Kuhn's Changing Concept of Incommensurability

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DISCUSSION

Kuhn's Changing Concept of Incommensurability

ABSTRACT

Since 1962 Kuhn's concept of incommensurability has undergone a process of transformation. His current account of incommensurability has little in common with his original account of it. Originally, incommensurability was a relation of methodological, observational and conceptual disparity between paradigms. Later Kuhn restricted the notion to the semantical sphere and assimilated it to the indeterminacy of translation. Recently he has developed an account of it as localized translation failure between subsets of terms employed by theories.

1 INTRODUCTION

The year 1962 saw the introduction by Kuhn and Feyerabend of the thesis of the incommensurability of scientific theories.[1] Since then, the thesis has been widely debated and attracted much criticism. Yet it has enjoyed considerable influence, particularly in the area of the history and philosophy of science concerned with scientific theory change and choice. This influence is in large part due to the immense popularity of Kuhn's master work, *The Structure of Scientific Revolutions*, which ensures that the idea of incommensurability continues to reach a broad audience. It is, however, less widely appreciated that Kuhn's version of the idea has, in the meantime, undergone a process of continual revision and clarification. As a result, the version of the thesis for which Kuhn is best known differs markedly from the version which he presently espouses. In this paper I present a study of the process of change which chronicles the key stages of the developments of Kuhn's concept of incommensurability.

[1] Both Kuhn [1970a] and Feyerabend [1981a] originally appeared in 1962.

Kuhn's treatment of incommensurability divides into early and late positions, separated by a transitional stage.[2] Originally, Kuhn's notion of incommensurability involved semantical, observational and methodological differences between global theories or paradigms. His initial discussion suggested that proponents of incommensurable theories are unable to communicate, and that there is no recourse to neutral experience or objective standards to adjudicate between theories. In subsequent efforts to clarify his position he restricted incommensurability to semantic differences, and assimilated it to Quinean indeterminacy of translation. During this intermediate stage Kuhn's treatment of the issues tended to be incomplete, often resulting in cursory discussion.[3] However, in recent years he has begun to develop his position in more refined form. His present view is that there is translation failure between a localized cluster of interdefined terms within the languages of theories.

The views of Feyerabend, the other main advocate of the incommensurability thesis, will be dealt with here only to the extent that consideration of them illuminates some aspect of Kuhn's position. However, it is worth briefly indicating the key differences between their views. Unlike Kuhn, whose notion of incommensurability initially included non-semantic factors, Feyerabend always restricted his use of the notion to the semantical sphere ([1978], pp. 66–7). Feyerabend originally developed his idea of incommensurability as an objection to the reductionist account of theory succession, according to which earlier theories are deductively subsumed by the later theories which replace them [1981a]. He argued that because of conceptual disparity between theories, successive theories may fail to have common semantic content, in which case the overlap of consequence classes necessary for reduction would not obtain. His idea of incommensurability differs from Kuhn's in that semantic variance between theories extends to the entirety of the observational and theoretical terms employed by incommensurable theories, whereas for Kuhn such semantic variance tends to be confined to central subsets of the terms which occur in such theories. Moreover, apart from some early clarifications ([1981b], [1981c]), and an apparent extension of incommensurability to world views ([1975], ch. 17), Feyerabend's idea has remained fundamentally unchanged since originally being developed.

2 KUHN'S EARLY POSITION

Incommensurability figures integrally in Kuhn's account of revolutionary

[2] The main body of Kuhn's [1970a] is the source for his early position. The transitional phase is represented by the 'Postscript' to his [1970a], his [1970b], [1976] and [1979]. His later position is found in his [1981], [1983] and [1989].

[3] Kuhn's first main attempts at clarification were published around 1970. See the 'Postscript' to his [1970a] and his [1970b]. Over the next ten years his discussion of incommensurability was confined to brief remarks in his [1976] and [1979].

scientific change in *The Structure of Scientific Revolutions* [1970a]. (Unless otherwise indicated, the page references for quotations from Kuhn's early position are to Kuhn [1970a].) According to Kuhn, scientific activity divides into periods of 'normal science' punctuated at intervals by episodes of 'revolution'. Normal science is 'research firmly based upon one or more past scientific achievements' (10), and scientific revolutions are when 'an older paradigm is replaced in whole or in part by an incompatible new one' (92). The pivotal notion here is that of a 'paradigm'. Kuhn takes paradigms to be 'universally recognized scientific achievements that for a time provide model problems and solutions to a community of practitioners' (viii); as such, they 'provide models from which spring particular coherent traditions of scientific research' (10). However, Kuhn also uses 'paradigm' in the broader sense of a global theoretical structure embracing the 'network of commitments—conceptual, theoretical, instrumental, and methodological' (42) of a normal research tradition.[4] Besides 'tell[ing] us different things about the population of the universe and about that population's behaviour', paradigms 'are the source of the methods, problem-field, and standards of solution accepted by any mature scientific community at any given time' (103).

Revolutionary transition between paradigms is at the heart of Kuhn's account and is the point at which incommensurability enters. As it figures in Kuhn's account, incommensurability constitutes an impediment to choice of paradigm: 'Just because it is a transition between incommensurables, the transition between competing paradigms cannot be made a step at a time, forced by logic and neutral experience' (150). Because of incommensurability, the decision between rival paradigms does not admit of a neat resolution. Kuhn likens the process of choice to a 'gestalt switch' (150), and says 'the transfer of allegiance from paradigm to paradigm is a conversion experience' (151).

The influence of incommensurability is mainly apparent in paradigm debate: 'the proponents of competing paradigms are always at least slightly at cross-purposes', and 'fail to make complete contact with each other's viewpoints' (148). The incommensurability which thus besets paradigm debate is due 'collectively', Kuhn says, to the following three factors:

> [T]he proponents of competing paradigms will often disagree about the list of problems that any candidate for paradigm must resolve. Their standards or their definitions of science are not the same. (148)
>
> Within the new paradigm, old terms, concepts, and experiments fall into new relationships one with the other. The inevitable result is . . . a misunderstanding between the two competing schools . . . To make the transition to Einstein's

[4] The ambiguity of Kuhn's original use of 'paradigm' has been widely noted; see, for example, Shapere ([1984a], p. 39) and Masterman [1970]. Kuhn subsequently distinguished the paradigm as 'constellation of beliefs, values, techniques' from the paradigm as 'shared exemplar', referring to them as 'disciplinary matrix' and 'exemplar' respectively; see the 'Postscript' to his [1970a] as well as his [1977a].

> universe, the whole conceptual web whose strands are space, time, matter, force, and so on, had to be shifted and laid down again on nature whole . . . Communication across the revolutionary divide is inevitably partial. (149)

> In a sense that I am unable to explicate further, the proponents of competing paradigms practice their trades in different worlds . . . practicing in different worlds, the two groups of scientists see different things when they look from the same point in the same direction. (150)

Incommensurability thus emerges as a complex relation between paradigms consisting, at least, of standard variance, conceptual disparity, and theory-dependence of observation.

The thesis that there may be no appeal to neutral observation and that standards of theory appraisal are internal to paradigm suggests a relativistic view of the epistemic merits of paradigms.[5] For if, in the absence of independent means of evaluating paradigms, a paradigm is to be assessed by standards dictated by the paradigm itself, such appraisal is relative to acceptance of paradigm. Yet Kuhn has subsequently resisted the charge of relativism, maintaining instead that there are shared scientific values independent of paradigms.[6] However, he insists that such values fail to unambiguously determine choice of theory. This enables him, in the 'Postscript', to restate the problem of deciding between paradigms:

> There is no neutral algorithm of theory-choice, no systematic decision procedure which, properly applied, must lead each individual in the group to the same decision. ([1970a], p. 200)

Since Kuhn later separates such methodological issues from incommensurability proper, we will not pursue the theme of standard variation any further. Instead, we will now focus upon the conceptual aspects of Kuhn's early account of incommensurability.

The second factor contributing to incommensurability involves change of conceptual apparatus: 'to make the transition to Einstein's universe, the whole conceptual web whose strands are space, time, matter, force, and so on, had to be shifted and laid down again on nature whole' (149). Kuhn takes such conceptual change to prevent the laws of a displaced paradigm from being derived from the paradigm which replaces it.

Kuhn argues that the analogues of Newton's laws that follow from Einstein's physics as a special case are not identical with those laws. This is because the statements of Einsteinian versions of the laws employ relativistic

[5] Kuhn's seeming denial of extra-paradigmatic criteria of theory-choice has appeared relativist and irrationalist to many commentators. See, for example, Scheffler ([1967], pp. 74ff) and Shapere ([1984a], p. 46).

[6] Kuhn lists such cognitive values as accuracy, simplicity, fruitfulness, internal and external consistency; see his 'Postscript' ([1970a], pp. 185, 199). He discusses the issues raised by differential weighting of values and variant application of the same value in his [1977b].

concepts which 'represent Einsteinian space, time, and mass', and so differ in meaning from the statements which express Newton's laws:

> the physical referents of these Einsteinian concepts are by no means identical with those of the Newtonian concepts that bear the same name. (Newtonian mass is conserved; Einsteinian is convertible with energy. Only at low relative velocities may the two be measured in the same way, and even then they must not be conceived to be the same.) Unless we change the definitions of the variables in the [Einsteinian versions of the laws], the statements we have derived are not Newtonian . . . the argument has [] not done what it purported to do. It has not, that is, shown Newton's Laws to be a limiting case of Einstein's. For in the passage to the limit it is not only the forms of the laws that have changed. Simultaneously we have had to alter the fundamental structural elements of which the universe to which they apply is composed. (101–2)

This passage reveals a fundamental convergence between Kuhn's and Feyerabend's notions of incommensurability. As with Feyerabend's original use of the notion ([1981a], pp. 62–9), Kuhn's argument against the derivation of Newton's laws from Einstein's is directed against the reductionist account of theory replacement. Indeed, since the failure of derivability is due to conceptual disparity between the theories, Kuhn's notion of incommensurability may even appear to coincide with Feyerabend's exactly.[7] The equivalence of their views is further suggested by the fact that Kuhn combines the claim of conceptual disparity with a rejection of the empiricists' neutral observation language (125–9). For this suggests that with Kuhn, as with Feyerabend, incommensurability does not consist simply in difference of the basic concepts of theories: it also involves dependence of the meaning of observational terms upon the theory in which they occur.

However, Kuhn later claimed only to have meant that part of the languages of incommensurable theories differ in meaning.[8] This attenuates the parallel between Kuhn's original notion of semantical incommensurability and Feyerabend's. For it suggests that the language used to report observations, while not being theory-neutral, is only in part semantically variant between theories.

While this implies that incommensurable paradigms are not altogether unrelated semantically, Kuhn is sometimes drawn toward a far stronger thesis. This is apparent from the third constitutive element of incommensurability: viz., that 'proponents of competing paradigms practice their trades in different worlds' (150). Kuhn's [1970a] contains numerous comments to the effect that

[7] Shapere, for example, explicitly equates their views; see his ([1984b], p. 83). The equation is implicit in Scheffler ([1967], pp. 49–50).

[8] In later writings Kuhn is careful to specify that meaning variance is only partial, *e.g.* [1970b], p. 267. In the following remark he claims always to have meant this: '"some difference in some meanings of some words [theories] have in common" is the most I ever have intended to claim' (in Suppe ([1977], p. 506). Yet it must be said that this was far from obvious in the original discussion in his [1970a].

'when paradigms change, the world itself changes with them' (111), and 'after a revolution scientists work in a different world' (135). Although the image of 'world-change' is usually qualified in some way, it suggests that the transition between incommensurable paradigms is a transition from the 'world' of one paradigm to the 'world' of another.

Often, such remarks are meant only to emphasize the influence of conceptual framework on perception, as in this comment on the failure to derive Newton's laws from Einstein's:

> the transition from Newtonian to Einsteinian mechanics illustrates with particular clarity the scientific revolution as a displacement of the conceptual network through which scientists view the world. (102)

At other times, Kuhn intends the difference to go beyond difference of perception:

> paradigm changes do cause scientists to see the world of their research-engagement differently. In so far as their only recourse to that world is through what they see and do, we may want to say that after a revolution scientists are responding to a different world. (111)
>
> in the absence of some recourse to that hypothetical fixed nature that he "saw differently," the principle of economy will urge us to say that after discovering oxygen Lavoisier worked in a different world. (118)

In such passages, Kuhn seems inclined to view the world independent of scientific belief and perception as dispensable.

Kuhn wishes to say that incommensurable paradigms present scientists with different 'visual gestalts' of the same world (*cf.* 111–2). And he insists that 'though the world does not change with change of paradigm, the scientist afterward works in a different world' (121). Yet his tendency to dispense with the world beyond the perceptual and epistemic states of the scientist strongly suggests that there is nothing over and above the 'world' presented by the gestalt of a paradigm, or at least that the world in itself is of no relevance to science. The tension between admitting an independent reality and discarding it is never clearly resolved in Kuhn's original account, and has resulted in the widespread impression that his version of incommensurability involves some form of idealism.[9]

[9] For the charge of idealism see Scheffler ([1967], p. 19); the issue is discussed at length in Nola [1980]. There is, however, strong textual evidence to show that Kuhn is not an idealist who rejects the existence of a reality independent of theory. As a number of authors have pointed out, Kuhn operates with a distinction between the changeable world of theory, and nature or the environment which remains stable between theories ([1970a], pp. 111–2, 114, 125); see Brown ([1983a], pp. 19–20 and [1983b], p. 97), Devitt ([1984], p. 132) and Mandelbaum ([1982], pp. 50–2). Yet this does not rule out a weaker form of idealism which contrasts the reality independent of theory with the changing and constructed reality experienced by the scientist; see Hoyningen-Huene [1989].

However, the 'world-change' image may also be interpreted in a weaker sense as expressing a thesis about reference. It may be taken as the idea that there is a major difference in reference between paradigms. This interpretation is suggested by Kuhn's previously quoted discussion of Newtonian and Einsteinian concepts (101–2). In that passage Kuhn asserts that 'the physical referents of these Einsteinian concepts are by no means identical with those of the Newtonian concepts that bear the same name'. And he remarks that 'Newtonian mass is conserved; Einsteinian is convertible with energy', which suggests that the terms for mass in the two theories do not have the same reference. In the light of such remarks, the 'world-change' image may be taken to mean that in the transition between incommensurable paradigms there is a wholesale change in what is referred to. Thus, talk of the 'world' of a theory may be construed as talk about the set of entities to whose existence the theory is committed and to which its terms purportedly refer.

In sum, not even the conceptual component of Kuhn's original diffuse notion of incommensurability admits of unified analysis. Paradigms which are incommensurable due to conceptual variance are not derivable from one another; in some sense, they may even be about different worlds; or perhaps they simply fail to have common reference. These disparate elements begin to coalesce during Kuhn's transitional phase, which we will now consider.

3 THE TRANSITIONAL PHASE

In subsequent development of his views, three general points emerge as basic to Kuhn's position. First, direct comparison of theories requires their formulation in a common language: 'The point-by-point comparison of two successive theories demands a language into which at least the empirical consequences of both can be translated without loss or change' ([1970b], p. 266). Second, no such common language is available: 'There is no neutral language into which both of the theories as well as the relevant data may be translated for purposes of comparison' ([1979], p. 416). Third, exact translation between the languages of theories is impossible: 'translation of one theory into the language of another depends . . . upon compromises . . . whence incommensurability' ([1976], p. 191). Thus, in clarifying incommensurability, the issue of translation failure between theories becomes the dominant theme.

Reflection on translation has led Kuhn to draw a connection between incommensurability and Quine's thesis of the indeterminacy of translation.[10]

[10] Kuhn points to a parallel between incommensurability and translational indeterminacy on several occasions: e.g. ([1970a], p. 202), ([1970b], p. 268) and ([1976], p. 191). Later, however, he distinguishes the two notions sharply ([1983], pp. 679–81); see also ([1989], p. 11).

Quine's thesis, in brief, is that 'manuals for translating one language into another can be set up in divergent ways, all compatible with the totality of speech dispositions, yet incompatible with one another' ([1960], p. 27). The thesis stems from a behaviourist critique of meaning: Quine holds that verbal behaviour leaves meaning indeterminate; and he denies that there are facts about meaning beyond what is evident in such behaviour. The key to the thesis is an indeterminacy in the reference of sortal predicates, as illustrated by Quine's imagined native word 'gavagai' ([1960], p. 52). Quine argues that the reference of 'gavagai' is inscrutable: ostension does not determine whether it refers to rabbits, rabbit-stages, or undetached rabbit parts ([1969], p. 30), while the translation of the native 'individuative apparatus' needed for fine discrimination of reference is also indeterminate ([1969], p. 33). Inscrutability of reference renders the translation of sentences containing such terms indeterminate.

At times Kuhn draws support from the indeterminacy thesis. In arguing that translation 'always involves compromises', Kuhn cites Quine's discussion of indeterminacy as evidence that 'it is today a deep and open question what a perfect translation would be and how nearly an actual translation can approach the ideal' ([1970b], p. 268). He appeals to Quine's 'gavagai' example to indicate the epistemological difficulties of translating a language with different concepts:

> Quine points out that, though the linguist engaged in radical translation can readily discover that his native informant utters 'Gavagai' because he has seen a rabbit, it is more difficult to discover how 'Gavagai' should be translated . . . Evidence relevant to choice among [] alternatives will emerge from further investigation, and the result will be a reasonable analytic hypothesis . . . But it will be only a hypothesis . . . [T]he result of any error may be later difficulties in communication; when it occurs, it will be far from clear whether the problem is with translation and, if so, where the root difficulty lies. ([1970b], p. 268)

At a later stage, however, Kuhn seeks to distance his position from Quine's. In the following passage he explains how his views on reference and translation diverge from those of Quine:

> Unlike Quine, I do not believe that reference in natural or scientific languages is ultimately inscrutable, only that it is very difficult to discover and that one may never be absolutely certain one has succeeded. But identifying reference in a foreign language is not equivalent to producing a systematic translation manual for that language. Reference and translation are two problems, not one, and the two will not be resolved together. Translation always and necessarily involves imperfection and compromise; the best compromise for one purpose may not be the best for another; the able translator, moving through a single text, does not proceed fully systematically, but must repeatedly shift his choice of word and phrase, depending on which aspect of the original it seems most important to preserve. ([1976], p. 191)

As opposed to Quine, Kuhn holds that while it may be determined what the terms of another language or theory refer to, they may prove not to be translatable in a faithful or uniform manner.

Kuhn's appeal to Quine is somewhat misleading, since it tends to suggest that incommensurability is a form of the indeterminacy of translation. For Quine, translation is indeterminate in the sense that there is no fact of the matter about how to translate from one language into another: indeterminacy means no sense can be made of correct translation. Kuhn's claim that translation involves compromise and imperfection runs counter to indeterminacy since it presupposes that, at least in principle, correct translation is possible: translation is only compromised if there is something to be right about.[11] As will become clear in the sequel, for Kuhn incommensurability implies failure of exact translation between theories: terms of one theory have meaning which cannot be expressed within the language of another theory. As such, the claim of incommensurability denies translation in a manner which is impossible if translation is indeterminate in Quine's sense.

Despite treating translation as the basic issue, Kuhn does not provide a detailed analysis of translation failure between theories during this transitional period. What little he does say amounts at most to a general indication of the cause and extent of such failure. Kuhn explains that translation is problematic, 'whether between theories or languages', because 'languages cut up the world in different ways' ([1970b], p. 268). Theories employ different systems of 'ontological categories' ([1970b], p. 270) in order to classify the objects in their domain of application. In the transition between theories classificatory schemes change:

> One aspect of every revolution is, then, that some of the similarity relations change. Objects which were grouped in the same set before are grouped in different sets afterwards and vice versa. Think of the sun, moon, Mars, and earth before and after Copernicus; of free fall, pendular, and planetary motion before and after Galileo; or of salts, alloys, and a sulphur-iron filing mix before and after Dalton. Since most objects within even the altered sets continue to be grouped together, the names of the sets are generally preserved. ([1970b], p. 275)

Such categorical change involves change in the meaning, and even the reference,[12] of the retained terms:

> In the transition from one theory to the next words change their meanings or

[11] Admittedly, if there is a choice between incorrect translations, one might say that translation is indeterminate. But for Quine indeterminacy implies a choice between equally good translations, not a choice between equally bad ones. His point is that there are numerous translations consistent with the linguistic evidence, not that there are none. For a full discussion of the contrast between Quinean indeterminacy and Kuhnian incommensurability, see my [1991].

[12] For change of reference, cf. Kuhn's remarks that 'the line separating the referents of the terms 'mixture' and 'compound' shifted; alloys were compound before Dalton, mixtures after' ([1970b], p. 269).

> conditions of applicability in subtle ways. Though most of the same signs are used before and after a revolution—e.g. force, mass, element, compound, cell—the ways in which some of them attach to nature has somehow changed. Successive theories are thus [ ] incommensurable. ([1970b], p. 267)

Since it is only some of the 'similarity-sets' that change, and only some terms 'attach to nature' differently, the translation failure resulting from such conceptual change is of limited scope.[13]

Apart from the claim that translation between theories involves compromise and imperfection, Kuhn does little at this stage to clarify the semantical aspects of such translation failure. On occasion Kuhn oversimplifies the issue by writing as if change in meaning of retained terms were in itself sufficient for untranslatability. In the preceding quotation, for example, Kuhn's inference from change of meaning to incommensurability is direct and without qualification. Elsewhere he claims that scientists who 'perceive the same situation differently' while using common vocabulary 'must be using words differently', and hence speak from 'incommensurable viewpoints' ([1970a], p. 200). Such a pattern of inference suggests that assigning different meanings to old terms is all that is required for incommensurability to occur.

But this makes the connection between change of meaning and incommensurability too direct. If incommensurability involves failure to translate from one theory into another, mere change in the meaning assigned to shared words does not in itself suffice for incommensurability. The point is simply that a vocabulary can undergo change of meaning without necessarily resulting in failure to translate. For one thing, such a change in the meaning of words can occur in a trivial manner: words may have their meanings switched around. A fixed stock of meanings may be reassigned to different terms of a given vocabulary without leading to translation failure between the alternative interpretations of the vocabulary.

Less trivially, single words with identical meanings are unnecessary for translation: translation need not be word-for-word. Even if there are terms in one language not matched by individual words the same in meaning in the other language, it may still be possible to translate them by combinations of terms, or phrases, of the other language. Hence a change in the meaning of some of the terms which are retained between theories need not lead to an inability to translate from the language of one theory into that of another.

The general point is that what is needed for translation failure is something more than mere change of meaning. At the very least, Kuhn's claim of partial

[13] Hoyningen-Huene [1990] emphasizes Kuhn's [1977a] account of the acquisition of similarity-sets from exemplars in his discussion of Kuhnian incommensurability. But this emphasis is misplaced: *that* similarity-sets vary explains translation failure between theories; *how* they are learned does not affect the issue.

translation failure requires an inability on the part of some theory to define terms which are employed within another theory.[14]

A further source of unclarity is Kuhn's treatment of the relation between translation and comparison of content. As we noted earlier, Kuhn takes 'point-by-point comparison' of theories to require formulation in a common language ([1970b], p. 266). And he takes incommensurability to imply that theories are unable to be compared in such a manner:

> In applying the term 'incommensurability' to theories, I had intended only to insist that there was no common language within which both could be fully expressed and which could therefore be used in a point-by-point comparison between them. ([1976], p. 191)

Yet Kuhn also denies that incommensurability is to be construed as incomparability:

> Most readers [ ] have supposed that when I spoke of theories as incommensurable, I meant that they could not be compared. But 'incommensurability' is a term borrowed from mathematics, and it there has no such implication. The hypotenuse of an isosceles right triangle is incommensurable with its side, but the two can be compared to any required degree of precision. What is lacking is not comparability but a unit of length in terms of which both can be measured directly and exactly. ([1976], p. 191)

This is puzzling, for it raises the question of how the content of theories inexpressible in a common language can be compared, if not in point-by-point manner.[15]

However, while denying comparison in a common language, Kuhn notes that 'comparing theories . . . demands only the identification of reference' ([1976], p. 191), and that 'systematic theory comparison requires determination of the referents of incommensurable terms' ([1976], p. 198, fn. 11). Although he fails to elaborate, Kuhn is implicitly contrasting 'point-by-point' comparison with comparison by means of reference. He does not explain what 'point-by-point' comparison is, but he seems to be operating with a distinction between direct comparison of statements expressed in a common vocabulary and comparison of statements with different meaning by means of overlapping reference.

More specifically, two theories which share a common vocabulary invariant

[14] The point that more than conceptual difference is required for incommensurability is made with reference to Kuhn by Feyerabend ([1981e], p. 154, n. 54).

[15] Siegel points out that Kuhn's remarks appear self-contradictory: 'unless there is a substantive difference between "comparison" and "point-by-point" comparison, Kuhn is saying that incommensurable paradigms can be compared, but not compared "point-by-point". This is equivalent to saying that they can be compared, but not compared, which does little to illuminate Kuhn's position' ([1987], p. 61). Siegel is right that Kuhn's discussion is imperspicuous. Yet he seemingly overlooks the 'substantial difference' provided by Kuhn's explicit mention of comparison by means of reference (see next paragraph in the text).

in meaning may diverge simply with respect to the truth-values they assign to a common set of statements. Such theories may be compared 'point-by-point' in the sense that one theory asserts precisely the same statement that the other denies. By contrast, theories expressed in vocabulary which is variant with respect to meaning may still be compared by means of overlapping reference. Such theories do not assert or deny a common set of statements. But even if their statements do not have the same meaning, they may be compared if the constituent terms of their statements have the same reference. Such a comparison fails to be 'point-by-point' because it does not consist in pairing a statement asserted by one theory with its denial drawn from another theory. It may also fail to be 'point-by-point' in another sense: since not all terms of one theory need co-refer with terms of the other, not all statements of the theories may be brought into conflict by means of relations of co-reference.[16]

To conclude discussion of Kuhn's middle period, recall the disparate elements of his original position mentioned earlier. Kuhn's original conception involved failure of derivation, 'world-change' and wholesale change of reference. The picture which emerges from this transitional phase combines these elements in more coherent fashion. It remains the case that the central statements of a theory are not entailed by a theory with which it is incommensurable. But given Kuhn's restriction of change of meaning and reference to only some of a theory's terms, it follows that incommensurable theories share a modicum of semantically invariant vocabulary. As a result, there is neither complete change of reference, nor is the world independent of theory subject to change. Thus, Kuhn's 'world-change' image may be interpreted as change in the basic 'ontological categories' which different theories impose upon the world.[17]

4 KUHN'S LATER POSITION

Incommensurability, as portrayed during Kuhn's middle period, involves partial translation failure between theories committed to different basic categories. Though such broad features of Kuhn's position subsequently remain unaltered, the details are refined in more recent work, especially his [1983]. Kuhn's later position is characterized by a more nuanced account of translation failure and its connection with categorical change.

In his [1983] Kuhn outlines a notion of 'local incommensurability' which

[16] Kuhn's remarks about reference indicate acceptance on his part of the point, originally made in this context by Scheffler [1967], that reference suffices for comparison. This is further apparent in Kuhn ([1979], pp. 412, 417) where, with some reservation, he endorses the causal theory of reference as a 'technique for tracing continuities between successive theories and [ ] for revealing the nature of the differences between them' ([1979], pp. 416–17).

[17] *Cf.* Hacking [1979] and Hoyningen-Huene [1990].

he claims to have been his original idea.[18] Local incommensurability consists in failure to translate between localized clusters of interdefined terms:

> The claim that two theories are incommensurable is [] the claim that there is no language, neutral or otherwise, into which both theories, conceived as sets of sentences, can be translated without residue or loss . . . Most of the terms common to the two theories function the same way in both; their meanings, whatever they may be, are preserved; their translation is simply homophonic. Only for a small subgroup of (usually interdefined) terms and for sentences containing them do problems of translatability arise. ([1983], pp. 670–1)

So construed, incommensurability is a limited inability to translate from a local subgroup of terms of one theory into another local subgroup of terms of another theory. As such, language peripheral to the non-intertranslatable subgroups of terms constitutes semantic common ground between incommensurable theories. Hence, as Kuhn admits ([1983], p. 671), at least part of the content of such theories may be directly compared.

Kuhn continues to link translation failure closely with change of classification, maintaining, as previously, that the membership classes of certain key categories are altered in the transition between incommensurable theories. Since the categories are interrelated, such changes are not isolated, but have a holistic effect:

> What characterizes revolutions is [ ] change in several of the taxonomic categories prerequisite to scientific descriptions and generalizations. That change, furthermore, is an adjustment not only of criteria relevant to categorization, but also of the way in which given objects and situations are distributed among pre-existing categories. Since such redistribution always involves more than one category and since those categories are interdefined, this sort of alteration is necessarily holistic. ([1981], p. 25)

Kuhn explains, in his ([1983], pp. 682–3), that languages and theories deploy sets of 'taxonomic categories' constitutive of 'taxonomic structures'. In translating between them, it is necessary to preserve categories; and, because of the interconnection of categories, intertranslatable languages must have the same taxonomic structure. Translation problems arise because 'different languages [and theories] impose different structures on the world' (682); for translation to succeed, 'taxonomy must [ ] be preserved to provide both shared categories and shared relationships between them' (683).

The holistic nature of category change is directly reflected in translation failure: the interconnection of categories is paralleled by the interdefinition of concepts. Kuhn illustrates this with examples, arguing, for instance, that while much language used in phlogistic chemistry is subsequently retained, 'a small

[18] Kuhn notes that 'the claim that two theories are incommensurable is more modest than many of its critics have supposed', and says that 'insofar as incommensurability was a claim about language, about meaning change, its local form is my original version' ([1983], p. 671).

group of terms remains for which the modern chemical vocabulary offers no equivalent' ([1983], p. 675). The residual terms, which include 'phlogiston' and its cognates, as well as 'element' and 'principle', constitute an interdefined cluster not definable within later theory. While Kuhn grants that various applications of such terms may be specified in the language of modern theory, he denies that translation is possible:

> Among the phrases which describe how the referents of the term 'phlogiston' are picked out are a number that include other untranslatable terms like 'principle' and 'element'. Together with 'phlogiston', they constitute an interrelated or interdefined set that must be acquired together, as a whole, before any of them can be used, applied to natural phenomena. Only after they have been thus acquired can one recognize eighteenth-century chemistry for what it was, a discipline that differed from its twentieth-century successor not simply in what it had to say about individual substances and processes but in the way it structured and parceled out a large part of the chemical world. ([1983], p. 676)

Translation between such local complexes of terms fails because the meaning of such terms is determined in relation to other terms of the interdefined set. Terms which are defined within an integrated set of concepts cannot be translated in piecemeal fashion into an alternative complex in which the necessary conceptual relations do not obtain.

The notion of a localized translation failure between interdefined sets of terms is the central feature of Kuhn's later account of incommensurability and the most significant refinement of his position. As we saw earlier, the thesis of local incommensurability was neither developed in detail nor clearly evident in Kuhn's original discussion of the issue. While the local thesis is suggested obliquely during his middle period, explicit development of the local version constitutes a further step in the process of clarification and refinement which Kuhn's account of incommensurability has undergone.

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