate image of what goes on in the different landscapes of scientific disciplines and their interdisciplinary relationships.

It is true, that at least the "third culture" (Lepenies), namely social science, has to be supposed to (have) overcome the mentioned polarity. Indeed there are additional mixed disciplines and many other sorts of interdisciplinary areas and methods on diverse levels as mentioned before so that even some formal and operational "sciences" (like mathematics or logics or game theory, chaos theory etc.) have to be identified as special types of interdisciplinary approaches as done before in our diagram of the types of interdisciplinarity. The same is true for descriptive and historical disciplines as well as linguistic research areas between the perspective traditional borderlines of the natural sciences and say, the linguistic disciplines. For instance, within the history of the development of language and in the evolution of the primates and australopithecines we would find interesting examples of such a mixture of different approaches from very diverse schools, disciplines and faculties. The traditional separatism has to be rejected. It is methodological speaking false and also not only outdated by practice but also rather skewed by outdated ideological lenience.

This is also true for the traditional distinction between "understanding" ("Verstehen") and "explaining" ("Erklären"). Who would say that natural scientists only explain but don't understand anything - or the other way around that humanities would only "understand" but "explain" nothing. This is senseless. Instead, it is possible to go beyond this dichotomisation by entering on or ascending to a higher meta-level. It is time to bridge these cleavages and allegedly absolute distinctions and differentiations between the different methodologies in order to come to a certain kind of basic, if higher-level union.

The general perspective of a constructive theory of scheme-interpretations and interpretative construct(ion)s (see above) seems to be a way out which promises to be conducive for gaining a certain kind of overriding if methodological and rather abstract higher-level unity within a problem field of interdisciplinary perspectives and approaches [13-29].

Let's go higher-level and interdisciplinary!

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[4]Already Snow [12] did not mean the methodological analysis in terms of philosophy of science but he talked about a tradition of a "science-culture" versus the "cultural tradition of literature" and the respective mentality of the intellectuals versus the "traditional attitude of the natural scientists". He did not in fact criticize the contradistinction or contrast between kinds of sciences, but a contrast between more general activities and attitudes of representative people.

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