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CRITICIZING A DIFFERENCE OF CONTEXTS – ON REICHENBACH'S DISTINCTION BETWEEN "CONTEXT OF DISCOVERY" AND "CONTEXT OF JUSTIFICATION"

With his distinction between the "context of discovery" and the "context of justification", Hans Reichenbach gave the traditional difference between genesis and validity a modern standard formulation. Reichenbach's distinction is one of the well-known ways in which the expression "context" is used in the theory of science. The extensive criticism of Reichenbach's distinction in the last century can be understood as criticism of a context distinction. This criticism could be summed up by saying that Reichenbach's view was very one-sided; it concentrated on particular aspects of the difference between discovery and justification and thereby underrated their common feature of being a part of scientific knowledge. Critics proposed other concepts of context, or they questioned the existence of Reichenbach's context distinction, but they did not question the use of the concept of context. My argument is that Reichenbach's concept is unsuitable and leads to contradictions in the semantic fields of genesis and validity. I would like to demonstrate this by examining the different meanings of Reichenbach's context distinction. My investigation also shows how the difference between genesis and validity precedes Reichenbach's context distinction and indicates approaches for meaningful applications of the concept of context to the phenomena designated by Reichenbach.

Considering the extensive critical reception of Reichenbach's distinction, it is truly surprising that his argumentation has received virtually no analysis so far.[1] This circumstance is all the more remarkable considering that an analysis would only need concentrate on relatively few aspects of Reichenbach's work. Reichenbach introduces his distinction in passing and hardly explains it. He refers to it briefly in his "Zur Induktions-Maschine" (Reichenbach 1935). In the first paragraph of *Experience and Prediction*, he uses the distinction to explain the tasks of epistemology, and touches on it again in the next-to-last paragraph of this work (Reichenbach 1938, in the German translation Reichenbach 1983). He also briefly mentions it in the introduction to *Elements of Symbolic Logic* (Reichenbach 1948, in the German translation Reichenbach 1999) and in a passage in his book *The Rise of Scientific Philosophy* (Reichenbach 1951, in the German translation Reichenbach 1968).

I will reconstruct Reichenbach's argumentation only insofar as it is required for a criticism of the use of the concept of context. The expression "context" is

an amply vague term that is similar in meaning to the German expression "Zu-sammenhang", but is found more commonly than the latter in scientific usage. Reichenbach probably took the expression "Zusammenhang" from everyday language, as a matter of course. I would like to assume that there are sufficient similarities between the spectrum of meaning which this expression had in those days and which the context expression has today. In order to discuss a specific application, it is necessary to limit the diverse meanings of the term context. My definition aims to summarize features of its everyday usage, as documented in relevant dictionaries, and to combine these with the meaning found in Reichenbach's texts. Accordingly, a context designates a non-singular class of phenomena or a field of reference which is distinguished so clearly from other comparable fields of reference that it is reasonable to give it a summarizing concept (e.g., the context of the meaning of a text in contrast to other contexts of meaning in different texts by the same author, the context of a specific situation contrasted with other contexts of action, historical contexts as parts of a more comprehensive history).

Within these rough guidelines, I will begin by reconstructing the way in which Reichenbach introduces the distinction between discovery and justification as a difference of contexts. The common features of the distinction are given with the concept of knowledge, and its specific differences are given with Carnap's method of "rational reconstruction". "Rational reconstruction" identifies conditions of validity and can be contrasted with the genesis of its objects. Reichenbach also uses the method to characterize justification and discovery as contexts. Using the concept of context in this way, he achieves neither an intensional nor an unambiguous extensional definition of the two proposed fields of reference (1).

Drawing on the numerous meanings of the term "context", I will then emphasize some chief characteristics and review, through exemplification, the usage of this term. First of all, I turn to the context of discovery as the non-rational part of all scientific knowledge and show that this meaning cannot be defined consistently (1a). For the context of justification, one can distinguish two main cases: the context of justification is either contrasted with the context of discovery, or it forms a unit therewith. In the first case, the use of the context term becomes paradoxical, insofar as justification separated from scientific practice does not represent a field of reference which could be specifically contrasted with another field of reference (1b). In the second case, the unifying definitions contradict the contextual meaning of discovery and justification (1c). In the last section, I point to a useful application of the concept of context which can be found in Reichenbach's argumentation and which refers to the practical conditions of justification (2).

1. REICHENBACH'S DISTINCTION BETWEEN CONTEXTS

Reichenbach himself does not designate his distinction as normative. Rather, he introduces it in the first paragraph of *Experience and Prediction* in order to explain a task of epistemology, which he calls the "descriptive" one because its results are supposed to correspond to real thinking.[2] To characterize this task, he first distinguishes between the "internal and external relations between those human utterances the whole of which is called 'knowledge'" (Reichenbach 1938 4).[3] Reichenbach seems to understand scientific disciplines as closed units which may be combined with "utterances of another kind" (ibid.).[4] The social sciences are responsible for the analysis of the external relationships.

A sociologist, for instance, might report that astronomers construct huge observatories containing telescopes in order to watch the stars, and in such a way the internal relation between telescopes and stars enters into a sociological description. The report on contemporary astronomy begun in the preceding sentence might be continued by the statement that astronomers are frequently musical men, or that they belong in general to the bourgeois class of society; if these relations do not interest epistemology, it is because they do not enter into the context of science (ibid.).[5]

The concept of knowledge encompasses not only scientific notions and theories but also the entire scientific, i.e. non-epistemological, practice. Reichenbach advocates a comprehensive concept of knowledge, the historically changeable criteria of which are determined by the social sciences. The inside and outside of knowledge is not separated by a sharp line of demarcation, as Reichenbach himself admits. Nevertheless, Reichenbach takes this separation as a basis for further differentiation. This differentiation does not yet lead to the distinction between discovery and justification, but it does result in the preceding separation of the "internal structure of knowledge" into a "system of logical interconnections of thought and the actual way in which thinking processes are performed" (Reichenbach 1938 4f.).[6]

Reichenbach gives this separation a universal validity and also allocates responsibility to different subject disciplines: the analysis of the logical connections is to be the task of epistemology, and the analysis of the real thought processes is to be the task of psychology.[7] This assignment of competencies underlines the considerable range covered by the concept of knowledge, a concept which includes thinking that follows no logical rules and can at best be understood psychologically. Moreover it prepares the use of a concept of context which can be applied to the reference fields of academic disciplines or to their corresponding methods, respectively.

In order to introduce the as yet missing link between real thinking and the fictitious field of reference of epistemology, Reichenbach resorts to Rudolf Carnap's concept of "rational reconstruction".[8] Epistemology is connected with

the starting and ending points of the real scientific thought processes and tries to rationally reconstruct logically structured links, which are in greatest possible agreement with the real thought processes, between these points.[9] The purpose of this procedure is to investigate the conditions of validity:

[The] fictive set of operations [...] is chosen from the point of view of justifiability; we replace actual thinking by such operations as are justifiable, that is, as can be demonstrated as valid (Reichenbach 1938 7).[10]

The distinction between actual thinking and its rational reconstruction belongs to the tradition of the *difference of genesis and validity*. While genesis of knowledge generally means its origin and evolution, its validity designates the intersubjective, definite and objective basis of its recognition.[11] The distinction between genesis and validity expresses that the legitimacy of validity claims of knowledge is independent of a report on their genesis. The distinction does not rule out answering validity questions by referring to the conditions of origin or development. Rather, the question of validity not only presupposes the genesis, but must refer to its results, whose validity conditions are in question. Moreover, the distinction is not characterized by a temporal relation of succession. At every stage of a genesis, one can inquire about validity. Because genesis and validity do not designate separate fields of reference, but rather describe two properties which are constitutive of every object of knowledge, the concept of context should not be used.

Nonetheless, Reichenbach introduces the context distinction to explain how epistemology is responsible for determining validity conditions. The ambiguities arising from this are linked to an analogy which he draws between epistemological and scientific justifications:

If a more convenient determination of this concept of rational reconstruction is wanted, we might say that it corresponds to the form in which thinking processes are communicated to other persons instead of the form in which they are subjectively performed. [... The] well-known difference between the thinker's way of finding [... a] theorem and his way of presenting it before a public may illustrate the difference in question. I shall introduce the terms *context of discovery* and *context of justification* to mark this distinction. Then we have to say that epistemology is only occupied in constructing the context of justification. But even the way of presenting scientific theories is only an approximation to what we mean by the context of justification (Reichenbach 1938 6f. – emphasis in original).[12]

To what does Reichenbach relate the expression of context (expressed notably in the singular)? One can distinguish two main cases. In the first case, he admits with his analogy that rational reconstructions are *similar to the normal representation of theories in scientific practice*. This would suggest understanding the context of justification as a part of scientific practice and its reconstruction as an epistemological activity. [13] This interpretation finds support in Reichenbach's 1935 remark on the context difference. In this remark, the procedure of justifica-

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tion refers to a method by which the researcher "makes his theories public".[14] The formal criteria of justification which must be fulfilled in the communication of theories are analogous in structure to the criteria of epistemological reconstruction. The transition between scientific justification and epistemological reconstruction is fluid. Reichenbach leaves room for justifying activities in science too, when he strictly limits the extension of the context of discovery. This context contains only those "procedures which the individual researcher uses during the discovery of new theories".[15] In *The Rise of Scientific Philosophy*, Reichenbach also assumes an extension that only partially covers scientific knowledge when he relates the context of discovery explicitly to the "act of discovery" (Reichenbach 1951 231).[16]

On the other hand however, in the last sentence of the aforementioned quotation from *Prediction and Experience* Reichenbach clearly contrasts the expression "context of justification" with scientific practice. This gives the impression that the *context of justification might not be the subject but only the result of rational reconstruction* and might therefore not appertain to scientific work.[17] This interpretation finds support in the competence Reichenbach allocates to subject disciplines, along the lines of his context distinction:

We emphasized that epistemology cannot be concerned with the [... context of discovery] but only with the [... context of justification]; we showed that the analysis of science is not directed toward actual thinking processes but toward the rational reconstruction of knowledge (Reichenbach 1938 382).[18]

The mutually exclusive and universally conceived fields of reference of epistemology and psychology meet in this passage with those of the context distinction. An expansion of the context of discovery to all actual thought processes is not excluded and would only be the reverse side of limiting the context of justification to an exclusively epistemological field of reference. Several authors followed this interpretation in equating Reichenbach's context distinction with the fields of reference or methods of epistemology and psychology.[19] It is this understanding more than any other, which refers back to the traditional difference between genesis and validity, which connects with Reichenbach's division of subject disciplines. It transforms the difference of aspects of knowledge into a difference of contexts and thus, mistakenly, allows object properties to be contrasted as if they were fields of reference.

However, my reconstruction proceeds on the assumption that this case has but little relevance in Reichenbach's work. He mostly relates the context of discovery to just one vaguely defined aspect of scientific work. But even less well-defined is his extension of the context of justification. However, before I come to discuss this in more detail, I will begin as proposed with a closer consideration of the context of discovery.

a) Context of Discovery

According to Reichenbach, the sciences have the "task of finding logical inter-
connections between divergent ideas about newly observed facts" (Reichenbach
1938 5).[20] In order to fulfil this task "the scientific genius", paradoxically, never
finds himself committed "to the narrow steps [...] of logical reasoning" (ibid.):[21]

The act of discovery escapes logical analysis; there are no logical rules in terms of which
a 'discovery machine' could be constructed that would take over the creative function of
the genius. But it is not the logician's task to account for scientific discoveries; all he can
do is to analyze the relation between given facts and a theory presented to him with the
claim that it explains these facts (Reichenbach 1951 231).[22]

As in this quotation, Reichenbach often applies the expression "discovery" to
laws and theories. Examples are not only Boyle's law,[23] Newton's law of gravi-
tation[24] or quantum mechanics,[25] but also formal theories like the non-Euclidean
geometries.[26] In addition, he uses the expression for the discovery of phenomena,
including blood circulation[27] or electric current,[28] as well as for technical inven-
tions such as the telescope, the air-pump,[29] the railroad or the radio.[30] The full
scope of the concept corresponds to the comprehensive sociological concept of
knowledge, which is not based on criteria of rationality, but on historical fea-
tures.

The semantics of the expression "discovery" has a realistic connotation and
assumes that knowledge is not so much produced, but is rather, like facts, found.
Accordingly, the discoverer only has a "function". He is guided, as Reichenbach
writes, by an attitude toward knowledge, by the desire to come to know some-
thing about the secrets of nature.[31] His action takes place under the compulsion
of a drive, but is nonetheless determined by his will.[32] Basically, the discoverer
only removes alien circumstances that conceal his view of the essential parts of
reality. Therefore, the search for a discovery must be directed towards objects
that have no inner connection with the discovery itself.

This explanation of the difference claimed to exist between the process of
discovery and its result, is characterized by the duality of will and knowledge.
On this basis, Reichenbach characterises discoveries as non-rational. Accord-
ingly, the discovery of theories, he claims, is guided by unjustified presumptions,
follows no exact methods (Reichenbach 1951 230), and resembles an "irrational
guessing" (ibid. 231).[33] Only this negative characterization of lacking rationality
or, respectively, logical structure, constitutes the particular difference from the
context of justification. This property not only excludes every rational recon-
struction, but also leads to psychology, the subject matter of which includes dis-
coveries that have but a limited capacity of explanation:

Let me say that I should be the last to discredit the work of the great men of science. [...]
The obscurity of the birth of great ideas will never be satisfactorily cleared up by
psychological investigation (Reichenbach 1938 381).[34]

Not even in retrospect, with background knowledge of the personalities and the
historical circumstances involved, does Reichenbach believe that the occurrence
of discoveries is to be understood.[35] He sees discoveries as following an irreduci-
ble voluntary process, the accidental character of which is most clearly evident
when contrasted with the logical structure of the process's own result – the
discovery.

It is questionable whether this characterization applies to any of the objects in
Reichenbach's context of discovery. The main criticism concerns the inclusion
of inventions. The history of technology in the latter half of the last century has
destroyed the idealised image of ingenious personal achievements of technicians
and engineers.[36] New technical constructions can result from a complex net of
coincidences just as well as from a systematic research process. The origins of
the technical systems mentioned by Reichenbach (railroad, broadcasting) go
back to countless conditions and practical goals that are quite accessible to
rational analyses. This might also be the case for the emergence of new empirical
laws or theories. Moreover, the very concepts of law and theory are linked to
testable validity conditions, which contradicts the supposed inclusion in the non-
rational context. Empirical laws and theories refer to data according to proved
rules.[37] Critics of Reichenbach's context distinction have pointed out that the
"non-rational" aspects of discoveries are only dominant in an initial stage in
which new intuitive ideas, hypothetical presumptions and so forth are impor-
tant.[38] Their characterization as a context would nonetheless still be problematic,
insofar as this would assume a division of genesis and validity. It seems to be
more suitable to suppose a minimisation of validity for specific stages of the
genesis.

One can also formulate this criticism by using the terminology of context.
Not the "inner" aspects of knowledge, not its genesis or validity, but the "exter-
nal" influencing factors can be arranged into several contexts, i.e., into particular
fields of reference. Discoveries could be inextricably entangled in the most
diverse psychological, social, historical etc. contexts.

b) The Epistemological Context of Justification

I now turn to both extremes of the meaning of justification. The first is the
assumption that justification is an exclusively epistemological activity and there-
fore situated beyond scientific work. Epistemology enjoys far-reaching freedoms
in fulfilling the task of reconstructing logical structures. Only the starting and the
endpoints of a rational reconstruction must match empirical data according to
rules of correspondence. However, rational reconstruction represents only the
first stage in the epistemological procedure of justification. Rational reconstruc-

tion can fail in its aim to replace the real thinking process with a logically struc-
tured system, because it may be impossible to find connections between the real
starting and endpoints. In its (second) "critical" task, which has priority over the
descriptive one, epistemology is no longer committed to the demand for corre-
spondence with the real processes, but rather to achieving "valid thinking"
(Reichenbach 1938 7).[39] Reichenbach allocates this analysis of science to the
logic which he separates fundamentally from experience.[40]

Deductive logic is empty, consisting of tautologies, that is, it does not express
properties of physical objects.[41] According to Reichenbach, the "manifold forms
of [logical] induction [...] are expressible in terms of deductive methods" that
need only to be to supplemented by one non-analytical principle – induction by
means of enumeration (Reichenbach 1951 243).[42] This restriction of the purely
analytical character might not, he says, prevent one from being allowed to
ascribe absolute validity to logic, even though this quality is "unknowable, since
we never know whether we have it" (Reichenbach 1948 188).

One could describe the analytical character of logic as also being relatively
context-independent. The absolute has neither boundaries nor is it specifically
distinguished from something else. If the concept of the context of justification
were applied exclusively to logic, it would receive the paradoxical semantics of a
non-contextual context. Reichenbach, as I would like to maintain, uses the con-
cept of context to defend the context-independence of his own concept of logic.
The semantics of demarcation, which is combined with the context term, served
him as a means for contrasting logical investigation with scientific practise. He
did not notice the resulting inconsistent definition of the concept of context. This
shortcoming is not only a consequence of an inadmissible division of genesis and
validity, but also of a conception of logic that is no longer maintainable after
Quine's criticism of the distinction between the analytical and the synthetical.

c) Scientific Contexts of Justification and of Discovery

However, Reichenbach does not only contrast justification and discovery of
knowledge. In a twofold manner, he also understands them as an unit. Following
a terminology used by Lutz Danneberg, I would like to distinguish between a
model of succession and a model of levels.[43] The succession model has a hori-
zontal and excluding structure. It divides up the two aspects of knowledge into
two contexts following each other within a given period of time, being parts of
the same process.[44] The model of levels, on the other hand, has a vertical order.
It abolishes the exclusive non-rational characterization of discoveries and,
instead, assumes that they partially satisfy a logic of induction. It views the prac-
tical process of science as the surface of a hidden logical structure. Both models
point towards a cancellation of the concept of context.

Once again, the *succession model* reveals the distortion of the relation
between genesis and validity caused by the concept of context. In this model, the

scientist arrives at a new finding, without having previously been occupied with the validity that he needs to present his findings in his scientific community:

[The] same scientist who discovered his theory through guessing presents it to others only after he sees that his guess is justified by the facts. It is this claim of justification in which the scientist performs an inductive inference, since he wishes to say not only that the facts are derivable from his theory, but also that the facts make his theory probable and recommend it for the prediction of further observational facts (Reichenbach 1951 231).[45]

The assumption that the effort of justification does not start before the discovery is complete underlines the small extension of the context of discovery (cf., 1a). Logic does not determine the emergence of a finding, but follows immediately after its establishment. With this, Reichenbach himself reaches the limit of his concept of discovery and justification contexts. The contact of the two contexts already suggests their overlap and their cancellation. If inductive considerations determine the first communication about a new finding, why should they not also already influence the intuitively guided process of discovery?[46]

With the *model of levels*, Reichenbach takes a different course. The forms of justification mentioned so far are based on findings which have already been advanced. This situation corresponds to Reichenbach's dictum that epistemology does not "maintain anything about the question of how [... a discovery] is performed" (Reichenbach 1938 382).[47] In the model of levels, by contrast, he relates the object of justification to the search for new knowledge which has not yet been successfully completed. Induction turns from a method of justification into a method of searching.[48] In 1951, he notes generally:

Induction is the instrument of a scientific method that is intended to discover something new, something going beyond a summary of previous observations (Reichenbach 1951 229).[49]

Reichenbach argues for using induction in processes such as the extrapolation and interpolation of data, but he does not discuss to what degree scientists use induction in order to find new laws and theories. The assumption that they do use it is, however, strongly suggested by his reconstructions; Galileo's law of falling bodies and Kepler's law of planetary motion result inevitably, in his view, from observed bodily positions.[50] He sees the simplest combination of the two laws as being represented in Newton's law.[51] From this perspective, historical progress comes close to a succession of solutions of mathematical probability problems.

I will not repeat last century's well-known debate within the history of science on the inductive or accumulative view of the evolution of knowledge.[52] With regard to Reichenbach's use of the concept of context, the more important question is in what way the contexts of justification and discovery are related, if the former has an effect on the latter that is not found in other variants of their meaning. For Reichenbach, the inductive view of the progress of knowledge is not only a possible, but also a hidden, already given, reality. He is so convinced

of his reconstructions that it seems probable to him that they also influence – and even in fact control – the actual discovery process:

> If we were to analyze the discoveries of [... scientists], we would find that their way of proceeding corresponds in a surprisingly high degree to the rules of the principle of induction [...]. The mysticism of scientific discovery is nothing but a superstructure of images and wishes; the supporting structure below is determined by the inductive principle. [... It] seems to be a psychological law that discoveries need a kind of mythology (Reichenbach 1938 403).[53]

Accordingly, discoveries could have been following inductive logic all along without science having noticed it. Science would have the "wrong", logic the only "correct" consciousness of the real process.

With this view, Reichenbach gives his dual conception of knowledge an ontological meaning. The two new contexts of the upperstructure and the substructure are separated by the unchanged criterion of rational reconstruction. The mythological upper level is as non-rational as the discoveries in the model of succession; the substructure has a structure analogous to epistemological justification. The model of levels puts the structure of justifications under scientific practice and transforms only the non-rational elements of discoveries into insignificant surface phenomena. Situated now between both levels are discoveries influenced by inductive logic. At the price of the introduction of two new fields of reference, the inevitable interaction of justification and discovery has at least led to a dissolution of the separate context of discovery.

2. CONTEXTS OF SCIENTIFIC JUSTIFICATION

I assumed the expression "context" to be a concept that means a field of reference that is specifically distinguished from other fields. With this meaning, the concept is suitable for the characterization not only of the external influences on science (cf., 1a), but also for the "inner" conditions of scientific knowledge. Reichenbach himself offers an example when he derives the practical necessity of scientific justifications from the requirements of academic communication. In this sense, scientific justifications *have* a context, the context of their verbal presentation and written publication – independent of whether or not they themselves *form* a context.

Reichenbach takes the reconstruction and analysis of epistemology as criteria for the examination of justification in science. Because inaccuracies inevitably occur under the practical conditions of science, the epistemological examination of scientific justifications is necessary. Where logical shortcomings exceed a certain measure, epistemology has the (third) task of advising the researcher.[54] But the criteria of epistemology are not sufficient to examine the validity conditions of normal science. For instance, logical inaccuracies can be necessary in the pursuit of research tasks. The communication of most scientific findings

would be impossible if one were to insist on the proof of the countless accepted alleged logical connections. In this respect, there is a *strained relationship* between the interests of communication and justification. On the other hand, Reichenbach refers to an *equivalence* between communication and justification, so that successful scientific communication also requires a minimum of justification.

Reichenbach hereby offers a surprising common ground with modern contextualism, which also claims that the legitimate requirements of justification find their measure in the particular argumentative context within science.[55] Reichenbach would agree with contextualists that science does not need to worry about the justification of its statements independent of its practice – this is indeed Reichenbach's reason for separating scientific and epistemological tasks. Reichenbach would furthermore accept that only the conditions of communication constitute that part of practice in which the practical necessity for the justification can be determined positively. Finally, he would even be able to agree with contextualism that science must only justify knowledge to the extent that the specific context of communication requires.

3. CONCLUDING REMARKS

Assuming a concept of context that was probably meant by Reichenbach and is commonplace today, I have examined different meanings of his distinction between discovery and justification. For this distinction, the difference between genesis and validity is fundamental, primarily because it affects the preceding separation of knowledge into actual thought processes and the system of the logical connections.

If one understands discoveries as a subset of genesis and their justification as a subset of validity, it is of course evident that the presupposed concept of context cannot be reasonably applied to them. It follows, then, that discoveries cannot be separated from validity questions any more than justifications can be separated from questions of the origin and evolution of their objects.

Because of the comprehensive definition of knowledge, the exclusion of the connection between validity and genesis caused by the application of the concept of context is especially obvious in Reichenbach. In the large spectrum of meanings of knowledge that Reichenbach puts into the extension of his concept of discovery, one can easily find counter-examples to refute his division of the conditions of origin and validity. Conversely, as a method that comprises the whole variety of scientific knowledge, rational reconstruction must have a general definition that is situated at such a distance from the definition of its specific objects that designating justification as context becomes questionable. Reichenbach's attempts to combine the separation of discovery and justification in the models of succession or levels adhere to the one-sided difference of genesis and validity and are not convincing.

It is not the conceptual properties of knowledge, but its practical conditions which offer opportunities for a reasonable application of the concept of context. Historical, cultural, economic, social, communicative etc. conditions, in which knowledge is developing and valid at the same time, offer opportunities to employ the concept. While Reichenbach's unifying understanding of these manifold conditions prevents just this, his well-informed description of the practical scientific justification processes permits a reasonable use of concepts of context.

NOTES

1. Approaches appear in Nickles 1980, Curd 1980, Siegel 1980 and Danneberg 1994. Literature references dealing with the reception can be found in Nickles 1980, Hoyningen-Huene 1987 and Danneberg 1994.
2. Reichenbach 1938 7.
3. Der "Unterschied der inneren und äußeren Beziehungen zwischen den menschlichen Äußerungen, deren Ganzes 'Erkenntnis' genannt wird" (Reichenbach 1983 1).
4. "Äußerungen anderer Art" (Reichenbach 1983 1).
5. "So könnte ein Sozialwissenschaftler berichten, daß die Astronomen große Observatorien bauen, die Fernrohre zur Beobachtung der Sterne beherbergen; auf diese Weise ginge die innere Beziehung zwischen Fernrohren und Sternen in eine soziologische Beschreibung ein. Der Bericht über die heutige Astronomie, der im vorhergehenden Satz begann, könnte mit der Aussage fortgesetzt werden, Astronomen seien oft musikalisch oder gehörten meistens der bürgerlichen Klasse an. Daß diese Beziehungen die Erkenntnistheorie nicht interessieren, rührt daher, daß sie nichts mit dem Inhalt der Wissenschaft zu tun haben" (Reichenbach 1983 1f.).
6. "Es besteht ein großer Unterschied zwischen dem System logischer Verknüpfungen im Denken und der tatsächlichen Art und Weise, wie die Denkprozesse ablaufen" (Reichenbach 1983 2).
7. Reichenbach 1938 5f.
8. Carnap 1928.
9. Reichenbach 1938 5.
10. Die "fiktiven Operationen [...] werden unter dem Gesichtspunkt der Rechtfertigung gewählt; das wirkliche Denken wird durch legitimierbare Operationen ersetzt, das heißt, durch solche, deren Gültigkeit erwiesen werden kann" (Reichenbach 1983 4).
11. See Tiehl 1980ff.; Mühle 1971ff.
12. "Um den Begriff der rationalen Nachkonstruktion auf einfachere Weise zu kennzeichnen, könnte man sagen, er entspräche der Art, wie Denkvorgänge anderen Menschen mitgeteilt werden, als der Art, wie sie sich subjektiv vollziehen. [... Der] wohlbekannte Unterschied, wie jemand einen Lehrsatz findet und wie er ihn einem Publikum vorführt, ist wohl ein gutes Beispiel. Ich führe dafür die Ausdrücke 'Entdeckungszusammenhang' und 'Rechtfertigungszusammenhang' ein. Dann können wir sagen, daß sich die Erkenntnistheorie nur mit der Konstruktion des Rechtfertigungszusammenhangs beschäftigt. Aber selbst die Art und Weise, wie wissenschaftliche Theorien dargestellt werden, ist nur eine Annäherung an das, was wir mit Rechtfertigungszusammenhang meinen" (Reichenbach 1983 3).
13. In theory of science the distinction is mostly understood as a conceptual instrument for better understanding the process of scientific knowledge acquisition from the emergence to the recognition of a finding. See Nickles 1980 and Hoyningen-Huene 1987.
14. "Verfahren, in welchem [... der einzelne Forscher] seine Theorien vor der Öffentlichkeit darlegt" (Reichenbach 1935 172).
15. "Verfahren, welche[...] der einzelne Forscher bei der Auffindung neuer Theorien benutzt" (Reichenbach 1935 172).
16. "Der Entdeckungsakt selbst" (Reichenbach 1968 260).

17. This interpretation is supported by Danneberg 1994 244: "The philosopher doesn't reconstruct given 'procedures of justification' or explanations; it is he himself who creates the explanation" ("Der Philosoph rekonstruiert nicht vorliegende 'Rechtfertigungsverfahren' oder Begründungen; er selbst ist es, der Begründung schafft"). Naturally, scientists are also acting as philosophers if justifying theories is philosophy.

18. "Wir betonten, daß sich die Erkenntnistheorie nicht mit dem [... Entdeckungszusammenhang] beschäftigen kann, sondern nur mit dem [... Rechtfertigungszusammenhang]; wir zeigten, daß sich die Analyse der Wissenschaft nicht auf die tatsächlichen Denkvorgänge richtet, sondern auf die rationale Nachkonstruktion der Erkenntnis" (Reichenbach 1983 239). See also Reichenbach 1999 2 (where Reichenbach uses explanation and justification synonymously).

19. Siegel 1980 304 speaks of "two parallel distinctions". Nickles 1980 claims that Reichenbach only wanted to logically differentiate "between the psychological processes which occur when a scientist thinks of new ideas and the logical argument which exhibits the degree to which those ideas are supported by the facts and other evidential considerations". "[I]ntimately connected with the [...] distinction between the process of discovery and the methods of justification" is according to Hoyningen-Huene 1987 505 "the distinction between academic disciplines". See also Footnote 53. Hoyningen-Huene 1987 504f. also offers literature references supporting this claim.

20. "[L]ogische Beziehungen zwischen unterschiedlichen Hypothesen über neue Beobachtungsdaten aufzufinden" (Reichenbach 1983 2).

21. "[N]ie an die pedantischen Schritte [...] des logischen Denkens gebunden gefühlt" (Reichenbach 1983 2).

22. "Der Entdeckungsakt selbst ist logischer Analyse unzugänglich; es gibt keine logischen Regeln, auf deren Grundlage eine Entdeckungsmaschine gebaut werden könnte, die die schöpferische Funktion des Genies übernehmen würde. Es ist jedoch auch gar nicht die Aufgabe des Logikers, wissenschaftliche Entdeckungen zu machen, er kann nur die Beziehungen zwischen gegebenen Tatsachen und einer Theorie analysieren, die mit dem Anspruch aufgestellt wird, daß sie diese Tatsachen erklärt" (Reichenbach 1968 260).

23. Reichenbach 1968 116.

24. Reichenbach 1968 119.

25. Reichenbach 1968 197.

26. Reichenbach 1968 148f.

27. Reichenbach 1968 116.

28. Reichenbach 1968 140.

29. Reichenbach 1968 116.

30. Reichenbach 1968 140.

31. Die "Einstellung auf ein Wissen, de[n] Wunsch etwas zu erfahren von den Geheimnissen der Natur" (Reichenbach 1929 2).

32. Reichenbach 1968 352.

33. "[I]rrationale[s] Raten[...]" (Reichenbach 1968 260).

34. "Ich möchte betonen, daß ich der letzte wäre, der das Werk der großen Männer der Wissenschaft herabsetzen wollte. [... Das] Geheimnis großer Schöpfungen wird nie zufriedenstellend durch psychologische Untersuchungen aufgeklärt werden können" (Reichenbach 1983 239).

35. For Reichenbach, the baffling emergence of Newton's theory of gravity and Einstein's theory of relativity are paradigms of this misunderstanding. See Reichenbach 1968 238.

36. See e.g. Staudenmaier 1994.

37. Kordig 1978 110 correctly emphasized that quite generally "Real discoveries are well established. What is well established is justified".

38. E.g., Laudan 1977, Kordig 1978, see. Nickles 1980 18ff.

39. "[G]ültige[s] Denken" (Reichenbach 1983 4). See also Reichenbach 1999 2 (where Reichenbach uses "Rekonstruktion" synonomously with "Nachkonstruktion").

40. Reichenbach 1939 8. On Reichenbach's Kantianism, in which the categorical separation lives on, see e.g. Hecht (1994).

41. Reichenbach 1968 250.

42. Die "verschiedenen Formen der Induktion [...] können durch deduktive Methoden dargestellt werden, zu denen lediglich die Induktion durch Aufzählung hinzutritt" (Reichenbach 1968 273).

43. Danneberg 1994 231ff. allocates a variant of Popper's distinction between discovery and justification to his succession model, which converges with my definition. He ascribes the model of levels (which diverges with my definition) to the class of meaning from Reichenbach's distinction which in general concerns validity and genesis (see p. 231).

44. The textual basis for the claim that "there are no textual grounds for thinking that Reichenbach's distinction is a temporal one" (Nickles 1980 13) is lacking.

45. Derselbe "Wissenschaftler, der seine Theorie durch raten entdeckte, [teilt] sie seinen Kollegen erst mit[…], nachdem er gesehen hat, daß die Tatsachen sein Raten gerechtfertigt haben. Die induktive Schlußweise kommt gerade in diesem Rechtfertigungsanspruch zur Geltung, denn der Wissenschaftler will nicht nur behaupten, daß die Tatsachen aus seiner Theorie ableitbar sind, sondern auch, daß die Tatsachen seine Theorie wahrscheinlich machen und man die Theorie darum zur Voraussage zukünftiger Ereignisse verwenden darf" (Reichenbach 1968 260).

46. In line with the reception of Reichenbach's distinction as a criteria for the analysis of the process of scientific knowledge acquisition (see footnote 13), the critics mostly presuppose a succession model and contest the time separation. See Hoyningen-Huene 1987 507.

47. "[I]ch sage nichts über die Frage der Theoriefindung" (Reichenbach 1983 239).

48. The fact that Reichenbach considered discoveries to be on the one hand philosophically meaningless and on the other to be inductively controllable is for Laudan 1980 173 an example of hardly surpassable "nonsense" and "confusion" in the "philosophy of discovery". The model of levels is above all related to those interpretations of Reichenbach's distinction made by theoretical scientists interested in a logic of discovery.

49. "Induktion wird in der Wissenschaft benutzt, wenn es sich darum handelt, etwas Neues zu entdecken, d.h. zu einer Erkenntnis zu kommen, die über die Summe der bisherigen Beobachtungen hinausgeht" (Reichenbach 1968 258).

50. Reichenbach 1938 371.

51. Reichenbach 1938 371ff.

52. See e.g. Diederich Hg. 1974.

53. "Würde man die Entdeckungen [... von Wissenschaftlern] analysieren, so fände man, daß ihre Vorgehensweise in überraschend hohem Maße den Regeln des Induktionsprinzips entspricht […]. Das mystische Gerede über die wissenschaftliche Entdeckung ist nur ein Überbau von Bildern und Wünschen; der stützende Unterbau wird vom Induktionsprinzip bestimmt. [... Es] scheint ein psychologisches Gesetz zu sein, daß Entdeckungen eine Art Mythologie brauchen" (Reichenbach 1983 252f.).

54. Reichenbach 1938 12ff.

55. More generally, in the sense of Analytic Philosophy, contextualism designates an epistemological "theory that standards of knowledge and justification vary with context" (Brower 1998). See Brower 1998 and Williams 2001 for a survey, and introductory literature, and also Jutta Schickore's contribution in this volume.

REFERENCES

Brower, B.W. (1998): "Contextualism, Epistemological", in: *Routledge Encyclopedia of Philosophy*. London.

Carnap, R. (1928): *Der logische Aufbau der Welt*. Berlin.

Chmielecka, W. (1982): "The Context of Discovery and Justification: A Reappraisal", in: W. Krajewski (Ed.), *Polish Essays in Philosophy of the Natural Sciences*. Dordrecht 68, 63ff.

Danneberg, L. (1994): "Die philosophische Analyse im Logischen Empirismus. Explikation und Rekonstruktion", in: Danneberg, Kamlah und Schäfer (Hg.)

Danneberg, L., A. Kamlah und L. Schäfer (Hg.) (1994): *Hans Reichenbach und die Berliner Gruppe*. Braunschweig/Wiesbaden.

Diederich, W. (Hg.) (1974): *Theorien der Wissenschaftsgeschichte. Beiträge zur diachronischen Wissenschaftstheorie*. Frankfurt am Main.

Hecht, H. (1994): "Hans Reichenbach zwischen transzendentaler und wissenschaftsanalytischer Methode", in: Danneberg, Kamlah und Schäfer (Hg.)

Hoyningen-Huene, P. (1987): "Context of Discovery and Context of Justification", in: *Stud. Hist. Phil. Sci.* 18, 501ff.

Kamlah, A. (1991): "H. Reichenbach: Prinzipien, Konventionen, Wahrscheinlichkeit", in: J. Speck (Hg.), *Grundprobleme der großen Philosophen. Philosophie der Neuzeit VI.* Göttingen, 67ff.

Kamlah, A. (1993): "Hans Reichenbach – Leben, Werk und Wirkung", in: R. Haller und F. Stadler (Hg.), Wien-Berlin-Prag. *Der Aufstieg der wissenschaftlichen Philosophie. Centenarien Rudolf Carnap, Hans Reichenbach, Edgar Zilsel.* Wien, 238ff.

Kantorovich, A. (1988): "Philosophy of Science: From Justification to Explanation". *British Journal for the Philosophy of Science* 39, 469ff.

Klein, C. (1998): *Konventionalismus und Realismus. Zur erkenntnistheoretischen Relevanz der empirischen Unterbestimmtheit von Theorien.* Paderborn.

Kordig, C.R. (1978): "Discovery and Justification", in: *Philosophy of Science* 45, 110ff.

Nickles, T. (1980): "Introductory Essay: Scientific Discovery and the Future of Philosophy of Science", in: Nickles (Ed.)

Nickles, T. (1990): "Discovery", in: R. Olby (Ed.), *Companion to the History of Science.* London / New York.

Nickles, T. (1995): "Philosophy of Science and History of Science", in: *Osiris* 10, 139ff.

Nickles, T. (Ed.) (1980): *Scientific Discovery, Logic and Rationality.* Dordrecht etc.

Mühle, G. (1971 ff.): Art. "Genese, genetisch", in: J. Ritter und K. Gründer (Hg.), *Historisches Wörterbuch der Philosophie.* Darmstadt.

Poser, H., und U. Dirks (Hg.) (1998): *Hans Reichenbach. Philosophie im Umkreis der Physik.* Berlin

Reichenbach, H. (1929): "Ziele und Wege der physikalischen Erkenntnis", in: H. Geiger und K. Scheel (Hg.), *Handbuch der Physik.* Bd. 4. Berlin, S. 1ff.

Reichenbach, H. (1935): "Zur Induktionsmaschine", in: *Erkenntnis* 5, 172f.

Reichenbach, H. (1938): *Experience and Prediction. An Analysis of the Foundation and Structure of Knowledge.* Chicago/Illinois.

Reichenbach, H. (1940): "On the Justification of Induction", in: *The Journal of Philosophy* 37 (4): 97ff.

Reichenbach, H. (1948): *Elements of Symbolic Logic.* New York.

Reichenbach, H. (1951): *The Rise of Scientific Philosophy.* Berkeley etc.

Reichenbach, H. (1968): *Der Aufstieg der wissenschaftlichen Philosophie.* Braunschweig.

Reichenbach, H. (1971ff.): *Gesammelte Werke in 9 Bänden.* Braunschweig/Wiesbaden

Reichenbach, H. (1983): *Erfahrung und Prognose. Eine Analyse der Grundlagen und der Struktur der Erkenntnis,* in: Reichenbach 1971 ff., Band 4.

Reichenbach, H. (1999): *Grundzüge der symbolischen Logik,* in: Reichenbach 1971ff., Band 6.

Salmon, W.C. (1979): "The Philosophy of Hans Reichenbach", in: Salmon Ed. (1979), 1ff.

Salmon, W.C. (Ed.) (1979): *Hans Reichenbach, logical empiricist.* Dordrecht etc.

Siegel, H. (1980): "Justification, Discovery, and the Naturalizing of Epistemology", in: *Philosophy of Science* 47, 297ff.

Staudenmaier, M. (1994): "Rationality versus Contingency in the History of Technology", in: M. R. Smith and L. Marx (Hg.), *Does Technology Drive History?* Cambridge usw.

Thiel, C. (1980ff.): Art. "Geltung", in: J. Mittelstrass (Hg.): *Enzyklopädie Philosophie und Wissenschaftstheorie.* Mannheim usw.

Williams, M. (2001): *Problems of Knowlwedge. A Critical Introduction to Epistemology.* Oxford.

Zittlau, D. (1981): *Die Philosophie von Hans Reichenbach.* München.

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