The Difference Between Right and Left

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1. The 'paradox' about right and left

Kant seems to have been the first to notice that there is something peculiar about the difference between right and left, but he failed to say exactly what the peculiarity is. His clearest account of the matter is in his inaugural lecture (see Bibliography at the end of the paper):

> We cannot describe [in general terms] the distinction in a given space between things which lie towards one quarter, and things which are turned towards the opposite quarter. Thus if we take solids which are completely equal and similar but incongruent, such as the right and left hands. . . although in every respect which admits of being stated in terms intelligible to the mind through a verbal description they can be substituted for one another, there is yet a diversity which makes it impossible for their boundaries to coincide. (15 C.)

One can see roughly what Kant's point is. Take two coins which differ only in their spatial positions: any description of one in general terms also fits the other; but then it is also true that 'their boundaries coincide' or, as Kant says elsewhere, that 'each can be replaced by the other in all cases and all respects, without the exchange causing the slightest recognizable difference'. For example, if I tell you that I earned *this* coin and stole *that*, then shuffle them and show them to you again, you cannot reidentify the one I earned unless you have tracked one of them through the shuffle.

A left and a right hand are more different than this. If I showed you two detached hands which differed only as right and left, told you that I was given *this* one and stole *that*, then shuffled and reproduced them, you could re-identify the stolen one without having tracked either through the shuffle. The two hands would be qualitatively different as well as numerically distinct; it would not be true that 'each can be replaced by the other. . . without the exchange causing the slightest recognizable difference'; for example, a glove which fitted one would not fit the other. And yet, Kant thinks, this difference between the two hands cannot be 'stated in terms intelligible to the mind through a verbal description': he says that it is a qualitative difference which cannot be captured in language.

That is false. We can state in language what the difference is between the two hands, for we can describe one as 'a right hand' and the other as 'a left hand'. If you did not see them before the shuffle, you can still identify the stolen one if

someone tells you 'The right hand is the one he stole', this being meant and understood not as saying what arm the hand used to grow on but rather as describing the hand itself, as saying what *kind* of hand it is.

That refutes what Kant says, taken dead literally. Behind what he actually says, though, there is a less vulnerable claim about the meanings of 'left' and 'right' and their equivalents in other languages. It is the claim that one could explain the meanings of these words only by a kind of showing—one could not do it by telling. That is the claim I am going to explore.

Still, there was a point in skirmishing with Kant on the basis of a ploddingly literal reading of his words. He uses several unsatisfactory formulations like the one I have attacked, and these help him to think he can report something surprising—in one place he calls it a 'paradox'—about the right/left distinction. 'Two things can differ qualitatively, although the difference cannot be expressed in words'—that would indeed be surprising if it were not false! Again, Kant says that two hands whose boundaries do not coincide may nevertheless be 'completely equal and similar', which would be astonishing if it were true. Other writers, too, have offered one-sentence formulations of what they suppose to be obviously a 'problem' about right and left. Reichenbach, for instance, refers to 'the problem of the existence of equal and similarly shaped figures that cannot be superimposed' (p. 109; see also Caird, p. 166). Taking 'similarly shaped' to mean 'having the same shape', that would be a problem indeed; but if you think that your hands have the same shape, just try putting a glove first on one and then, without turning it inside out, on the other.

When Kant and others say that a left and a right hand have 'similar shapes' or the like, perhaps they mean—as any mathematician would mean—that the hands do not differ in shape except to the extent that one is a right hand and the other a left. Then what they say is true. But now where is the 'problem' or 'paradox'? My two hands differ only as right and left; but they do differ in that way, so of course a single glove won't fit both. Why should I find this surprising or paradoxical?

There is indeed a peculiarity about the right/left distinction. But it does not lie on the surface: philosophical work will be needed to dig it out and lay it bare, and so it could not possibly afford a simple, immediate surprise of the sort Kant thought he had in store for us.

2. Kant's uses of the 'paradox'

The real peculiarity of the left/right distinction, as well as being more elusive than Kant realized, has a different kind of philosophical interest from any that he found in it. He tried to argue from it to some of his larger philosophical views, but without much success. His major attempt of this kind is definitively treated in a paper by Remnant; his minor ones are hardly worth discussing. Since Kemp Smith has fully described the roles which the left/right matter plays throughout Kant's writings (pp. 161–166), I need only to sketch them. This section and the next are not presupposed by the rest of the paper.

The relevant background facts are these. **(1)** Kant was a transcendental idealist, i.e. he held a certain view about the analysis of spatial concepts—any spatial concepts. **(2)** He took sides in the dispute about absolute versus relative space, i.e. the dispute about whether the concept of spatial location is more or less basic than that of spatial relations between things. **(1)** concerns the analysis of the basic spatial concepts, whatever they may be; whereas **(2)** concerns which spatial concepts are basic, whatever their further analysis might be. Yet we are told by Weyl:

> Kant finds the clue to the riddle of left and right in transcendental idealism; (p.84)

and by Russell:

> Right and left hands, spherical triangles, etc.. . . show, as Kant intended them to show, the essential relativity of space; (§150)

and by Smart:

> Kant supported the absolute theory of space. In particular he thought that the relational theory could not do justice to the difference between a left hand and a right hand. (p. 6.)

These conflicting accounts of Kant's intentions reflect the instability of those intentions themselves. Kant's first discussion of left and right was in a little paper in 1768. He returned to the topic briefly in his inaugural lecture of 1770. In the first *Critique* in 1781 he took over much of that lecture almost verbatim, but made no mention of left and right. In the *Prolegomena* of 1783, intended as a popular summary of the *Critique*, he resurrected left/right and gave it a short section to itself. But then in the second edition of the *Critique* (1787), in which several new arguments and emphases are borrowed from the *Prolegomena*, the left/right matter once more disappears from sight. Kant seems to have been genuinely unsure whether he could draw philosophical conclusions from his point about the right/left distinction.

He also wavered in his views about *what* conclusions he could draw. Although he did not firmly enough distinguish **(1)** the issue over transcendental idealism from **(2)** the issue about absolute versus relative space, it is not too misleading to say: in 1768 he used the left/right matter to support the absolute theory of space; in 1783 he took it to support transcendental idealism; while in 1770 he adduced it in support of a doctrine which is not quite either of these though it arguably entails both.

In short, Kant could not decide which if any of his doctrines about space can draw strength from special facts about the right/left distinction. I am sure none of them can.

3. Prolegomena §13

Behind Kant's words in the inaugural lecture I have detected the claim that an explanation of the meanings of 'right' and 'left' requires *showing*, i.e. demands an appeal to sensorily presented examples. I shall call this claim the **Kantian Hypothesis**. It may not be what Kant 'really meant' when he wrote about right and left, but it is the best we can get from him. In defense of this contention I shall examine *Prolegomena* §13, which is Kant's longest and most detailed treatment of the matter, and also, I believe, his last. When examined carefully) this passage can be seen to amount to a series of pointers toward the Kantian Hypothesis. This is not a bad thing to amount to; and really my only criticism is that in *Prolegomena* §13 Kant purports to be expressing, not merely pointing toward, the peculiarity of the right/left distinction. (In the final sentence I make two corrections which the translator accepts. The numbers are for subsequent reference.)

> One would have thought that if two things are **(1)** completely the same in all points that can be known at all about each separately (in all determinations belonging to quantity and quality), it must follow that each can be replaced by the other in all cases and all respects, without the exchange causing the slightest recognizable difference. This is in fact the case with plane figures in geometry; but various spherical figures show, notwithstanding this **(2)** complete inner agreement, an outer relation such that one cannot be replaced by the other. For example two spherical triangles on opposite hemispheres which

> have an arc of the equator as their common base can be completely equal, in respect of sides as well as angles, so that **(3)** nothing is found in either, when it is described alone and completely, which does not also appear in the description of the other (on the opposite hemisphere). Here then is an inner difference between the two triangles which **(4)** no understanding can show to be inner and which only reveals itself through the outer relation in space. But I will quote more usual cases which can be taken from ordinary life.
>
> What can be more like my hand or my ear, and more equal in all points, than its image in the mirror? And yet I cannot put such a hand as is seen in the mirror in the place of its original: for if the original was a right hand, the hand in the mirror is a left hand, and the image of a right ear is a left ear, which could never serve as a substitute for the other. Here are **(5)** no inner differences that any understanding could think; and yet the differences are inner so far as the senses tell us, for the left hand cannot be enclosed in the same boundaries as the right (they cannot be congruent) notwithstanding all their mutual equality and similarity; the glove of one hand cannot be used on the other. . . We cannot make the difference between similar and equal but yet incongruent things (e.g. spirals winding opposite ways) **(6)** intelligible by any concept whatsoever, but only by their relation to the right and left hand, which immediately involves intuition.

I have omitted Kant's 'solution'. The question I want to answer is: What is his problem?

The problem, as Kant sees it, is that a certain plausible proposition is false. (The opening words 'One would have thought that' at the start of the passage were added by me. This wrongly makes Kant explicit about this, but it must be legitimate, because otherwise Kant asserts something which he immediately proceeds to deny.) The proposition in question has the form

(x)(y) (Fxy $\rightarrow$ Gxy).

Kant says that, although this is plausible, there are in fact values of x and y such that (Fxy & $\neg$ Gxy); and to solve his problem will be to explain this surprising fact. *Our* problem is to discover what F and G are.

There is no difficulty about G. Gxy is the statement that x can be replaced by y 'without the exchange causing the slightest recognizable difference'. Thus Gxy is true if x and y are newly minted coins from the same die, and false if they are a normal pair of hands, i.e. a pair differing only as right and left.

The search for F is embodied in the question: What does Kant think he can say about a normal pair of hands from which one might naturally, though wrongly, infer that they could not be told apart? We can safely pin everything on the one example of a pair of hands, for it is universally agreed that in this area Kant's examples stand or fall together.

He expresses Fxy in six different ways. Here are two of them:

- **(1)** x and y 'are completely the same in all points that can be known at all about each separately (in all determinations belonging to quantity and quality)'.
- **(3)** When x is 'described alone and completely', its description is the same as y's.

To describe something 'alone and completely' is presumably to say everything about it except how it relates—spatially and otherwise—to other things. But then is **(3)** true of a normal pair of hands? In describing one of the pair 'completely' we can use a phrase which does not fit the other, namely 'a right hand'—taking this to express a fact not about which

arm it grows on but about its shape, e.g., about which sort of glove will fit it. To exclude this, Kant must say that if we use 'right' in describing a hand we are not describing it 'alone': the phrase 'a right hand', he must say, is covertly relational, and not merely in the attenuated way in which any description, e.g. 'a small hand', is covertly relational. This is not obviously true, and the only arguments I can find to support it stem from the Kantian Hypothesis.

If **(1)** is not also to amount to a pointer toward the Kantian Hypothesis, the phrase 'determinations [= properties] belonging to quantity and quality' must be turned to account. But it cannot be. The difference between a left and a right hand is 'qualitative' in any plain sense of the word; and Kant's technical sense of 'quality' in the *Critique* is too unclear to help us here.

Here are Kant's other four ways of expressing Fxy:

(2) There's a 'complete inner agreement' between x and y.

(4) The 'inner difference' between x and y is one which 'no understanding can show to be inner'.

(5) Between x and y there are 'no inner differences that any understanding could think'.

(6) 'We cannot make the difference between [x and y] intelligible by any concept whatsoever.'

We must presume **(2)** to be a careless contraction of **(4)** or **(5)**. Otherwise, Kant is saying that between x and y there is **(2)** a 'complete inner agreement' and also **(4)** an 'inner difference'. So **(2)** can be ignored.

(5) and **(6)** go together. For Kant, 'the understanding' is the faculty of 'concepts': to be thought by the understanding is to be brought under, thought through, or made intelligible by, concepts. So **(5)** and **(6)** both say that a right hand need not fall under any concepts which do not equally apply to a left hand, which is tantamount to denying that there is any concept of rightness-as-distinct-from-leftness. Since 'right as distinct from left' is a meaningful description, why should Kant deny that there is a concept corresponding to it? His only hint at an answer is in his remark, at the end of the passage, that we can explain the right/left difference only in a way 'which immediately involves intuition [= sense-experience]'. But this is—and so **(5)** and **(6)** are just unargued pointers toward—the Kantian Hypothesis.

Whereas **(5)** and **(6)** say that the understanding cannot show or express what the left/right difference is, **(4)** says that it cannot show that the difference is an inner one, implying that one could show this only with the aid of 'intuition' or sense-experience. To assess this, we must know what an 'inner' difference is. It seems to be just a difference in respect to something other than spatial location or orientation—a difference in respect to some property that a thing can carry around with it. This yields the wanted result that there is an inner difference between a pair of normal hands, and not between two new coins from the same die. It also fits my example in §1 above: if two things are to be separately re-identifiable after a shuffle, without being tracked through it, what is needed is precisely some 'inner' difference between them, i.e. some difference of the kind that can be carried through a shuffle.

So **(4)** seems to say that someone who has grasped what the difference is between a right and a left hand must make a further appeal to experience if he is to grasp that one hand cannot be made congruent with the other just by moving it around. This is in fact correct; for there are mathematically possible spaces in which a right hand could, by sheer travel, become a left hand; and if our space is not of such a kind, that is an empirical fact about it and in that sense a fact which can be known only by appeal to experience. But it is not credible that that is the point Kant was trying to make in **(4)**. I am sure that what he says about showing **(4)** that

the difference is inner is meant to follow from what he says about showing (5,6) what the difference is. When he says at **(5)** in the quoted passage:

> Here are no inner differences that any understanding could think; and yet the differences are inner so far as the senses tell us,

isn't it clear that he is simply failing to distinguish 'what the inner difference is' from 'that the difference is inner'? If he is, and if that explains **(4)**, then the latter goes the same way as **(5)** and **(6)**—toward the Kantian Hypothesis.

So Prolegomena §13 does, to its great credit, yield the Kantian Hypothesis. But that is all it yields; and it does not make clear just what the force of the Hypothesis is, or why it is true. There remains work to be done.

Before we go on with it, there are two footnotes to the claim that Kant was the first philosopher to notice that right/left is peculiar.

In a letter to Clarke, Leibniz says that God could have no reason for choosing **(a)** the way things are in fact arranged in space rather than **(b)** an arrangement 'preserving the same situation of bodies among themselves' and differing from (a) only in 'changing East into West'; whence he infers that **(a)** and **(b)** are not really different (p. 26). He probably thinks of **(b)** as the world's being rotated through 180°, changing north into south as well as east into west. Still, all he actually says is 'changing East into West'; so he could be envisaging a systematic left/right switch, or mirror-image transformation, in which case he has anticipated something like Kant's point. I find the latter reading implausible. It credits Leibniz with introducing an original philosophical insight in an incredibly offhand way, and arguing from it without first explaining or defending it—even though he could further his main argument much less vulnerably with the rigid-rotation version of **(b)**. Also, when he reverts to this matter in his next letter to Clarke he clearly construes it in the rigid-rotation rather than the mirror-transformation manner (p. 37). Kant's thoughts about right and left, however, grew out of his disagreements with Leibniz, and the east/west remark may well be what put him on the track.

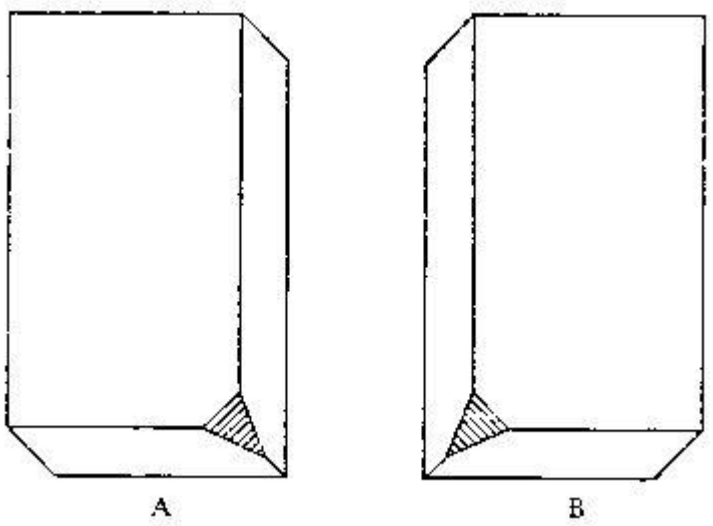
The 11th century Arab philosopher Ghazali has a better claim to have anticipated Kant's insight:

> The highest sphere moves from east to west and the spheres beneath it in the opposite direction, but everything that happens in this way would happen equally if the reverse took place, i.e. if the highest sphere moved from west to east and the lower spheres in the opposite direction. For all the same differences in configuration would arise just as well. Granted that these movements are circular and in opposite directions, both directions are equivalent; why then is the one distinguished from the other, which is similar to it? (Quoted in Averroës, Vol. I, p. 30.)

(I am indebted to George F. Hourani for calling this passage to my attention.)

4. Enantiomorphism

It is a nuisance that, when we want to use 'a left hand' to mean something about the hand's shape, what sort of glove will fit it, etc., the phrase can also mean 'a hand that grows on a left arm'. In either meaning it applies to just the same objects, but that is a mere contingency. For this reason, and for others that will emerge shortly, hands are not the best example of the relationship we are interested in. I prefer these two boxes:



In Kantian language, these differ as 'things which lie towards one quarter and things which are turned toward the opposite quarter'. Such pairs are sometimes called 'incongruous counterparts', which means that **(a)** their boundaries do not coincide, and that **(b)** one of them looks just as the other would in a mirror. If the sliced-off corners were restored, **(a)** would be false and the boxes would not be 'incongruous'; if just one had its corner restored, or if one were bigger, **(b)** would be false and the boxes would not be 'counterparts'.

The mathematical term for two things which are thus related is *enantiomorphs* ('having contrary shapes'). I shall sometimes use this word instead of the longer 'incongruous counterparts', but not to mark any distinction.

It is time to confess that my paper's real topic is not right/left as such, but rather enantiomorphism, or the difference between incongruous counterparts. The right/left distinction can bear the whole weight of the difference between any pair of enantiomorphs: that is, any such pair can be so described that a 'right'/'left' switch turns a description of either into a description of the other. In this section I shall show how such descriptions work, to show that in discussing incongruous counterparts it is convenient but not essential to use 'right' and 'left' or some other pair of terms which similarly refer to the two sides of the human body.

If the two boxes A and B are to be described by the use of 'right' and 'left', without anything's being assumed, it apparently cannot be done more simply than this:

> A: When **(1)** the line from its small cut to its small uncut face runs the same way as the line from your feet to your head, and **(2)** the line from its large cut to its large uncut face runs the same way as the line from your back to your front, then **(3)** the line from its middling cut to its middling uncut face runs the same way as the line from your right side to your left side.
>
> B: Switch 'left' and 'right' in that description of A.

The following would be simpler, but they make assumptions:

> A: When **(1)** its small cut face is downmost and **(2)** its large cut face is toward you, then **(3)** its middling cut face is to your right.
>
> B: Replace 'right' by 'left' in the above description of A.

Those simpler versions are accurate if you are on your feet and facing the box, or on your head with your back to it. They are wrong if you are on your feet with your back to the box, or on your head facing it.

What the longer descriptions make explicit is that we use 'right' and 'left' to express the difference between an object and its incongruous counterpart by fixing directions along two of the object's dimensions and then employing 'right' and 'left' to make the required distinction in the third dimension. (Here and throughout I ignore the mathematically sound but entirely unhelpful remark—e.g. in Wittgenstein 6.36111—that in a fourth spatial dimension A could be flipped over so as to become congruous with B.) To discriminate A from

B by reference to the human body in this way, we need to be able to pick out three axes of the human body and to be able to distinguish the two directions along each axis. It is harder to distinguish directions along the left/right axis than along either the head/feet or the back/front axis; but this fact, which connects with our being broadly and superficially left/right symmetrical, is irrelevant to the use of human bodies to discriminate A from B. My first description of B above could just as accurately have ordered a 'head'/'feet' or a 'front'/'back' switch in the long description of A.

We can also use 'right (side)' and 'left (side)' to distinguish the two sorts of hand, and not through the contingency about which sort of hand grows on which side (I now use a self-explanatory shorthand) :

> Left hand:
>
> > When thumb → little-finger runs with back → front, and wrist → fingertips runs with feet → head, then palm → knuckles runs with right-side → left-side.
>
> Right hand:
>
> > Switch 'right' and 'left' in the above description of the left hand.

But the two sorts of hand can be distinguished without reference to human flanks, just so long as we have some pair of enantiomorphs—e.g. the two boxes—to use as a standard:

> Left hand:
>
> > When thumb → little-finger runs with large-cut → large-uncut face of A, and wrist → fingertips runs with small-cut → small-uncut face of A, then palm → knuckles runs with middling-cut → middling-uncut face of A.
>
> Right hand:
>
> > Replace 'A' by 'B' in the above description of the left hand.

It is commonly believed that the distinction between a pair of enantiomorphs, when properly spelled out, must refer to the 'point of view' of an 'observer'; but this is false if it goes beyond the general point that any empirical distinction must, *qua* empirical, have a possible observer lurking in the conceptual background. The idea seems to be that we should describe A like this: 'When the line from its small cut to its small uncut face runs the same way as the line from the observer's feet to his head. . . etc.' But if a human body is used in describing A, why should it be an observer's body? A corpse would serve as well.

In any case, human bodies are not needed at all. It is sometimes said that we can distinguish enantiomorphs only because our bodies are asymmetrical in at least two dimensions, but this is false too. If our bodies were symmetrical about a point, we could still make the distinction we now make in terms of 'right' and 'left', the one exemplified by A and B; only we should have to express it in terms of something other than the sides of our bodies. Perhaps it is worth a paragraph to explain how this might be done.

Travelling from Ridge toward Lougheed, I must turn left at a certain corner to reach the University. If humans were spherical I might be told which way to roll at that corner by reference to the box A:

> If **(1)** small-cut → small-uncut face of A runs with ground → sky, and **(2)** large-cut → large-uncut face of A runs with turning-corner → Lougheed, then **(3)** middling-cut → middling-uncut face of A runs with the next part of your journey

That may seem to compare ill with the instructions I can in fact be given:

> If at that corner you **(1)** stand **(2)** facing Lougheed, **(3)** you must turn left before proceeding;

but this, though briefer, is not logically simpler. It spells out

into:

> If you so orientate yourself that **(1)** feet → head runs with ground → sky, and **(2)** back → front runs with turning-corner → Lougheed, then **(3)** right-side → left-side runs with the next part of your journey.

Also, it is routine work to construct definitions of 'A-turn' and 'B-turn' which would let us describe a route unambiguously and quite briefly by specifying where the spherical traveller should make an A-turn and where a B-turn. I have heard it insisted that if our bodies were spherical we could not remember the difference between A and B, or between A-like boxes and B-like boxes, or between A-turns and B-turns; but I know of no principles in the epistemology of spherical rational animals which could justify this claim.

Failure to grasp the conventions underlying our use of 'left' and 'right' has generated the mildly famous 'mirror problem': why does a mirror reverse left/right but not up/down? Martin Gardner (pp. 29–31) presents the only clear account I know of the solution to this: the answer to 'Why does a mirror. . . etc.?' is *It doesn't!* Your image in a normal mirror is a visual representation of an incongruous counterpart of your body, and we conventionally describe this sort of relationship as a 'left/right reversal'. But this convention does not pick out one dimension as privileged over the other two: it is merely a natural and convenient way of expressing the fact of enantiomorphism in a case where each member of the enantiomorphic pair has—like a normal human body—a superficial over-all bilateral symmetry. (Of course an object which was precisely and totally bilaterally symmetrical could not have an enantiomorph.) If we are to describe what an ordinary mirror does, in a way which really does select one axis of the body in preference to the other two, then we must say this: if you face the mirror, it reverses you back/front; if you stand side-on to it, it reverses you left/right; if you stand on it, it reverses you up/down. These facts, once they are properly described, do not offer a problem. They are explained by routine optics. For some deeper aspects of this matter, see the paper by Pears.

5. 'What is the difference?'

I am going to test the Kantian Hypothesis that the difference between right and left—by which I really mean 'the difference between anything and its enantiomorph'—can be explained only by showing and not by telling. Now, there is one way of taking this in which it is obviously false, the following being a counter-example:

> If you have a man on one side of you and a woman on the other, then you have either a man on your left and a woman on your right or a man on your right and a woman on your left, depending upon which side each is on.

Or we can tell someone what the difference is between the boxes A and B by giving him a mathematical description of each (the two descriptions will differ only in that one will have a minus sign before each value for x), and telling him that of these two descriptions one fits A and the other fits B.

In ways like these we can explain the difference: we can say what distinction is marked by 'right' and 'left', or what kind of difference there is between a pair of incongruous counterparts, without saying anything about how to tell which is which. Analogously, someone might learn what 'the difference between' blue and green is by being told that sunny skies characteristically have one of these colors and well-watered grass the other. Confronted with two shirts, say, he would then be in a position to say 'I know what the difference between these is—one is blue and the other green'; but he would not be able to say which is blue and which green.

When Kant says—in episode **(4)** of the long passage—that between two incongruous counterparts there is 'an inner difference which no understanding can show to be inner', he may mean that one could not explain in general terms 'what the difference is' even in this attenuated sense. If so, he is surely wrong. (Thus Weyl, p. 80. But Weyl errs in thinking that this is Kant's only point.)

The Kantian Hypothesis that I want to discuss says that we must use sensorily presented instances—must resort to showing—if we are to explain the direction of the left/right distinction, i.e. to explain which is which. I shall for brevity's sake go on using the phrase 'the difference between', but always intending it in this which-is-which manner. In my use, someone does not know the difference between right and left unless he knows which is his right side and which his left; and we have not told someone what the difference is between A and B unless we have equipped him to pick out A as distinct from B.

6. Tactics

A good way of examining how something could be explained is to consider how someone could discover that he has it wrong. So I shall invent someone—call him an Alphan—whose grasp of English is perfect except that he gives to 'right' the meaning of 'left' and vice versa. We have to see how he could learn of his mistake:

For a contrast case I shall take someone—call him a Betan—whose grasp of English is perfect except that he has switched the meanings of some other pair of spatial expressions. The Betan's mistake concerns the word 'between': he gives to the form 'x is between y and z' the meaning we give to 'y is between x and z'. (He thinks that the thing asserted to be between the other two is the thing whose name occurs between the names of the other two: any English sentence containing the form 'x is between y and z' is a kind of *picture* of what the Betan thinks it means.) The contrasts I shall draw between the Alphan and the Betan will not depend at all upon special features of betweenness—e.g. that it is a triadic relation, or that it concerns order rather than shape or size. Essentially the same contrasts could be drawn if the Betan had switched the meanings of 'large' and 'small', 'inside' and 'outside', 'round' and 'square', or any one of dozens of other pairs of spatial expressions. Nor does it matter that the Betan has not switched a pair of words. Pretend that English also contains 'botween', defined by

'y is botween x and z' = 'x is between y and z',

and then think of the Betan as having switched the meanings of 'between' and 'botween'.

Let us ask how the Alphan and the Betan can discover their respective semantic errors. In seeing how the two cases differ, we shall see that the Kantian Hypothesis is nearly true.

If the Alphan encounters a statement using 'right' or 'left' which he knows to be false given the meanings he attaches to those words, but which might for all he knows be true if their meanings were switched, he may guess that the speaker or writer is mistaken or lying. As such cases pile up, however, the Alphan ought to conclude that he has made an error—a semantic one. Similarly, the Betan will realize his mistake about 'between' if he encounters enough statements which he knows to be false on his understanding of them but which might for all he knows be true on the other relevant interpretation, i.e. the one which is in fact correct.

I shall take these to be the only ways in which either man can discover his error. Any corrective force that verbal definitions have can be expressed in the pattern of correction I have described, and it will make for clarity if everything is brought under the one pattern.

So our question about each man is: What true statements will he, interpreting them in his mistaken way, think to be false? The inquiry is not a psychological one. The intellectual responses of the Alphan and the Betan are dramatic embodiments of logical relations, so we credit them both with maximum alertness, intelligence, retentiveness, and so on.

7. Admissible evidence

Here are some boring ways of correcting the Alphan. Say to him 'I am now touching your right shoulder', while touching his right shoulder. Say to him 'Your right shoulder is the one with the birthmark', when he knows which of his shoulders has a birthmark and it is indeed his right shoulder. Say to him 'As I stood facing Boulogne, I had Dover on my left and Folkestone on my right', and give him a map of Europe or a look at Europe.

All these correct him by applying 'right' and 'left' to particular bits of the world of which he has relevant independent knowledge—from his own observation of those particulars, or from inspecting maps or pictures or statues of them. It is obvious—and the Kantian Hypothesis does not deny—that the Alphan can be corrected in ways like these, as indeed can the Betan. What the Hypothesis says, in effect, is that if we rigorously exclude all such references to particulars which are also known through observation, the Betan can still be corrected while the Alphan cannot. If we are to test the Hypothesis, therefore, we must deprive both men of any statements referring to particulars which they know about from observation.

We must also ban all English statements about particulars which the Alphan or Betan knows about from hearsay in languages other than English. Any attempt to capitalize on the Alphan's correct grasp of some pair of non-English synonyms of 'right' and 'left' would merely force us to redirect our inquiry—making us ask about his grasp of those other words rather than of 'left' and 'right' without altering the inquiry's fundamental nature.

So the English statements encountered by the Alphan or Betan are to say nothing relevant about any particular things or places or situations regarding which he has any relevant knowledge from any source other than what he reads in English. The word 'relevant' here means 'relevant to his semantic mistake', and it isn't always clear whether something is relevant in this way. Rather than constantly watching for hidden relevances, let us exclude more: the English statements encountered by the Alphan or the Betan are to say *nothing at all* about any particulars regarding which he knows *anything at all* from any source other than what he reads in English. This will be much easier to handle, and it cannot affect the validity of our results: anything allowed in by the weaker exclusion but kept out by the stronger must, *ex hypothesi*, be irrelevant to the matter in hand.

Think of each man as receiving an account, written in English, of some part of reality about which he knows nothing from any other source (and, in the meantime, forget that this involves his receiving ink-samples about which his correspondent might make comments in English). It is crucial that they are to know nothing about the described part of reality other than **(a)** general truths about it which hold true of all reality, and **(b)** truths about it in particular, or about particulars in it, which they learn simply from what they read in English. They can be in a position to say of something they observe, 'This is a thing of the kind the Englishman was referring to when he wrote. . . ', but never to say 'This is the thing the Englishman was referring to when he wrote. . . '. They must not even be in a position to relate

particulars described to them in English with particulars presented in any other way, apart from merely comparing them. So they must not be in a position to say 'This rain was caused by the atomic explosion the Englishman wrote about' or 'The mountain the Englishman wrote about is 7,568 miles NNE of my village'. It follows that among the things they must not know about the part of reality described to them in English is where it is in relation to themselves.

The line of exclusion I am drawing is not arbitrary or wilful. There is a good reason for depriving both Alphan and Betan of any independent knowledge, however remote and relational, of any particular they read about in English. Everything thus excluded is either irrelevant to our inquiry or else logically on a continuum with the trivial case where we touch the Alphan's shoulder while saying 'I am now touching your right shoulder'.

Even with all this excluded, the Alphan and Betan can still encounter millions of uses 'left' and 'right', or of 'between'. And they may still be able to judge some of what they read to be false; for one can reject a statement about a particular of which one has no independent knowledge, on the grounds that it conflicts with a generalization which one knows to be true. I heard the BBC say that 9,000 civilians would be evacuated from Aden within a year, at the rate of 500 per month: without investigating Aden I was entitled to reject that—the thing is logically impossible. In Shelley's *The Cenci*, a torturer says of his intended victim:

> As soon as we
> Had bound him on the wheel, he smiled on us,
> As one who baffles a deep adversary;
> And holding his breath, died.

I wasn't there; but I know that this report is false—Marzio cannot have committed suicide by holding his breath, because that is a physiological impossibility.

Of those two examples, one concerns a logical generalization, and the other a contingent, broadly causal generalization. I shall use this dichotomy in what follows.

8. Logical clues: the Betan

There are countless 'logical clues' to the Betan's error—that is, countless true statements which, interpreted according to his semantic error, will come out logically false. Here are two examples, with the Betan's pictures indicated in brackets:

(a) 'I sat between a silent old bore and a talkative young bore [I-bore-bore]. Since there were only two bores present, I resented having one on each side of me.'

(b) 'Since Baltimore is between Washington and New York [B-W-NY], and we were flying in a straight line, we passed over New York first, then Baltimore, then Washington.'

These bring the Betan's correct understanding of 'each' and 'side', and of 'straight' and 'first' and 'then', into logical conflict with his incorrect reading of the form 'x is between y and z'. With no independent knowledge of the dinner or of the flight, he nevertheless knows that there is something amiss with each statement or with his understanding of it.

Those statements are logical clues for the Betan only because he does understand all the other words correctly. Perhaps, then, we can shield him from logical clues to his error about 'between' by supposing that he errs also about other words such as 'straight' and 'each', and that these other errors match his mistake about 'between'. Can we do this? Can we credit him with a set of semantic errors which dovetail together so that no true statement will give him a logical clue to his having misunderstood 'between' or any of the other words in the set?

('Between' can conflict with itself, because the Betan would equate 'x is between y and z' with 'z is between y and x' but not with 'x is between z and y'. But since that is a special feature of 'between', and would not obtain for most of the examples I might have taken as contrasts to right/left, I cannot avail myself of it. The Betan is in enough trouble anyway.)

The first point to notice is that dozens of words have direct meaning-connections with 'between'. To remain sheltered from logical clues to his error about 'between', the Betan must err about the meanings not just of the words I have mentioned but also of 'symmetrical', 'lopsided', 'middle', 'pinch', 'trapped', 'separated', and many more.

Also, it is hard to see what semantic error we must suppose him to make in each case. In **(b)** for instance, will he give to the sentence 'We passed over New York first, then Baltimore, then Washington' the meaning we give to 'We passed over Baltimore first, then Washington, then New York'? It is not clear what underlying semantic error, concerning what word(s) or phrase(s), could generate that reading of the sentence.

Finally, if he is to have no logical clue to any of his semantic errors, then each error with which we initially credit him will presumably have to be matched by yet others, these in their turn by others again, and so on outward. I can't illustrate this in detail because, as just noted, I can't say what semantic error is required in any single case; but I am sure that if we could specify a semantic error which would produce a 'match' in a given case, it would be one which could remain unclued only if matched by further errors. For example, if we try to draw **(a)**'s sting by supposing the Betan to make a matching mistake about the word 'each', then we must protect the latter mistake from statements which connect 'each' with such words as 'both' and 'two' and 'neither' and so on. The Betan's semantic errors, in short, must ramify until they infect his understanding of most words in the language—and far beyond the point where we could still say that he does, with certain exceptions, understand English.

The proposed revision in our account of the Betan is, therefore, impossible.

9. Logical clues: the Alphan

What logical clues could the Alphan have to his error about the meanings of 'right' and 'left'? That is, what true statements might he read which, on his interpretation of them, would be logically false? Perhaps these would do:

(a) 'As I stood on the deck facing forward, a gun to my right fired a short burst. It was the starboard Oerlikon.'

(b) 'As a pitcher he is a southpaw—he can't pitch at all with his right hand.'

Confronted with either of these, the Alphan would smell a rat—provided he understood 'starboard' and 'southpaw' correctly.

Can we protect him from any such logical clues by crediting him with matching semantic errors?

It is encouraging that so few words are involved. Indeed, the only certain examples I can find —apart from ones drawn from very limited dialects—are 'port' and 'starboard', 'southpaw', the words for the four points of the compass, and a few cricketing terms. Also 'clockwise' and 'anticlockwise', if it is contingent that most clock-hands move clockwise. I have doubtless missed some, but not many.

Still, the language could have been otherwise. Screws might be called 'standard' and 'nonstandard' according to how they have to be rotated to be driven in, a right-handed golf club might be called 'a hogan' and a left-handed one 'a

charles', and so on. Let us pretend, as we easily can, that hundreds of English words are thus meaning-connected with the left/right distinction: *now* can we shield the Alphan from logical clues by the 'matching errors' move?

Easily! In each case we know exactly what the matching semantic error must be, namely a simple switch—of the meanings of 'port' and 'starboard', 'hogan' and 'charles', and so on. Furthermore, these errors need not ramify and infect words which are not directly meaning-connected with 'right' and 'left'. The initial set of switches completes the whole job, leaving the Alphan with no source of logical clues to his error about 'right' and 'left' or to any of his compensating semantic errors.

So we can, for example, comfortably suppose that he begins with his mistake about 'right' and 'left' and is smoothly seduced by it into his other mistakes without ever having, so far as meaning-relationships are concerned, the faintest hint that he has gone astray. The analogous supposition about the Betan collapses in chaos.

That, then, is my first contrast between 'left'/'right' and 'between'—indeed, I believe, between 'left'/'right' and any pair of spatial terms which is not equivalent to the left/right distinction. Our terminology for the left/right distinction, unlike any other part of our spatial terminology, has an extremely simple internal logical structure and is thoroughly insulated from the rest of the language. It is for those two reasons that good dictionaries, which do not define 'between' as 'the normal relation of the mouth to the nose and chin', or 'round' as 'the normal shape of the pupil of a human eye', do perforce define 'right' in terms of 'that hand which is normally the stronger of the two'.

10. Contingent clues: the Betan

I now drop logical clues to ask what 'contingent clues' either of our men could have to his semantic error. That is, what true statements can he read which, interpreted as he will interpret them, conflict with contingent generalizations which he knows to be true?

Here are some contingent clues for the Betan, again with his pictures indicated in brackets:

(a) 'James stood between a snow-clad mountain and me [James-mountain-me]: I could see him perfectly.'

(b) 'Finding myself between a sheer cliff and the oncoming tide [me-cliff-tide], I was naturally afraid that I should be drowned.'

(c) 'My brother flung himself between the gun and my body [brother-gun-me), so that the bullet hit him instead of me.'

Let us see whether the Betan can evade the force of all such contingent clues, in the following way. Each time he reads a statement which, on his understanding of it, conflicts with a generalization which he has hitherto accepted, he concludes that the generalization does not hold true in the part of the world described in the statement (call it 'England'). This would enable him to think that the statement is true on his interpretation of it, and is therefore not evidence that he has made a semantic mistake. It does not matter that he would be silly to try to neutralize each contingent clue by supposing that in England things happen differently. My question is: Can he succeed?

Well, under this strategy he must suppose that in England **(a)** things can be seen through snow-covered mountains, **(b)** the sea can scale sheer cliffs, and **(c)** bullets can swerve without being physically deflected. Furthermore, as clues accumulate, and as some occur containing 'because', 'since', 'so', etc., the Betan must suppose that these strange things

which can happen in England do regularly happen there in certain conditions: in England **(a)** an intervening snow-clad mountain *improves* one's view of dark objects beyond it, **(b)** waves *are drawn* up sheer cliffs by people at the top, **(c)** the availability of an alternative target *turns* a bullet in its tracks.

After dealing with variants of just three statements, the Betan already has a strange picture of English life; but there is worse to come. For one thing, each of his suppositions must be reconciled with the rest of what he reads about England, and this will force him into other, equally wild suppositions. (False factual beliefs, indeed, may not suffice. For our rules allow him to read such statements as 'In England waves are not drawn up cliffs by the presence of people at the top', which would require him to make a semantic error about—of all words—'not'.) And those three examples plus their progeny are only a tiny fragment of all the contingent clues he can encounter. There will be others, involving thousands of familiar, fundamental aspects of the behaviour of the macroscopic. world; and each will require him to think that England is different in the relevant respect and in hosts of other respects which follow from that.

If the Betan executes even a small portion of this clue-cancelling strategy, he will lose control of his picture of how things happen in England: it is humanly impossible to go any distance with this strategy. To take it all the way, however, is not just psychologically but logically impossible for the Betan as we have described him; for if we suppose him to adopt, remember, and retain all the beliefs about England demanded by his strategy, we must retract our original stipulation that he does, in the main, understand the English language. For example, we cannot say that he knows what 'bullet' means if he has endless false beliefs about how the things properly called 'bullets' behave, what they look like, what their structure is, and so on. Yet the proposed strategy, if applied to a suitable range of contingent clues, will indeed leave the Betan with hardly any true beliefs about bullets: when shown a real bullet he certainly won't classify it as an object of the sort called 'bullet' in English, and the longer he studies it the less inclined he will be to classify it thus. But this is just to say that he doesn't know what 'bullet' means—and the argument can be re-applied to virtually every English word.

So the proposed strategy is impossible. To save the Betan from correction by contingent clues we must try—as with logical clues—to credit him with matching semantic errors; and we have seen what that leads to. This result, like the one in §8, is not peculiar to 'between'. Other pairs of spatial words certainly yield the same result, and I conjecture that the story would run in essentially the same way for any meaning-switch involving a pair of spatial expressions, just so long as it was not logically equivalent to the 'left'/'right' switch. I shall give some evidence for this in §13.

11. Contingent clues: the Alphan

Here, perhaps, are some contingent clues for the Alphan:

(a) 'Most clock-hands move downward while to the right of center and upward while to the left of center.'

(b) 'I, like most people, am stronger in my right hand than in my left.'

These, on the Alphan's interpretations of them, may conflict with generalizations which he knows to hold true in Alpha, i.e. in that part of the world of which he has knowledge not gained through reading English. Can he disarm them by supposing that England differs from Alpha in the relevant respects? Yes, he can. This strategy is open to him as it was not to the Betan, for reasons which constitute the second big contrast between enantiomorphism and betweenness.

First, there are fewer contingent clues to the Alphan's error than to the Betan's. For every true generalization that becomes false under the 'left'/'right' switch there are hundreds that become false under the transformation of 'x is between y and z' into 'y is between x and z'.

Secondly, the beliefs about England which the Alphan must initially adopt under his clue-cancelling strategy will include only such items as that the English are mostly left-handed, that their hearts are on the right, that their clocks run counter-clockwise. None of these will ramify, demanding more and more suppositions about matters not directly concerning right and left.

Thirdly, each generalization which is challenged by a contingent clue to the Alphan's mistake concerns a relatively limited class of things. Where the Betan has to suppose the falsity (in England) of laws of elementary impact-mechanics which govern the behaviour of all middle-sized objects, the Alphan has only to suppose the falsity (in England) of certain generalizations about **(i)** classes of artefacts and other upshots of human decisions and conventions, and **(ii)** certain biological species. With one exception from sub-atomic physics, which I shall discuss in §14, the only generalizations I know of whose truth-value changes under the 'left'/'right' switch are ones which quantify over classes of one of these two kinds.

So the Alphan can easily believe what his clue-cancelling strategy requires him to believe. **(i)** Since the kinds of asymmetry in clock-movements, alphabets, rules of the road, positions of guests of honor, etc., are all matters of social choice, it is likely enough that in England 'they order these things differently'. **(ii)** Nor should the Alphan find it unbelievable that in England the relevant biological generalizations are false; for this is just to suppose that England differs from Alpha in its basic stock of biological material, like the supposition—which would be very believable if our planet weren't so well explored—that on some Pacific island there are green sparrows and white crows.

It would be different if the Alphan had to suppose that England contains animals with the proportions of mice and the bulk of elephants: he would choke on this, because it involves a ratio of leg-thickness to body-weight which goes against certain elementary and basic physical generalizations that hold true in Alpha. But nothing like that is involved in supposing that Englishmen are mostly left-handed, or in supposing, of a certain species of asymmetrical Alphan snail, that they do not occur in England though their incongruous counterparts do.

Another point worth noticing about these biological truths that become false under the 'left'/'right' switch is that most of them give rather specialized information. The strength of human hands and the placing of human hearts are exceptions to this; but I can think of no other generalizations of this kind which would be known to everyone who led a full, normal, observant, intellectually active life. This is in striking contrast with the ones the Betan has to wrestle with. In §14 I shall revert to this point.

12. The ambidextrous universe

There are endless matters which might seem to give the Alphan contingent clues which he cannot easily cancel by the proposed strategy. For guidance on these, and for other pleasures, see Martin Gardner's exceptionally fine book *The Ambidextrous Universe*. I shall discuss a few 'pseudo-clues' which I have found to be popular, showing that each fails in at least one of the three following ways: it is not a clue, because the generalization involved does not become false under the 'left'/'right' switch; it is not a legitimate clue because it breaks the rule forbidding reference to independently

known particulars; it is a clue which can easily be cancelled by the proposed strategy.

Mechanical phenomena won't correct the Alphan's error, but it is not obvious that this is so. Given a layout of billiard balls on a billiards table, and a choice of two ways (differing only as right and left) of striking the cue ball, the choice may make a big difference to the final positions of the balls. Does not this supply a basis for contingent clues for the Alphan? It does not. If the initial layout is symmetrical, then the result of striking the cue ball one way will be an incongruous counterpart of the result of striking it the other way, and so for the Alphan all will go smoothly. If the initial layout is not symmetrical, then the Alphan—interpreting our description of it according to his semantic error—will begin not with our initial layout but with its incongruous counterpart; and then striking the cue ball one way will give him a final position which is an incongruous counterpart of the one we got by striking it the other way; so again he will have no grounds for suspecting error. This example fairly illustrates the situation with regard to the entire range of mechanical phenomena.

Nor is there any guidance for the Alphan in the common run of electrical phenomena. Rules of thumb relating current-flow to direction of magnetic field, etc., will simply lead him to switch 'north' and 'south' as applied to magnets; and, short of the recherché matter to be discussed in §14, that switch would not ramify through causal laws or semantic links.

Of two enantiomorphic forms of a certain acid, only one reacts in a certain way with quinine. But that is a fact about the (asymmetric) form of quinine which happens to be the only one biologically available on our planet. Its enantiomorph is chemically and (given the right stock) biologically possible, and it would react in the given way with the other form of the acid in question. Like all other pseudo-clues involving organic molecules, this falls under the heading of generalizations over certain biological species.

As I implied in §9, the Alphan can get logical clues from the interrelations of 'north', 'east', etc., and so we must credit him with a meaning-switch in respect to these too: specifically, he must think that the orientation of any English map can be expressed in English by the pattern

suitably rotated. (Let's call this his 'compass-pattern'.) He may arrive at this through reading 'As one stands facing north, east is to one's right'; or, more elaborately, through reading how places in England relate to one another, these relations being expressed both in terms of 'left' and 'right' and in terms of compass-points. In the latter eventuality, he will find that his compass-pattern works beautifully on the map of England that he builds up. It will of course be a mirror-map of England, but it will give him no trouble unless he gets some independent knowledge of England—e.g. by trying to tour it with the aid of his map.

If he has a correct map of Alpha, can he comfortably impose his compass-pattern upon it? He has no right to assume that it belongs on his map at all; but never mind that. If he does try to impose it on his map of Alpha—or on Alpha—will he encounter any positive obstacles which will serve as contingent clues? To do so, he will have to have **(1)** something dictating how that compass layout should be rotated before being placed on the map of Alpha, and **(2)** something else casting doubt on that placement. That is, he needs two contingent correlates of compass-correlates which he is told are valid in England, and which concern

matters in respect to which he cannot easily believe that England differs from Alpha. This might be an example:

> 'North is the direction toward which compass-needles point. East is the direction from which the sun rises.'

One point to notice about these double-correlates which are needed if the Alphan's compass layout is to yield contingent clues is that if they can generate contingent clues at all they can do so without reference to 'north' etc., thus:

> 'As one stands looking in the direction toward which compass needles point, the rising sun is toward one's right.'

The vital point, though, is that the Alphan cannot have even one, let alone the needed two, of these correlates of 'north', 'east', etc. That is, he cannot have good reason to think that any such correlates which he knows to obtain in Alpha must also hold good in England.

Compass needles cannot help us to correct the Alphan, because they point south as well as north. That their ends are differently shaped, and how they are shaped, is a matter of convention.

Still, let us concede compass needles in order to get the sunrise to work. If the Alphan is to get a contingent clue from this, he must say: 'Surely the compass-direction of the sunrise in England must be the same as in Alpha!' But why should he say this? Not because a particular star shines on a particular rotating planet which contains both England and Alpha. Of the items which the Alphan knows about in ways other than by reading about them in English, he must not identify any one as *the item* to which the Englishman refers as 'the sun' or 'the earth (Terra)', though he may recognize some as *items of the kind* the Englishman calls 'sunlight' or 'stars', 'ground' or 'planets'. (I repeat that this niggardliness is not ad hoc or arbitrary. If the Alphan can read English statements about 'the earth' and 'the sun', and identify these with items known to him in other ways, then he might as well read about and independently identify the constellation Orion, or the box A in §4 above, or his right shoulder. From the point of view of the Kantian Hypothesis, any such use of an independently known particular is on a par with our touching the Alphan's right shoulder while saying 'I am now touching your right shoulder'. This does not make the Hypothesis trivial: its rules for the Betan are just as stern, yet *he* is deluged with logical and contingent clues to his semantic error.)

To mention just one more popular pseudo-clue: since the Alphan may not identify a particular planet—let alone its Northern Hemisphere—as the one containing both England and Alpha, he cannot have any contingent clues involving the direction from which the cold winds blow, or the like.

I cannot anticipate and criticize every plausible pseudo-clue to the Alphan's mistake, but my treatment of the ones I have mentioned may help to show how others should be dealt with.

It is time to consider what the Alphan is to make of the samples of English writing he receives. Clearly, he must not encounter English statements about these samples; and indeed if he encounters English statements about English writing in general—statements which become false under the 'left'/'right' switch—then he must suppose that his English correspondent eccentrically writes mirror-English, or that his missives come through a censorship office which photographs them and forwards the negatives, or some such nonsense. These are trivial details. What is not trivial is the following question. Suppose that the Alphan is somehow deprived of samples of written English, but is sent—in Morse-code English, say—very full instructions for writing English letters and words and sentences and paragraphs: what will he write if he follows those instructions

as he, with his 'left'/'right' switch, understands them? The answer is that he will, without any hitch or hesitation, write perfect mirror-English letters and words and sentences and paragraphs. Sceptics should try it for themselves. There are no clues for the Alphan here.

Of course it would have saved trouble if, following Borel (§§33–36), I had at the outset explicitly placed the Alphan and the Betan on a cloud-covered planet at a great distance in an unknown direction from ourselves. This would have had us communicating in Morse-code from the start; it would also have automatically ruled out all the biological, geographical, meteorological, and sociological overlap between Alpha and England, as well as much of the astronomical overlap; and thus it would have reduced the number of tempting pseudo-clues for the Alphan. I did not adopt this course because, although it would have made things easier, it would not have made clear just what sorts of overlap were being excluded or why they were being excluded.

13. Some other switches

When I first worked on this topic I contrasted left/right with large/small, but was charged with unfairly exploiting the fact that large/small is metrical. So I re-worked the contrast using 'between' instead. The latter, like anything else I might use, also has special features; but they have not essentially contributed to the contrasts I have drawn. To get prima facie evidence for this, consider how the story would go for certain alternatives to 'between'.

Had the switch involved 'large' and 'small' and their grammatical cognates, there would have been such logical clues as:

> 'My house is smaller than Jones's—indeed it is the same size as Jones's largest room.'

This and its like would require matching semantic errors involving 'part' and 'whole', 'inside' and 'outside', 'contain', 'surround', and hundreds more. And they would ramify: for example, 'surround' would infect 'grasp', 'penetrate', 'hole', etc. There would also be contingent clues:

> 'I couldn't see the water because the house between myself and the shore was so large.' 'The rock wasn't small enough for a child of ten to lift it.'

It is clear that a 'large'/'small' switch would be Betan rather than Alphan.

Suppose we had tried a 'round'/'square' switch. These words connect through logical clues with 'angle', 'smooth', 'equidistant', 'straight', 'curve', 'circle', 'triangle', and so on. And there would also be many contingent clues involving the role in English life of wheels, building bricks, land surveys, tree trunks, and so on. For example,

> 'Roundabouts are so-called because the path of someone riding on one is *round*. This is because roundabouts are built and operate as follows. . . '

with the blank filled by a correct account of how roundabouts work. Someone who had switched the meanings of 'round' and 'square' would have to adjust his semantics and/or his English physics in such a way that that account really would explain to him why the path of someone riding on a roundabout is square. Another Betan situation.

Perhaps I needn't offer details on 'near' and 'far', or 'inside' and 'outside', or 'toward' and 'away from'. These will very quickly connect, causally and semantically, with 'large' and 'small'—and we have seen where that switch leads.

What about 'head'/'feet' and 'front'/'back'? Either of these switches would generate a Betan situation, though an uninteresting one—like a switch in the meanings of 'teapot' and 'bread-board', or of 'nose' and 'elbow'. It could seem interesting only to someone who was still in thrall to the mistaken view, discussed in §4 above, that the human body

is essential to enantiomorphism rather than merely the basis for some convenient terminology for it.

The question 'What would happen with an "up"/"down" switch?', though it could be motivated by the same mistake, has more inherent interest. It is in fact hard to decide what a 'switch in the meanings of "up" and "down"' would be. The word 'down(ward)' can be defined as 'the direction of normal fall' or 'the direction toward the ground' or both; and analogously for 'up(ward)'. This suggests three possible interpretations of the switch, but I cannot control the details of any one of them. Part of the trouble is that the logical/contingent dichotomy, which has served well enough for the other switches, lets us down here. 'The direction of normal fall' connects with 'the direction toward the ground' at least to this extent: if those two directions were different we should have no objects left except ones that were fixed to the ground. Is that a merely contingent matter?

Still, without knowing just what an 'up'/'down' switch would be, I think I can show that it would have to be Betan rather than Alphan.

Suppose the contrary. Suppose there is a Gamman who understands English except that he has switched 'up'/'down' and certain related pairs such as 'above'/'below'. He reads many statements about England, interprets them according to his matching set of semantic errors, and believes them. If he is to be analogous to the Alphan, the Gamman's false beliefs about England must not be so far-reaching as to conflict with the postulate that he mainly understands English. So we must suppose that if he came to England with expectations based on what he had read, he would find it fairly much as he had expected, and yet unlike his expectations in some systematic respect.

What respect? The fact that we don't bounce around on our heads? The fact that unimpeded objects don't tend to shoot up into the sky? Anything along the lines of either of those mistakes would obviously generate a Betan state of affairs, not an Alphan one. The only other suggestion I have heard or can think of is this: 'He expects unimpeded objects to shoot upward toward the ground—i.e. he has false beliefs about the direction of object-fall in England and about where the English ground is in relation to the English sky.' But those two 'false beliefs' cancel out. The Gamman, in this version of him, would get no surprises if he arrived in England; which is just to say that his English reading has not been infected by any semantic error.

What about a switch in the meanings of 'before' and 'after'? Nothing in my paper requires an answer to this question; and that is just as well, for even a sketchy answer—which is all 1 know how to give—would take up far too much space.

14. The conservation of parity

The principle of the Conservation of Parity says in effect that if in any general truth of physics we substitute 'right' for 'left' and vice versa, the result will also be a truth of physics. This principle, though long accepted, is now thought to be false: work which began in Princeton in 1956 has satisfied physicists that there is a basic physical law which becomes false under the 'left'/'right' switch.

The point could be put as follows. Suppose that we have two experimental set-ups with initial states I_1 and I_2 and resultant states (arising from the initial ones in ways that can be wholly explained by basic physical laws) R_1 and R_2. The Parity principle implies that if I_1 is an enantiomorph of I_2 then R_1 is an enantiomorph of R_2; and it now turns out that this is sometimes false.

Our Alphan can now be exposed to contingent clues with far more force than any so far mentioned. Let us send him

a description of a Parity-refuting experiment, with initial state I_1 and resultant state R_1, and suppose that he tries to reproduce the experiment in Alpha. He will in fact start not with I_1 but with its enantiomorph I_2, and he will end up with a resultant state R_2 which is not an enantiomorph of R_1. So the resultant state won't be the one the Englishman predicted, nor will it be the one that the Alphan, with his semantic error, thinks the Englishman predicted. This should lead the Alphan to suspect that he has misunderstood the English description of the experiment, and if he perseveringly tests that suspicion he will learn what the misunderstanding was.

If we are to prevent this, we must try one of two courses.

(i) We may try to credit the Alphan with further semantic errors such that he will understand the English description of R_1 as an accurate description of R_2. But this takes us back into Betan territory; for these semantic errors—concerning words which are not meaning-linked with 'right' and 'left'—would ramify into the rest of the language. I believe the Alphan would in fact have to switch the meanings of 'more' and 'fewer' or some equivalent pair of terms (see Gardner and Frisch), and that switch would obviously lead the whole Alphan story to collapse.

(ii) We may present the Alphan as supposing that if he had performed his experiment in England it would have come out differently. But if he thus distinguishes sub-atomic particles into 'the ones we have here in Alpha' and 'the ones they have there in England', he will be cutting a very poor figure. Anything which seems to be a fundamental physical law may turn out to be a relatively local accident, but a scientist in his right mind would not accept such a conclusion if he could rationally avoid it. The Alphan has an alternative staring him in the face, namely that he has switched the meanings of 'right' and 'left' and therefore constructed I_2 instead of I_1.

At long last, we have got him. (I here suppress more recent developments and discoveries in the physics of this matter, as they lie beyond the scope of my present concerns. For details, see Gardner, *op.cit.*

This certainly refutes the Kantian Hypothesis as I formulated it: we can now *tell* the Alphan which is which as between right and left. But then we could have told him anyway, using 'port' and 'starboard'. The fact is that the Kantian Hypothesis has served less as a sharp-edged proposition than as a guide to the exploration of some contrasts between enantiomorphism and other spatial distinctions. And those contrasts have not been entirely lost.

Despite the failure of the Parity principle, it remains true that the left/right distinction constitutes, so far as meaning-relationships go, a self-contained unit with simple internal relations and no external relations—that is, no ramifications into the rest of the language.

What of the other contrast? Well, the generalization which we are now using to correct the Alphan is not one which he can easily suppose false in England—it is neither sociological nor biological, but is a matter of fundamental physics. Still, there is a contrast between it and the kinds of causal law which were available for correcting the Betan. Quite recently, two Nobel Prizes were awarded for the discovery of a physical law which does not survive the left/right switch, and so knowledge of that law is a perfect paradigm of specialized, non-common knowledge. Someone who grasps all the underlying fact and theory will not find the law 'easy to suppose false'; but we can lead busy, observant, intelligent lives without having the slightest need to think that the law is true. This situation could change, if our technology came increasingly to depend upon the law in question; but knowledge of that law and of any asymmetries depending upon it is, and will long continue to be, optional

intellectual equipment. So, even with the failure of the Parity principle taken into account, the right/left distinction (by which, always, I mean the distinction between the members of any enantiomorphic pair) still differs enormously from every other spatial distinction: it remains unique in its degree of isolation in the layman's language and the layman's *Weltanschauung*. Is it too ambitious to suggest that these simple facts help to explain physicists' surprise at the failure of the Parity principle?

It cannot be a coincidence that there are these two differences—logical and contingent—between enantiomorphism and other spatial distinctions. I am sure that the differences which show up semantically ('logical clues') are to be explained by the differences which show up in the extra-linguistic world ('contingent clues')—the explanation depending upon the fact that our language is our reasonable attempt to cope with that sort of world.[1]

[1] A version of this paper was read to several philosophy departments in 1966 and 1967, and was much helped by the comments and criticisms of many people to whom, though I cannot separately name them, I here express my sincere thanks. In other ways the paper has benefited from the generous collaboration of Lewis White Beck, D. G. Brown, Martin Gardner, James G. Hopkins, and Douglas F. Wallace, to all of whom I am deeply grateful.

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