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INTERPRETATION OF 'THE FACTS' IN THE LIGHT OF THEORY

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Popper claims that the statement 'Here is a glass of water' (hereafter referred to as 'S') is theoretical rather than observational[1]. Similarly for 'glass' and 'water' which he calls 'universal terms'. These are alleged to be dispositional terms and consequently are theoretical rather than observational[2]. From this Popper argues that the observational/theoretical distinction fails to make any real distinction since all terms and statements are theoretical to some degree or other. The least theoretical are those terms and statements which we might have, misleadingly, thought to be observational. The task of this paper will be to evaluate the claim that statements like S, and the terms they contain, are theoretical. One consequence Popper draws from this is the somewhat metaphorical claim : 'For even ordinary singular statements [such as S] are always *interpretations of 'the facts' in the light of theories.*'[3] This is a persistent theme in Popper, the precise import of which needs careful examination.

I

To begin with, consider the various claims Popper makes about the words 'glass' and 'water' :

(i) By the word 'glass', for example, we denote physical bodies which exhibit a certain *law-like behaviour*, and the same holds for the word 'water'[4].

(ii) ... the use of universals such as 'glass' or 'water', in a statement like 'here is a glass of water', necessarily transcends experience. It is due to the fact that words like 'glass' or 'water' are used to

characterize the *law-like behaviour* of certain things; which may be expressed by calling them 'dispositional words'[5].

(iii) ...singular statements transcend experience because the universal terms which normally occur in them entail dispositions to behave in a law-like manner, so that they entail universal laws (of some lower order of universality, as a rule)[6].

Popper casts some of his reasons for claiming the above in an epistemological mode when he says that in the application of universal terms, such as 'water' or 'glass', we transcend either the experience we currently have when looking at a nearby glass of water, or, more strongly, we transcend both current and non-current experience. If the point here is that current experience, and perhaps non-current experience as well, do not fully determine the classificatory schema of our concepts (or of our language) with which we describe that experience, then Popper is making a point at least as old as Plato[7] and perhaps one with which we could concur. If the observational/theoretical distinction is applied to words and sentences and is drawn in terms of what is and what is not fully determined by experience then, given the above point, all words and sentences are theoretical. There would then be no interest in such a distinction one part of which is empty. Much hinges on what is meant by 'determined' in the above, but an investigation of the issues raised by this epistemological argument is not part of the present paper.

We can also approach the issues raised in the above three quotations from the point of view of a theory of meaning for universal terms. Popper generally eschews any discussion of meaning. However, his account of universal terms does presuppose a view about their meaning not explicitly mentioned by him, namely, the Fregean distinction between reference or extension (Bedeutung) and sense or intension (Sinn).

Popper has often insisted that '...while theories and the problems connected with their truth are all-important, words and the problems connected with their meaning are unimportant'[8]. But he does not always disparage word-meanings and admits, albeit reluctantly, '...that there may be meanings of the word "meaning" such that the meaning of a theory depends entirely on that of the words used in a very explicit formulation of the theory.'[9] Frege's sense might fill such a role, Popper suggests. Elsewhere he openly embraces word-meanings. In section 4 of 'Three Views Concerning

Human Knowledge' Popper discusses an argument for instrumentalism by employing a distinction between kinds of word meaning. Non-dispositional terms are said to have descriptive meaning while dispositional terms also have instrumental meaning, a kind of meaning which '... exhausts itself in the permission or licence [it] gives us to draw inferences or to argue from some matters of fact to other matters of fact'.[10] In his essay on Carnap, 'The Demarcation Between Science and Metaphysics', he commits himself to Fregean senses : '... every scientific language must make use of *genuine universals*, i.e. of words, whether defined or undefined, with an indeterminate extension, though perhaps with a reasonably definite intensional 'meaning'.'[11] So, a theory of word-meaning, despite disclaimers to the contrary, is not without significance for Popper. In fact, a Frege-like theory is central to some of his arguments as will be shown.

In quotations (i), (ii) and (iii) above the terms 'glass' and 'water' are said to *denote* bodies which exhibit law-like behaviour, to *characterize* the law-like behaviour of these bodies, and to *entail* the laws which govern the law-like behaviour exhibited by these bodies. Applying Frege's distinction we can recast these claims in the following way. According to the first, each term refers to, or has in its extension, bodies which, we discover, behave in a law-like manner. Popper gives no examples of these laws; perhaps one might be that water quenches thirst. In the case of 'water' let us simply indicate the laws governing this behaviour by the set (L_1, L_2, ..., L_n). Nothing need be said yet about whether these laws are "observational" or theoretical. According to the second and third claims, the sense of each term is given by its entailments; in the case of 'water' the sense is given by the conjunction '$L_1 . L_2 ... L_n$'. Since on Frege's view sense determines reference, then not only does the set of laws give the sense for a term but it also fixes its reference or extension; what goes into the extension is whatever obeys these laws.

In the above quotations it is said that the universal terms themselves entail these laws and not the sentences in which they occur. This seems odd because entailment is a relation which properly holds between sentences (or, if you prefer, statements or propositions). Perhaps we could explicate Popper's claim that the term 'water' has entailments in the following way. If each of the L_i is of the form '$F_i x \supset G_i x$' (where '$\supset$' expresses a law-like connection) and '$\rightarrow$' stands for entailment, then :

$$(x)\ ([x \text{ is water}] \rightarrow [(F_1x \supset G_1x).(F_2x \supset G_2x) \ldots (F_nx \supset G_nx)]).$$

We can say derivatively that these law entailments give us the Fregean sense that Popper alleges is expressed by the term 'water'.

What will not be denied is that terms like 'water' or 'glass' refer to, or have in their extension, bodies which exhibit law-like behaviour. Some of these laws we can come to know from ordinary observation. Others we may only come to know after detailed scientific experiment and development of theory concerning the fine structure of these bodies (e.g., the current theory of the molecular structure of glass and water). What will be denied is that

(I) these terms express a sense, and
(II) the sense is given by a set of laws, either of ordinary observation or of high-level theory.

If Popper holds (II), and it seems from the above that he does, then he is committed to an unacceptably strong *a priori* view of much of science that one would have thought was empirical. There would be no need for us to perform the labour of scientifically investigating bodies, such as water or glass, to arrive at the laws governing their behaviour; all we need to do is draw out the entailments contained in the senses expressed by the terms 'water' or 'glass'. This seems plainly wrong and perhaps something to which Popper would not want to be committed.

But that Popper is committed to such a strong position is indicated by the above three quotations and by the following remark about the word 'swan' : 'For by calling something a 'swan', we attribute to it properties which go far beyond mere observation — almost as far as when we assert that it is composed of 'corpuscles'[12]'. Perhaps with the qualification 'almost as far as' Popper balks at attributing a corpuscularian view of bodies to any successful referer to swans. Clearly no such view is entailed by calling something a 'swan'. If it were, nobody ignorant of such theories, or holding a theory inconsistent with corpuscularianism, could successfully refer to swans by the use of the word 'swan'. Rather, what we want to say is that through scientific investigation we have discovered that those things we have called 'swans' are corpuscularian in nature (supposing that our current corpuscularian theories are correct), but nobody referring to swans need have such theories as part of their intension of the word 'swan'. We need to keep distinct four items, namely,

the term, its extension, its intension, and the theory about the items in the extension. Perhaps some of these are related in some way. However, theory and intension can not be related in such a way that the intension entails those very theories that we have laboured scientifically to discover. This is to make claim (II) from which stems the unacceptable *a priori* view of much of science.

Unclarity about claim (II) and his theory of word-meaning leads Popper to make the following confused comment (which is directed against a certain Cornelius) on the definition of 'lead' :

> Thus according to the views of Cornelius... the statement, 'The melting point of lead is about 335° C' is part of the definition of the concept 'lead' (suggested by inductive experience) and cannot therefore be refuted. A substance otherwise resembling lead but with a different melting point would simply not be lead. But according to my view the statement of the melting point of lead is, *qua* scientific statement, synthetic. It asserts, among other things, that an element with a given atomic structure (atomic number 82) always has this melting point, whatever name we may give to this element[13].

Popper is correct about the synthetic character of the statement. But he immediately errs in precisely the same way of which he is critical in claiming that part of the *assertion* made is that lead is an element with such-and-such an atomic structure. This could only be the case if being an element with such-and-such an atomic structure is part of the sense expressed by 'lead'. But this is strongly counter-intuitive; if it were true, then we would have to attribute a great deal of scientific prescience to many users of the term 'lead'. Our term 'lead' may well refer to items which, if our current theories are correct, turn out to be an element with such-and-such an atomic structure. But 'lead' does not express this as its meaning. Once again, Popper is committed by his theory of meaning of universal terms to an *a priori* view of much of science that we would have otherwise thought empirical.

A similar view to the above is expressed by Popper in his 'Reply to My Critics', but the example is changed from the melting point of lead to the freezing point of water. Popper wishes to deny that 'water freezes at 0° C' is true by definition because he wants to admit the possibility of discovering water with a freezing point other than 0° C. Let us agree that Popper is correct on this. What he says

subsequent to this, however, raises problems about the meaning of 'water'.

> For let us assume we have discovered water with a different freezing point. Is this still to be called 'water' ? *I assert that the question is totally irrelevant.* The scientific hypothesis was that a liquid (no matter what you call it) with a considerable list of chemical and physical properties freezes at 0^{o} C. If any of these properties which have been conjectured to be constantly conjoined should not materialize then *we were wrong;* and thus *new and interesting problems open up.* The least of them is whether or not we should continue to call the liquid in question 'water' : *this* is purely arbitrary or conventional[14].

How is the transition made from 'water freezes at 0^{o} C' (call this 'p') to what is alleged to be the same scientific hypothesis 'a liquid with a considerable list of chemical and physical properties [call this list 'ø'] freezes at 0^{o} C' (call this 'q') ? The transition to q could be made by substituting in p the right-hand side of the following extensional equivalence : (x) (x is water ≡ x is a liquid with properties ø). This is not a definitional truth; it must be established empirically. Consequently, what is to count as water must be established independently of the properties mentioned on the right-hand side before we can check the truth of the equivalence. But how is water to be independently specified ? Regardless of what we call water, Popper gives no account of how our language latches onto the world in order that we may specify what it is that is alleged, on the basis of empirical research, to have the right-hand side properties.

The transition from p to q could be made in another way : substitute an expression with the same intension as 'water'. This might be what Popper intends because he does claim that q is the same scientific hypothesis as p. On this interpretation 'water' has an intension, viz., that intension expressed by 'whatever is a liquid and has ø'. Even though the use of the term 'water' is arbitrary and conventional in the sense that speakers could have used any other term, the intension expressed by whatever term we employ is not arbitrary or conventional.

The upshot of the above is that either Popper has not given us an account of how words like 'water' gain a purchase on the world independently of the empirical characteristics ø that we discover of whatever it is that the word 'water' has already picked out for us;

or Popper is commmitted to the view that 'water' has an intension given by the intension of some descriptive phrase such as 'is a liquid with properties ø'. This brings us back to questions of meaning that Popper eschews and we find that, in the absence of any other account of how words latch onto the world, Popper does fall back on a Frege-like position embodied in claim (II) as was pointed out above. In the second section of this paper an alternative to the Frege-like account which Popper seems to adopt is developed which in many respects fits Popper's general philosophical position better.

Claim (II) also leads us directly to the following two views of Popper : (i) all universal terms are dispositional; and following from this, (ii) no theoretical/observational distinction can be drawn for universal terms because all must be theoretical to some degree since they are dispositional[15]. (i) arises directly from claim (II) since the sense of universal terms is given by the set of laws which govern the behaviour of the items to which they refer. What is not disputed is that terms such as 'glass' and 'water' have in their respective extensions naturally occurring bits of stuff which, we have discovered, do exhibit law-like behaviour. But from this nothing follows about these terms being dispositional simply because what they have in their extension exhibits law-like behaviour. These terms do not even name dispositional properties of water or glass in virtue of which their law-like behaviour arises; other terms do that, e.g., in the case of glass, 'brittle', 'fragile', etc. 'Water', and 'glass', simply refer to water, and glass, and not the dispositional properties of these entities. If any argument is going to succeed in showing that these terms are dispositional then we must move up to the level of their intensions. If we can find grounds for rejecting the view that the intensions expressed by universal terms are given by the intensions expressed by law sentences (i.e. claim (II)), then we do not have to accept that these terms are dispositional. Consequently, there is no sound argument for their being theoretical. With this also goes the claim that sentence S is theoretical.

Recently, not only claim (II) about the sense expressed by such terms as 'glass', 'water' and 'swan' has been challenged, but also claim (I) that these terms have senses. Important arguments have been advanced by Kripke[16] to show that general terms which refer to natural kinds function more like proper names — they are rigid designators — and consequently lack a sense. Kripke's rejection of claim (I) will not be discussed here, but some consequences of his theory of names for claim (II) will be. What will be investigated is

whether on the Kripkean theory of general terms Popper's claims about the theoretical status of universal terms and singular sentences such as S can be sustained.

'Definitions' Popper tells us 'are dogmas; only the conclusions drawn from them can afford us any new insight'[17]. And only from the acceptability of these conclusions can we judge the acceptability of the definition. Let us apply this to the contrasting theories of the meaning of universal terms of Popper and Kripke. One unpalatable conclusion of the Popperian view already noted is that much of science turns out to be *a priori*. Another unpalatable conclusion is that there are no non-dispositional terms and thus no observational terms. Further unpalatable consequences also flow from Popper's seemingly exciting claim that facts are always interpretations in the light of theory. It will be shown in the next two sections that this claim follows directly from Popper's theory of universal terms and leads in turn to incommensurability and to referential relativity. If these three consequences are felt to be unpalatable, and Popper thinks that the third concerning incommensurability is, then these would be grounds for abandoning the Popperian view of universal terms for some other such as Kripke's.

II

The moral of the preceding section is that the following must be kept distinct: (i) the sense expressed by a term, (ii) the item the term refers to, or the items in its extension and (iii) our scientific theories (either current or earlier) of these items. Claim (II) connects all three. To sever the connection we need to investigate how the reference of terms like 'water' and 'glass'[18] is fixed, and show that laws and scientific theory play no role either in reference-fixing or in specifying senses. This is not to say that laws and theory may not play a role in any *tests* we may have devised to *tell* what is water, or glass. So, to the above three distinctions we can add another, viz., (iv) current test procedures for telling whether or not some item is glass or water. Ontological/semantic considerations of reference, extension and sense should be kept distinct from epistemological considerations concerning how we can tell whether something is glass, or water, or how good our current test procedures are.

To begin with let us see, very briefly, how Kripke envisages the way in which we fix the reference of a natural kind term such as 'water'[19]. The account has some admittedly artificial features but

is a significant departure from the way that has been suggested in the traditional accounts of Mill and Frege, and followed by Popper. For Kripke the characteristics we commonly associate with water do not fix the intension of 'water' but help us, on the whole correctly but not always, to tell what items are water. Kripke envisages a somewhat fictitious term introduction, or baptismal procedure, in which the word 'water' is introduced as the name of a specific kind of substance. Imagine a person, or a group of people, in the presence of a number of original samples, say, of rain, puddles, or streams. The term is introduced in the presence of these samples as the name of a natural kind of which they may be just a few instances. The extension of the term 'water' is also fixed when the name is introduced, its extension being those original samples and anything else of the very same kind. The amount of water that there is in the cosmos remains constant unless, of course, some of it is created or destroyed. It is all these bits of water that comprises the extension of the term 'water'. The term introduction procedure is, in effect, the naming of a natural kind in the presence of a few of its instances. No elaborate scientific theory need enter into this procedure when the term is introduced. However, *that* there is a kind of which the samples present are instances is presupposed. Whatever this presupposition involves, clearly no empirical scientific theory enters at this stage into *determining what* kind it is that is being referred to.

Given that a name for a naturally occurring kind of substance has been introduced in this way, how do those at the original naming ceremony extend the use of the term to other items not in the original sample, and how do we, not present at the original ceremony, tell whether any item is water ? Most members of the original speech community can determine quite quickly by observation whether or not items found elsewhere are like items in the original sample. On the whole, in the case of water, items of the same kind look, feel, smell and taste the same. They have the same properties of quenching thirst, dissolving salt, etc., etc. It is by these characteristics that other items can be recognized as being like those in the original sample and from which we can conclude that these items are of the same kind as the original sample. The term is transmitted throughout the community and down its history. Each of us was, at some time, shown what *for us* was an "original sample" and thus came to apply the term correctly to items generally recognized by our community to be water. We also came to hold the standard beliefs about the characteristics of water, both the

directly observable ones and those like thirst quenching.

But none of these characteristics fix the intension of 'water' even though they help us *tell* whether or not some item is water. We do not mean, for example, by 'water', 'that which quenches thirst'. First, this is not sufficient because many things that quench thirst need not be water. Secondly, water need not always be picked out by its thirst-quenching properties. Envisage a possible world slightly different from ours in which there is the very same water that there is in our world, in which we use the term 'water' to refer to it, but in which we are different creatures to the extent that we never experience thirst (perhaps we have no thirst sensations and have some other means that are not bodily sensations for detecting our need for water). Then we would refer to the very same water that we refer to now but would not mean by 'water' that it is that which quenches thirst. By this argument no law such as 'whatever is water quenches thirst' is entailed by the term 'water' contrary to such claims made by Popper, if this law is one of the laws that he thinks is entailed by the term. The common characteristics we associate with water may help us decide in most cases whether or not some item is water, but they do not give its sense. The argument employed here is modelled on similar arguments employed by Kripke to show that, for example, being yellow is not part of the sense of the term 'gold', or being four-legged is not part of the sense of 'tiger'.[20] The claim that water quenches thirst should not be elevated into the sense of the term 'water' but should be treated for what it is, namely a generalization about water which is contingent and empirically knowable, which is, on the whole, true of water and generally believed by most to be true of water.

The common characteristics just listed whereby we come to recognize items as water are added to with the growth of science. We now hold the highly theoretical belief that water is a collection of molecules of H_2O (give or take impurities in the water). But none of this science is needed to pick out the natural kind in the first place. Our present scientific theory is merely a set of beliefs we now hold about the nature of the kind, and, like all scientific beliefs, could be revised with the next important advance of science.

With the growth of science we could come to alter even our belief that water is a uniform substance. Such has been the case. With the discovery of isotopes it has been recognized since the 1930's that there are at least two kinds of water, "ordinary" water and "heavy" water (in fact there are eighteen possible distinct kinds

of isotope of H_2O). Scientists now hold that water is a mixture of distinct isotopes (ignoring other impurities in water at the micro-level) and not a uniform substance. How does this affect our presupposition, mentioned above, that in introducing the term 'water' we were referring to a distinct *kind* of stuff ? Should we conclude that because we now discover that water is not a uniform substance that no reference was fixed because there was no distinct kind to refer to ? Such questions put pressure on what role this presupposition plays in reference-fixing. This general question will not be pursued here. Considering the case of 'water' it would be distinctly odd to claim that the term lacks a reference because we discover that there are isotopes *of water*. Rather we should say that the very water we have always referred to by the term 'water' has been discovered, to our surprise perhaps, not to be a uniform substance at the micro-level. Thus scientific discovery can force us to change one of our quite central beliefs about water, namely the kind of thing it is, uniform substance or mixture. However, none of this constitutes a case for claiming either failure of reference of 'water' or failure of the presupposition in the original term introduction that a certain kind of thing exists and it is the kind being named via some of the instances. Since scientific theory plays no role in reference-fixing at this stage, no deep change in our theory can lead us to conclude that no reference had been originally fixed for 'water'.

However, situations may arise in which we can have serious doubts as to whether or not we have an item of a particular kind in front of us, and our common beliefs about that kind's characteristics are of no help in telling us. Consider the case of glass. Prior to the development of modern chemistry our ancestors probably had a number of rough and ready tests to determine whether or not something was glass. Their tests may have included the rather unspecific low-level dispositional, beloved by philosophers, that if a piece of glass were to be dropped in appropriate circumstances then it would shatter. A more likely practical test would be the use of certain materials in a controlled production process which was guaranteed to produce glass. But nowadays if we wish to tell whether or not some item is glass we can appeal to the analytic techniques of expert chemists and physicists who use the latest theories about the nature and properties of substances in their tests. Scientific theory is an evolving business. It may turn out that with the growth of scientific knowledge a change in our theory of glass could come about in which we are forced to revise a previous judgment as to whether

some item is, or is not, glass. Such a revision could even affect one of our most certain samples. The history of our various tests for glass may result in a large core of agreed items for all tests, but some items over which the various tests have disagreed. That we can make sense of the claim that our tests can agree or disagree over items of glass presupposes that the extension of 'glass' can be fixed in a manner independent of these tests. As has already been indicated in the case of 'water', the burden of fixing the reference of terms like 'glass' falls on the presupposition in the introduction of the term that it applies to items which are of the same kind. However, the presupposition that there is such a kind does not carry with it the means for telling whether or not some item is of that kind. This our ordinary beliefs about the kind will do for most everyday needs, and hopefully our developing scientific theory of the kind will do fully for difficult cases.

III

The upshot of the above is that our current theories of, and tests for, glass, or water, do not fix the extension of the terms 'glass', or 'water'. At best they help us resolve an epistemological problem by providing our best current means for *telling* whether some item is glass, or water. Our best current theories can be wrong and exclude some item that is the genuine thing, or include some item that is not, yet we remain ignorant of this until some new theory and test procedure comes along to tell us differently. Ultimately what we aim for is a scientific theory which holds true for all instances of the natural kind glass, or water.

There are further reasons why we should not insist on too close a link between sense, extension and theory. Consider once again the view that the sense of, say, 'water' is given by the laws governing the behaviour of water. Many of these laws will be couched in terms of the vocabulary of some special underlying theory of the fine structure of water and may well involve laws distinctive of this underlying theory (for example, some of the properties of water can only be explained by reference to the special laws of quantum mechanics). To illustrate this consider some of the theories of water that have been proposed in the history of science. Theory T_1 is due to Aristotle. The underlying theory is that water is a pure element which nevertheless comprises the two qualities cold and moist. Theory T_2 is due to the phlogiston theorists

Cavendish and Priestley. The underlying theory is that water is not an element but a compound of inflammable air and dephlogisticated air. They held that the phlogistication of dephlogisticated air yielded water. Essential to this theory is the belief in the existence of phlogiston and its role in chemical processes. Theory T_3 is due to Lavoisier and Dalton. The underlying theory is that water is a collection of molecules each of which comprises one atom of oxygen and two of hydrogen. (In all of the above we ignore the fact that water often contains impurities.) Each of these underlying theories will yield laws governing the behaviour of water couched in vocabulary peculiar to these theories.

We can now ask : what do each of these theorists mean, and what do they refer to, when they use the term 'water' ? If we continue to maintain that the sense of the term 'water' is given by its law entailments and these laws are couched in the vocabulary of the underlying theory, then clearly each theorist will express something different by the term. No Aristotelian will express the same sense as a phlogiston theorist and neither will express the same as a modern theorist when using the term 'water'. Nor will any person ignorant of all this theorising be able to use the term since he has not grasped the theory (which one ?) requisite for entertaining the sense of the term. Nor will any of these theoreticians express the same thought when they utter sentence S 'Here is a glass of water'. Their problems will be further compounded since the same applies to 'glass' as applies to 'water'. Denying that these terms have such law entailments would free us from these imagined communication difficulties.

What of extension ? Since sense determines extension these laws will also fix the extension of 'water' as whatever entities obey these laws as expressed in the vocabulary of some theory T. But each of the three theories T_1, T_2, T_3 will give rise to distinct laws and there is no guarantee that whatever entities satisfy the laws of one theory will be the same class of entities that satisfies the laws of another theory. Thus each of the three theories could well determine quite distinct extensions for 'water'. This certainly will be the case since we deny the existence of Aristotle's pair of qualities cold and moist, and deny the existence of phlogiston. Only a person wedded to the doctrine of incommensurability would be willing to hold that what Aristotle was talking about when he used the Greek word for water ($\upsilon\delta\omega\rho$), what Cavendish and Priestley were talking about when they used the term 'water', and what Lavoisier and Dalton

were talking about when they used the term 'water' (or 'eau'), were completely different things. Yet this is what must follow if T_1, T_2 and T_3 determine the extension of 'water'.

However, the extension of 'water' does not depend on the different theories mankind has produced at different times. That extension is constant unless, of course, some water is created or destroyed. Rather, the theory-independently specified water is what the various theories conjectured from Aristotle to our own time have been about. In the absence of the final correct theory of water we may wonder whether any item we have before us is water. We may turn the item over to expert analysts to carry out tests using the best current theory of water, the final judgment being open to revision if a subsequent and better theory determines differently. Thus there is a sharp division between semantic/ontological questions concerning the reference of terms such as 'glass' and 'water', and epistemological questions concerning whether or not an item is known to be glass or water. Our current science only plays a role concerning the second sort of question thereby leaving open the question that we do not want prematurely closed off, viz., is our theory true, or quite false, of water ?

Let us for the moment adopt Popper's view that the sense of a term such as 'water' is given by a set of law entailments (L_1, L_2, ..., L_n). Also suppose, despite what Popper says, that some theory/observation distinction can be drawn that distinguishes laws, such as water quenches thirst, from those laws which may be couched in the distinctive vocabulary of theories T_1, T_2 or T_3. The former are theory-independent, or observational, laws; the latter are theoretical laws. Suppose now that each law of the set of law entailments is observational. Then none of the above objections of the previous three paragraphs hold; the sense and reference of 'water' is invariant with respect to theories T_1, T_2 and T_3. All we are left to dispute is whether or not the sense of 'water' is given by such a set of theory-independent laws. It has been argued above that it cannot; at best these laws are merely true of what 'water' refers to.

Now take Popper at his word when he says that no theory/observation distinction can be drawn and that all universal terms are theoretical to some degree. This must mean *with respect to some particular theory*, for example, sufficiently different theories such as T_1, T_2, or T_3. Not all of the laws allegedly entailed by the term can now be theory independent. Some must depend on the particular theory adopted. So the term 'water' will entail a distinct set of laws

for each theory T_1, T_2 or T_3. Consequently the sense and reference of 'water' will be relative to the theoretical context in which it occurs. The difficulties which arise from such theory relativization mentioned in the paragraphs just above must now be squarely faced. That universal terms terms carry the baggage of some theory was already noted in section I. Terms such as 'swan' and 'lead' were alleged by Popper to be loaded with some part of the atomic theory of matter. The above theory relativization highlights this. It shows that the law entailments of universal terms will, in the absence of a theory/observation distinction, carry some of the burden of a special theory; hence the loading on 'swan' and 'lead'. However, such loading is not invariant with respect to a sufficiently deep change in theory; incommensurability manages to creep in from theory to theory.

This now brings us to a consideration of Popper's claim that even facts are interpretations in the light of theory. His full remarks to this effect are :

> 'For even ordinary singular statements are always *interpretations of 'the facts' in the light of theories.* (And the same holds even for 'the facts' of the case. They contain *universals;* and universals always entail a *law-like* behaviour.)[21]

Consider the fact that S, viz., here is a glass of water. The above quotation commits us to the quite strong claim that there are no facts which are independent of laws or theory and which might remain the same despite the different "interpretations" which might be given to them "in the light of" different theories. Consider a change in the theory of water from Aristotle's to our own in which the term 'water' has different law entailments. Then there will be a new interpretation of ... what fact ? We can not say the fact that there is a glass of water here, because this will not be the same fact when embedded in Aristotle's theory and in our own theory. The sentence expressing this fact 'Here is a glass of water' contains the term 'water' and this, it is alleged, entails sets of laws which will be different according to whether Aristotle's theory of water is adopted or our own. So the sentence 'Here is a glass of water' will express different facts with change in theoretical context because of the alleged differing entailments of the sentence due to its term 'water'. Presumably the same goes for the term 'glass' which would add to the differing entailments of 'Here is a glass of water' according to the theory of glass in which the sentence is embedded.

So the facts become the interpretations themselves[22]. But none

of this will follow if we admit that there is a theory-independent state of affairs (or a fact, but the word 'fact' has now been ruined) which can be expressed by the sentence 'Here is a glass of water'. We would need to strip this sentence of its law entailments allegedly due to the terms 'water' and 'glass'. On the Kripke account of reference-fixing 'water' and 'glass' are rigid designators and, lacking intensions, do not entail any laws. So 'Here is a glass of water' will entail no laws and can express theory-independent facts. Here is another argument which shows that even though 'water' and 'glass' denote bodies which exhibit law-like behaviour these terms should not be viewed as entailing the laws governing the behaviour.

Reasons have been given why statement S is not a theoretical statement based on considerations concerning the meaning of universal terms in S. But it does not follow that statement S should not be subject to test like any other statement. Perhaps what is in front of us looks like a glass container with water in it, perhaps it is not. Popper makes an important point when he suggests that statement S may have to be subject to considerable test using our current theories of water and glass before it can be accepted as a true statement. For it cannot be rigorously tested using observation (or sense-experience) alone, though in many normal situations this may be sufficient for the acceptance of its truth. If some other theory T (of, say, physics or molecular biology) is being tested and if glasses of water are involved in the experimental set up, or if basic statements such as S are involved in the test of theory T, then part of the assumed background beliefs will be the current theory of glass (G) and of water (W). If theory T and the background beliefs, G and W, get into difficulties then a situation could arise in which either G or W, or both, come into question rather than theory T under test. For example, the theory of glass or of water may be deficient to the extent of admitting a container of liquid into the experimental set up that was not real glass containing real water, and T in conjunctin with G and W leads to false predictions. Or G and W may be deficient in some respect concerning the properties of glasses containing water, and T, in conjunction with these false background theories, gives false predictions. In both cases the modus tollens of a false prediction can be directed against false background theories G and W rather than T. However, none of this is an argument for doubt about the reference of terms such as 'glass' or 'water'. Successful reference of these terms pre-dates, and will survive the demise of, our currently established theories of glass and water. But it is an

argument for the role our current theories play in settling serious doubts about whether or not we really have a glass of water in front of us. But that theories may be employed in testing statements like S should not lead us to conclude that they are theoretical.

The remark that statements like S are always 'interpretations of 'the facts' in the light of theory' needs careful handling. Not handled carefully we lose a grip on common-place facts, such as here is a glass of water, and end up with interpretations for which there are no facts of which they are interpretations. But all of this follows only if we accepted that terms like 'water' and 'glass' have law entailments. If we abandon this then we remove the threat of referential incommensurability for these terms from theory to theory; and we remove the threat of fact incommensurability which leaves us with just interpretations. This is not to say, however, that there may not be some other good sense in which we "interpret the facts in the light of theory". By adopting a theory of universal terms like Kripke's rather than that which seems to be implicit (and occasionally explicit) in what Popper says we are rescued from some rather unpalatable doctrines about science, doctrines with which Popper would not want to concur on other grounds.

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NOTES

[1] See Popper (1959), pp. 94–5 and pp. 424–5.

[2] For the arguments concerning this see Popper (1959), pp. 422–5 and Popper (1963), pp. 118–9.

[3] See Popper (1959), p. 423. Popper makes this claim quite often in his writings, for example, Popper (1959), p. 59 footnote, p. 107 footnote and in the various articles that comprise Popper (1963) e.g., p. 23, p. 38 footnote, p. 41 footnote, pp. 44–7, p. 187 and p. 387.

[4] Popper (1959), p. 95.

[5] Popper (1959), p. 424.

[6] Popper (1959), p. 425.

[7] *Theaetetus* 184B to 186E.

[8] P. 441, Addendum, 1968 to Popper (1959). The same view is repeated on p. 28 of Popper (1963), pp. 123—4 of Popper (1972) and pp. 14—18 of 'Karl Popper, Autobiography' in Schilpp (1974).

[9] Schilpp (1974), p. 17.

[10] Popper (1963), p. 109.

[11] Popper (1963), p. 262.

[12] Popper (1959), p. 423.

[13] Popper (1959), p. 79, footnote 2.

[14] Schilpp (1974), Vol. 2, p. 983.

[15] Popper claims that there is no dispositional/non-dispositional distinction either, and that all universal terms are dispositional to some degree. See Popper (1959), p. 425, and Popper (1963) pp. 118—9.

[16] Kripke (1972), especially Lecture III pp. 309—42.

[17] Popper (1959) p. 55, a quotation from Menger.

[18] In what follows it will be assumed that 'glass' and 'water' are used to refer to naturally occurring bits of stuff. However, the word 'glass' can be used to refer to an artifact which performs the function of containing a liquid such as water and which is of a certain shape. Such artifacts are normally made of glass but need not be even though we refer to them as glasses. In the context of sentence S the term 'glass' will be understood to refer to the naturally occurring stuff and not to the artifact. The statement expressed by 'S' could be more precisely expressed by the sentence: 'Here is an object made of glass which contains water'.

[19] For a much fuller account concerning the problems of term introduction see Kripke (1972), especially pp. 328—30.

[20] See Kripke (1972), pp. 314—9.

[21] Popper (1959), p. 423.

[22] Compare the remark of Nietzsche (1968), p. 267: 'I would say: ... facts is precisely what there is not, only interpretations.'

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