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Commensurability, Comparability, Communicability[1]

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Twenty years have passed since Paul Feyerabend and I first used in print a term we had borrowed from mathematics to describe the relationship between successive scientific theories. 'Incommensurability' was the term; each of us was led to it by problems we had encountered in interpreting scientific texts (Feyerabend 1962; Kuhn 1962).[2] My use of the term was broader than his; his claims for the phenomenon were more sweeping than mine; but our overlap at that time was substantial.[3] Each of us was centrally concerned to show that the meanings of scientific terms and concepts -- 'force' and 'mass', for example, or 'element' and 'compound' -- often changed with the theory in which they were deployed.[4] And each of us claimed that when such changes occurred, it was impossible to define all the terms of one theory in the vocabulary of the other. The latter claim we independently embodied in talk about the incommensurability of scientific theories.

All that was in 1962. Since then problems of meaning variance have been widely discussed, but virtually no-one has fully faced the difficulties that led Feyerabend and me to speak of incommensurability. Doubtless, that neglect is due in part to the role played by intuition and metaphor in our initial presentations. I, for example, made much use of the double sense, visual and conceptual, of the verb 'to see', and I repeatedly likened theory-changes to Gestalt switches. But for whatever reasons, the concept of incommensurability has been widely and often dismissed, most recently in a book published late last year by Hilary Putnam (1981, pp. 113-124). Putnam redevelops cogently two lines of criticism that had figured widely in earlier philosophical literature. A brief restatement of those criticisms here should prepare the way for some extended comments.

Most or all discussions of incommensurability have depended upon the literally correct but regularly over-interpreted assumption that, if two theories are incommensurable, they must be stated in mutually

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untranslatable languages. If that is so, a first line of criticism runs, if there is no way in which the two can be stated in a single language, then they cannot be compared, and no arguments from evidence can be relevant to the choice between them. Talk about differences and comparisons presupposes that some ground is shared, and that is what proponents of incommensurability, who often do talk of comparisons, have seemed to deny. At these points their talk is necessarily incoherent. (For this line of criticism see: Davidson 1974, pp. 5-20; Shapere 1966; and Scheffler 1967, pp. 81-83.) A second line of criticism cuts at least as deep. People like Kuhn, it is said, tell us that it is impossible to translate old theories into a modern language. But they then proceed to do exactly that, reconstructing Aristotle's or Newton's or Lavoisier's or Maxwell's theory without departing from the language they and we speak every day. What can they mean, under these circumstances, when they speak about incommensurability? (For this line of criticism see: Davidson 1974, pp. 17-20; Kitcher 1978; and Putnam 1981.)

My concerns in this paper arise primarily from the second of these lines of argument, but the two are not independent, and I shall need also to speak of the first. With it I begin, attempting first to set aside some widespread misunderstanding of at least my own point of view. Even with misunderstanding eliminated, however, a damaging residue of the first line of criticism will remain. To it I shall return only at the end of this paper.

1. Local Incommensurability

Remember briefly where the term 'incommensurability' came from. The hypotenuse of an isosceles right triangle is incommensurable with its side or the circumference of a circle with its radius in the sense that there is no unit of length contained without residue an integral number of times in each member of the pair. There is thus no common measure. But lack of a common measure does not make comparison impossible. On the contrary, incommensurable magnitudes can be compared to any required degree of approximation. Demonstrating that this could be done and how to do it were among the splendid achievements of Greek mathematics. But that achievement was possible only because, from the start, most geometric techniques applied without change to both of the items between which comparison was sought.

Applied to the conceptual vocabulary deployed in and around a scientific theory, the term 'incommensurability' functions metaphorically. The phrase 'no common measure' becomes 'no common language'. The claim that two theories are incommensurable is then 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. No more in its metaphorical than its literal form does incommensurability imply incomparability, and for much the same reason. Most of the terms common to the two theories function the same way in both; their meanings, whatever those 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. The claim that two theories are incommensurable is more modest than many of its critics have supposed.

I shall call this modest version of incommensurability 'local incommensurability'. Insofar as incommensurability was a claim about language, about meaning change, its local form is my original version. If it can be consistently maintained, then the first line of criticism directed at incommensurability must fail. The terms that preserve their meanings across a theory change provide a sufficient basis for the discussion of differences and for comparisons relevant to theory choice.[5] They even provide, as we shall see, a basis from which the meanings of incommensurable terms can be explored.

It is not clear, however, that incommensurability can be restricted to a local region. In the present state of the theory of meaning, the distinction between terms that change meaning and those that preserve it is at best difficult to explicate or apply. Meanings are a historical product, and they inevitably change over time with changes in the demands on the terms that bear them. It is simply implausible that some terms should change meaning when transferred to a new theory without infecting the terms transferred with them. Far from supplying a solution, the phrase 'meaning invariance' may supply only a new home for the problems presented by the concept of incommensurability. This difficulty is real, no product of misunderstanding. I shall be returning to it at the end of this paper, and it will then appear that 'meaning' is not the rubric under which incommensurability is best discussed. But no more suitable alternative is presently at hand. In search of one, I now turn to the second main line of criticism directed regularly at incommensurability. It survives the return to the original local version of that notion.

2. Translation versus Interpretation

If any non-vacuous terms of an older theory elude translation into the language of its successor, how can historians and other analysts succeed so well in reconstructing or interpreting that older theory, including the use and function of those very terms? Historians claim to be able to produce successful interpretations. So, in a closely related enterprise, do anthropologists. I shall here simply premise that their claims are justified, that there are no limits of principle on the extent to which those criteria can be fulfilled. Whether or not correct, as I think they are, these assumptions are, in any case, fundamental to the arguments directed at incommensurability by such critics as Davidson (1974, p. 19), Kitcher (1978, pp. 519-529), and Putnam (1981, p. 116). All three sketch the technique of interpretation; all describe its outcome as a translation or a translation schema; and all conclude that its success is incompatible with even local incommensurability. As I now try to show what is the matter with their argument, I come to the central concerns of this paper.

The argument or argument sketch I have just supplied depends

critically upon the equation of interpretation with translation. That equation is traceable at least to Quine's Word and Object. I believe it is wrong and that the mistake is important. My claim is that interpretation, a process about which I shall be having more to say, is not the same as translation, at least not as translation has been conceived in much recent philosophy. The confusion is easy because actual translation often or perhaps always involves at least a small interpretive component. But in that case actual translation must be seen to involve two distinguishable processes. Recent analytic philosophy has concentrated exclusively on one and conflated the other with it. To avoid confusion I shall here follow recent usage and apply 'translation' to the first of these processes, 'interpretation' to the second. But so long as the existence of two processes is recognized, nothing in my argument depends upon preserving the term 'translation' for the first.

For present purposes, then, translation is something done by a person who knows two languages. Confronted with a text, written or oral, in one of these languages, the translator systematically substitutes words or strings of words in the other language for words or strings of words in the text in such a way as to produce an equivalent text in the other language. What it is to be an "equivalent text" can, for the moment, remain unspecified. Sameness of meaning and sameness of reference are both obvious desiderata, but I do not yet invoke them. Let us simply say that the translated text tells more or less the same story, presents more or less the same ideas, or describes more or less the same situation as the text of which it is a translation.

Two features of translation thus conceived require special emphasis. First, the language into which the translation is cast existed before the translation was begun. The fact of translation has not, that is, changed the meanings of words or phrases. It may, of course, have increased the number of known referents of a given term, but it has not altered the way in which those referents, new and old, are determined. A second feature is closely related. The translation consists exclusively of words and phrases that replace (not necessarily one-for-one) words and phrases in the original. Glosses and translators' prefaces are not part of the translation, and a perfect translation would have no need for them. If they are nonetheless required, we shall need to ask why. Doubtless, these features of translation seem idealizations, and they surely are. But the idealization is not mine. Among other sources, both derive directly from the nature and function of a Quinean translation manual.

Turn now to interpretation. It is an enterprise practiced by historians and anthropologists, among others. Unlike the translator, the interpreter may initially command only a single language. At the start, the text on which he or she works consists in whole or in part of unintelligible noises or inscriptions. Quine's "radical translator" is in fact an interpreter, and 'Gavagai' exemplifies the unintelligible material he starts from. Observing behavior and the

circumstances surrounding the production of the text, and assuming throughout that good sense can be made of apparently linguistic behavior, the interpreter seeks that sense, strives to invent hypotheses, like 'Gavagai' means "Lo, a rabbit," which make utterance or inscription intelligible. If the interpreter succeeds, what he or she has in the first instance done is learn a new language, perhaps the language in which 'gavagai' is a term, or perhaps an earlier version of the interpreter's own language, one in which still current terms like 'force' and 'mass' or 'element' and 'compound' functioned differently. Whether that language can be translated into the one with which the interpreter began is an open question. Acquiring a new language is not the same as translating from it into one's own. Success with the first does not imply success with the second.

It is with respect to just these problems that Quine's examples are consistently misleading, for they conflate interpretation and translation. To interpret the utterance 'Gavagai', Quine's imagined anthropologist need not come from a speech community that knows of rabbits and possesses a word which refers to them. Rather than finding a term that corresponds to 'gavagai', the interpreter/anthropologist could acquire the native's term much as, at an earlier stage, some terms of his or her own language were acquired.[6] The anthropologist or interpreter, that is, can and often does learn to recognize the creatures that evoke 'gavagai' from natives. Rather than translate, the interpreter can simply learn the animal and use the natives' term for it.

The availability of that alternative does not, of course, preclude translation. The interpreter may not, for reasons previously explained, merely introduce the term 'gavagai' into his or her own language, say English. That would be to alter English and the result would not be translation. But the interpeter can attempt to describe in English the referents of the term 'gavagai' -- they are furry, long-eared, bushy-tailed, and the like. If the description is successful, if it fits all and only creatures that elicit utterances involving 'gavagai', then 'furry, long-eared, bushy-tailed . . . creature' is the sought-after translation, and 'gavagai' can thereafter be introduced into English as an abbreviation for it.[7] Under these circumstances, no issue of incommensurability arises.

But these circumstances need not obtain. There need be no English description coreferential with the native term 'gavagai'. In learning to recognize gavagais, the interpreter may have learned to recognize distinguishing features unknown to English speakers and for which English supplies no descriptive terminology. Perhaps, that is, the natives structure the animal world differently from the way English speakers do, using different discriminations in doing so. Under those circumstances, 'gavagai' remains an irreducibly native term, not translatable into English. Though English speakers may learn to use the term, they speak the native language when they do so. Those are the circumstances for which I would reserve the term 'incommensurability'.

3. Reference Determination versus Translation

My claim, then, has been that circumstances of this sort are regularly encountered, if not always recognized, by historians of science attempting to understand out-of-date scientific texts. The phlogiston theory has provided one of my standard examples, and Philip Kitcher has used it as the basis for a penetrating critique of the whole notion of incommensurability. What is currently at issue will be considerably clarified if I first exhibit the kernel of that critique and then indicate the point at which I think it goes astray.

Kitcher argues, successfully I think, that the language of twentieth-century chemistry can be used to identify referents of the terms and expressions of eighteenth-century chemistry, at least to the extent that those terms and expressions actually refer. Reading a text by, say, Priestley and thinking of the experiments he describes in modern terms, one can see that 'dephlogisticated air' sometimes refers to oxygen itself, sometimes to an oxygen enriched atmosphere. 'Phlogisticated air' is regularly air from which oxygen has been removed. The expression 'α is richer in phlogiston than β' is coreferential with 'α has a greater affinity for oxygen than β'. In some contexts, for example in the expression 'phlogiston is emitted during combustion', the term 'phlogiston' does not refer at all, but there are other contexts in which it refers to hydrogen (Kitcher 1978, pp. 531-536).

I have no doubt that historians dealing with old scientific texts can and must use modern language to identify referents of out-of-date terms. Like the native's pointing to gavagais, these reference-determinations often provide the concrete examples from which historians may hope to learn what the problematical expressions in their texts mean. In addition, the introduction of modern terminology makes it possible to explain why and in what areas older theories were successful.[8] Kitcher, however, describes this process of reference-determination as translation, and he suggests that its availability should bring talk of incommensurability to a close. In both these respects he seems to me mistaken.

Think for a moment of what a text translated by Kitcher's techniques would look like. How, for example, would non-referring occurrences of 'phlogiston' be rendered? One possibility -- suggested both by Kitcher's silence on the subject and by his concern to preserve truth-values, which are in these places problematic -- would be to leave the corresponding spaces blank. To leave blanks is, however, to fail as a translator. If only referring expressions possess translations, then no work of fiction could be translated at all, and for present purposes, old scientific texts must be treated with at least the courtesy normally extended to works of fiction. They report what scientists of the past believed, independent of its truth-value, and that is what a translation must communicate.

Alternatively, Kitcher might use the same context-dependent strategy he developed for referring terms like 'dephlogisticated air'.

'Phlogiston' would then sometimes be rendered as 'substance released from burning bodies', sometimes as 'metallizing principle', and sometimes by still other locutions. This strategy, however, also leads to disaster, not only with terms like 'phlogiston' but with referring expressions as well. Use of a single word 'phlogiston', together with compounds like 'phlogisticated air' derived from it, is one of the ways by which the original text communicated the beliefs of its author. Substituting unrelated or differently related expressions for those related, sometimes identical terms of the original must at least suppress those beliefs leaving the text that results incoherent. Examining a Kitcher translation, one would repeatedly be at a loss to understand why those sentences were juxtaposed in a single text.[9]

To see more clearly what is involved in dealing with out-of-date texts, consider the following epitome of some central aspects of the phlogiston theory. For the sake of clarity and brevity, I have constructed it myself, but it could, style aside, have been drawn from an eighteenth-century chemical manual.

> All physical bodies are composed of chemical elements and principles, the latter endowing the former with special properties. Among the elements are the earths and airs, and among the principles is phlogiston. One set of earths, for example, carbon and sulphur, are, in their normal state, especially rich in phlogiston and leave an acid residue when deprived of it. Another set, the calxes or ores, are normally poor in phlogiston, and they become lustrous, ductile, and good heat conductors -- thus metallic -- when impregnated with it. Transfer of phlogiston to air occurs during combustion and such related processes as respiration and calcination. Air of which the phlogistic content has been thus increased (phlogisticated air) has reduced elasticity and reduced ability to support life. Air from which part of the normal phlogistic component has been removed (dephlogisticated air) supports life especially energetically.

The manual continues from here, but this excerpt will serve for the whole.

My constructed epitome consists of sentences from phlogistic chemistry. Most of the words in those sentences appear in both eighteenth-century and twentieth-century chemical texts, and they function in the same way in both. A few other terms in such texts, most notably 'phlogistication', 'dephlogistication', and their relatives, can be replaced by phrases in which only the term 'phlogiston' is foreign to modern chemistry. But after all such replacements are completed, a small group of terms remains for which the modern chemical vocabulary offers no equivalent. Some have vanished from the language of chemistry entirely, 'phlogiston' being the presently most obvious example. Others, like the term 'principle', have lost all purely chemical significance. (The imperative "purify your reactants" is a chemical

principle in a sense very different from that in which phlogiston was one.) Still other terms, 'element' for example, remain central to the chemical vocabulary, and they inherit some functions from their older homonyms. But terms like 'principle', previously learned with them, have disappeared from modern texts, and with them has gone the previously constitutive generalization that qualities like color and elasticity provide direct evidence concerning chemical composition. As a result, the referents of these surviving terms as well as the criteria for identifying them are now drastically and systematically altered. In both respects, the term 'element' in eighteenth-century chemistry functioned as much like the modern phrase 'state-of-aggregation' as like the modern term 'element'.

Whether or not these terms from eighteenth-century chemistry refer -- terms like 'phlogiston', 'principle', and 'element' -- they are not eliminable from any text that purports to be a translation of a phlogistic original. At the very least they must serve as place-holders for the interrelated sets of properties which permit the identification of the putative referents of these interrelated terms. To be coherent a text that deploys the phlogiston theory must represent the stuff given off in combustion as a chemical principle, the same one that renders the air unfit to breathe and that also, when abstracted from an appropriate material, leaves an acid residue. But if these terms are not eliminable, they seem also not to be replaceable individually by some set of modern words or phrases. And if that is the case, a point to be considered at once, then the constructed passage in which those terms appeared above cannot be a translation, at least not in the sense of that term standard in recent philosophy.

4. The Historian as Interpreter and Language Teacher

Can it, however, be correct to assert that eighteenth-century chemical terms like 'phlogiston' are untranslatable? I have, after all, already described in modern language a number of ways in which the older term 'phlogiston' refers. Phlogiston is, for example, given off in combustion; it reduces the elasticity and life-supporting properties of air; and so on. It appears that modern-language phrases like these might be compounded to produce a modern-language translation of 'phlogiston'. But they cannot. 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 inter-defined set that must be acquired together, as a whole, before any of them can be used, applied to natural phenomena.[10] 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.

A more restricted example will clarify my point. In learning Newtonian mechanics, the terms 'mass' and 'force' must be acquired

together, and Newton's Second Law must play a role in their acquisition. One cannot, that is, learn 'mass' and 'force' independently and then empirically discover that force equals mass times acceleration. Nor can one first learn 'mass' (or 'force') and then use it to define 'force' (or 'mass') with the aid of the Second Law. Instead, all three must be learned together, parts of a whole new (but not a wholly new) way of doing mechanics. That point is unfortunately obscured by standard formalizations. In formalizing mechanics one may select either 'mass' or 'force' as primitive and then introduce the other as a defined term. But that formalization supplies no information about how either the primitive or the defined terms attach to nature, how the forces and masses are picked out in actual physical situations. Though 'force', say, may be a primitive in some particular formalization of mechanics, one cannot learn to recognize forces without simultaneously learning to pick out masses and without recourse to the Second Law. That is why Newtonian 'force' and 'mass' are not translatable into the language of a physical theory (Aristotelian or Einsteinian, for example) in which Newton's version of the Second Law does not apply. To learn any one of these three ways of doing mechanics, the interrelated terms in some local part of the web of language must be learned or relearned together and then laid down on nature whole. They cannot simply be rendered individually by translation.

How, then, can a historian who teaches or writes about the phlogiston theory communicate his results at all? What is it that occurs when the historian presents to readers a group of sentences like those about phlogiston in the epitome above? The answer to that question varies with the audience, and I begin with the one presently most relevant. It consists of people without any sort of previous exposure to the phlogiston theory. To them the historian is describing the world in which the phlogistic chemist of the eighteenth century believed. Simultaneously, he or she is teaching the language which eighteenth-century chemists used in describing, explaining, and exploring that world. Most of the words in that older language are identical both in form and function with words in the language of the historian and the historian's audience. But others are new and must be learned or relearned. These are the untranslatable terms for which the historian or some predecessor has had to discover or invent meanings in order to render intelligible the texts on which he works. Interpretation is the process by which the use of those terms is discovered, and it has been much discussed recently under the rubric hermeneutics.[11] Once it has been completed and the words acquired, the historian uses them in his own work and teaches them to others. The question of translation simply does not arise.

All this applies, I suggest, when passages like the one emphasized above are presented to an audience that knows nothing of the phlogiston theory. For that audience these passages are glosses on phlogistic texts, intended to teach them the language in which such texts are written and the way they are to be read. But such texts are also encountered by people who have already learned to read them, people for whom they are simply one more example of an already familiar type. These are the people to whom such texts will seem merely translations,

or perhaps merely texts, for they have forgotten that they had to learn a special language before they could read them. The mistake is an easy one. The language they learned largely overlapped the native language they had learned before. But it differed from their native language in part by enrichment, e.g., the introduction of terms like 'phlogiston', and in part by the introduction of systematically transformed uses of terms like 'principle' and 'element'. In their unrevised native language, these texts could not have been rendered.

Though the point requires far more discussion than can be attempted here, much of what I have been saying is neatly captured by the form of Ramsey sentences. The existentially quantified variables with which such sentences begin can be seen as what I previously called "placeholders" for terms requiring interpretation, e.g., 'phlogiston', 'principle', and 'element'. Together with its logical consequences, the Ramsey sentence itself is then a compendium of the clues available to an interpreter, clues that, in practice, he or she would have to discover through extended exploration of texts. That, I think, is the proper way to understand the plausibility of the technique introduced by David Lewis for defining theoretical terms through Ramsey sentences (Lewis 1970, 1972). Like contextual definitions, which they closely resemble, and like ostensive definitions as well, Lewis's Ramsey-definitions schematize an important (perhaps essential) mode of language learning. But the sense of 'definition' involved is in all three cases metaphorical or at least extended. None of these three sorts of "definitions" will support substitution: Ramsey sentences cannot be used for translation.

With this last point, of course, Lewis disagrees. This is not the place to respond to the details of his case, many of them technical, but two lines of criticism may at least be indicated. Lewis's Ramsey-definitions determine reference only on the assumption that the corresponding Ramsey sentence is uniquely realizable. It is questionable whether that assumption ever holds and unlikely that it holds regularly. When and if it does, furthermore, the definitions it makes possible are uninformative. If there is one and only one referential realization of a given Ramsey sentence, a person may of course hope simply by trial and error to hit upon it. But having hit upon the referent of a Ramsey-defined term at one point in a text would be of no help in finding the referent of that term on its next occurrence. The force of Lewis's argument depends therefore on his further claim that Ramsey definitions determine not only reference but also sense, and this part of his case encounters difficulties closely related to but even more severe than the ones just outlined.

Even if Ramsey definitions escaped these difficulties, another major set would remain. I have previously pointed out (Kuhn 1970, pp. 188f.) that the laws of a scientific theory, unlike the axioms of a mathematical system, are only law sketches in that their symbolic formalizations depend upon the problem to which they are applied. That point has since been considerably extended by Joseph Sneed and Wolfgang Stegmüller who consider Ramsey sentences and show that their

standard sentential formulation varies from one range of applications to the next (Sneed 1971, Stegmüller 1973). Most occurrences of new or problematic terms in a science text are, however, within applications, and the corresponding Ramsey sentences are simply not a rich enough source of clues to block a multitude of trivial interpretations. To permit reasonable interpretation of a text studded with Ramsey definitions, readers would have first to collect a variety of different ranges of application. And having done so they would still have to do what the historian/interpreter attempts in the same situation. They would, that is, have to invent and test hypotheses about the sense of the terms introduced by Ramsey definitions.

5. The Quinean Translation Manual

Most of the difficulties I have been considering derive more or less directly from a tradition which holds that translation can be construed in purely referential terms. I have been insisting that it cannot, and my arguments have at least implied that something from the realm of meanings, intensionalities, concepts must be invoked as well. To make those points I have considered an example from history of science, an example of the sort that brought me to the problem of incommensurability and thence to translation in the first place. The same sorts of points can, however, be made directly from recent discussions of referential semantics and related discussions of translation. Here I shall consider the single example to which I alluded at the start: Quine's conception of a translation manual. Such a manual -- the end product of the efforts of a radical translator -- consists of parallel lists of words and phrases, one in the translator's own language, the other in the language of the tribe he is investigating. Each item on each list is linked to one or often to several items on the other, each link specifying a word or phrase in one language that can, the translator supposes, be substituted in appropriate contexts for the linked word or phrase in the other. Where the linkages are one-many, the manual includes specifications of the contexts in which each of the various links is to be preferred (Quine 1960, pp. 27, 68-82).

The network of difficulties I want to isolate concerns the last of these components of the manual, the context specifiers. Consider the French word '*pompe*'. In some contexts (typically those involving ceremonies) its English equivalent is 'pomp'; in other contexts (typically hydraulic), its equivalent is 'pump'. Both equivalents are precise. '*Pompe*' thus provides a typical example of ambiguity like the standard English example, 'bank': sometimes a riverside and sometimes a financial institution.

Now contrast the case of '*pompe*' with that of French words like '*esprit*' or '*doux*'/'*douce*'. '*Esprit*' can be replaced, depending on context, by such English terms as 'spirit', 'aptitude', 'mind', 'intelligence', 'judgment', 'wit', or 'attitude'. The latter, an adjective, can be applied, *inter alia*, to honey ('sweet'), to wool ('soft'), to underseasoned soup ('bland'), to a memory ('tender'), or to a slope or a wind ('gentle'). These are not cases of ambiguity,

but of conceptual disparity between French and English. Esprit and doux/douce are unitary concepts for French speakers, and English speakers as a group possess no equivalents. As a result, though the various translations offered above preserve truth-value in appropriate contexts, none of them is in any context intensionally precise. 'Esprit' and 'doux'/'douce' are thus examples of terms that can be translated only in part and by compromise. The translator's choice of a particular English word or phrase for one of them is ipso facto the choice of some aspects of the intension of the French term at the expense of others. Simultaneously it introduces intensional associations characteristic of English but foreign to the work being translated.[12] Quine's analysis of translation suffers badly, I think, from its inability to distinguish cases of this sort from straightforward ambiguity, from the case of terms like 'pompe'.

The difficulty is identical with the one encountered by Kitcher's translation of 'phlogiston'. By now its source must be obvious: a theory of translation based on an extensional semantics and therefore restricted to truth-value preservation or equivalent as a criterion of adequacy. Like 'phlogiston', 'element', and so on, both 'doux'/'douce' and 'esprit' belong to clusters of interrelated terms a number of which must be learned together and which, when learned, give a structure to some portion of the world of experience different from the one familiar to contemporary English speakers. Such words illustrate incommensurability between natural languages. In the case of 'doux'/'douce' the cluster includes, for example, 'mou'/'molle', a word closer than 'doux'/'douce' to English 'soft', but which applies also to warm damp weather. Or, in the cluster with 'esprit', consider 'disposition'. The latter overlaps 'esprit' in the area of attitudes and aptitudes, but also applies to state-of-health or to the arrangement of words within a phrase. These intensionalities are what a perfect translation would preserve, and that is why there can be no perfect translations. But approximating the unobtainable ideal remains a constraint on actual translations, and, if the constraint were taken into account, arguments for the indeterminacy of translation would require a form very different from that now current.

By treating the one-many linkages in his translation manuals as cases of ambiguity, Quine discards the intensional constraints on adequate translation. Simultaneously, he discards the primary clue to the discovery of how the words and phrases in other languages refer. Though one-many linkages are sometimes caused by ambiguity, they far more often provide evidence of which objects and situations are similar and which are different for speakers of the other language; they show, that is, how the other language structures the world. Their function is thus very much the same as that played by multiple observations in learning a first language. Just as the child learning 'dog' must be shown many different dogs and probably some cats as well, so the English speaker learning 'doux'/'douce' must observe it in many contexts and also take note of contexts where French employs 'mou'/'molle' instead. These are the ways, or some of them, by which one learns the techniques for attaching

words and phrases to nature, first those of one's own language and then, perhaps, the different ones embedded in other languages. By giving them up, Quine eliminates the very possibility of interpretation, and interpretation is, as I argued at the start, what his radical translator must do before translation can begin. Is it then a wonder that Quine discovers previously unanticipated difficulties about "translation"?

6. The Invariants of Translation

I turn finally to a problem that has been held at arm's length since the beginning of this paper: What is it that translation must preserve? Not merely reference, I have argued, for reference-preserving translations may be incoherent, impossible to understand while the terms they employ are taken in their usual sense. That description of the difficulty suggests an obvious solution: translations must preserve not only reference but also sense or intension. Under the rubric 'meaning invariance', that is the position I have taken in the past and that I adopted faute de mieux in the introduction to this paper. It is by no means merely wrong, but it is not quite right either, an equivocation symptomatic, I believe, of a deep duality in the concept of meaning. In another context it will be essential to confront that duality directly. Here I shall skirt it by avoiding talk of 'meaning' entirely. Instead I shall discuss, though as yet in quite general, quasi-metaphorical terms, how members of a language community pick out the referents of the terms they employ.

Consider the following thought experiment which some of you will have encountered previously as a joke. A mother first tells her daughter the story of Adam and Eve, then shows the child a picture of the pair in the Garden of Eden. The child looks, frowns in puzzlement, and says, "Mother, tell me which is which. I would know if they had their clothes on." Even in so condensed a format, this story underscores two obvious characteristics of language. In matching terms with their referents, one may legitimately make use of anything one knows or believes about those referents. Two people may, moreover, speak the same language and nevertheless use different criteria in picking out the referents of its terms. An observer aware of their differences would simply conclude that the two differed in what they knew about the objects under discussion. That different people use different criteria in identifying the referents of shared terms may, I think, safely be taken for granted. I shall posit, in addition, the now widely shared thesis that none of the criteria used in reference determination are merely conventional, associated simply by definition with the terms they help to characterize.[13]

How can it be, though, that people whose criteria are different so regularly pick out the same referents for their terms? A first answer is straightforward. Their language is adapted to the social and natural world in which they live, and that world does not present the sorts of objects and situations which would, by exploiting their

criterial differences, lead them to make different identifications. That answer, in turn, raises a further and more difficult question: what is it that determines the adequacy of the sets of criteria a speaker employs when applying language to the world which that language describes? What must speakers with disparate reference-determining criteria share in order that they be speakers of the same language, members of the same language community?[14]

Members of the same language community are members of a common culture, and each may therefore expect to be presented with the same range of objects and situations. If they are to co-refer, each must associate each individual term with a set of criteria sufficient to distinguish its referents from other sorts of objects or situations which the community's world actually presents, though not from still other objects that are merely imaginable. The ability to identify correctly the members of one set often therefore requires a knowledge of contrast sets as well. Some years ago, for example, I suggested that learning to identify geese may also require knowing such creatures as ducks and swans (Kuhn 1974). The cluster of criteria adequate to the identification of geese depends, I indicated, not only on the characteristics shared by actual geese, but also on the characteristics of certain other creatures in the world inhabited by geese and those who talk about them. Few referring terms or expressions are learned in isolation either from the world or from each other.

This very partial model of the way speakers match language with the world is intended to reintroduce two closely related themes that have emerged repeatedly in this paper. The first, of course, is the essential role of sets of terms that must be learned together by those raised inside a culture, scientific or other, and which foreigners encountering that culture must consider together during interpretation. That is the holistic element which entered this paper at the start, with local incommensurability, and the basis for it should now be clear. If different speakers using different criteria succeed in picking out the same referents for the same terms, contrast sets must have played a role in determining the criteria each associates with individual terms. At least they must when, as is usual, those criteria do not themselves constitute necessary and sufficient conditions for reference. Under these circumstances, some sort of local holism must be an essential feature of language.

These remarks may also provide a basis for my second recurrent theme, the reiterated assertion that different languages impose different structures on the world. Imagine, for a moment, that for each individual a referring term is a node in a lexical network from which radiate labels for the criteria that he or she uses in identifying the referents of the nodal term. Those criteria will tie some terms together and distance them from others, thus building a multi-dimensional structure within the lexicon. That structure mirrors aspects of the structure of the world which the lexicon can be used to describe, and it simultaneously limits the phenomena that

can be described with the lexicon's aid. If anomalous phenomena nevertheless arise, their description (perhaps even their recognition) will require altering some part of the language, changing the previously constitutive linkages between terms.

Note, now, that homologous structures, structures mirroring the same world, may be fashioned using different sets of criterial linkages. What such homologous structures preserve, bare of criterial labels, is the taxonomic categories of the world and the similarity/difference relationships between them. Though I here verge on metaphor, my direction should be clear. What members of a language community share is homology of lexical structure. Their criteria need not be the same, for those they can learn from each other as needed. But their taxonomic structures must match, for where structure is different, the world is different, language is private, and communication ceases until one party acquires the language of the other.

By now it must be clear where, in my view, the invariants of translation are to be sought. Unlike two members of the same language community, speakers of mutually translatable languages need not share terms: 'Rad' is not 'wheel'. But the referring expressions of one language must be matchable to coreferential expressions in the other, and the lexical structures employed by speakers of the languages must be the same, not only within each language but also from one language to the other. Taxonomy must, in short, be preserved to provide both shared categories and shared relationships between them. Where it is not, translation is impossible, an outcome precisely illustrated by Kitcher's valiant attempt to fit the phlogiston theory to the taxonomy of modern chemistry.

Translation is, of course, only the first resort of those who seek comprehension. Communication can be established in its absence. But where translation is not feasible, the very different processes of interpretation and language acquisition are required. These processes are not arcane. Historians, anthropologists, and perhaps small children engage in them every day. But they are not well understood, and their comprehension is likely to require the attention of a wider philosophical circle than the one currently engaged with them. Upon that expansion of attention depends an understanding, not only of translation and its limitations, but also of conceptual change. It is no accident that the synchronic analysis of Quine's Word and Object is introduced by the diachronic epigraph of Neurath's boat.

Notes

[1]Since this paper was first drafted, many people have contributed to its improvement, among them colleagues at M.I.T. and auditors at the P.S.A. meeting and at the Columbia seminar in History and Philosophy of Science where a preliminary version was first tried out. I am grateful to all of them, above all to Ned Block, Paul Horwich, Nathaniel Kuhn, Stephen Stich, and my two official commentators.

[2]I believe that Feyerabend's and my resort to 'incommensurability' was independent, and I have an uncertain memory of Paul's finding it in a draft manuscript of mine and telling me he too had been using it. Passages illustrating our early usages are: Kuhn (1970, pp. 102f., 112, 128f., 148-151, all unchanged from the first (1962) edition) and Feyerabend (1962, pp. 56-59, 74-76, 81).

[3]Both Feyerabend and I wrote of the impossibility of defining the terms of one theory on the basis of the terms of the other. But he restricted incommensurability to language; I spoke also of differences in "methods, problem-field, and standards of solution" (Kuhn 1970, p. 103), something I would no longer do except to the considerable extent that the latter differences are necessary consequences of the language-learning process. Feyerabend (1962, p. 59), on the other hand, wrote that "it is possible neither to define the primitive terms of T' on the basis of the primitive terms of T nor to establish correct empirical relations involving both these terms." I made no use of a notion of primitive terms and restricted incommensurability to a few specific terms.

[4]This point had been previously emphasized in Hanson (1958).

[5]Note that these terms are not theory independent but are simply used in the same way within the two theories at issue. It follows that testing is a process that compares two theories, not one that can evaluate theories one at a time.

[6]Quine notes that his radical translator might choose the "costly" way and "learn the language direct as an infant might." But he takes this process to be simply an alternate route to the same end as those reached by his standard means, that end being a translation manual (Quine 1960, pp. 47, 70f).

[7]Some would object that a string like 'furry, long-eared, bushy-tailed . . . creature' is too long and complex to count as a translation of a single term in another language. But I incline to the view that any term which can be introduced by a string can be internalized so that, with practice, its referents can be recognized directly. In any case, I am concerned with a stronger version of untranslatability, one in which not even long strings are available.

[8]Kitcher supposes that his translation techniques permit him to specify which statements of the older theory were true, which false. Thus statements about the substance released on combustion were false but statements about the effect of dephlogisticated air on vital activities were true because in those statements 'dephlogisticated air' referred to oxygen. I think, however, that Kitcher is only using modern theory to explain why some statements made by practitioners of the older theory were confirmed by experience, others not. The ability to explain such successes and failures is basic to the historian of science's interpretation of texts. (If an interpretation attributes to the author of a text repeated assertions which easily available observations would have infirmed, then the interpretation is almost certainly wrong, and the historian must go to work again. For an example of what may then be required, see Kuhn (1964) in Kuhn (1977).) But neither interpretation nor Kitcher's translation techniques allow individual sentences containing terms from the older theory to be declared true or false. Theories are, I believe, structures that must be evaluated as wholes.

[9]Kitcher, of course, does explain these juxtapositions by referring to the beliefs of the author of the text and to modern theory. But the passages in which he does this are glosses, not parts of his translation at all.

[10]Perhaps only 'element' and 'principle' have to be learned together. Once they have been learned, but only then, 'phlogiston' could be introduced as a principle that behaved in certain specified ways.

[11]To the sense of 'hermeneutic' I have in mind (there are others) the most useful introduction is Taylor (1971). Taylor, however, takes for granted that the descriptive language of the natural sciences (and the behavioral language of the social sciences) is fixed and neutral. A useful corrective from within the hermeneutic tradition is provided by Apel (1972). Both are conveniently reprinted in Dallmayr and McCarthy (1977), an anthology useful also for other aspects of the hermeneutic tradition.

[12]Glosses which describe how the French view the psychic (or the sensory) world can be of great help with this problem, and French language textbooks usually include material on such cultural matters. But glosses describing the culture are not parts of the translation itself. Long English paraphrases for French terms provide no substitute, partly because of their clumsiness but mostly because terms like '_esprit_' or '_doux_'/'_douce_' are items in a vocabulary certain parts of which must be learned together. The argument is the same as the one given previously for 'element' and 'principle' or 'force' and 'mass'.

[13]Two points must be underscored. First, I am not equating meaning with a set of criteria. Second, 'criteria' is to be understood in a very broad sense, one that embraces whatever techniques, not all

of them necessarily conscious, people do use in pinning words to the world. In particular, as used here, 'criteria' can certainly include similarity to paradigmatic examples (but then the relevant similarity relation must be known) or recourse to experts (but then speakers must know how to find the relevant experts).

[14] I have found no brief way to discuss this topic without seeming to imply that criteria are somehow logically and psychologically prior to the objects and situations for which they are criterial. But, in fact, I think both must be learned and that they are often learned together. For example, the presence of masses and forces is criterial for what I might call the 'Newtonian-mechanics-situation', one to which Newton's Second Law applies. But one can learn to recognize mass and force only within the Newtonian-mechanical-situation, and vice-versa.

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