

nouncement but terribly bad from there onwards. It simply showed how cleverly the human mind can invent supposed 'explanations' of already-known facts and consequently how cautious we must be not to be impressed by agreements which are really accidental." (p. 92).

11. As in the case of the irritating habit of some under-confident people of claiming 'to have known things all along' after the event.
12. I have discussed this question extensively in several recent papers. The answer is, I think that mathematics is fundamentally the science of hypothetical truths arising from formal definables. So the absolutely indefinable represents something totally unsuitable for incorporation into mathematics. A contrary argument sometimes offered here is that i was initially regarded as indefinable. Surely the insolubility of certain polynomial equations was abolished by fiat! The case is, however, completely different. In the case of complex numbers 'solubility' was restored within the extended system. There is no suggestion in the present case that indefinable sequences, on being incorporated into the continuum, somehow become 'definable' in the new, extended system.
13. There is no largest integer because, for any integer suggested beforehand, N , however large, we can always find a larger integer, namely $N + 1$. (The implied intention in suggesting N is to offer a 'largest integer'. The argument shows that once N has been put on the table, we can immediately 'cap' it with $N + 1$, which visibly denies N the role of 'largest integer'.)
14. All the games have been love-games.
15. John Barrow (1988) discusses the effect on another person of the attempt to predict his/her future actions "... I could never come up with a prediction of your future behaviour that you had to regard as true, since you could always falsify my forecast after it had been revealed to you." (p. 5)

16. The 'ergo' here differs from Descartes' in that it is an empirical-type inference to the existence of a mind or minds 'out there' controlling the experience. But it is an empirical inference of the most convincing kind. I am indebted to Jane Chaundy for the Latin translation of the new dictum.

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A dialogue on scientific realism

DAVID COCKBURN and HOWARD SANKEY

DC: I quite often hear people say things of the following kind: 'What fundamentally (ultimately) exists are those things which are spoken of in the best, and most basic, science.' On this view, if the physicist finds no need to speak of God, or good and evil, or colours — if he can complete his explanatory project while making no reference to such

entities — then these things are not part of what really, in the final analysis, exists. Perhaps we could label views of this general kind 'scientific realism' (though I am aware that that term is not always used in precisely this way.)

Now it seems to me that any claim along those general lines is simply 'scientism'. To

assume that those entities which the scientist finds need to speak of are the only ones that 'really' exist is to assume that the scientist's description of the world is the only one that reflects a genuine interest in the world. And surely there is no reason at all to make that assumption. If my interest in some phenomenon is different from the scientist's then naturally the terms in which I describe it will be different from the scientist's; and there seems to be no reason to hold that his description is any more fundamental than mine.

HS: What you say is, at first blush, puzzling, since what exists seems to have nothing to do with human interests. If, for example, a scientist says that there are electrons then what he says is true if, indeed, there are electrons. On the other hand, if a practitioner of magic says that there are witches, then what he says is true if there are witches. In either case, what decides whether the claim of existence is true is a matter of fact; and the interests of the person who makes the claim, and indeed of any person, have nothing to do with it.

DC: My suggestion was not that what exists depends on human interests. My point was rather that the terms in which we describe some phenomenon depends on our interest in it. Thus, one person might describe a certain painting in terms of what it is a painting of—in terms of the expression on the child's face and so on—while another describes the very same object in terms of patches of colour on the canvas—'There is a yellow patch two inches across four inches in from the left' and so on. Which form of description we give will depend on the kind of interest that we have in this canvas. That is not to say that either the smile on the face or the arrangement of colour patches is dependent on anyone's interest.

Now what I was suggesting was this. To suppose that one form of description—say that employed by the physicist—is more fundamental than any other is to assume that one form of interest in the world—the physicist's—is more fundamental than any other. And that is an assumption which I see no reason to accept.

HS: Consider the case you mention. There is clearly a sense in which talk of a patch of yellow paint is more basic than talk of the child's expression. For it is only in virtue of



Is the smile as much a part of the furniture of the world as are the roses?

the painting being a particular arrangement of colour that it is a painting of the child. The former explains the latter, and I imagine that is all the scientific realist means by talk of a more fundamental level of description.

DC: You suggest that the arrangement of the patches of paint explains the painting of the child. And the more general claim, I take it, would be that the scientific description of any phenomenon is fundamental in this sense: any explanation of why things are as they are will ultimately be in scientific terms. Thus, for example, the scientific realist would not be claiming that anger or love do not exist; he would simply be claiming that the explanation of why this person is angry or in love is ultimately to be given in the terms of basic science: in, perhaps, neurophysiological terms.

Now my impression is that there are many who want to make a stronger claim than this: holding that only what the scientist finds need to speak of exists at all. It take it you and I agree that there is no reason to say that. I, however, see no reason to accept even the weaker claim which you outline. That is, I see no reason to accept that there is such a thing as 'basic science' in terms of which everything that happens is to be explained. To stick for the moment with the example we were discussing: is the description of the painting in terms of patches of colour more

basic in this sense than that in terms of the child's face? Surely the paint is arranged in that way on the canvas because the artist wanted to produce a picture of a smiling child. Can it not be argued then that the explanation goes in the *opposite* direction from that which you suggest: it is the fact that it is a painting of a child which explains the particular arrangement of colours on the canvas.

HS: You say 'Surely the paint is arranged in that way on the canvas because the artist wanted to produce a picture of the smiling child'. That is, you are suggesting that the artist's desire to produce such a picture is what caused him to so arrange the paint. You are right, of course, but it does not follow that what I said before about the colour arrangement being more basic was wrong.

Everything depends on what is to be explained. If what is to be explained is the artist's action—arranging the blotches of colour in a given way—then appeal is made to the desire to paint a picture of the child. If what is to be explained is why a particular painting depicts a smiling child, then explanation must proceed in terms of the arrangement of colour patches. You confuse explanation of why the artist arranged the colours such and such a way with explanation of why we see an image of a smiling child when we look at the painting. To explain the latter, reference to colour patches rather than the artist's intention is relevant.

DC: We are looking for a sense in which it can be said that a description of the painting in terms of splodges of paint is more fundamental than one in terms of what it is a painting of. You suggested that we find this in the way in which the former kind of description will feature in explanations of the latter. But it seems now that which form of description is more fundamental, in this sense, depends on just what it is that we want explained. Given that that is so I cannot see that you have articulated any general, 'metaphysical', sense in which a description in terms of 'splodges of paint' can be said to be 'fundamental'. That claim, it seems to me, cannot be defended in *this* way.

HS: I agree with your general point that the notion of one thing explaining another does not, by itself, yield an analysis of the idea that one description is more fundamental

than another. In order for the notion of explanation to do this, it is necessary to further describe the context in which explanation takes place. To clarify this I would like to go back and consider something you said at the outset.

DC: What did you have in mind?

HS: You defined 'scientific realism' as the view that 'what fundamentally (ultimately) exists are those things which are spoken of in the best and most basic, science'. You described this view as 'scientism', and claimed that it depends on the erroneous assumption that 'the scientist's description of the world is the only one that reflects a genuine interest in the world'.

DC: That's right. I do not see what makes scientific descriptions fundamental.

HS: That is the wrong way to formulate the issue. The point is not that science is in some sense more fundamental than anything else. The point, rather, is that we should look to science if we want to know what exists. And science, itself, is highly reductive. The scientific realist turns to science to see what really exists, and within the sciences one science is more fundamental than another.

DC: You suggest that 'we should look to science if we want to know what exists'. Well, what about this case: 'There is a faint, ironic smile playing on her lips'? Or this: 'There is an appalling clash of colours in that room'? These, I take it, are claims about what exists. But I don't suppose that any of the sciences—least of all, the most fundamental: physics—will be of great help in establishing whether they are true.

HS: It is unclear what the two cases you describe are supposed to show. If you intend them as counter-examples to the view that science informs us of what exists, then you have some explaining to do. It is not clear that either case must necessarily fail to be described scientifically, perhaps by theories of human physiology or perception.

DC: I do not deny that there might be some sense in which what is going on in these cases—for example, when a person smiles—might be 'described scientifically'. The point of the examples was to suggest that it was far from obvious that we can say in a completely general way that 'we should look to science if we want to know what exists'. I, at any rate, would not 'look to science'—let

alone to physics—if I wanted to answer either of these questions. Are you suggesting that I ought to?

HS: I, at any rate, would reserve judgement on the existence of ironic smiles or clashing colours until it was shown that science included mention of such things in the list of what exists.

DC: Surely you cannot mean that, Howard! At any rate, it seems to me that in one sense what you have just said is clearly untrue. I am not sure if you ever say things like 'That is an awful clash of colours'; but I take it you do say things like 'There was an ironic (happy) smile on his face'. In that sense you do not reserve judgement on the existence of these things. Now you might, I suppose, reply that that is because science has already established that such things exist. Alternatively, you might reply that while in that sense you do not reserve judgement, we must wait on science for the final confirmation of the truth of what you say. Either way, I will have further questions.

HS: When I say we should look to science I do not mean that we are ourselves incapable of judging whether people are smiling, laughing, or whatever. There are, of course, a great variety of practices involving judgements such as these, which we all carry out without any appeal to science. My point, rather, was that the practices—and the ontological assumptions underlying them—may be mistaken; and that science may show this to be so.

DC: I do not deny that there are cases in which science might show that a certain way of thinking rests on assumptions which are mistaken. My problem is that I cannot see how that might work in the cases which we have been discussing. What I need then is some indication of what scientific discoveries might show that, for example, our practice of speaking of each other as 'smiling' rests on a mistaken assumption. I simply cannot see how anything that science might come up with could possibly bear on this practice in this way.

HS: My point that science can correct our practices does not mean that, in any given case, it will do so. It may be that smiles are something which the final inventory of what exists will include. I suspect, however, that this is not so. It will turn out that smiling, and smile-recognition, will just be a con-

ventional social custom. That is not to say that there will be no such thing as smiles, where smiles are construed in a thin sense as a given kind of facial expression. It means, rather, that smiles have their place in a given social context, and that what they do in the context depends on social conventions in the same way that what our words mean depends on conventions.

DC: I am not certain that I understand what you have just said. Still, I can see roughly the direction in which you are going. What I cannot see is just how you take your point to relate to the suggestion that 'We should look to science if we want to know what exists'—if, for example, we want to know whether there was a smile on his face. Perhaps you could say a little more about the connection with that thought.

HS: Obviously I cannot predict what science will ultimately say about smiles. Perhaps it will say there are no smiles beyond given facial expressions. But I suspect it will add to this that they are facial expressions which have taken on a function within a given social context to communicate feeling. Further, as with other communicative symbols, there is an arbitrary element involved. The particular facial expression we call a smile might, in another society, serve to convey a different emotion than it does for us. So I am suggesting that smiles, in the thick sense which includes their meaning, are not natural kinds of things that science will include in its inventory of what exists. Perhaps smiles, thinly described as facial expressions, and the feeling they convey, will, separately, belong on the inventory. But the composite of smiles with its communicated feeling will not. For that is just a conventional thing. If this is right, there will be no universal empirical laws governing the relation between smiles, in the thin sense, and their circumstances of use.

DC: Well, suppose that we agree that smiles are not 'natural kinds of things'—I suppose, roughly, in the sense in which language is not a 'natural kind of thing'. (And is it science that shows us *that*?) It does not, on the face of it, follow from this that smiles don't exist. So if science leaves them out of its inventory of what exists then it looks as though science's inventory is incomplete.

HS: I doubt scientific realism requires anything beyond the concession you have just

made that smiles are not natural kinds. To put the point in the terms you used before, what 'fundamentally exists' for the scientific realist are the natural kinds discovered by science. Socio-cultural kinds are constructs superimposed by humans upon reality, and they ought not to be included in the inventory of 'what fundamentally exists'.

DC: We have come back to a notion—the notion of what 'fundamentally exists'—which we were working on earlier. I said that I was not clear about the sense of that phrase; and you suggested that this might become clearer if we considered the claim, made by the scientific realist, that we should look to science if we want to know what exists.

I am not sure that this has become much clearer to me. But I wonder if the key is to be found in your remark that 'socio-cultural kinds are constructs superimposed by humans upon reality'. Is your thought that the categories employed by the scientist are not, in that sense, 'superimposed by humans upon reality'; and that is the sense in which these categories are more fundamental?

HS: I say we should look to science to see what exists, and that some sciences are more fundamental than others. Fundamental science reveals fundamental natural kinds, to which other natural kinds are reducible; and it is fundamental natural kinds which exist fundamentally. So that is my answer to the question we were working on before about 'fundamental existence'.

Socio-cultural kinds, such as smiles, are merely conventional categories brought into being by human practice. This is the main difference between such kinds and natural kinds, since the latter exist independently of human conceptualization of them.

DC: I have a number of problems with the way you express yourself here. First, you say that smiles are merely conventional categories. It seems to follow that if he has a smile on his face he has a conventional category on his face. And that sounds a bit bizarre.

HS: No, what follows is that he has an instance of a conventional category on his face.

DC: That sounds bizarre too. But perhaps the problem here is simply that each of us is used to a different terminology. I wonder if you would be happy to put your point this way: the category of smiles is a merely conventional one.

HS: Yes. I would be happy with that way of expressing it.

DC: Fine. My other problem here is closely related to that. You say that natural kinds exist independently of human conceptualization of them. Now I am not certain whether you mean that, for example, *gold* exists independently of human conceptualization of it; or if you mean that the *category* of gold—or, as we might put it, the *concept* of gold—exists independently of human conceptualization. Or does neither of those formulations capture your meaning precisely?

HS: As I understand it, a natural kind is a category, either of things or of substance, whose membership is determined independently of us.

DC: Might the point you are making here be put in this way. It is something quite independent of us—namely, their common atomic structure—which dictates that all of the lumps of stuff which we call 'gold' are to be grouped together and referred to by this single term. By contrast, with 'socio-cultural kinds'—for example, with smiles—which things are thought of as being of the same kind, and so are grouped together and referred to by a single term, is in some measure (or perhaps entirely) up to us.

HS: Yes. That's it.

DC: In that case, I'm afraid I just don't see it. My problem lies, I think, with what you say about 'natural kinds'. For surely nothing independent of us dictates that we must have an interest in atomic structure. Nothing independent of us dictates that we must see its atomic structure as being the significant feature of a thing; and so nothing independent of us dictates that all things that have the same atomic structure be grouped together and referred to by a single term. Thus, if we imagine a being for whom colour was of enormous importance then we imagine a being who might group substances into categories in ways very different from us. He will, perhaps, group together, and have a single term for, everything with that distinctive gold colour; and will call by a different name this piece of stuff which we call 'gold' but which has lost its distinctive colour.

HS: It is true that we might be mistaken about what natural kinds there are. It is true too that we may employ concepts which do not

designate natural kinds. Both these things are true because, as you indicate, it is in large part up to us which conceptual divisions we choose to employ in dealing with the world.

Nevertheless, it does not follow that it is impossible for conceptual divisions which we employ to pick out categories which coincide with naturally occurring kinds. For example, it might be the case that our word 'gold', as we now use it, denotes a substance with a particular atomic structure. Further, it might also be the case that the substance exhibits certain behavioural regularities, due to that structure, which mark it off from all other substances. I take it, moreover, that there is much empirical evidence that many of the kinds described by science exhibit quite specific lawlike behaviour, suggesting strongly that they are natural kinds.

As to the being you mention, I have admitted that we might be mistaken about what natural kinds there are. But that is to say nothing more than that our knowledge is fallible; for example, there might be some crucial piece of evidence about structure which is missing, and which would result in a new taxonomy of kinds being introduced. As I noted at the start, our interests have nothing to do with what exists.

DC: My point was not that 'we might be mistaken about what natural kinds there are', but rather, as you express it, that 'we may employ concepts which do not designate natural kinds'.

Another example might help here. Imagine a group of people living in an extremely cold region for whom ice is first and foremost a building material. They have a single word—'stice'—for ice and stone, which they also use for building. They have (as we do) a quite different word for water. Their scientists then tell them that ice (i.e. some of what they call 'stice') and water have the same atomic structure, and that some stice (ice) has quite different atomic structure from other stice (stone). This, perhaps, will come as little surprise to them; for they already knew that, for example, some, but not other, stice could be turned into water by heating it. Now if the scientists add that this shows that they ought to change their categories if they want to be true to the world they may regard this as obviously confused. From their point of view what we call 'ice' and

'stone' have the important thing in common, while ice and water are as different as chalk and cheese.

These people, we might say, carve the world up in a way different from the scientist who categorizes things by their atomic structure. I take it that you will agree that, given their particular way of life, there need be no mistake involved in doing this. That is to say, there is no sense in which the world dictates that the concepts that the scientist employs, as opposed to the ones these people employ, are the correct ones. In what sense, then, can it be said that the membership of the category of gold or water is 'determined independently of us'?

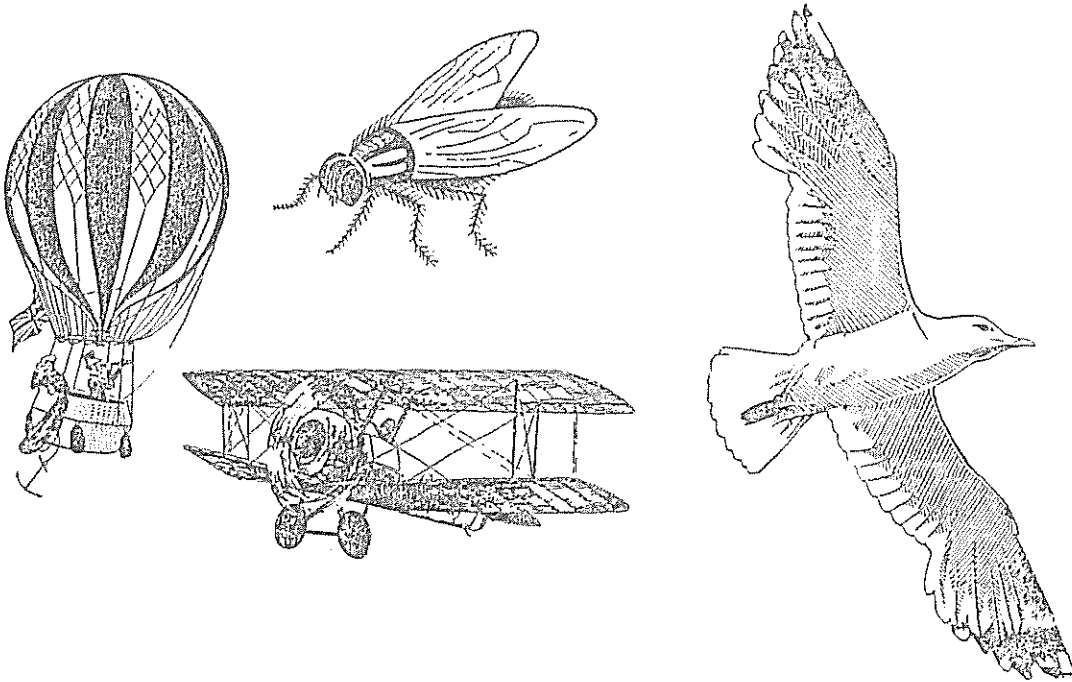
Well, this much is true: I may think this is a piece of gold when it is not. But equally, I may think this is a piece of stice when it is not; or again, I may think that is a friendly smile on his face when it is not. So I am still at sea with your contrast between 'natural kinds' and 'socio-cultural kinds'.

HS: You say 'there is no sense in which the world dictates that the concepts that the scientist employs, as opposed to the ones these people employ, are the correct ones'. This is perhaps right as a point about language. But it is wrong as a point about ontology.

The concepts we employ in talking about the world reflect our needs and interests. They are not forced upon us by the world's structure. For this reason, we cannot decide matters of ontology by looking at the way languages 'carve the world up'.

In ontology, our interest is in how the world itself is carved up. Science can shed much light on this. While science might not show that the word 'stice' has no use among the people you describe, it could show that it does not denote a natural kind. Some function may be served by the word 'stice'. But if the aim is a list of what kinds exist apart from human intervention, it will not include stice.

The crucial difference between the artificial kind you call 'stice' and the natural kind gold is that the former is not constituted as a kind independently of human intervention. You claim not to understand this. But the contrast is clear. All samples of a natural kind such as gold exhibit the same law-governed uniformity of behaviour which characterizes it as a natural kind.



Flying things do not form a natural kind.

No analogous uniformity characterizes stice.

DC: No precisely analogous uniformity certainly. But there are uniformities of another kind that characterize stice. For example, all bits of stice can support a weight of five stones. In this respect stice is more uniform than gold; for in *this* sense solid gold has very different properties from liquid gold. So my question is: why does not this uniformity earn stice a place on the list of 'what exists apart from human intervention'?

HS: The answer to that is clear. Stice is not a natural kind because the uniformity it displays is one which ice and stone (as well as frozen chunks of polar bear and other frozen solid matter) all have in common. The uniformity exhibited by gold is one which all and only items having the same underlying physical make-up are able to exhibit. Mere uniformity is not enough to make something a natural kind. For this would make the set composed of birds, butterflies, flying squirrels, hang-gliders and airplanes a natural kind, since they all are capable of flight.

In sum: non-natural kinds may exhibit behavioural uniformity, but the uniformity

of relevance to natural kinds is uniformity based upon uniform underlying structure.

DC: Fine. Given what you mean by the term 'natural kind' I have to agree that stice is not a natural kind. What I do not see is how that answers the question that I raised in my last speech. But perhaps we should pursue the matter on another occasion.

Suggestions for further reading:

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