2000 Developmental stages in philosophy of science

DEVELOPMENTAL STAGES IN PHILOSOPHY OF SCIENCE

AND BASIC RELATIONS BETWEEN SYSTEMS

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I. Introduction: the study of developments and relations

The philosophy of science has undergone in this century a development in which one can distinguish several stages. The first main stage is logical empiricism, due to the Wiener Kreis. Popper's broad and lasting influence in philosophy of science meant an essential new development, so a new stage. Next, the work of Kuhn on paradigms and scientific revolutions created a revolution in philosophy of science itself. The radical ideas of constructivism proposed in recent years by Latour and others can be seen as a last step.

Aim of this paper is to elucidate these stages which seem to be the most important developmental stages in philosophy of science. The questions I want to clarify are: Why do we have just this development? This sequence of stages does it have an internal logic or is it mere accidental? What is precisely the lasting (though perhaps limited) value of each stage?

My approach to these questions is a very general one: it is part of a general study of development and developmental stages. Development is a central concept in many sciences. Not only because it is characteristic of scientific disciplines that they should undergo a development, but especially because much research is focused on systems capable of development. Due to this central role, there are disciplines in which these developments are investigated at a metatheoretical level. In the "Philosophy of science" the development of sciences is studied, "General system theory" investigates systems in general and therefore also the development of systems, and the recently proposed "Philosophy of development"[1] focuses on all kinds of developmental theories, their foundations and the comparison of their sequences of stages. The approach I present in this paper can be seen as a particular kind of combination of these three investigations.

My approach starts with the observation that the development to a new basic stage of a system not only is a qualitative change of the system concerned, but always also is a change of the relation of this system to other systems. Though it is generally recognised that relation too is a central concept in science (because systems always exist in relation to other systems) and that systems develop through their relationships with other systems[2], these relationships have rarely been investigated in a general and abstract way.

It is precisely this investigation which is the starting point of my approach. We may get a better understanding of the basic stages in all kinds of developments once we know by a fundamental and abstract analysis which qualitatively different relations can exist, in principle, between two systems.

This can provide a clarification, not only of the development of systems (such as organisms), but also of the development of sciences and even of the philosophy of science. For, in these disciplines, too, a relation between two systems plays a crucial role, namely the relation between the (epistemic) subject system and the object system. Insight in the different kinds of this subject-object relation can elucidate the stages in the development of these disciplines. I shall argue that the basic stages in these disciplines can be interpreted as the exploration of all the different kinds of relations that can exist in principle.

II. Analysis of the possible relations between two systems

By a system-theoretical analysis of the possible relations between two systems we can easily see that, concerning the basic **structure** of the relationship between two systems -- i.e., the degree in which the systems share elements (or parts) of each other -- there are four and only four **qualitatively different** possibilities: the systems are either distinct (R0), or linked (R1), or they overlap partially (R2), or the one is completely encompassed by the other (R3)[3]. Other differences, e.g. concerning the degree both systems partly overlap, or which of both systems encompasses the other, are not important in so far that they do not produce qualitatively new kinds of relations and ways of participation for both systems. The fact that there can exist only these **four qualitatively different fundamental relations** has far-reaching consequences especially in the case of those systems we are interested in, namely real systems i.e. systems as complex organised wholes.

The realisation of each of these relations, in other words, of each of the four different ways of sharing elements and of participation, requires that the systems concerned have a specific structure. Therefore, with each of the four relations necessarily corresponds a specific structure of the systems themselves. Consequently, a **transition** of a system from one relation to another involves a fundamental change in the structure of the system itself as well.

We are dealing with a real **development** of a system if, concerning an aspect or dimension of that system, qualitative or structural changes occur. Without such qualitatively new changes it is only a matter of growth or mere living[4]. Some of the structural changes of systems can be called fundamental, namely when, as discussed, a transition of the system to another relation takes place. Therefore, due to the fact of four and only four fundamental relations, there are in any complete development at most four and no more than **four** such **fundamental stages**. With that it does not matter whether the development of the systems runs from complete encompassment via two intermediate stages to distinctness, or the other way round from distinctness to a situation of complete participation.

Let me give an example. The stages can be easily seen in a child's biological development in which the relation with the mother is pivotal. The basic developmental stages are: embryo (R3), suckling baby (R2), dependent child (R1), self-reliant autonomous person (R0). That these relations and concomitant basic stages differ qualitatively is especially evident from the different forms of acquisition of nourishment.

[[We encounter a reverse development in an other aspect of many living systems, namely sexuality. The development in a sexual relationship runs in the following four stages: distinctness, the systems touch erotically, a partly overlap during sexual intercourse, the complete fusion of two systems.]]

The given analysis of four relations applies in principle to all kinds of systems. And indeed, we can observe the four fundamental developmental stages to occur in different ways in all kinds of developments. Because each stage is essentially determined by one of the four relations between systems, this analysis provides an understanding not only of the number of the basic developmental stages, but (what is more important) also of the structure of those stages themselves. Here I shall not elaborate this further. The aim of this paper is to focus on a particular kind of relations, namely the subject-object relations which play a central role in the practice of science.

III. Epistemological relations and developments

Since it holds, universally, that there are precisely four qualitatively different relations between systems, the same must also hold in case one of the two systems is a cognitive system and can be regarded as the epistemic subject system. In this case the relation between the two systems has the character of a subject-object relation. From the fact of four system relations it immediately follows that in principle there are also four and only four qualitatively different subject-object relations. Dealing with a subject-object relation of a particular kind means of course that we are dealing with cognition of a specific kind. Consequently, with the four s-o relations there correspond four qualitatively different kinds of cognition. [[These are the four aspects of acquisition of knowledge which -- as we shall see later -- in a certain domain are needed for complete knowledge]].

In science it is by means of measuring instruments that we get the primary information concerning the object systems. So, at the experiential level it is the instrument which is the epistemic subject. By means of the relations of these particular systems (the instruments) to the object systems the relations between the systems in general in a specific domain can be discovered. I conclude that in science we can encounter in principle four qualitatively different subject-object, i.e. instrument-object relations. This holds in principle for the natural sciences as well as for the social sciences, e.g. for psychology.

Elsewhere I have shown that in **physics** these four instrument-object relations and the corresponding kinds or aspects of cognition are indeed pivotal in the fundamental development of physics[5].

In **classical physics** the act of measurement is not crucial (I call this aspect of cognition A0). So the object observed can consistently be said to exist independently of the instrument and to be separate from it, in which case we have relation R0. In **relativity theory** signal is a key concept. So this aspect of cognition, the information transport (aspect A1) is pivotal. The signal intrinsically connects the instrument and the object system, so that we have relation R1 here.

In **quantum theory** due to the central quantum of action a different aspect namely information transaction (A2) is pivotal. In quantum measurements, measuring results are partly determined by the experimental conditions. Heisenberg's indeterminacy relations express not only that instrument and object system partly overlap during the interaction but also the extent to which they overlap. So we are dealing here with the instrument-object relation R2.

In basic **elementary particles** research, concerning the fundamental properties (mass and charge) of the particles, particle tracks play a crucial role. The track, the single record is now crucial, because by this record only the existence as such of a particular particle is known. Consequently, in these experiments a third aspect of cognition (A3) is pivotal, namely information production. In the (irreversible) process in which the record comes into being, e.g. in a bubble

chamber, instrument and object both participate completely. Though instrument and object are distinguishable conceptually, it is only **after** the cognitive event that one can conclude to the existence of a particular particle. So we have in this situation, connected with the third aspect of cognition, a new instrument-object relation, R3.

In each of these stages one specific aspect of cognition and one type of i-o relation is pivotal. In this way, the main stages in the development of a specific science (e.g. physics) can be understood as successively revealing the qualitatively different relations which can exist in that domain.

IV. Stages in the development of philosophy of science

As indicated, the special aim of this paper is to elucidate the basic stages in the development of philosophy of science. The analyses and discussions in the general philosophy of science especially concern the relation between scientists and empirical reality. This subject-object relation is different from the former one, the relation between instrument and object. The questions now are:

How should the relation between scientists and empirical reality (that is, this specific subject-object relation) be conceived? What exactly is the role of the investigators in the determination of the facts? Is objective or realistic knowledge possible and what does that mean? How are, in science, facts actually established? The epistemological views on these issues are decisive for the developed philosophies of science as a whole.

A survey of the relevant philosophical investigations in our century reveals a growing awareness by the philosophers of science of the active and constructive role of the scientists (the epistemic subject) in the establishment of the scientific facts. The main stages to be distinguished in this development can be specified concisely as follows:

Logical positivism (or logical empiricism) can be seen as the first stage. According to this view (which is, in this respect only a refinement of the traditional philosophy of science), science should deal with pure naked facts which can be obtained by (passive) observers. Here clearly a strict subject-object separation, in other words the relation R0, is defended.

Authors like Popper and Hanson have criticised this view. They argued that observation is always theory laden. Facts necessarily appear in a context of background information and are conceptually dressed by that prior knowledge. Therefore, the facts are indissolubly linked with (and therefore shaped by) the conceptual frame of reference of the investigators. This implies the relation R1.

In the Kuhnian revolution in the philosophy of science a different aspect is analysed. Kuhn emphasised that it is the paradigm, i.e. the whole framework that determines which data are legitimate, which should be seen as real facts, i.e. relevant facts. Facts are not given, they do not exist beforehand. Facts are partly constituted by the particular framework of a scientific community. In other words, they are partly constituted and stamped by the epistemic subject. So we here have the s-o relation R2.

Latour and Woolgar in their anthropology of science focused on yet another aspect of cognition, namely the construction as such of facts. In their investigation of science in action, of Laboratory Life, they wanted to analyse the processes at work in the constitution as such of phenomena. They showed that facts are constructed in a complex process in which the whole epistemic subject participates. This constructivist perspective means the most radical departure from the idea of facts

as given. Though distinguishable conceptually, beforehand no distinction whatsoever is possible between epistemic subject and object. Only **after** the cognitive process one can conclude to a particular effect or object. Therefore, we are dealing here with the subject-object relation R3.

I conclude from this analysis, that -- after the first stage -- philosophers of science have discovered successively that different fundamental aspects of cognition are of crucial importance; aspects which cannot be neglected for a good complete understanding of science.

I now summarise these four aspects and their corresponding relations. I call the first aspect of cognition A0 because this concerns the situation (as emphasised by logical empiricism) that the act of cognition as such can be neglected. Thus:

A0, the act of cognition can and should be neglected and therefore is not crucial; the corresponding relation is R0.

A1, the inevitable conceptualisation of (existing) facts, corresponding relation R1.

A2, the determination in a particular/ specific framework of the legitimate and relevant facts, R2.

A3, the construction of facts as such in a complex network, relation R3.

This overview makes it clear that for a complete understanding of cognition in science all four are needed. Apparently they are pivotal at different levels of investigation.

I conclude: in science we have to distinguish different levels, and the crucial role of each of the four aspects is restricted to one specific level. This makes it possible to understand many quarrels in the philosophy of science as a consequence of only seeing and emphasising one aspect, of building an overall philosophy of science on one particular aspect only. Evidently, for understanding science completely all the aspects and relations should be taken into account.

[[The four qualitatively different relations and aspects of cognition form a complete set. Therefore I can conclude that in the development of philosophy of science indeed all the fundamental relations and aspects are discovered successively. So, it seems that this particular aspect of philosophy of science, namely the investigation of the relation between scientists and empirical reality can be considered as essentially completed.]]

As remarked, we encounter developments and developmental stages in all kinds of domains and they are studied by many scientific disciplines. The aim of science at its most fundamental level is to understand why its subject matter is the way it is; why a development runs like it does, why we encounter precisely the actual basic stages. In this paper I have argued that the study of the four fundamental system relations can contribute essentially to such an understanding.

[1]. See W. van Haaften, M.Korthals (eds.) Philosophy of Development Kluwer: Dordrecht 1997.

[2]. Cf. e.g. A.Fogel Developing through relationships Harvester: New York 1993.

[3]. For reasons of convenience I prefer this numbering, but the relations might also have been numbered e.g. R1, R2, R3 and R4.

[4]. Cf. M.Mahmer; M.Bunge, Foundations of biophilosophy, Springer-Verlag Berlin, 1997, p.272.

[5]. See my article `The fourth Structure of Physical Reality', Journal for General Philosophy of Science (Zeitschrift für allgemeine Wissenschaftstheorie) XIV/2 (1983), pp.354-367.