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Among philosophers of science, such writers as Hanson, Feyerabend and Kuhn have advanced revolutionary new views concerning the relation between theory and observation. What all these views have in common is that the observations that are supposed to confirm the theories are determined by the theories themselves, or as Feyerabend puts it, what is perceived depends upon what is believed.¹ This view that scientific theories determine how it is that things are perceived should be distinguished from the view that scientific theories determine the natures of the things observed. The distinction is important because while it is true that the ways in which we perceive things are affected to a considerable extent by our beliefs and inferences, and for that matter by our hopes and fears, it is not true that any of these affect the natures of what is observed, nor is it true that our perceptions do. It may be that the official position of these writers is to accept only the first of these propositions. Nevertheless, there is a tendency, as their language amply illustrates, to accept the second as well, and the acceptance of the second may result from a faulty analysis of what perception is.

I will try to locate some of the difficulties of this new way of looking at science by examining what Hanson has to say about the heliocentric-geocentric controversy in the first chapter of his book, *Patterns of Discovery*.² He imagines Tycho Brahe and Johannes Kepler sitting on a hill at dawn seeing the sun coming up in the east. He says that the two scientists see different things when they look from the same point in the same direction.³ Tycho sees the sun beginning its journey around the earth, while Kepler sees the horizon of the earth dipping away from the sun. Carl Kordig has attempted to summarize Hanson's argument.⁴ While I am not sure that Kordig's interpretation is correct, and it is likely that Hanson would not have approved of this way of putting his argument, the interpretation may nevertheless reveal some links in Hanson's thinking that led him to his conclusion. Other interpretations will be considered later, but Kordig's interpretation provides a good starting point for the discussion. The premises in Kordig's version of the argument are as follows:

- (1) Tycho sees the sun Tycho sees.
- (2) Kepler sees the sun Kepler sees.
- (3) If someone sees the Tycho sees, he sees that it is mobile.
- (4) If someone sees the sun Kepler sees, he sees that it is static.

From (1) and (3) Hanson is supposed to obtain

- (5) Tycho sees that the sun Tycho sees is mobile
- And from (2) and (4) Hanson is supposed to obtain
- (6) Kepler sees that the sun Kepler sees is static.
- Under the assumption that nothing that is static is mobile Hanson would obtain
- (7) Kepler sees that the sun Kepler sees is not mobile.
- Under the assumption that the same object cannot possess inconsistent properties, Hanson would then conclude from (5) and (7) that
- (8) The sun Tycho sees is not the sun Kepler sees.

Hanson may have believed, or may have believed at times, that seeing *x* as *p* entails seeing that *x* is *p*. The evidence is mixed. On the one hand he tells us that seeing contains two elements, seeing as and seeing that, and this recognition of two elements might suggest that seeing as is a necessary though insufficient condition for seeing.⁵ On the other hand, he gives examples which suggest that seeing as may be sufficient. One such example is the following: "Tycho and Simplicius see that *the universe is geocentric*; Kepler and Galileo see that it is *heliocentric*."⁶ What is common to the perceptions of Tycho and Simplicius, on the one hand, and Kepler and Galileo, on the other, is the seeing as component. Evidently seeing *x* as *p* is sufficient for seeing that *x* is *p*. Tycho and Simplicius see that the universe is geocentric because they see it as geocentric.

If Hanson believed, or sometimes believed, that seeing as entails seeing that, his line of reasoning might be captured in the argument that is given below. The argument is like Kordig's interpretation, except that it is more explicit. The premises of the argument are:

- (1) Tycho sees the sun Tycho sees.
- (2) Kepler sees the sun Kepler sees.
- (3) If someone sees the sun Tycho sees, he sees the sun Tycho sees as mobile.
- (4) If someone sees the sun Kepler sees, he sees the sun Kepler sees as not mobile.
- (5) If someone sees the sun Tycho sees as mobile, he sees that the sun Tycho sees is mobile.
- (6) If someone sees the sun Kepler sees as not mobile, he sees that the sun Kepler sees is not mobile.
- From (1) and (3) Hanson could obtain
- (7) Someone sees the sun Kepler sees as not mobile.
- From (5) and (7) Hanson could obtain
- (9) Someone sees that the sun Tycho sees is mobile.
- From (6) and (8) Hanson could obtain
- (10) Someone sees that the sun Kepler sees is not mobile.
- From (9) Hanson could get
- (11) The sun Tycho sees is mobile.

And from (10) Hanson could get

(12) The sun Kepler sees is not mobile.

Therefore

(13) The sun Tycho sees is not the sun Kepler sees.

This more explicit rendering of what might have been Hanson's line of thinking will be criticized in terms of the relations between seeing, seeing as and seeing that. The relations hold when "see" is used in its primary sense.

1. Seeing x entails x . A person does not see a skunk unless there is a skunk there to be seen.

2. Seeing x does not entail seeing x as p even if p is an essential characteristic of x . A person does not have to see a skunk as a skunk in order to see a skunk. If the animal is a skunk, then he sees a skunk even if he sees it as something else. Perhaps all seeing is seeing as, and it may even be the case that seeing x entails seeing x as something or other, but seeing x does not entail seeing x as any particular thing.

3. Seeing x does not entail seeing that x is p even if p is an essential characteristic of x . A first person utterance in the present tense by a person that he sees a skunk is a claim that the person sees that the animal is a skunk, but that fact merely serves to confuse the issue. There is not an entailment in either direction between the facts of seeing a skunk and claiming to see a skunk.

4. Seeing that x is p entails that x is p . If a person really does see that the animal is a skunk, then the animal is a skunk.

6. Seeing x as p does not entail that x is p and so does not entail seeing that x is p . Seeing x as p does, however, entail x , and under the assumption that x is seen as p because x is seen, seeing x as p will also entail seeing x . A person sees a skunk but sees it as a pussycat or that he sees that the skunk is a pussycat. On the other hand, the occurrence of this event does entail the existence of the skunk and the fact that he saw the skunk.

The logic of the primary use of "see" is very much like the logic of other perceptual verbs, except that the language employing these other verbs is much less developed. For example, a person hearing a police siren does not entail he thinks or knows that he is hearing a police siren. He may think he is hearing an ambulance siren when what he is really hearing is a police siren. "Hearing that as" is analogous to "seeing that as," but "hearing that" by itself, without the "as," is not analogous to "seeing that." Seeing that x is p entails x is p , but hearing that x is p does not entail that x is p . A man hearing that his wife has been cheating on him does not entail that she has. In general the word "hears" is much less entangled in our language with the words "thinks" and "knows" than is the word "sees," and "smells" is less entangled than "hears," though even with "smells" a residual confusion remains. The way the first person present works may cause someone to believe that there is an entailment relation in one direction or the other between the facts of smelling a skunk and claiming to smell a skunk, but there is not.

I turn now to a brief criticism of the argument adapted from Kordig that was intended to capture some of the links in Hanson's thinking. First, note the startling nature of the conclusion. If the conclusion is true, Tycho and Kepler have not been arguing about anything. If they are observing the same object, that object cannot be both mobile and static. But if they are observing different objects, one object may be static and the other mobile. Neither need be wrong.

The argument, however, though valid, is unsound. (1) and (2) are trivially true, but the other premises are false. The third premise is false. It is not true that if anyone sees the sun Tycho sees he sees the sun as mobile. Kepler sees the sun Tycho sees, but he does not see the sun as mobile. The singular conditional obtained from (3) by taking Tycho as the substitution instance is indeed true, but the conditional is not a logical truth. It does not follow from the fact that Tycho sees the sun he sees that Tycho sees the sun as mobile. The fourth premise is false. Tycho sees the sun Kepler sees, but he does not see it as static. On the other hand, the singular conditional obtained from (4) by taking Kepler as the substitution instance is true, but again it is not a logical truth. It does not follow from the fact that Kepler sees the sun he sees that he sees it as static. The fifth premise is false. Tycho sees the sun he sees, but he does not see that this sun is mobile. (6) is less obviously false (2) - (5), but even it is false if there is somebody who sees the sun as static but does not have good reasons for thinking so. The singular conditional obtained from (6) by taking Kepler as the substitution instance is true, but it is not a logical truth. Kepler may have been mistaken. Summing up, the faults in this line of reasoning are evident. No one would believe that (3) and (4) are true unless he mistakenly believed that Tycho's seeing the sun he saw entailed he saw it as mobile and Kepler's seeing the sun he saw entailed he saw it as static, and no one would accept (5) and (6) as true unless he mistakenly believed that Tycho's seeing the sun as mobile entailed that he saw that it was mobile and Kepler's seeing the sun as static entailed he saw that it was static.

Kordig and I could be accused of attacking a straw man, and perhaps we are. Hanson admits that in one sense, though not the important sense, Tycho and Kepler do see the same sun. When Hanson says that Tycho and Kepler do not see the same sun, he means that they do not see the same sun in the important sense of "see," but Kordig and I refuse to take his word in the sense intended. There is some excuse, though, for our stubbornness. "Seeing," "seeing as" and "seeing that" have several meanings and are ambiguous in certain contexts, but there does not seem to be any ambiguity in the sentence "Tycho and Kepler do not see the same sun." In one very clear sense of "see"—the primary sense of "see"—the sentence is false, and I do not see (in another meaning of "see") any sense in which the sentence is true. Difficulty may arise, however, in the *analysis* of the meaning of sentences of the form "A and B did not see the same thing," but the difficulty is more in the meaning

of "same" than it is in the meaning of "see." Hanson asks us to imagine that Tycho and Kepler are brought into a room in which they both see a lead cylinder. They are asked what they see. Tycho says that he sees a pipe, and Kepler says that he sees a telescope. Hanson reasons that since a pipe is not a telescope they did not see the same thing in the important sense of "see."⁷ Supposing that both reports are true and "same" is used in the sense of numerical identity, and unequivocal answer should be given to the question of whether or not Tycho and Kepler saw the same thing, and that answer is yes. The word "pipe" does not have the same meaning as the word "telescope," but unless being a pipe and being a telescope are inconsistent properties, the same object may be both a pipe and a telescope. To give an answer to the question "What do you see?" is automatically to classify the object you see. Two persons may classify the same object in different ways, but this does not mean that they see different objects. Seeing things differently is not the same thing as seeing different things.

Hanson is ambiguous in what he has to say about the sense of "see" in which he admits that Tycho and Kepler see the same sun. He tells us that Tycho and Kepler see the same sun because the sun appears to them in the same way.⁸ Appearing in the same way is neither a necessary nor sufficient condition for two persons seeing the same physical object, but perhaps Hanson does not mean that what Tycho and Kepler both see is a physical object. Tycho and Kepler see the same thing because "...something about their visual experiences at dawn is the same for both: a brilliant yellow-white disc centered between green and blue colour patches."⁹ This might be interpreted to mean that Tycho and Kepler see their visual experiences, and since their visual experiences are the same, they see the same object. But Tycho's visual experience is not the same visual experience as Kepler's. Perhaps there is only one kind of experience, but there are two experiences. In another place, Hanson strongly suggests that what Tycho and Kepler both see are visual sense-data. "If Tycho and Kepler are aware of anything visual, it must be of some pattern of colours. We do not touch or hear with our eyes, we only take in light."¹⁰ If the pattern of colors is a characteristic of the sun, and there is no reason to think otherwise, Tycho and Kepler would be seeing the same pattern, not just the same kind of pattern. However, Hanson tells us that sense-data owe their existence to being had, and that suggests that he thinks that sense-data are conscious states.¹¹

Passages like the ones that have been cited are some indication that Hanson thinks that Tycho and Kepler see the same sun only in the weak sense of "see." The weak sense of "see" is the sense we use when we speak of the physical capacity for seeing or the exercise thereof. The squirrel hunter does not see squirrels as well as he did when he was a young man, but this is not because he has forgotten how to identify squirrels; it is because his eyesight is not as good as it once was. Seeing in this sense is what the oculist is concerned with. When he asks his patient to read the

letters on the eyechart, he is not testing his patient's knowledge of the alphabet. This weak sense of "see" is the sense of "see" that G. E. Moore must have had in the back of his mind when he said that, strictly speaking, we see only the surfaces of physical objects. And Hanson says, "They say they see the sun. But they do not see every side of the sun at once; so what they really see is discoid to begin with. It is but a visual aspect of the sun."¹² Only in the weak sense of "see" is it at all sensible to challenge the statement Tycho and Kepler see the sun.

The weak sense of "see" is not the primary sense of "see," but there are passages in which Hanson uses the primary sense of "see." Hanson says that Tycho and Kepler see the same sun in the sense that they are aware of the same physical object, the sun.¹³ This is the primary sense of "see." A person being visually aware of the sun does not entail that he is aware that it is static or mobile; it does not even entail that he is aware that the sun is the sun. Hanson's admission is for him quite an admission. It seems to undercut his position. He admits that the sun that Tycho is visually aware of is the very same sun that Kepler is visually aware of, and presumably he would admit that this sun is the sun that is about 92 million miles from the earth. Is it the same object that Tycho sees as mobile and that Kepler sees as static? If the answer is yes, which see reasonable, what object does Kepler see that Tycho doesn't see? Hanson might want to say that Tycho sees a mobile sun and Kepler sees a static sun, but that is no answer. If that were the case, they would indeed be seeing different suns, but then they would be seeing different physical objects, something which Hanson denies.

Hanson's comments about the sense of "see" that is important for science are as ambiguous as his comments about the sense of "see" in which Tycho and Kepler see the same sun. He is ambiguous as between whether "seeing" means seeing as or seeing that, or at least does not make a clear distinction that he sticks with. In the sentence (verbatim from Hanson) "Seeing the dawn was for Tycho and Simplicius to see that the earth's brilliant satellite was beginning its diurnal circuit around us," Tycho and Simplicius do not see the dawn unless "sees that" is read as saying "sees as."¹⁴ It is anyhow more reasonable to regard the seeing that is important for science as seeing as rather than seeing that. If all seeing is seeing that, it is impossible for a scientist to make a visual observation that is not veridical.

It would be instructive to see what would remain of the argument attributed to Hanson if it is assumed that Hanson meant only that all seeing is seeing as and did not mean that all seeing is seeing that. Here "All seeing is seeing as" must be taken to mean that seeing x entails seeing x as p and not just the weaker seeing x as p or something or other. Thus, Tycho's seeing the sun entails not only that he saw the sun as something or other but also that he saw the sun as a mobile sun. Unless the stronger entailment is assumed, nothing remains of the argument. On the other hand, it is no longer assumed that seeing as entails seeing that. In the following

reconstruction the existential generalizations are inferred rather than introduced as premises.

- (1) Tycho sees the sun Tycho sees.
- (2) Kepler sees the sun Kepler sees.
- (3) If Tycho sees the sun Tycho sees, he sees the sun Tycho sees as mobile.
- (4) If Kepler sees the sun Kepler sees, he sees the sun Kepler sees as not mobile.

From (1) and (3) Hanson could obtain

(5) Tycho sees the sun Tycho sees as mobile

And from (2) and (4) Hanson could obtain

(6) Kepler sees the sun Kepler sees as not mobile.

(5) logically implies

(7) Tycho believes the sun he sees is mobile

And (6) logically implies

(8) Kepler believes the sun he sees is not mobile.

(9) Some people believe the sun they see is mobile. (7, E. G.)

(10) Some people believe the sun they see is not mobile. (8, E. G.)

If it is agreed that "they see" does no useful work in (9) and (10), the conclusion becomes

(11) Some people believe the sun is mobile, and some don't.

This conclusion is true, but unsurprising.

Hanson could hardly have been satisfied with the preceding argument. Besides being insignificant, the conclusion of the argument is not relevant to his purposes. It is the kind of discovery an historian reports of, not a physicist, and his book was about the discoveries of physicists. Perhaps he did mean to say that all seeing is seeing that. If that is what he meant to say, he should have been led straight to conceptual relativism. In his first chapter he was talking about the visual observations of Tycho and Kepler. I take the work "observation" to refer to what something is observed as being, i.e., "K's observation of x was that it is p" is equivalent to "K observed x as being p." For example, "Tycho's observation was that the sun is mobile," is not equivalent to the false proposition that Tycho observed that the sun is mobile, but instead is equivalent to the true proposition that Tycho observed the sun as mobile. The distinction may be overlooked because of first person uses of perceptual verbs. Any person who has just made an observation that he has no reason to doubt is almost bound to say that so-and-so is such-and-such and not to say that he has observed so-and-so as such-and-such. To use the latter form of word would be to express a lack of confidence that he would not feel. Suppose, however, that Hanson would have it that "Tycho's observation was that the sun is mobile" is true and that it means that Tycho observed that the sun is mobile and that "Kepler's observation of the sun was that it is not mobile" is true and that it means that Kepler observed that the sun is not mobile. At this point, in order to avoid the

obvious contradiction, Hanson, or some conceptual relativist, might want to say that the truth for Tycho is that the sun is mobile and that the truth for Kepler is that the sun is not mobile, but that statement is either the expression of the innocuous truth that people disagree about whether the sun is mobile or else it is a contradiction and any argument that has it as its conclusion is unsound.

NOTES

1. Paul K. Feyerabend, "Problem of Empiricism," in *Beyond the Edge of Certainty*, ed. R. Colodny (Englewood Cliffs, N. J.: Prentice-Hall, 1965) pp. 220-21.
2. Norwood R. Hanson, *Patterns of Discovery* (Cambridge: Cambridge Univ. Press, 1958), pp. 4-30.
3. *Ibid.*, p. 18.
4. Carl R. Kordig, "The Theory-Ladenness of Observation," in *Philosophical Problems of Science and Technology*, ed. Alex C. Michalos (Boston: Allyn and Bacon, 1974), pp. 321-52.
5. Hanson, pp. 19-20.
6. *Ibid.*, p. 25.
7. *Ibid.*, p. 7.
8. *Ibid.*, p. 8.
9. *Ibid.*, p. 9.
10. *Ibid.*, p. 7.
11. *Ibid.*, p. 7.
12. *Ibid.*, p. 7.
13. *Ibid.*, p. 7.
14. *Ibid.*, p. 20.