

The Cognitive Program of Constructivism and a Reality that Remains Unknown

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I.

Interest in epistemological questions is not limited to philosophy today. Numerous empirical sciences have, in the normal course of their research, been forced to proceed from the immediate object of their research to questions involving cognition. Quantum physics is perhaps the best-known example, but it is no exception. In linguistics the question is raised today of what problems arise from the fact that research into language has to make use of language. Cognitive instruments have to be acquired via the object investigated by means of these very instruments and not, for example, through reflection of consciousness upon itself.¹ Brain research has shown that the brain is not able to maintain any contact with the outer world on the level of its own operations, but - from the perspective of information - operates closed in upon itself. This is obviously also true for the brains of those engaged in brain research. How does one come, then, from one brain to another? Or to take a further example: the sociology of knowledge had demonstrated at least the influence of social factors on all knowledge, if not their role as sole determinants. This is also true, then, for this statement itself since no justification for an exception can be found, in the sense, say, of Mannheim's »free-floating intelligence«. What conclusion is to be drawn from this? It was thought that one would have to found all knowledge on »convention«² or that knowledge was the result of a kind of »negotiation«.³ But these attempts only wound up designating an ancient problem - that of the unity of knowledge and reality - by means of a new concept. Not without reason have these attempts been criticized for epistemological naiveté⁴, since one either learns nothing about the relationship to reality or the connection is only made over theoretically unacceptable »both/and« concessions. There is little more to be gained by calling such »constructivism«, as has recently been done, »radical«⁵ since what is identified here as »constructivism« hardly at first seems unfamiliar. It might be that the theory of knowledge - at least in some of its traditional variants - will be confirmed rather than caught unaware. Science is apparently reacting here to its own power of resolution. This can already be found in Plato who reduces everyday experience to mere opinion and raises the question of what reality lies behind it. As a result, these philosophic reflections were termed, at first, »idealism«. As we come to modern times the emergence of modern science led more and more to the conclusion that this »underlying« reality was knowledge itself. This altered the meaning of the concept of the subject, while it is only in our century that the name »idealism« has been replaced by »constructivism«. There was a shift in emphasis in the conflict between realism and idealism, but it is not easy to discover in this a new theory. There is an external world, which results from the fact that cognition, as a self-operated operation, can be carried out at all, but we have no direct contact with it. Without knowing, cognition could not

reach the external world. In other words, knowing is only a self-referential process. Knowledge can only know itself, although it can - as if out of the corner of its eye - determine that this is only possible if there is more than only cognition. Cognition deals with an external world that remains unknown and has to, as a result, come to see that it cannot see what it cannot see.

So far there is nothing new here, unless it be in the definiteness and self-confidence with which all this is presented as knowledge. One has to look more closely at the theoretical distinctions with which this view of things is presented in order to discover something new. Insofar as constructivism maintains nothing more than the unapproachability of the external world »in itself« and the closure of knowing - without yielding, at any rate, to the old skeptical or »solipsistic« doubt that an external world exists at all - there is nothing new to be found in it. Nonetheless, the theoretical form in which this is expressed has innovative aspects - even such radical innovations - that it is possible to gain the impression that the theory of a self-referring cognition closed in upon itself has only now acquired a viable form. One can express this more precisely: it has only now acquired a form in which it can represent itself as knowledge. A problem arises here, however. With the word »constructivism« (taken over from mathematics) premature victories have been proclaimed, and one has to accept that there will be those who step aside, with a shake of the head, denying the validity of these claims. It is important, therefore, to investigate the question of what is new and convincing here - and this will lead the discussion far afield.

II.

For reasons that can only be clarified subsequently we begin our investigation with the question: by means of what distinction is the problem articulated? That is, we do not begin with the Kantian question: how is knowledge possible? We have avoided this form of the question because it might lead us to the premature response: in *this* way! At first the difference is of no great consequence. The one form of the question can be translated into the other (if one is not afraid to face problems of logical hierarchies as well as their failure). One can answer the question: »how is knowledge possible?«, with »by the introduction of a distinction«. In contrast with the tradition involving such concepts as »diapherein«⁶ or »discernment«⁷ here the concept of distinction is radicalized. For in order to recognize knowing it is necessary to distinguish it from what is not knowing. As a result, the question with regard to the foundation of knowledge is transformed into a question with regard to the distinction of distinguishing, that is, into an obviously self-implicative question.⁸ The passage from the search for a founding - and therefore asymmetric - relationship with regard to some unity is transformed into a search for an operatively employed difference. It is, further, easy to recognize, that circularity and paradoxes can no longer be rejected but will come to play a role.

So, once again, the question is: by means of what distinction is the problem of knowledge articulated? (And, for the sake of clarity, let it be said once again: We are

aware that with this question we have taken upon ourselves the difficulty of the distinction of distinguishing.)

In any case one will not be able to approach constructivism if one proceeds from the old controversy of whether the knowing system is a subject or an object. The subjectivist problem was to state and to show how it is possible by means of *introspection* - that is by passage to the self-reference of one's own consciousness - to form judgments about *the world of others*. That »intersubjectivity« is only a word which therefore does not solve the problem should be obvious. Objectivism, on the other hand, came up with the idea of describing knowledge as a condition or process in a particular object which was often called »organism«.⁹

The mistake here lies in the assumption that it is possible to describe an object completely (we won't go so far as to say »explain«) without making any reference to its relation to its environment (whether this relation be one of indifference, of selective relevance and capacity for stimulation, of disconnection, or of closure). In order to avoid these problems, which arise from the point of departure taken, both subjectivist and objectivist theories of knowledge have to be replaced by the system-environment distinction, which then makes the distinction subject-object irrelevant.

With this we have the distinction central to constructivism: it replaces the distinction transcendental/empirical by the distinction system/environment. The concept environment (as well as the corresponding one of system) was not available during Kant's day. What we call »environment« today had to be conceived of as the state of being contained and carried (*periechon*); and what we call »system« had to be thought of as order according to a principle. Both of these were already objects of knowledge. In order to answer the question of how knowledge is possible without falling into a self-referring circle the distinction transcendental/empirical was developed. Hardly anyone accepts this distinction today despite the labor that goes into the exegesis of historical texts. But if one drops this distinction how does one then avoid the circle of the self-founding of knowledge? Why must one avoid this circle? Can't one simply say: Knowledge is what knowledge takes to be knowledge?

The serving as medium foundation for dealing with these questions offers up the distinction system/environment and, in its context, a worked-out systems theory. This makes - virtually automatically - all the investigations and knowledge gained in systems theory of potential relevance for the theory of knowledge. In contrast to the procedure in transcendentalism, investigations bearing relevance for epistemological questions do not need to be carried out primarily with this end in mind. The relevance emerges as a side-effect of other investigations (e.g., of neurophysiological investigations or in the history of science) and one only has to take care that the transitions are smoothed over and now and then put in order, for example by adequate terminological recommendations. A good example of this is Humberto Maturana's use of the word »cognition« (»conocimiento«) for the extension of operations under the condition of interaction with the environment¹⁰, however annoying this terminology might be for professional epistemologists afraid of a biological invasion of their domain.

It has been known for a quite some time already that the brain has absolutely no qualitative and only a very slight quantitative contact with the external world. All stimuli coming from without are coded purely quantitatively (principle of undifferentiated coding); furthermore, their quantity, as compared with purely internal processing events, plays but a marginal role.¹¹ Incoming stimuli are also erased in fractions of a second if they are not stored in internal storage areas with somewhat longer retention times (short-term memory) - an event which is more the exception than the rule. With this, even time is made to serve the internal economy of complex processes. Apparently it is fundamental for the functioning of the brain that selected information is enclosed and not that it is let through. As if it were already information (or data) before it motivates the brain to form a representation. Such knowledge as this was not made use of by theoretical epistemology and it is only a formulation in terms of systems theory that leads to an insight which must seem surprising to epistemologists¹²: only closed systems can know. The sociology of science has arrived at similar conclusions (which are still, for the most part, rejected as being too shocking).¹³ Whoever still maintains that knowledge is the construction of a relation to the environment that fits things as they are, is welcome to his opinion, but he is forced to begin his theoretical reflections with a paradox: it is only non-knowing systems that can know; or, one can only see because one cannot see.

Philosophical epistemology has become marginal scientifically if not completely isolated; a situation that has often been lamented.¹⁴ This *was* the case for the Neo-Kantians and *is* the case for the Neo-Wittgensteinians. Nonetheless, anyone familiar with both sides is aware of the numerous possibilities for contact. Systems theory or, more precisely, the distinction between system and environment, could play the role of mediator here.

The effect of the intervention of systems theory can be described as a *de-ontologization of reality*. This does not mean that reality is denied, for then there would be nothing that operated - nothing that observed, and nothing on which one would gain a purchase by means of distinctions. It is only the epistemological relevance of an ontological representation of reality that is being called into question. If a knowing system has no entry to its external world it can be denied that such an external world exists. But we can just as well - and more believably - claim that the external world is as it is. Neither claim can be proved; there is no way of deciding between them. This does not, however, call the external world into question but only the simple distinction being/non-being which ontology had applied to it. As a consequence, the question arises: why do we have to begin with precisely this distinction? Why do we wound the world first with this distinction and no other?

Systems theory suggests *instead* the distinction between system and environment.

III.

If one accepts this suggestion the answer to the question, how is knowledge possible?, is to begin with, as the operation of a system separated from its environment. If one, further, takes seriously that the system always has to be operationally closed then to the

initial idea of separation assumptions are added regarding self-reference and recursivity. Operations of this kind are only possible within the context of a network of operations of the same system towards which they point and on which they are founded. There is no single operation that can emerge without this recursive network. At the same time the network itself is not an operation. »Multiplicity does not act as a relay«.¹⁵ The whole cannot as a whole itself become active. Every operation reproduces the unity of the system as well as its limits. Every operation reproduces closure and containment. There is nothing without an operation - no cognition either. And every operation has to fulfil the condition of being one operation among many, as it cannot exist in any other form, cannot otherwise possibly be an operation.

As a result, for an observer the system is a paradox, a unity which is a unity only as a multiplicity, a *unitas multiplex*. Even when the system observes itself one has what is true for every observation. If a system wants to know what makes it possible that it can know, it encounters this paradox. All theory of knowledge has to begin with the resolution of a paradox.

A further consequence is: No system can perform operations outside its own limits. If new operations are integrated it means that the limits of the system have been extended. Consequently, the system cannot use its own operations to connect itself with its environment since this would require that the system operate half within and half without the system. The function of the boundaries is not to pave the way out of the system but to secure discontinuity. Whatever one wants to call cognition, if it is supposed to be an operation then the operation necessarily has to be one incapable of contact with the external world, one which, in this sense, acts blindly.

These ideas can be worked out further and the foreseeable extensions of a theory of closed, self-referring systems-in-an- environment will doubtless come to have over this route an influence on the theory of knowledge. But we will leave this question aside for the moment since we are now confronted with a fundamental question: is it possible, and is it acceptable, to call what here becomes perceptible »knowledge« at all?

In the search for an answer to this question it is advisable to introduce a second distinction between *operation* and *observation*. This distinction occupies the place that had been taken up to this point by the unity-seeking logic of reflection. (This means, therefore, a substitution of difference for unity).

An operation that uses distinctions in order to designate something we will call »observation«. We are caught once again, therefore, in a circle: the distinction between operation and observation appears itself as an element of observation. On the one hand, an observation is itself an operation; on the other hand, it is the employment of a distinction. An example would be that between operation and observation. A logic that would take its point of departure here could only be established as the unfolding of a circle, and it would have to make certain that the distinction can re-enter into what it has distinguished. Spencer Brown provides explicitly for this »re-entry« after deliberately ignoring it at the beginning with his instruction to an observer to »draw a distinction«. (Among other things this means that time is employed for the resolution of self-referring circles and paradoxes).

An observation leads to knowledge only insofar as it leads to re-usable results in the system. One can also say: Observation is cognition insofar as it uses and produces redundancies - whereby »redundancy« here means limitations of observation that are internal to the system. In consequence, particular observations are more or less probable.¹⁶

The passage to »constructivism« follows from the insight that *it is not only for negations that there are no correlates in the environment of the system but even for distinctions and designations (therefore for observations)*. This does not mean (to say it once again) that the reality of the external world is being called into doubt. It is also beyond doubt that an observer can observe that and how a system is influenced by its environment or deliberately and successfully acts upon its environment. Nonetheless, all distinctions and designations are purely internal recursive operations of a system (that is, operations that form or disturb redundancies). These are operations that are not able to go beyond the system and, as if at a distant remove, pull something into it. As a result, all achievements following from these operations, above all what is usually called »information«, are purely internal achievements. There is no information that moves from without to within the system. For even the difference and the horizon of possibilities on the basis of which the information can be selection (that is, information) doesn't exist in the external world, but is a construct - i.e. internal to the system. Does this mean, however - as is claimed in a direct line from Maturana - that the cognitive system operates »blindly«?

The metaphor of seeing and blindness can be retained as an abbreviated mode of speech, although it does not correspond to the current level of knowledge. One must also distinguish here: if every relation to the outer world is being denied in such a metaphor, too much is being called into question. On the other hand, it must be made clear that all observation (including the observing of observations) presupposes the operative deployment of a distinction which at the moment of its use must be employed »blindly« (in the sense of »non-observably«). If one wants to observe the distinction in its turn, one has to employ a different distinction for which the same is true.

There can be no doubt, therefore, that the external world exists or that true contact with it is possible as a necessary condition of the reality of the operations of the system itself. It is the differentiation of what exists that is contributed by the observer's imagination, since, with the support of the specification of distinctions an immensely rich structure of combinations can be obtained, which then serves the system for decisions about its own operations.

Expressed in other word, the unity of a distinction employed for observation is constituted within the system. It is only in the observing system that things distinguished are brought to the unity of being distinct. Cognition is neither the copying nor the mapping nor the representation of an external world in a system. Cognition is the realization of combinatorial gains on the basis of the differentiation of a system that is closed off from its environment (but nonetheless »contained« in that environment).¹⁷ If a system is forced to cognize with the aid of distinctions and is unable to cognize in any other manner, it means further that everything that is for the system, and which therefore

has reality, has to be constituted over distinctions. The »blind spot« of each observation, the distinction it employs at the moment, is at the same time its guarantee of a world. For example, social reality is what one, in observing a majority of observers, can observe to be uniform among them despite their differences.¹⁸ Social reality exists only when an observer can distinguish a majority of observers (which may or may not include himself). By »world« is meant that which has to be assumed for every system to be the unity of the system/environment distinction (self-reference and external reference), when (and only when) this distinction is employed.

In conclusion we can say that knowing systems are real (empirical - that is, observable) systems in a real world. Without a world they could neither exist nor know. It is only cognitively that the world is unapproachable for them.

IV.

The contribution of the systems that makes cognition possible at all and which nothing in the environment corresponds to consists in the act of distinguishing. This recognition, which (as a distinction itself) implies its own limitation, has helped us as far as it goes. This would seem to answer the question usually raised in controversies about constructivism. But the interesting analyses are still to come: They involve not the question of a real agreement between knowledge and reality but questions of *time*. Cognitive systems (at least the brain, consciousness and the systems of communication called societies) operate on the basis of events that have only a momentary presence and that already begin to disappear at the moment of their emergence. Furthermore, these systems operate on the basis of events that cannot be repeated but which must be *replaced* by other events. Their structures must, therefore, provide for the passage from event to event - something for which there are also no equivalents in the environment. It is neither the case that the environment changes itself with the same tempo and rhythm (and this can only be spoken of on the basis of cognitive acts), nor can one find in the environment those autopoietic structures that suggest the one in the other. How then is the time relation between system and environment to be understood? The only answer can be: as *simultaneity*. The foundation for the reality of the system - whatever the contours of its own meaningful observations might be - is the simultaneity of its operation with the conditions of reality that sustain it. Whatever the system might contribute in the way of a non-present future and a non-present past - that is, of distinctions - the simultaneity of the environment and the eternally immediate present of the system is a condition that cannot be eliminated. Whatever is simultaneous cannot be influenced, cannot be integrated into the causal constellations of the system, cannot be synchronized, but is nonetheless the precondition for the application of distinctions in time. The system can place itself in relation to time between future and past, or as a moment in relation to duration or to eternity. Whatever might emerge from this, the system constructs time in relation to itself. What one does not have control over is the simultaneity that reemerges from moment to moment in all the operations of the system, the »common aging« in the sense of Alfred Schütz¹⁹ or the splashing of the water on the bank of the Isle de

Saint Pierre, that »continuing noise that is, however, filled by intervals«, which, in convergence with internal movements, is sufficient »to make me sense my existence with pleasure, without my having to think«. ²⁰ It is out of the unavoidable certainty of the simultaneity of the system and the environment that current time projections can arise. Examples of this can be found in the widespread »anticipatory reactions« in the plant and animal kingdoms, that is, in mere reactions to something assumed to be present on the basis of regularities that prove to be beneficial for the future, although they have not been perceived (i.e., have not been integrated into the processing of information). ²¹ Highly developed cognitive systems can, in addition, make prognoses, which does not mean that they can now perceive future present times. They are able to span this impossibility by means of constructions that organize their own information processing with the help of a distinction between what is past and what is to come that cannot appear in the external world as a *distinction*. Presumably, prognosis has to be understood as a product of our own imagination that can be evaluated by the memory ²², that is, as the creation of an excess of individual possibilities which is then offered up for selection according to self-constructed criteria of »suitability«. In other words, systems that make prognoses can prepare themselves for risks that they themselves have created and derive benefits from this.

Cognitive systems, therefore, have only a momentlike existence, as a result of the burden of simultaneity which keeps them on the ground. This existence must reproduce itself autopoietically in order to attain stability, even if it is only a dynamic one. They experience the world, therefore, with future and past - that is, as *duration* - only in the form of *non-presentness*. These systems can, therefore, consider their history to be finished insofar as they do not make present - as if in a dream - retrospective preferences. In the same way their future is full of enticing and threatening possibilities (although in reality there is no possibility at all, since everything is as it is). It is possible then to keep the non-present constant, which yields in turn the fascinating possibility for cognition of representing *changes* in the external world by terminological *constants* (instead of through changes in the system itself). Such systems need, as a result, records, which can, however, only be currently accessed; subsequently they help themselves with a kind of »vicarious learning«, with observing observations of others which have the same limitation. The vast unfolding of the world materially, temporally and socially is a construct ²³ anchored in the simultaneity of the world which, in this regard, never changes but is nonetheless inseparable from every realization.

On the other hand, the freedom of cognition in its constructions is founded on a radical »de-simultaneity« of the world, on the reduction of the contemporaneous to an instant almost devoid of meaning. What is gained by this is a terrifying plethora of possibilities in which cognition has to find its way by its own guidance. This existential moment is doubtlessly only a moment for an observer who can see the limits of this presentness and can call it »existence«. Descartes was aware of this - and therefore made God responsible for continuity.

V.

The refined constructivist theory of knowledge that has been presented here not only dissolves the traditional rationalistic continuum of being and thinking - which presupposed the possibility of an agreement between both and had founded it upon such concepts as nature or creation. The theoretical transcendental position which had been first the reaction to the dissolution of this rationalist continuum is also renounced. Furthermore, the assumption is rejected of a subjective faculty of consciousness that can guarantee a priori the conditions of the possibilities of cognition. But then, it is not sufficient to replace this conception by the distinction between irritation (or perturbation) from without and self-determination from within, which simply gives the difference between inner and outer yet another formulation and weight.²⁴ What remains (and has to replace those assumptions) is the *recursivity* of observation and cognition.

A process is called »recursive« when it uses the results of its own operations as the basis for further operations - that is, what is undertaken is determined in part by what has occurred in earlier operations. In the language of systems theory (which is not quite suitable here) one often says that such a process uses its own outputs as inputs. In any case recursivity requires a continuous testing of consistency and it has been shown by investigations in perception and memory that this necessitates a binary schematization, even on the neurophysiological level, which holds in readiness the possibilities of acceptance and rejection.²⁵ The states of the system that have been produced by its own operation serve then as criteria for the acceptance or rejection of further operations; stimuli from the environment that effect the system can play a role here also. Decisive, however, is the continuous self-evaluation of the system - which always operates in a state of irritation or agitation by means of a code that permits acceptance and rejection with regard to the adoption of further operations. The brain functions in this way. And the same will be true for psychic and social systems. The codification true/false only gives this schematization its final finish and a form that is only used under very special circumstances.

One can, therefore, think of binarily schematized recursivity as a continuous calculation of operations on the basis of the current states of the system. The pleasure/pain mechanism also seems to function in this manner. With regard to observations, this structure makes possible the observation of observations. This can mean, first of all, that one repeats the same operation in order to see whether its results are confirmed or not confirmed. This leads then to a »condensation« of units of meaning whose verification can no longer be obtained by a single operation. More or less clear deviations can be built into such a replication. One observes the same thing at different times in different situations, under different aspects, which leads to a further enrichment of the condensed meaning and finally to the abstraction of denotation for what seems identical in the different observations. Thus, assumedly, the meaningful construction of the world comes about, gaining thereby a power no single operation can possibly dispose of. One speaks here, in the language of mathematics, of the »eigenvalues« of a system.²⁶ Again,

no correspondence between system and environment is presupposed, but only the claim is made that it was possible to bring about these states.²⁷

This theory provides a good explanation for the normal evolution of a knowledge that overcomes distance, so-called »distal knowledge«, as Donald Campbell, following Egon Brunswik, has called it.²⁸ If one takes into consideration the dependence of all observation on distinction, other possibilities of recursive observation emerge. The usual understanding of the observations of observation focusses above all on *what* an observer observes (distinguishing thereby between subject and object, but concentrating above all on the object). Constructivism describes an observation of observation that concentrates on *how* the observed observer observes. This constructivist turn makes possible a qualitative change, a radical transformation, in the style of recursive observation, since by this means one can also observe what and how an observed observer *is unable* to observe. In this case one is interested in his blind spot, i.e. the means by which things become visible or non-visible. One observes (distinguishes) the distinction used by the primary observer in his observing. Since this observer, in the midst of his observation, cannot distinguish this distinction, what is observed is something that remains unknown to him or incommunicable. In the terms of sociology one could also say that observation is directed now to the observed observer's *latent* structures and functions.

The kind of reality, the kind of »eigenvalue« produced by recursions of this type is still largely unknown, as the technique itself is no older than 200 years. It was probably first practiced in the novel, then in the Counter-enlightenment, and then in the critique of ideology that is always from a holier-than-thou perspective. The primary observer was placed into the domain of the harmless or the naive; or he was treated as someone who, without realizing it, had something to hide. This holier-than-thou perspective fed upon suspicion. And the generalization of the principle of suspicion made it possible for whole disciplines - from psychoanalysis to sociology - to establish themselves with additional credentials in a world in which everyone knows, or imagines he knows, the situation in which he acts and the reasons for his actions.

It does not seem a coincidence that this observation of latent structures developed parallel to transcendental theory - at first at the end of the 18th century and then with particular intensity a century later during the heyday of Neo-Kantianism. Apparently, something had been lacking in transcendental philosophy. All the same, a constructivist theory of knowledge goes beyond this state of affairs (again a hundred years later). Its concept of recursive observation includes the observation of latency, freeing it from the prejudice that latent structures give a false picture of the world, as it really is and as science sees it. The assumption - to be found above all in the classical sociology of knowledge - that latent structures, functions and interests lead to distortions of knowledge, if not to blatant errors, can and must be abandoned.²⁹ The impossibility of distinguishing the distinction that one distinguishes with is an unavoidable precondition of cognition. The question of whether a given choice of distinction suits one's latent interests only arises on the level of second order observation. The claim of ideological distortion can then be observed in the person making the claim (for which he has to be observed as observer, that is, in relation to what he is observing).³⁰

The important question after all this is what »eigenvalues« a system is converging towards when it extends the recursivity of its observations in this direction - that is, when it continually turns its observations towards things other observers *cannot* observe. For the results of this method of observing we have, in the absence of anything better, a variety of different names: Gotthard Günther speaks of »polycontextuality«, others of »pluralism«, and still others of the postmodern arbitrariness in the emergence and passage of »discourses«. For constructivism this is, above all, an epistemological question and a kind of compensation for the limitations inherent in every act of cognition as a consequence of its dependence upon a distinction. One cannot draw the conclusion from the theory that now special »eigenvalues« of the social system will emerge that will be resistant to enlightenment for there is no guarantee that under all conditions such »eigenvalues« can be found and become stabilized. Still, the question can at least be raised and observation directed accordingly.

VI.

If one takes seriously the endeavor to set up a constructivist theory of knowledge an important question becomes shifted: that of the paradoxes. By a paradox is meant a permissible and meaningful statement that leads nonetheless to antinomies or undecidability (or, more strictly, a demonstrable proposition that has such consequences). Two possibilities for dealing with such a problem should be rejected. The first is used in the construction of formal systems and consists of an ad hoc procedure of exclusion. The paradoxes are eliminated by suitable precautionary measures. Structures that lead to paradoxes are forbidden - for example by the well-known but questionable theory of types. The epistemological questionability of such a procedure comes from its lack of justification; moreover, it usually has the consequence that it excludes more than just paradoxical possibilities for the construction of sentences.

As a result, philosophers have felt compelled to look for other means that would lead to a justifiable exclusion of paradoxes. MacKie, for example, suggests returning to a semantic theory of truth that would make it possible to say that the supposed objects designated by meaningful paradoxical propositions do not exist.³¹ It is, however, not possible for a constructivist theory of knowledge to accept this way out, since what is claimed here as being non-existent, does not exist for constructivism anyway. Given that paradoxes re-emerge despite all the attempts to eliminate them, MacKie finally even calls for a »construction« of the paradoxical by adopting self-referring propositions into the construction and (at least implicit) quantification.³² This suggestion is grist for the constructivist's mill: constructivism can view paradox as a problem in the machinery of the calculation of calculations, as a possible but nonetheless destructive construction. Should one look the Gorgon straight on - aware however that it is not the deadly Medusa one has before one, but her immortal sisters, Stheno (the Mighty) or Euryale (the Far Springer)?

We suggest instead a view from the side, the observing of observation. This enables one, when one includes observation of latency, to observe how other observers render

invisible the paradoxes that get in their way, for example the paradox of each of our binary codes.³³ It is, therefore, not a psychoanalytical infection or a critical socio-ideological frivolity that brings us to include observation of the blind spot of the observer in the theory of knowledge. It is furthermore not simply an encouragement to propound values that are, in any case, irrational, as William James and Max Weber had thought. To see what others cannot see (and to accept that they cannot see what they cannot see) is, in a way, the systematic keystone of epistemology - taking the place of its a priori foundation.

It is, therefore, of importance that every observer involves himself in a paradox because he has to found his observing on a distinction. As a result, he is unable to observe either the beginning or the ending of his observing - unless it be by means of another distinction that he has already begun to make or by continuing with a new distinction after having ended.³⁴ This is why all projection, or the setting of a goal, every formation of episodes necessitates recursive observation and why, furthermore, recursive observation makes possible not so much the elimination of paradoxes as their temporal and social distribution onto different operations. A consensual integration of systems of communication is, given such conditions, something that should sooner be feared than sought for. For such integration can only result in the paradoxes becoming invisible to all and remaining that way for an indefinite future.

This remedy solves, as it were, the problem of the paradoxes by reference to a concrete theory: the theory of autopoietic systems, which by means of recursive operations produce and reproduce a network of such operations as the condition for the very possibility of this reproduction (a solution logicians will hardly find satisfying). In such systems (one of which is science) there is no operation without reference to other operations of the system. Even when one forms universal propositions that refer to all the operations of the system, and also when one exposes these universal propositions on the basis of the classic Cretan pattern to self-reference, one only produces an operation that is a point of departure for other operations. We simply claim: it is this way; and logicians who attempt to dispute this are, in consequence, punished by paradoxes.

VII.

Given all that has been said, what understanding of reality does constructivism have?

It may be useful here to review classical responses once again. As far as visual metaphors were used, two solutions were offered. Objectivists said that reality was manifold, which meant that there was no single observation point from which it could be seen in toto: what one sees conceals what one does not see. This deficiency can only be countered by changing the point of observation, that is by working sequentially or by a division of labor. Subjectivists could speak instead of a multiplicity of perspectives each of which makes possible a conditioned seeing, but which at the same time makes impossible or difficult the perception of the perspective one sees with.³⁵ More eyes - and therefore more emotions: that was Nietzsche's postulate in *The Genealogy of Morals*. Constructivism goes beyond these positions by radicalizing the relationship between

cognition and reality. It is no longer a question of the difficulties that arise from a multiplicity of sides or perspectives, and the problem is no longer how one arrives, given this situation, at unity. This multiplicity, regardless of whether it is a multiplicity of sides or of perspectives, is itself a product of cognition, resulting from certain types of distinctions, which, as distinctions, are instruments of cognition. It is precisely by means of distinguishing that cognition separates itself from everything that is not cognition. Nonetheless, one is always dealing with concretely determined operations - even in the case of knowledge. Without water the jelly-fish goes limp. But in order to recognize that, distinctions are necessary: with/without water; not-limp/limp. These distinctions are codifications specific to cognition, which function independently of the environment (i.e. of stimuli), because there are not and cannot be any equivalents for them in the external world.

Cognitively all reality must be constructed by means of distinctions and, as a result, remains construction. The constructed reality is, therefore, not the reality referred to. This too can be recognized, but recognized only by means of precisely this distinction. For cognition, only what serves in a given case as a distinction is a guarantee of reality, an equivalent of reality. One could say more precisely: The source of distinction's guaranteeing reality lies in its own operative unity. It is, however, precisely as this unity that the distinction cannot be observed - except by means of another distinction which then assumes the function of a guarantor of reality. Another way of expressing this is to say that the operation emerges simultaneously with the world which as a result remains cognitively unapproachable to the operation.

The conclusion to be drawn from this is that the connection with the reality of the external world is established by the blind spot of the cognitive operation. Reality is what one does not perceive when one perceives it. In no way does this mean, however, that somewhere in the world there are states of affairs one cannot know, above all not in the old sense of the essence of nature's being secret. All that is meant is that the fruits of the concrete operation of cognition, which issue from the use of distinctions - that is, the proliferation of combinatorial possibilities - is due to an instrument requiring an operational closure specific for the given system. To attain this no »similarities« with the environment can be tolerated. If cognition demands meaning and meaning demands distinctions then the final reality must be thought of as devoid of meaning.

VIII.

If one compares this result with what has traditionally been called »idealism« one can recognize an important change. It affects the basic question to which an answer is sought and, therefore, the whole theoretical structure.

One had proceeded from the distinction between knowledge and object and, as a result, been forced to face the problem that could not be answered by means of this distinction: how does knowledge arrive at its object? In the final analysis, the problem lay then in the unity of the difference between knowledge and object. One answer was provided by the claim of a dialectical relationship. Dialectical theories proved to be the

adequate form here and required hardly any further argument. If one accepts, however, the argument suggested above the distinction between knowledge and object is itself only a distinction, that is a construction used to wound, dissect, observe the world. The unity of this distinction is simply the blind spot used by someone who, by means of this distinction, produces observations and descriptions.

If one starts from the assumption, however - as constructivism does - that this is always a real process in a real environment, which is always subject to limitations coming from the environment, what might then be the problem?

The problem could reside in the question of how a system is able to transform such *limitations into conditions for increasing its own complexity*. The *non-arbitrariness* of knowledge would then be nothing other than the evolutionarily-controlled *selectivity* of this process of change. It assumes no operations of the system projecting into the environment, that is, no knowledge in the traditional sense. One has to postulate instead: Everything issuing from this process of a transformation of limitations into conditions for the increase of complexity is, for the system in question, knowledge.

In contrast with idealism, constructivist cognition neither seeks nor finds a ground. It reflects (when it reflects) the change in world-orientation from unity to difference. It begins and ends with distinctions, well aware of the fact that this is its own affair and not forced to this recognition by an unapproachable outer world. As the unity of the drawing of a distinction it can conceive of itself as a symbolic processing. The unity of the separated, the mutual suitability of the differentiated, is what serves as a symbol here. Francisco Varela has considered this, too, to be an operation or a value and called it »self-indication«. ³⁶ We must leave the question open as to whether this leads to an effective calculus. On the other hand, it is easy to recognize that we are living in the world after the fall. We have eaten of the tree of the knowledge of good and evil. »Distinctions« can only be employed using »indications«. The symbol can only be employed diabolically; only what has been distinguished is integrable.

IX.

A few further thoughts on the matter will be given only cursorily. The concept of observing has been defined extremely formally as a distinguishing description. We reject, nonetheless, founding this formality »transcendentally«. With observing, distinguishing, designating we always mean an empirical operation that changes the system executing them - which means an operation which, in its own turn, is observable. No observer can avoid being observed, not even in its quality as »subject«.

On the other hand the formality of the concept leaves open which empirical operations are meant. Which organ - to speak in these terms - carries out the observation?

The abstraction of the concept is not meant to conduct one to a ground. Which results already from the fact that the operation of observing can lead to both true und false knowledge, as an observer can determine who observes observing by means of the distinction of true and false. The abstractness of the concept is not, therefore, intended

to provide a grounding for knowledge, but only to keep open the possibility of observation operations' being carried out by very different empirical systems - living systems, systems of consciousness, systems of communication. The abstraction makes allowances for the very wide domain of the »cognitive sciences«, above all for the differentiation into disciplines in biology, psychology and sociology. Observation takes place when living systems (cells, immune systems, brain, etc.) discriminate and react to their own discrimination. Observation occurs when thoughts that have been processed through consciousness fix and distinguish something.³⁷ It occurs as well when a communicable integrable understanding of conveyed information - be it linguistic or non-linguistic - is attained (whatever psychic processes might occur in the minds of the participating individuals).

Given the state of research today one cannot get around taking into account the differences between these empirical realizations of distinguishing and designation (or should one perhaps for once say here: of discriminative focussing?). With this, the traditional attribution of cognition to »man« has been done away with. It is clear here, if anywhere, that »constructivism« is a completely new theory of knowledge, a post-humanistic one. This is not intended maliciously but only to make clear that the concept »man« (in the singular!), as a designation for the bearer and guarantor of the unity of knowledge, must be renounced. The reality of cognition is to be found in the current operations of the various autopoietic systems. The unity of a structure of cognition (or the »system« in the sense of transcendental theory) can only lie in the unity of an autopoietic system which reproduces itself with its boundaries, its structures and its elements.

By this means the significance of psychological epistemologies is considerably reduced, but relieved at the same time of the unreasonable expectation that they should provide more than individual-psychological knowledge. There is no such thing as »man«, no one has ever seen him and if one is interested in the system of observation that organizes its distinctions by means of this word or concept one discovers the communication- system called society. There are now approximately 5 billion psychological systems. It has to be asked which of these 5 billion is intended when a theory of knowledge employing a psychological reference system relates concepts such as observation and cognition to consciousness. If no answer is forthcoming, such a theory has to be characterized as practicing socio-communicative observation. And the suggestion would have to be made that it would be better if this practice were reflected upon.

Up to now, constructivism has profited mainly from research in biology, neurophysiology and psychology (Maturana, Varela, Piaget, von Glasersfeld), although it actually favors development of a sociological theory of knowledge. What we know as cognition is the product of the system of communication called society, where consciousness plays a permanent but always only fractional role. It is only in extreme exceptions that one has to know individual persons in order to know what is known - and these are typical instances (for example, statements by witnesses in court) in which direct perception plays a central role. Neither in its claim to validity nor in the evaluation of its possibilities for development is the fund of knowledge of modern society approachable

through processes of consciousness. It is an artifact of communication - and what is amazing here is not so much that the world is as it is constructed by modern science, as that it is still possible to pursue communication under the conditions of this construction. It is obvious that this cannot be explained by some capacity of consciousness (which one?!) but by the possibilities of storage made available originally by printing and, more recently, by electronic data processing.³⁸

This preference for society as a referential system (that is, as the choice of a system from the perspective of which something else is environment) becomes absolutely unavoidable when one takes into consideration the difference between everyday knowledge and scientific knowledge. Whatever this distinction might mean and whatever theory might offer it, it cannot be presented convincingly as a distinction between different psychic types of knowledge. The distinction is a consequence of the differentiation of the social system of society. And it is only from here that psychical systems can be influenced. No further argument is necessary when one recalls the well-known phenomena of exponential growth, increasing differentiation and specialization or the problems of the pace of change.

It is, finally, only in a sociological context that the ideas on recursive observation and second-order observation (i.e., the observation of observation) acquire their full significance. But why would an observer observe another observer as observer, as another psychical system? Why isn't the other system seen simply as a normal object in the external world, that is, why isn't it simply observed directly instead of as a pathway for the observing of its observing?

It is usually assumed that this is made possible by a sudden, intuitive analogy: the other is experienced as an alter ego, as operating like another I.³⁹ But we question, how does this occur? And further, is this phenomenon culturally invariant, independent of social structure? The usual answer describes only the result, is only another formulation of the problem and does not explain how it occurs.

Maturana avoids this problem by shifting to the mutually coordinating interaction of two organisms that interreact with each other in a sufficiently comparable area of interaction.⁴⁰ This makes it possible for him to explain the origin of language as a possibility of consensual coordination of the coordination of these interactions despite closure of the mode of operation of the participating systems. This still doesn't provide, however, a satisfying explanation of how the observation of observing emerges, that is, how observers construct the objects they have constructed as other observers.

A third theoretical suggestion (which draws on sociology, since psychology and biology have not sufficed) can begin with the assumption that the construction of the other observer is a necessary consequence of communication.⁴¹ For communication is only possible when an observer is able, in his sphere of perception, to distinguish between the act of communication and information, that is, to understand communicative acts as the conveying of information (and not simply as behavior).⁴² Out of this distinction - which only remains evolutionarily stable and only reproduces itself as a communication system when it is able to maintain itself - there emerges then a second one: that of subject and object. That communication can be continued requires no more than a kind

of black-box concept for the subject and for the object, as far as the distinction operates. As a participant one can make use of one's own constructions, which can then be evaluated during the course of one's participation in the communication. One does not need to know what is going on »inside« the subject (and of course, could never know this) and also does not need to know the »essence« of things (which is of itself infinite): the filling necessary for the continuation of communication suffices. However, to the degree that systems of communication, in the course of their own evolution, become more sophisticated, differentiated and complex, more demanding concepts for subject and object are called for. It is in the course of this that one finally also learns to observe others as observers (even at times they are not communicating) and finally even to observe that others do not observe what they do not observe while observing. Society, finally, makes even latent observation of latent structures possible.

The question still has not been answered why communication together with its resulting achievements progresses. The answer can only be that the evolutionary force of a particular distinction - that between communication and information - has proven itself. This can, of course, be claimed of everything that exists, and is still not an explanation. Important, however, in the constructivist context outlined above is that this claim has been made for a *distinction*. With this another distinction has been added to those already used - system/environment and operation/observation: that of communication/information, which is of special importance for the analysis of social systems. The familiar distinction between ego and alter ego can be dealt with as derivative, and with it the whole theory of knowledge founded on the concept of intersubjectivity.

X.

The above has made it abundantly clear, we believe, that constructivism does not question the existence and reality of the world - but only constructs. But even after one has seen this, one can, as a sociologist, still ask why this happens, and why precisely today, after both ancient skepticism and idealism have been overcome, this constructivistic world-construction is of value. If a philosopher were to ask this question he would be faced with the difficult problem of a deeper analysis of Hegelian logic, which is the most profound scheme so far developed for the processing of distinctions of what is implied in them with regard to identical and contrary. For a sociologist the matter is simpler. He can take a theory of social evolution as his point of departure, a theory obviously, that itself is founded on a relevant distinction - for example, constructed on a Darwinian-scheme of variation and selection. It is possible then to understand constructivism as an epistemology suitable for a society with a highly differentiated system of the sciences.⁴³ In other words, in a society that can produce science in the modern sense, conceptual problems arise that can only be solved constructivistically - whatever one in this society might normally think about the world in which he lives and works, rides the bus and smokes cigarettes.

It shouldn't be very difficult to recognize that progress in science (whatever »progress« might mean here) is tied to even more sophisticated distinctions. This is, above all, the case for what Donald Campbell has called development in the direction of »distal knowledge« - that is, for the distinction between knowledge and the knower himself.⁴⁴ Divorce of the perspectives of comparison from the interests of the one doing the comparing also belongs here. One need, moreover, only think of the use of rigorously formal cognitive instruments - of logic, mathematics, quantification - as a form of representation of distinction in reality. This could still be dealt with under the concept of »idealism«, and it is in this context that Husserl makes his criticism of modern, »Galilean« science.⁴⁵ Today the »cognitive sciences« and the theory of self-referential systems add a new perspective which cannot be subsumed under »idealism« or criticized as »idealism«, that is, insight into the operative closure of self-referential systems. A theory of knowledge today that is to be compatible with the latest developments in science must be able to bear this new perspective. It is not surprising, therefore, that, after a period of open and rather irresolute epistemological pragmatism and a period in which highly formalized methodology was presented as epistemology - after James and Dewey, Baldwin, Rescher, Popper and others - epistemological constructivism is beginning to come into its own. Quantum physics, cytochemistry and neurophysiology, as well as historic-sociological relativism make this convergence necessary. If the task of epistemology is to analyze science as a social cognitive undertaking one will not be able simply to ignore scientific results. Constructivism is the form assumed in reflection on the system of science facing its own extravagances; it is the form in which an increasingly improbable distinguishing is finally recognized as the contribution of cognition. But it is also the form that can no longer mislead one to conclude it has nothing to do with reality.

A society that increasingly differentiates its most important sub-systems in relation to specific functions intensifies to a highly improbable degree its cognitive output in the area of science. If one then reflects on this situation, one arrives at theories that themselves seem improbable. For this reason epistemology cannot provide a foundation for the sciences. It cannot offer basic principles, arguments or even certainty. It can no longer be understood as a theory of the founding of knowledge. The opposite is true: it analyzes the uncertainty of knowledge and gives reasons for it. It therefore should come as no surprise that no theory of knowledge today can attain the degree of certainty to be found in quantum physics or biochemistry.

It is perhaps not the least important function of constructivist epistemology to make society irritatingly aware of the fact that it produces science.

Notes and References

1. As a typical solution the distinguishing of several levels of language or of cognition has been suggested, with the possibility of »autologic« relationships on the higher level. See L. Lofgren, »Towards System: From Computation to the Phenomenon of Language«, in M.E. Carvallo (ed.), *Nature, Cognition and System: Current Systems - Scientific Research on Natural and Cognitive Systems*, Dordrecht: Reidel, 1988,

- p. 129-55. But this is a transparent stopgap solution, since a level derives its identity only from the fact that there are other levels that can be reached from it.
2. See D. Bloor, *Wittgenstein: A Social Theory of Knowledge*, London: Routledge & Kegan Paul, 1983, esp. p. 119ff. This »conventionalism« going back to Poincaré, has become a tradition, it meets with little opposition today as it has become almost reflex.
 3. See D. Bloor, *Wittgenstein: A Social Theory of Knowledge*, London: Allen & Unwin, 1979, passim., for example, p. 95.
 4. This can be found in the recent publication by A. Chalmers, »The Sociology of Knowledge and the Epistemological Status of Science«, *Thesis Eleven* 21 (1988), 81-102: The argument presented, however, shows no progress.
 5. See P. Watzlawick (ed.) *Die erfundene Wirklichkeit*, Munich: Piper, 1981; H. Gumin/A. Mohler (eds.), *Einführung in den Konstruktivismus*, Munich: Oldenbourg, 1985; S.J. Schmidt (ed.), *Der Diskurs des radikalen Konstruktivismus*, Frankfurt am Main: Suhrkamp, 1987; E. v. Glasersfeld, *Wissen, Sprache und Wirklichkeit: Arbeiten zum radikalen Konstruktivismus*, Braunschweig: Vieweg, 1987.
 6. See Plato, *Theaetetus*, 208 C.
 7. See, for example, C. Buffier, *Cours de sciences sur des principes nouveaux et simples*, Paris 1732, reprint Genf: Slatkine 1971, p. 800ff. where this concept dealt with at length in the »Traite des vérités des conséquences« (not in the »Traité des première vérités«).
 8. See in this regard, as well as for the limiting cases of universal distinction (nothing is excluded) and elementary distinction (nothing is included), R. Glanville/F.J. Varela, »Your Inside Is Out and Your Outside Is In« (Beatles 1968), in G.E. Lasker (ed.), *Applied Systems and Cybernetics, Vol. II*, New York: Pergamon Press 1981, p. 638-641. Following S. Brown, the authors distinguish inclusion and exclusion by using the concept of form in order to distinguish the act of distinguishing. Their argument corresponds, moreover, exactly to the idea Nicolas Cusanus used to found the *coincidentia oppositorum* and upon it his concept of God beyond all distinctions.
 9. See, for example, the »object-psychological« epistemology of A. Naess, *Erkenntnis und wissenschaftliches Verhalten*, Oslo: Dypverd, 1936, in particular p. 103ff., where the author demands that all epistemology should be limited to description »of the process in the internal functional space« of an organism. See also p. 105: »The common distinction between >situation< and >behavior< is, viewed psychologically, a distinction between two kinds of >behavior<«.
 10. See H.R. Maturana, *Erkennen: Die Organisation und Verkörperung von Wirklichkeit*, Braunschweig: Vieweg, 1982, esp. p. 32ff. (German translation of the English); H. R. Maturana/F.J. Varela, *Der Baum der Erkenntnis: die biologischen Wurzeln des menschlichen Erkennens*, Bern: Scherz, 1987, esp. p. 31ff. See the critical discussion precisely this connection between biological systems theory and epistemology, in G. Roth, »Autopoiese und Kognition: Die Theorie H.R. Maturana und die Notwendigkeit ihrer Weiterentwicklung«, in Schmidt, *op. cit.*, 1987, note 5, p. 256-286.
 11. See G. Roth, »Die Entwicklung kognitiver Selbstreferentialität im menschlichen Gehirn«, in D. Baecker, et.al. (eds.), *Theorie als Passion*, Frankfurt am Main: Suhrkamp, 1987, p. 394-422 (419f).
 12. See the contributions of H. v. Foerster, *Sicht und Einsicht: Ausgewählte Arbeiten zu einer operativen Erkenntnistheorie*, Braunschweig: Vieweg, 1985. See also F.J. Varela, »Living Ways of Sense-Making: A Middle Path for Neuroscience«, in P. Livingston (ed.), *Disorder and Order: Proceedings of the Stanford International Symposium* (Sept. 14-16, 1981), Saratoga, California: Anma Libri 1984, p. 208-223; G. Roth, »Selbstorganisation-Selbsterhaltung-Selbstreferentialität: Prinzipien der Organisation der Lebewesen und ihre Folgen für die Beziehungen zwischen Organismus und Umwelt«, in A. Dress, et al. (eds.), *Selbstorganisation: Die Entstehung von Ordnung in Natur und Gesellschaft*, Munich: Piper, 1986, p. 149-180, esp.

- 168ff.; G. Roth, »Erkenntnis und Realität: Das reale Gehirn und seine Wirklichkeit«, in Schmidt, *op. cit.*, 1987, note 5, p. 229-255.
13. »The natural world has a small or non-existent role in the construction of scientific knowledge«, is claimed, e.g., by H. Collins, »Stages in the Empirical Programme of Relativism«, *Social Studies of Science*, 11 (1981), 3-10 (3). See also, H. Collins, *Changing Order*, London: Sage Publications, 1985. There would be far less controversy if one read the latter work in conjunction with works on brain research and not as an alternative to them. The question isn't whether brains or language construct the world; the claim is that if it's brains, then it must be language, and *vice versa*.
 14. See, for example, D.T. Campell, »Descriptive Epistemology, Psychological, Sociological and Evolutionary«, William James Lectures at Harvard University, 1977; noted from an unpublished manuscript.
 15. M. Serres, »Dream«, in Livingston (ed.), *op. cit.*, 1984, note 12, p. 225-239 (238).
 16. See with regard to this systems-theoretic use of the concept of redundancy: H. Atlan, *Entre le cristal et la fumée*, Paris: Editions du Seuil, 1979; or, H. Atlan, »Disorder, Complexity and Meaning«, in Livingston, *op. cit.*, 1984, note 5, p. 109-128.
 17. On closure as »enclosure« see H. v. Foerster, »Entdecken oder Erfinden. Wie läßt sich Verstehen verstehen?«, in Gumin, Mohler, *op. cit.*, 1985, note 5, p. 27-68.
 18. Subtle analyses of this question are to be found in F.H. Tenbruck, *Geschichte und Gesellschaft*, Berlin: Duncker & Humblot 1986, resp. p. 175ff.
 19. A. Schütz, *Der sinnhafte Aufbau der sozialen Welt: Eine Einleitung in die verstehende Soziologie*, Vienna: J. Springer, 1932, p. 111f.
 20. J.J. Rousseau, *Les rêveries du promeneur solitaire, Cinquième promenade*, quoted from *Oeuvres complètes* (Éd. de la Pléiade), Vol. 1, Paris: Gallimard, 1959, p. 1040ff (1045).
 21. Of course, these are always the statements of an observation that itself sees more time from the observed system does. An extensive analysis of these questions can be found in R. Rosen, *Anticipatory Systems. Philosophical, Mathematical and Methodological Foundations*, Oxford: Pergamon Press, 1985.
 22. The same is true for language and this similarity points to a close evolutionary and even neuro-physiological association. See on this question H.J. Jerison, *Evolution of the Brain and Intelligence*, New York: Verlag?, esp. p. 426f.
 23. For greater detail see N. Luhmann, *Soziale Systeme: Grundriß einer allgemeinen Theorie*, Frankfurt am Main: Suhrkamp, 111f.
 24. This is the formulation of Glasersfeld, *op. cit.*, 1987, note 5, in his presentation of »radial constructivism«. Maturana also uses such formulations to explain his constructivist position.
 25. See H. v. Foerster, »What is Memory that it May Have Hindsight and Foresight as Well?«, in S. Bogoch (ed.), *The Future of the Brain Sciences*, New York: Plenum Press, 1969, p. 19-64.
 26. See v. Foerster, *op. cit.*, 1985, note 12, esp. p. 205ff.
 27. In Maturana's theory the corresponding concept is »Conservation of Adaption«. See Maturana/Varela, *op. cit.*, 1987, note 10, p. 113f. or, in greater detail, H.R. Maturana, *Evolution: Phylogenetic Drift through the Conservation of Adaptation*, Ms. 1986. It is crucial that adaptation can only be preserved, not improved. A system is adapted for the processing of its autopoiesis in its environment or it isn't, and is destroyed. There is no more or less in this regard, just as the operations of the system either can take

place or can't take place. Every other judgement is the affair of an observer and can only be observed in an observer.

28. S. Donald, T. Campbell, »Natural Selection as an Epistemological Model«, in R. Navoll/R. Cohen (eds.), *A Handbook of Method in Cultural Anthropology*, Garden City, New York: The National History Press, 1970, p. 51-85.
29. And has been given up today. See, for example, B. Barnes, *Scientific Knowledge and Sociological Theory*, London: Routledge & Kegan Paul, 1974; D. Bloor, *Knowledge and Social Imagery*, London: Routledge & Kegan Paul, 1976.
30. Quite consistently, Marxists learn about the critique of political economy from Marx; they don't turn to political economy for this. But the result is that the common views of the political economy of Marx' day are discussed with reference to Marx works, that Marx himself seems like a political economist (not completed without this being his own fault) and that changes in the critique that have occurred over the best 150 years are not sufficiently taken into account.
31. See J.L. MacKie, *Truth, Probability and Paradox: Studies in Philosophical Logic*, Oxford: Clarendon Press, 1973, ch. 6 in association with ch. 2.
32. J.L. MacKie, *op. cit.*, 1973, note 31, p. 273.
33. As case studies in this question of N. Luhmann, »The Third Question: The Creative Use of the Paradoxes in Law and Legal Theory«, *Law and Society Review* 15 (1988), 153-165.
34. See R. Glanville, »Distinguished and Exact Lies«, in R. Trappl (ed.), *Cybernetics and Systems Research* 2, Amsterdam: North-Holland Publications, 1984, p. 655-662.
35. N. Rescher expresses this perspective on perspectivity: »Perspectives are diaphanous, and one tends not to see them as such«, in his *The Strife of Systems: An Essay on the Grounds and Implications of Philosophical Diversity*, Pittsburgh: University of Pittsburgh Press, 1985, p. 187.
36. See F.J. Varela, »A Calculus for Self-Reference«, *International Journal of General Systems* 2 (1975), 5-24.
37. See in this regard N. Luhmann, »Die Autopoiesis des Bewußtseins«, in A. Hahn/V. Kapp (eds.), *Selbstthematization und Selbstzeugnis: Bekenntnis und Geständnis*, Frankfurt am Main: Suhrkamp, 1987, p. 25-94.
38. Furthermore, what is offered as epistemology in the context of the cognitive sciences is inconceivable without computers - both from the theoretical aspect. See F.J. Varela, *The Sciences and Technology of Cognition: Emerging Trends*, Ms., Paris, 1986. This is also true of logical theories and their truth procedures.
39. This is also held by strict constructivists. See, for example, E. v. Glasersfeld, »Konstruktion der Wirklichkeit und des Begriffs der Objektivität«, in Gumin, Mohler, *op. cit.*, 1985, note 5, p. 1-26 (20f).
40. See Maturana, *op. cit.*, 1982, note 10, p. 52ff. The literature that follows uses »parallelion« or »parallelizing«, instead of »analogy«. See, for example, P.M. Hejl, »Konstruktion der sozialen Konstruktion: Grundlinien einer konstruktivistischen Sozialtheorie«, in Schmidt, *op. cit.*, 1987, note 5, p. 303-339.
41. Related to this, but nonetheless to be distinguished from it, are the well-known attempts of ... to use the process of learning a language for the elucidation of epistemological questions. See, for example, W. v. O. Quine, *Word and Object*, New York: Wiley, 1960. See also the less well known ideas of D.T. Campbell, »Ostensive Instances and Entita.... in Language Learning«, in W. Gray/N.D. Rizzo (eds.), *Unity Through Diversity, A Festschrift for Ludwig von Bertalanffy*, New York: Gordon and Breach, 1973, Vol. II, p. 1043-1057. The question dealt with here is the claim that the learning of language is not

possible without reference to things of the external world, which means that language can never completely construct reality out of itself.

42. See Luhmann, *op. cit.*, 1984, note 23, p. 191ff.
43. See here also N. Luhmann, »Intersubjektivität oder Kommunikation: Unterschiedliche Ausgangspunkte soziologischer Theoriebildung«, *Archivio di Filosofia* 54 (1986), p. 41-60.
44. See, for example, Campbell, *op. cit.*, 1970, note 28, p. 51-85.
45. See E. Husserl, »Die Krisis der Europäischen Wissenschaften und die transzendente Phänomenologie«, *Husserliana*, Vol. VI, Den Haag: Nijhoff, 1954. See also A.N. Whitehead, *Science and the Modern World* (Lowell Lectures 1925), quoted from the edition New York: Free Press, 1954.