SELF-REFERENCE, PHENOMENOLOGY, AND PHILOSOPHY OF SCIENCE

by

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Historical Note

After a doctoral dissertation that sought to formulate, from a phenomenological standpoint, a rigorous, compelling, and self-reflexive methodology for a therapy of concepts, and then devoting much of a decade to further work within a phenomenological framework, I came to the conclusion that phenomenology was encumbered by much dead weight from the past, much terminological top-heaviness, and insufficient resistance to obscure thinking and its expression in avoidably convoluted language. This paper describes how I made the transition from a scientifically-oriented phenomenological approach to what I felt then, and continue to believe now, is a more exact and proof-based method that seeks to identify and eliminate conceptual pathologies. In the following paper, the focus of application is philosophy of science.

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Abstract

The paper begins by acknowledging that weakened systematic precision in phenomenology has made its application in philosophy of science obscure and ineffective. The defining aspirations of early transcendental phenomenology are, however, believed to be important ones. A path is therefore explored that attempts to show how certain recent developments in the logic of self-reference fulfill in a clear and more rigorous fashion in the context of philosophy of science certain of the early hopes of phenomenologists. The resulting dual approach is applied to several problems in the philosophy of science: on the one hand, to proposed rejections of scientific objectivity, to the doctrine of radical meaning variance, and to the Quine-Duhem thesis, and on the other, to an analysis of hidden variable theory in quantum mechanics.

Phenomenological philosophy began in rigor and has gradually submitted to imprecision. Early in its development, phenomenology was cultivated in close connection with natural science and mathematics, and was inspired by an appreciation of exact standards of justification.[1] On the whole, it seems evident that phenomenology

1. J. Robinson (1788), W. Whewell (1847), E. Mach (1894) variously conceived of phenomenology as a methodological tool of research in physics. Brentano (1888) extended

has placed this attitude to one side, and has become a humanistic tool of interpretation currently under the wing of hermeneutics and existentialist thought. Even within the individual lives of its main contributors, there has been a perceptible transition from scientific standards of exactness to humanistic *Verstehen*.

As a result of this change of orientation, phenomenology offers what is often judged to be an obscure and terminologically top-heavy set of tools for use by philosophers of science. However, phenomenology, at least in the earlier thought of Husserl and to a lesser extent, in some works of Meinong and Brentano, offers a methodology which is distinguished by a number of properties of special interest to philosophy of science.

I

Phenomenology as conceived by the young Husserl – and I have in mind that variety of phenomenology which identifies itself as non-genetic (non-explanatory), descriptive, transcendental phenomenology – aspired to these ends: It sought to provide a method of descriptive analysis capable of explicating the transcendental preconditions which of necessity would need to be satisfied in order for it to be possible for certain objects of conscious life to possess essential properties which they do. An easily identifiable Kantian thread bound together a variety of interests in studies of the constitution of particular objects of consciousness, the constitution of the ontology of regions, the constitution of time, etc. In these investigations, phenomenology was to comprise, in the words of Stumpf, a "neutral pre-science" (*Vorwissenschaft*) which would introduce into its framework of descriptive analysis no special presuppositions,

Whewell's classificatory conception into phenomenological psychology. Baron Jakob Johann van Uexküll (1909) published a group of studies undertaken from a phenomenologically sensitive ecological standpoint, well ahead of his time. Husserl's doctoral research under Weierstrass on the calculus of variations supported his Habilitation thesis on the concept of number (reworked later into the uncompleted *Philosophie der Arithmetik* of 1891). Husserl's *Logische Untersuchungen* (the first volume published in 1900) and his *Formale und transzendentale Logik* (1929) add to this early picture of phenomonology's close association with the sciences.

and would enable the phenomena treated to speak for themselves, as it were, without suffering from perturbations due to the method employed in their analysis. As a *radical* enterprise, in the special phenomenological sense of this term, this presuppositionfree approach would seek to account for its own transcendental structure. It would, that is to say, possess the property of self-reflexiveness, falling within the scope of its own proper subject-matter.[2]

The methodology resulting from this rigorous phenomenological orientation can be distinguished, then, by its claims to presuppositionlessness and self-reflexivity, and by its transcendental concern to explicate preconditions which must be granted for individual phenomena, classes of phenomena, and a wide range of properties and relations between them, to be possible.

Such a proposal, had it borne fruit, would have found important applications in the context of a study of scientific theories. Ideally it would have provided a wholly *intrinsic* mode of analysis of the structure of a scientific theory, because it would have comprised an approach that claimed to impose no external standards of criticism. The results of such an intrinsic critique of a scientific theory could indeed "command the assent of all who are competent to form an opinion."[3] Such a phenomenological approach would make possible an analysis of the presuppositional structure of a theory if not in its own terms, then *of* those terms from a neutral standpointless metraframework compatible with the framework of the theory. The approach would constitute a rigorous metatheory which could be applied in the dispassionate spirit of scientific neutrality both to individual scientific theories as well as to itself.

This proposal – and there is no judgment made here of the in principle possible future the proposal could have had or may yet enjoy – historically has not been successful in the context of scientific interest. This is not, indeed, the sole arbiter of a philosophical methodology, but it is the one of interest to philosophers of science who share the desire to free their discipline from the uncertainties

2. For a fuller account of this interpretation of early phenomonology, see Bartlett (1975).
3. Russell (1914), p. 69 in 1972 edition.

of controversy, and to contribute to the development of what has been called a "vertical discipline", one which builds progressively upon the demonstrated results of the past.

II

Frederic Brenton Fitch, a mathematical logician with an unusual sensitivity to things philosophical, has proposed an approach to philosophy somewhat analogous to the transcendental phenomenological variety I have, perhaps too summarily for some, laid to rest. The "universal metalanguage for philosophy" that Fitch has endeavored to describe bears a close resemblance to one of the defining properties we have mentioned in connection with the methodology of rigorous, scientific phenomenology.[4] Fitch's universal metalanguage has not been formulated so as to include the critical resources needed to make possible its application as a tool of criticism by philosophers of science. Yet, unlike the approach of transcendental phenomenology, the view is clear, and with some phenomenologically-motivated supplementation which I shall suggest, appears to lend itself extremely well to certain of the objectives of philosophy of science.

Fitch argues that the level of generality required for much philosophical discourse is such that the Russell-Whitehead theory of types must be rejected. Philosophical discourse desires "extreme comprehensiveness" of the kind which requires self-reference. In philosophy, this situation is frequently encountered:

> Theories are constructed which purport to deal with all entities whatsoever and which therefore have an unrestrictedly extensive subject matter. In dealing with all entities, such theories in particular deal with all theories, since theories are themselves entities of a special sort. In philosophy we thus encounter theories about the general nature of theories ...
>
> If a theory is included within its own subject matter, we say that it is a *self-referential* theory.[5]

4. To be precise, Fitch discusses a *family* of languages any one of which avoids Tarski's limitative criterion for an acceptable definition of truth.
5. Fitch (1952), p. 218.

In particular, the concern of phenomenology "to explicate its own foundation" requires the self-reflexiveness which characterizes a self-referential theory.

Discoveries since the turn of the century of set theoretical, semantical, and pragmatical paradoxes rendered suspect any self-referential theory of this sort. Self-reference was blamed, and it was banned by the cures that were prescribed to eliminate the occurrence of paradox. In the process, and virtually ignored by the phenomenological community, the Cartesian radicalness of phenomenology was made incapable of realization. The road to the desired self-reflexiveness of the phenomenological approach would remain closed as long as it could be proved that such a theory of theories, or science of sciences, was paradox-generating.[6]

The disturbance due to the discovery of the paradoxes was felt by another field of study, within philosophy of science. Philosophy of behavioral science has often sought the extreme degree of comprehensiveness Fitch describes. A philosophical reflection on human behavior comprises, when undertaken by a human being, a human behavior which falls within the scope of concern of behavioral science and its philosophy.

Similarly, a comprehensive theory of human reflection, when the theory itself is an expression of this capability, requires self-reference.

The anti-paradox cures which were prescribed and which have almost universally been endorsed (e.g., variations on the theory of types and Tarski's limitative semantical results), effectively blocked hopes for extreme comprehensiveness involving self-reference.

Fortunately, in the years since paradox paranoia first disabled the logic of self-reference, certain constructive attempts were made to save the self-referential interests of phenomenology, philosophy of behavioral science, studies of human reflection, etc. In 1963, Fitch demonstrated that non-Tarskian systems do exist which (a)

6. It would be possible to escape this conclusion if it could be shown that the methodological framework of phenomology forms a system of an essentially non-formalizable kind, to which formal set theoretical, semantical, and pragmatical constraints do not apply. However, this has not, as far as I know, been done.

are provably consistent, and (b) permit self-reference.[7] Others, including Smullyan, Myhill, and R.M. Martin, have reinforced Fitch's general conclusion.

As a result of these and similar efforts, it is no longer necessary to avoid all forms of self-reference in order to avoid the occurrence of paradox nor is it necessary to resort to an endless ladder of formal metalanguages. The extreme comprehensiveness desired by much philosophy, by phenomenology, and by other fields, may now again be viewed in a favorable light.

III

With these traditional formal blocks removed, it is possible to consider how a self-referential universal metatheory may be constructed as phenomenology wished. Certain of the fundamental interests of rigorous phenomenology can perhaps be realized in a more perspicuous and more effectively applicable form, following recent contributions to the logic of self-reference.

Specifically, (1) phenomenology's wish to explicate the essential structure of phenomena in a manner free from special presuppositions may be paired with (1′) the intrinsic style of self-referential criticism of which a number of accounts are now available. (2) The self-reflexivity of transcendental phenomenology has a real analog in (2′) a self-referential metalogic that seeks to identify preconditions of referring. (3) The twin foci of phenomenology's intentional and transcendental forms of analysis may be paired with (3′) these two similar foci: a pragmatical description and analysis of intentions involved in referring, and a metalogical account of referential presuppositions subscribed to. Finally, (4) the wish in phenomenology for non-controversial results may be fulfilled by (4′) the proof-oriented approach of a self-referential metalogic of reference.

In earlier work, I have explored the idea of a general metalogic of reference, and have examined certain of the formal properties of

7. Specifically, these systems permit semantical self-reference, which is needed for such a system to formalize its own truth concept. Cf. Fitch (1963).

the resulting metalogic.[8] Here I would like to consider the concerns of a general metalogic of reference which correspond to analogous phenomenological interests.

A sense of presuppositionlessness is achieved by intrinsic, self-referential criticism of a position. Henry W. Johnstone, Jr., has attempted to show that philosophical arguments are successful only when ultimately they are *ad hominem*. For Johnstone, valid critical argument in the *ad hominem* style takes seriously claims made within the framework of a position, and then shows how some claims are self-refuting, short-circuiting the intended purposes of the advocate of the position.

Johnstone distinguishes seven types of philosophical argument. One of these, which he calls 'the charge of denying presuppositions', is worth mentioning here.[9] A denial of presuppositions occurs when a statement made on behalf of a position denies just what the position presupposes. As an example, Johnstone gives the statement, "life is a dream," which is meaningful only if it is presupposed that a meaningful distinction between dreams and waking-states is possible. But this possibility is precisely what is denied by the statement.

Since philosophical argument appears to serve primarily a critical function for Johnstone, *negative* disputation is emphasized by him. (So it was when Kant suggested, in a 1772 letter to Lambert, the need for a *phaenomenologia generalis*, a "negative science" propaedeutic to metaphysics). An approach resembling the one suggested by Johnstone can, however, be used equally to show, as we shall see, the reverse: that one cannot *not* accept certain claims made within the framework of a position.

John Passmore has formulated a position similar in some respects to Johnstone's. Passmore reviews three ways in which one can "con-

8. The latter study will appear in a forthcoming paper, "Referential Consistency as a Criterion of Meaning"; the former may be found in Bartlett (1970); (1975); (1976); and (1978) §§ 10, 12.

9. Cf. Johnstone (1959), pp. 90f. It may later be noticed that Johnstone's denial of presuppositions, if extended beyond its intended factual, *ad hominem* range of application, closely resembles the metalogical variety of self-referential inconsistency. (See below.)

tradict oneself". One of these results in what Passmore calls an "absolute self-refutation". It resembles Johnstone's denial of presuppositions. In Passmore's case, however, it is not that the special presuppositions of a particular position are denied, but "implicit assumptions ... about the conditions of inquiry." These "invariant conditions of discourse" cannot coherently be repudiated. Attempts to deny these conditions result in absolute self-refutation. For example,

> ... it is presupposed in all discourse that some propositions are true, that there is a difference between being the case and not being the case, and to deny this in discourse is already to presume the existence of the difference – since otherwise the notion of 'denying' is quite meaningless ...
>
> Only if a philosophical argument can show in this way that a sentence can propose nothing – because what it asserts, if it were taken to propose something, would be inconsistent with the presuppositions of all proposing – is it pointing, I suggest, to an absolute self-refutation.[10]

Although the positions articulated by Johnstone and Passmore complement one another, there is disagreement. Johnstone, for example, does not accept the view that Passmore's allegedly absolute self-refutations cannot be evaded. Johnstone agrees that "invariant conditions of discourse" do exist and are significant in the context of self-refutations. But, he argues,

> I only insist that we think of such invariant conditions as being hypothetical rather than categorical in form. While I am suspicious of 'Every sentence conveys something', and doubt it has a role in self-refutation, I would be perfectly happy with 'If a sentece is used as an assertion, it must convey something'. For I am willing to see the consequent of this conditional apply to every sentence to which the antecedent applies. It is only the cases to which the antecedent does not apply that cause me to reject the categorical version.[11]

For Johnstone, an effective argument must always take into account the intentions of the advocate of the position under analysis. For Passmore, this is not always necessary because some presuppositions of discourse cannot be suspended by personal fiat. There are other disagreements in the extensive literature treating self-refutation and *ad hominem* argumentation, but they need not concern us here.

Neither Johnstone nor Passmore has shown that the invariant con-

10. Passmore (1961), p. 68.
11. Johnstone (1964), p. 478.

ditions of discourse which both authors claim exist, do exist. A few examples are given, but for most purposes these illustrations fail to establish the general thesis.

The mathematical logician Paul Lorenzen has also endorsed undeniable conditions of discourse in his treatment of "*elementary sentences*", which can be used to express basic assertions and denials. He reasons that the

> ... decision to accept elementary ways of speaking is not a matter of argument. It does not make sense to ask for an 'explanation', or to ask for a 'reason'. For to 'ask' for such things demands a much more complicated use of language than the use of elementary sentences itself. If you ask such questions, in other words, you have already accepted at least the use of elementary sentences.[12]

Collingwood and his constructive interpreter, Rynin, also argue that there exist "absolute presuppositions" which, although not themselves truthfunctional propositions, underlie as necessary conditions for systematic thought propositions that *are* true or false. For Collingwood, a study of absolute presuppositions is a central task of philosophy. Such a view of philosophy requires self-reference.

> Philosophy is reflective. The philosophizing mind never simply thinks about an object, it always, while thinking about any object, thinks also about its own thought about the object.[13]

IV

We have described several views concerning self-refutation which are of interest in the context of an approach to intrinsic, and, in some as yet undeveloped sense, presuppositionless analysis. The views we have reviewed share a self-referential perspective, and focus either on (a) what must be presupposed as a general condition of discourse or of systematic thought, or on (b) what the advocate of a position in fact is forced to acknowledge if his intentionsare to be

12. Lorenzen (1969a), p. 14.
13. Collingwood (1946), p. 1.
Overtones of self-reference are found, too, in Lorenzen's claim, in connection with his operative logic, that "the method is identified with its own result." (1969a), p. 89. Cf. Lorenzen (1969b).

realized. Whichever alternative is followed, the claim is made that the conclusion of an argument by means of self-refutation is not dependent upon the prior acceptance of special norms or criteria alien or external to the position analyzed. Analysis of this kind uses, so to speak, the energy of a position to provide a critique of that position. Philosophical argument in this style suggests a form of intellectual judo. In this general sense, it advances no special presuppositions of its own, endorses no partisan criterion of meaning, but has what we might be tempted to call a "tautological structure": A formulation of the regulative metalogic followed is devoid of positive content, and would articulate general principles that express equivalences of meaning.[14]

In a second analogy to phenomenology, transcendental self-reflexivity corresponds in a self-referential metalogic to a concern to identify preconditions of referring. A metalogical precondition of referring is specified when any attempt to reject that condition results in self-referential inconsistency. This "test" lends itself to formalization and supplies an intrinsic analysis with a logically non-arbitrary and compelling criterion,[15] as I shall try to illustrate. Furthermore, such a critical criterion complements Johnstone's approach to a denial of presuppositions, and is in agreement with Fitch's understanding of a presupposition as "an assumption whose denial is self-referentially inconsistent."[16] A metalogical precondition of referring is "absolute" within all contexts of reference of a certain kind. It will, as things turn out, share some of the properties ascribed by Passmore to his invariant conditions of discourse, and some of those ascribed by Johnstone to his *ad hominem* approach to philosophical argument.

Two major varieties of self-referential inconsistency have been

14. Barlett (1970), Chapter 1.4.
15. This is shown in the forthcoming paper mentioned in note 8.
16. Fitch (1952), p. 221. Fitch has in mind here that the acceptance or rejection of accepted principles of logic must rely upon the use of at least some of these principles. The kind of self-referential inconsistency he has in view turns out to be of a lower "modal order" than the transcendental variety to be described: that is to say, Fitch is concerned with principles which *in fact* must be presupposed, in contrast to presuppositions which *in principle* cannot be rejected.

studied in analyses of self-refutation. It will be important to us to distinguish these clearly, since, in the transformation of exact phenomenology to a metalogic of reference which I am suggesting, these two varieties comprise rough analogs of the phenomenological modes of analysis, intentional and transcendental. In the remainder of this section, we shall look at one of these, and discuss two divergent conceptions of presupposing with which it has been associated. The self-referential analog to transcendental analysis will be considered in the next section.

Both Passmore and Johnstone appear, in spite of their disagreements, to have in view fundamentally the same variety of self-referential inconsistency. Passmore claims that a proposition is absolutely self-refuting if the assertion of that proposition is equivalent to asserting both that proposition and its negation.[17] He gives a quite different formulation a few pages later when he claims that a proposition is absolutely self-refuting if it is taken as proposing something and if what the proposition does propose is "inconsistent with the presuppositions of all proposing."[18] The first claim has the form

$$p \text{ is self-refuting if } \vdash p \equiv p \,\&\, -p, \tag{1}$$

while the second has the form

$$\begin{aligned} &p \text{ is self-refuting if } (p \text{ proposes } q)\ \&\\ &(q \text{ is inconsistent with every } \alpha \text{ where } \alpha\\ &\text{is presupposed by all propositions}). \end{aligned} \tag{2}$$

It is not at all clear that (1) and (2) say the same thing, nor is it clear, given the confusion consequent to the array of analyses that have been supplied which treat the relation of presupposing, whether or not α should be interpreted as truth-functional.[19]

Johnstone's corresponding view is this: He argues that a valid philosophical criticism (a) identifies an inconsistency between an opponent's thesis and what the thesis presupposes, and (b) shows why one's opponent must acknowledge this inconsistency.[20] It

17. Passmore (1961), p. 60.
18. Passmore (1961), p. 68.
19. On this question, see, e.g., the controversy between Donagan (1962) and Rynin (1964).
20. Johnstone (1961), p. 353.

should be clear that Johnstone's attention is focused on the *intentions* of his opponent. It is relative to an opponent's acknowledged intentions that both (a) and (b) above are to be accomplished.

Both Passmore and Johnstone, while clearly not in total agreement, are concerned with what is *in fact* presupposed by the claims of a position. Passmore wishes to make recourse to invariant and categorical conditions of discourse; Johnstone is more modest, contenting himself with "a *logic of intentions*"[21] revealed in a case-by-case analysis through the means of explicit controversy.

The variety of self-referential inconsistency of concern to both Passmore and Johnstone has been termed 'pragmatical' or 'performative'. A substantial literature has been devoted to its study.

A pragmatical self-referential inconsistency may be generally defined as follows:

> If a proposition p is used in a manner such that reference is made by an individual a to an object o at a place-time s, and if o is a pragmatical (or performatory) aspect of the use made of p by a at s, then p is called *pragmatically* (or performatively) *self-referential*. If a pragmatically self-referential proposition p is such that o falsifies p, then p is said to be *self-refuting*. (3)

The assertion, for example, "There are no truths", is self-refuting. It is absolutely self-refuting for Passmore in that "to assert is to assert to be true."[22] It is self-refuting for Johnstone if we can determine that the claim *is* intended by its propounder as a claim to truth (and is not, e.g., for him merely a sequence of meaningless noises or marks). In either case, the self-refutation concerns a factual aspect of the use made of a proposition. We note, then, that pragmatically self-referentially inconsistent or self-refuting statements are factually self-falsifying.

Such a pragmatical variety of self-referential inconsistency, if it is to be used in a non-paradox-generating context, appears to require the rejection of excluded middle.[23] The effect of this is twofold: First, a strengthened case for Strawson's familiar definition of 'presupposing' can be made. Strawson's view, that S presupposes S′ iff S is neither true nor false unless S′ is true, was objected to by

21. Johnstone (1959), p. 120.
22. Passmore (1961), p. 68 (Passmore's emphasis).
23. Fitch (1963) and (1952).

Rynin,[24] as follows: Rynin reasoned that if S presupposes S′, then both $S \rightarrow S'$ and $-S \rightarrow S'$ will be the case. By excluded middle, the conclusion follows that S′ is true, i.e., that all presupposed statements are true – which is of course highly doubtful. Rynin's objection is dissolved when excluded middle no longer applies. Strawson's analysis is left if not in a wholly unproblematical condition, at least repaired.

Alternatively, the rejection of excluded middle makes it intelligible to consider presuppositions in Collingwood's sense: For him, absolute presuppositions are neither true nor false, but they express what might be called "quasi-propositions" that articulate basic conceptual commitments.[25] This is the path I will pursue for reasons that will be evident shortly. It will be useful to make this restriction:

For purposes here, S is said to presuppose S′ in a frame of reference F iff S is neither true nor false unless S′ expresses a framework constraint that holds or is in force when S is asserted relative to F. According to this formulation, it makes no sense to say of a presupposition that it is true (or false) relative to a frame of reference, just as it makes no sense to say in the context of a game (e.g., chess) that a rule (e.g., the rule governing castling) is true (or false). It *does* make sense to speak of such rules as holding or as having been broken in a particular game, just as it is intelligible to say that a presupposition holds or is violated in relation to a claim made in a particular frame of reference.

When a presupposition holds or is in force, one may conclude that the consequent of an associated conditional is true. For example, a presupposition of referring to an individual named 'Rima' is that there exist some object of reference so named. This presupposition of name-use, when in force, implies that the statement "There is some object of reference named 'Rima' " is true. But it is a mistake,

24. See note 19.

25. Collingwood limited the term 'proposition' to what may be understood as the (true or false) answer to a particular question. He did not wish to view absolute presuppositions as expressing genuine propositions, since they are not answers to particular questions, but rather underlie the asking of such questions.

rom the point of view described here, to equate the presupposition n question with the truth of the latter statement. The distinction nade here takes into account differences between a rule, instances vhich satisfy it, and statements about those instances.

V

Referential presuppositions analyzed in this way, constitute, in the phenomenological sense, preconditions of valid reference. Their rejection, relative to a particular frame of reference, leads to a form of self-referential inconsistency which elsewhere I have termed '*projective*'.[26] A logic which studies relations between the referring use of concepts or expressions, and the referential preconditions which must be satisfied for that use to be meaningful, I have called a '*metalogic of reference*'. Its focus is, in the proper sense of the word, transcendental, and its range of concerns parallels that of transcendental phenomenology.

The strength of such an approach lies in the fact that the principles of the metalogic "*self-validate*" in the sense that their rejection leads to *projective* self-referential inconsistency. This metalogical variety of self-referential inconsistency is essentially distinct from the pragmatical variety. Where Passmore and Johnstone are alternatively concerned with absolute self-refutation or *ad hominem* argument in the context of factual conditions of discourse and acknowledged intentions, a metalogic of reference investigates the transcendental logic underlying all referring. Its interest is in preconditions of possible reference, and hence comprises a study which is properly metalogical.

The metalogical variety of self-referential inconsistency may be defined as follows:

> A proposition p is termed ***metalogically self-referential*** if p is such that (i) If p is asserted, reference is made by some individual a to an object o at a place-time s, and (ii) such reference metalogically presupposes endorsement by a at place-time s of a precondition M_p which must hold in order for p in principle to have a significant truth-value.
> If p is metalogically self-referential and p is such that its assertion denies one or more conditions which must be satisfied in order for it to be possible meaningfully to assert p, then p is said to be ***projective***. (4)

26. Bartlett (1970), (1975), (1978).

A "precondition of reference", M_p, may be viewed as expressing a quasi-proposition, as described earlier. Such an M_p comprises a necessary condition of possible reference, a constraint which if violated in a particular context of reference results in projection.

Elsewhere I have argued that metalogical referential consistency constitutes a transcendental criterion of meaning in the sense that rejection of projective self-referential inconsistencies is a necessary condition of the possibility of meaning, truth-functionally understood.[27] From this point of view, a pragmatical analysis describes what one is *in fact* committed to in making an assertion, while a metalogical analysis describes what one *must* be committed to if an assertion *in principle* is to be meaningful.

A comparison of definition (4) and the earlier definition (3) of the pragmatical self-referential variety enables the reader to note these differences between the two forms of self-referential inconsistency we have discussed. The distinction between the two roughly parallels, I have suggested, the distinction between certain intentional and transcendental phenomenological analyses. On the one hand, a metalogical explication of preconditions of referring has an unmistakable transcendental orientation. On the other, *ad hominem* argumentation, or argumentation which attends to invariant conditions of discourse, requires a careful phenomenological description of identifiable intentional relations, either acknowledged by an individual advocate of a position or of necessity subscribed to in any use of discourse. A descriptive, intentional analysis of this kind would correspond closely to Johnstone's "logic of intentions" and to Passmore's study of absolute commitments of discourse.

We turn now to several examples which illustrate applications of this self-referential, phenomenologically-motivated metatheory to certain problems in philosophy of science.

VI

Carl R. Kordig has argued forcefully that most contemporary philosophies of science are self-referentially inconsistent in the sense of

27. See note 15.

being self-falsifying. His analyses emphasize the pragmatical mode of criticism, and merit attention.

For example, Kordig argues that the denial of objectivity in science and the doctrine of radical meaning variance are both self-referentially inconsistent. Specifically, both constitute self-falsifying assertions. The falsity of each claim is derivable from the assumption of its truth.

In connection with Kuhn's and Feyerabend's rejections of scientific objectivity, Kordig is in agreement with Scheffler: "Objectivity is presupposed by any statement which purports to make a cognitive claim. To put forth any such claim in earnest involves a presuppositional commitment to the view that the claim has an objective truth value."[28]

Kording opposes the views of Feyerabend (1962), Hanson (1958), Hesse (1963) and (1968), Kuhn (1962), Smart (1953), and Toulmin (1961) who have each argued that a shift from one scientific theory to another involves an incommensurable change in the meanings of the terms used, and hence that there can be no statements whose meaning is invariant across scientific theories. Kordig supplies an argument resembling Scheffler's: A statement which rejects radical meaning invariance is intended by its advocates to express the sort of meaning invariance it denies. Thus, its falsity follows from its assumed truth.

A possible objection is foreseen by Kordig: that the proposed rejection of objectivity in science and the endorsement of radical meaning variance are made from a restricted standpoint which is excepted from the claims made. It is true that in so doing the pragmatical self-referential inconsistency is evaded. However, the consequences of the evasion are unfortunate. The denial of scientific objectivity and the doctrine of radical meaning variance then result, according to Kordig, in an unjustified dualism: On the one hand, both scientific objectivity and invariance across scientific theories are denied; on the other hand, objectivity and meaning invariance are presumed in the special perspective of philosophy of

28. Scheffler (1965), p. 21.

science. This preference and privilege are not justified. Therefore Kordig is able to conclude that objectivity and meaning invariance in science cannot consistently be rejected, or this rejection entails the arbitrariness of dogmatism.

A third illustration of the pragmatical variety of self-referential argument is available in an analysis, also due to Kordig, relating to the so-called Quine-Duhem thesis. Quine (1963) and (1972) has been responsible for extending Duhem's thesis concerning physical hypotheses to all hypotheses. Kordig distinguishes two versions of Quine's thesis: (i) No hypothesis can be irrevocably falisified. (ii) No hypothesis can be immune to revision. To show the pragmatical self-referential inconsistency of both versions, Kordig argues as follows:

(i) The Quine-Duhem thesis is itself an hypothesis. By its own claim, it cannot be irrevocably falsified. Like the thesis itself, the negation of the Quine-Duhem thesis is an hypothesis which, according to the thesis, cannot be irrevocably falsified. Hence the denial of the thesis cannot be rejected with finality: It is possible to sustain the negation of the thesis, viz., that some hypothesis can be irrevocably falsified. Consequently, from the Quine-Duhem thesis, its falsification can be deduced. It is a self-falsifying pragmatical self-referential inconsistency, hence is not tenable.

Alternatively, (ii) the Quine-Duhem thesis is an hypothesis which claims that no hypothesis can be immune to revision. Hence it is open to revision. To revise an hypothesis, in Quine's view, is to change its truth-value. In other words, from the assumption that the Quine-Duhem thesis is true it follows that it may be false, in which case some hypothesis can be immune to revision. But this latter claim is in direct conflict with the original thesis. Once again, from the assumption that the Quine-Duhem thesis is true, it follows that it is false.

These three examples of pragmatical self-referential argumentation make two things clear: The claim that a position is pragmatically self-referentially inconsistent is forced, first, to suppose that the position attacked will acknowledge the legitimacy of its self-application. This is often problematic. As Passmore has ob-

served in connection with pragmatical self-refutation, the propounder of a position under criticism is always free in principle, "even if sometimes with almost inconceivable hardihood"[29] to deny the intentions attributed to him.

Secondly, provided the self-application of a position *is* accepted as legitimate by its propounder, it follows from a valid self-refutation that the statement of the position in question is self-falsifying. But it does not necessarily follow that what is claimed by the position cannot be the case. It may not be possible coherently to *state* the claim that there is no objectivity in science, or that there exists radical meaning variance, or that all hypotheses are open to revision, yet, it can be argued, it does not follow that any one of these cannot nevertheless be true. They may be true, but *this* possibility cannot be expressed consistently. The sceptical metaclaim, in attempting to say what cannot consistently be said, is doomed to self-referential inconsistency. The suspicion may linger that Feyerabend, Hanson, Hesse, Kuhn, Polyani, Quine, Smart, Toulmin may be right, but the suspicion cannot consistently be voiced. Among other things, this is what it means to say that a position is untenable.

Kordig's self-referential analyses do not, in their current formulation, focus on invariant conditions of discourse (although elsewhere there are some hints that he may eventually move in this direction[30]). His analyses appear to express self-referential *ad hominem* arguments in Johnstone's sense. That this is so appears to be confirmed by the vulnerability of Kordig's arguments to objections regarding the legitimacy of forcing the self-application of a position. (Objections of the second kind, "Even if the position *is* self-referentially inconsistent, it still may be true," are effectively silenced.)

Most self-referential analyses in philosophy of science have been pragmatical in focus, and have treated theories developed in philosophy of science *about* scientific theories.

29. Passmore (1961), p. 63.
30. In connection with Kordig's arguments that objectivity and meaning invariance *are* possible, see Kordig (1971a), (1971b), (1971c), (1973).

In contrast to such a pragmatical analysis of theories of theories, we turn to a metalogical argument concerning a particular scientific theory. Before doing so, let us recapitulate.

We recall that in a metalogical analysis of preconditions of referring an attempt is made to identify constraints which cannot be violated without projective self-referential inconsistency. A projective claim is not, like a pragmatical self-referential inconsistency, self-falsifying, but is *self-undermining*: A concept or proposition is used in a position in such a way that, literally and logically, precludes that the forms of reference involved can possibly obtain. A projective self-referential inconsistency results if one attempts to refer to an object o in such a way that denies one or more conditions which must be satisfied in order for it to be possible to refer to o at all. A self-undermining claim does not falsify itself, but is such that it is incoherent to associate any meaningful truth-value with the claim. In a somewhat metaphorical sense, pragmatical self-referential inconsistencies express factual short-circuits which involve either the intentions acknowledged by a position or certain invariant conditions of discourse, and which result in a falsification of that position. Projective self-referential inconsistencies express transcendental short-circuits which (a) involve self-validating preconditions of referring, and which (b) undermine the possible meaningfulness of a claim endorsed. These varieties of inconsistency, among others, represent ways in which conceptual structures may become dysfunctional and self-defeating.

VII

There has been strong opposition among philosophers to the Copenhagen interpretation of quantum mechanics. Among physicists, however, this interpretation has been the substructure for progress in theoretical and experimental research in microphysics for several decades. Contrary to this trend in physics, a bias in favor of realism and physical determinism was expressed in the opposing hidden variable interpretation of quantum mechanics. Numerous philosophers and a few physicists have claimed, in spite of the uncertainty

relations, that a microparticle in fact has a well-defined simultaneous position and momentum. From the standpoint of current quantum statistical mechanics, such a claim involves a metalogical self-referential inconsistency.

The uncertainty principle grows out of a calculus of operators. Two observables are said to commute if the observations are non-interfering. Quantum mechanics, specifically, matrix mechanics, asserts that for a class of dynamical variables, if P and Q are non-commuting operators, then P and Q are canonically conjugate quantities: that is, if a physical system is in a state for which P is determined with an accuracy ϵ, then there is a maximum limit to which Q may be determined, viz., $\eta = h/2\pi : \epsilon$.

The relation between such canonically conjugated variables is essentially one of uncertainty. Heisenberg's uncertainty principle, which expresses the logic of such variables, is normally discussed in the context of the noncommuting observables, position and momentum. However, there are analogous uncertainty relations involving other dynamical variables which cannot be precisely measured simultaneously, for example, energy/time, number/phase, etc.

The Copenhagen interpretation of quantum mechanics accepted the limitative results expressed in Heisenberg's application of the formalism of noncommuting matrices. In this view and in related formulations, the uncertainty relations do not merely represent technical limitations, but they rather constrain, in principle, what may meaningfully be stated in matrix mechanics, in wave mechanics, or in the more general so-called transformation theory. The microphysical theory built on this foundation has been vigorously opposed by many philosophers and not very many physicists, among the latter Einstein, De Broglie, Jeffries, and Bohm. Of the arguments proposed, perhaps Bohm's is the only one which has not reduced simply to an endorsement of prejudices in favor of realism and complete physical determinism. Although it is not possible to go into the details of his view here, we may note that Bohm's rejection of the postulate of uncertainty did not evolve into more than a hopeful sketch of an alternative microphysical theory, one which

has received a sceptical response from physicists.[31] In discussing his alternative theory, Bohm speculated that

> ... the coordinates and momenta of individual atoms are hidden variables, which in a large scale system manifest themselves only as a statistical averages. Perhaps then, our present quantum mechanical averages are simply a manifestation of hidden variables, which have not, however, yet been detected directly.[32]

To show that this point of view expressed by Bohm and others is metalogically projective in relation to contemporary Copenhagen-based quantum theory, it is necessary to demonstrate these things:

- that the uncertainty relations have a presuppositional role in modern quantum statistical mechanics;
- that a denial of the postulate of uncertainty entails a denial of preconditions which must be satisfied in order for physical reference to specified dynamical variables to be possible.

It is rather straightforward to establish the first of these: Perhaps the most general assumption of existing quantum theory, as acknowledged even by Bohm, is that the state of a physical system "is completely specified by a wave function that determines only the probabilities of actual results that can be obtained in a statistical ensemble of similar experiments".[33] From this assumption, Bohm goes on to say,

> ... the uncertainty principle is readily deduced ... [I]t becomes a contradiction in terms to ask for a state in which momentum and position are simultaneously and precisely defined .... The uncertainty principle is ... a necessary consequence of the assumption that the wave function and its probability interpretation provide the most complete possible specification of the state of an individual system ....[34]

According to this view, the uncertainty relations can be derived from the assumption that the probability interpretation of the wave function constitutes a complete microphysical description. From the perspective of opponents to the Copenhagen interpretation, to claim, on this basis, that the postulate of uncertainty plays a presuppositional role would be to beg the question. It is precisely the foregoing assumption from which the principle of uncertainty is derived which they wish to question.

31. Heisenberg, Oppenheimer, Dirac, and Bethe expressed their strongest doubts concerning Bohm's proposal (in personal communications with Norwood Russel Hanson). Cf. Hanson (1958), p. 174.
32. Bohm (1952), p. 166.
33. Bohm (1952), p. 166.
34. Bohm (1952), p. 167.

Fortunately for our purpose, the reverse has also been shown: that solely from an operationally-based statement of the uncertainty relations the rest of quantum mechanics can be derived. In his famous proof, Von Neumann demonstrated[35] that, indeed, the uncertainty relations make up, as Hanson put it, "the logical backbone of *all* quantum theory."[36]

Two further remarks may exhibit some of the force behind this demonstration. First, so-called "interference terms" occur in quantum mechanics. They are not understood simply as products of probabilities, but are functionally defined as products of Ψ functions. Put somewhat differently, the noncommuting nature of such dynamical parameters as position and momentum is entailed by the nature of the Ψ function.

Secondly, it is interesting to note that, as a consequence, the algebraic analog of a statement simultaneously specifying precisely de-

35. Von Neumann (1955), Chapters IV, VI, especially pp. 323ff.

36. Hanson (1967), p. 46.

It should be noted that Bohm did not disagree with von Neumann's argument. Bohm conceded that as long as the usual rules of calculating quantum-mechanical probabilities are in force, it is inconsistent to postulate a set of hidden parameters which simultaneously determines the results of measurements of noncommuting observables. (Bohm (1952), II, p. 187.) Bohm's proposal essentially sought to modify these rules: in particular, to consider such observables as position and momentum as "potentialitieswhose precise development depends just as much on the observing apparatus as on the observed system. In fact, when we measure the momentum "observable", the final result is determined by hidden parameters in the momentum-measuring device as well as by hidden parameters in the observed electron. Similarly, when we measure the position "observable", the final result is determined in part by hidden parameters in the position-measuring device." (*Ibid.*) Bohm's proposal acknowledged that these two measurements are mutually exclusive since they depend on "mutually exclusive arrangements of matter that must be used in making different kinds of measurements." (*Ibid.*, pp. 187-188.)

In spite of this block to simultaneous measurements of, e.g., position and momentum, Bohm wished to be able to claim that both observables are in reality precisely determined in a physical system. To maintain this, Bohm describes the preparation of a physical system in a state "in which the Ψ-field and the initial particle position and momentum are precisely known." (*Ibid.*, p. 185.) According to Bohm's theory, then, it is possible to measure only one of these observables precisely: it is necessary to *infer* the value of the other on the basis of formal relations of the theory.

Bohm wished to preserve precise simultaneous determinability of both observables, not merely by inference, but in fact. The realistic claim, in the context of his own theory, is projective: The microphysical claim that both parameters are precisely defined and physically real presupposes that in principle both can simultaneously be measured. Yet, as we have seen, Bohm's position accepts the constraint that measurements of position and momentum are mutually exclusive.

fined values for position and momentum itself is without meaning in quantum statistical mechanics. The absence of meaning here is due to conflict with the rules of formation and transformation employed in the formalism. But there is another, perhaps more compelling, reason for its meaninglessness:

As long as an alternative, comparably detailed microphysical theory is unavailable, the physical meaningfulness of a microphysical claim – e.g., relating to mutually interfering observables – will be understood in terms of prevailing quantum statistical theory. The uncertainty relations have the status of presuppositions – conceived of as rule-based constraints – within the conceptual structure of the theory. The uncertainty relations are nothing more than the expression of a limitative postulate required in a calculus of operators. Now, a hidden variable theorist wishes to refer to subatomic events as currently understood in the context of existing quantum theory. He wishes, furthermore, to claim that mutually interfering observables actually posses well-defined simultaneous values. Such a claim is clearly projective: The hidden variable theorist refers to a pair of observables which are *essentially* defined in a noncommuting sense, and in so doing explicitly denies a condition which logically is forced on our current understanding of interfering observables. The condition he denies is a precondition which must be satisfied in order for it to be possible for him, or anyone else, to refer meaningfully in the theoretical context in question to such observables. It is not that what the hidden variable theorist says is self-falsifying; rather. his claim is self-undermining in terms of its possible meaningfulness.

Should an alternative microphysics someday be developed as Bohm hoped, in terms of which microparticles meaningfully may be said simultaneously to possess precisely determined positions and momenta, time and energy, number and phase, etc., the above conclusion will stand unaffected. The uncertainty relations essential to Copenhagen quantum mechanics remain essential in physics as long as that theory is held. A second theory in which this is not the case refers, in a quite literal and logical sense, to objects which are defined in an essentially distinct way. A physical metatheory – which

correlates predictions made by Copenhagen quantum mechanics and a possible alternative Bohm microphysics – would enable physicits to evaluate the comparative usefulness of the two theories. The predictive value of the competing theory conceivably might be greater than that of the Copenhagen view, in which case it would have to give way to the new theory. Thus, where Bohm's hidden variable claim expressed in its present conceptual environment is projective, a corresponding claim asserted in the context of a fully developed, alternative microphysics, is trivial. The two claims can by no means be reduced to the same claim: One is self-undermining, while the other is best likened to a tautology.

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2. *Conceptual Therapy: An Introduction to Framework-relative Epistemology*, Studies in Theory and Behavior, Saint Louis, 1983. An introductory text that gives students applied exercises in thinking using the author's approach to epistemology in terms of self-referential argumentation and self-validating proofs.

3. *Self-Reference: Reflections on Reflexivity*, edited with Peter Suber, Martinus Nijhoff, 1987; now published by Springer Science. The first of two collections (see #4 below), consisting of invited papers by leading contemporary authors, to be published in the new area of research, the general theory of reflexivity, pioneered by the author.

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normal, who so often — as world history has amply proved, and as such experimental studies as Milgram's and Zimbardo's confirm — will, when circumstances are right, subject others to abuse, cruelty, and death in state- or group-endorsed wars, genocides, and terrorism (see publication #5 above).

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