PART II

The Hemispheres & the Paths to Truth

A philosophic outlook is the very foundation
of thought and of life. The sort of ideas we attend to, and
the sort of ideas which we push into the negligible background,
govern our hopes, our fears, our control of behaviour.
As we think, we live. This is why the assemblage
of philosophic ideas is more than a specialist study.
It moulds our type of civilization.

ALFRED NORTH WHITEHEAD[1]

'True philosophy entails learning to see the world anew.

— MAURICE MERLEAU-PONTY[2]

1 Whitehead 1938 (87).
2 Merleau-Ponty 1945 (lxxxv).

WHAT IS TRUTH?

> Truth is a noun only to God; to men, truth is really best known as an adverb, ‘truly’.
>
> —*Rabbi Jacob Agus* [1]

IN PART II, I WANT TO MOVE BEYOND CONSIDERATION OF THE DIFFERENT *means* made available by each hemisphere, to a consideration of the different *paths* human beings have adopted, in their approach to a truer understanding of the world we inhabit. I take it that these can be encompassed under the very broad, and to some extent overlapping, headings of science, reason, intuition and imagination. In the case of each path I will examine its claims to lead us towards truth, particularly in the light of what we know about the hemispheres.

In these times especially, truth is a pressing question for all of us; it is not enough to leave it to academic philosophers only. That’s in part because our beliefs about it not only help make the world what it is, but make *us* who we are.

No single overarching theory of truth can encompass everything we would wish from such a theory, and indeed truth is never finally known; but that does not in any way invalidate the attempt. We can at least point to what is unlikely to be the case, and indicate a more reasonable path to pursue. And if our aim is to take a new look at what we mean by reality through the lens of the hemispheres, we must begin with the nature of truth;

for each hemisphere is likely to have a different approach to truth itself, as to everything else.

That does not, however, entail that each idea of truth is equally valid. Indeed, one of the conclusions of this chapter, and ultimately of this book, is that one hemisphere's idea of truth is likely to be more fruitful than the other's. As we have seen in Part I, the aspect of reality revealed by the left hemisphere must be contextualised by being taken up into the broader, and deeper, overarching vision available to the right hemisphere; alas, when the left hemisphere takes the lead, it leads us astray. As always, it is a good servant but a poor master.

But if reality is always mediated by the two hemispheres, how can one decide which is more veridical? It has even been put to me that one would need a third hemisphere, so to speak, to decide. This is a lovely idea, but of course why stop there? How would one decide that the third had got there, unless there were a fourth, and a fifth, and so on? But this is to make a basic mistake.

I believe that, despite our always contributing to the reality we experience, there is *something* apart from ourselves to which we *can* be true – that reality, in other words, is not purely *made up by the brain*. There is a relationship there – something to be *true to*. Assuming there is something there to know implies that some understandings will inevitably be better than others. And since each hemisphere provides a different understanding of it, it is perfectly coherent – and indeed necessary – to ask which is superior. (The validity of the question is not affected by the observation that we can, and may be best to, use both.) If a pilot is flying blind and has two navigation systems to rely on, each of which, though they differ, provides significant information, the criterion for having to prefer one over the other is clear: following which one is less likely to lead to a crash. Or again, as a piece of music cannot be experienced without a player, who inflects what it is that we hear, there is nonetheless such a thing as a better or worse performance, one that is more or less faithful to the potential enshrined in the piece – a potential that *is*, essentially, the piece of music, and becomes realised in every true performance. The arbiter, then, in either case, is the experience of the whole embodied person as he or she responds to a more, or less, accurate – a richer, or poorer – account of the world.

Furthermore, if one such account, rendering or assessment was better able, at the same time, to incorporate the best of what was seen by its

counterpart, we should clearly prefer the one that saw the bigger, and better integrated, picture.

What would clearly be crazy would be to use the poorer system only: to admit only the poorer performance. That’s the point at issue here. Because our current condition in the modern world, I suggest, is the consequence of doing just that.

EXPERIENCE: PRESENCING VS RE-PRESENTATION

The single most profound difference between the hemispheres, which I will have cause to return to repeatedly, is the distinction between the experience of something as it 'presences' to us in the right hemisphere, and as it is 're-presented' to us in the left. Just because we so rarely deal with the world nowadays except as it is represented, and because we are used to mistaking the representation for the thing itself, the full significance of this may not be apparent. Yet as our awareness moves from one to the other, an extraordinary transformation takes place, like moving from a photo album into the living space that was photographed. The two are not necessarily in conflict, but neither are they at all the same kind of experience.

The word 'presences' is important, but sounds unnatural. Unfortunately we don't have an available everyday term, or I'd use it. This in turn is fascinating: why don't we have a verb to describe the experience of an encounter with reality that strikes us at once as of fundamental importance? The experience not being part of the left hemisphere's repertoire, language has side-lined it. To 'presence' is not the same as to 'be present', which is too finished and inert, leaving little place for whatever is there to play an active part in the encounter; or, worse, to 'be presented', which is passive, and gets dangerously near to 'being re-presented'. The shift from the noun ('presence') to the verb form ('to presence') signals a shift from a passive state to an active process, from a thing to a dynamic, two-way relationship. Historically English-speaking philosophers have adopted the verb 'to presence' as a way of translating Heidegger's use of *anwesen* – though he, too, had to re-invent the verb from what, by his time, existed only as a noun. What I believe he meant by this word is something like to 'reveal or disclose itself to us', to 'come into being for us', with all the vital, pre-conceptual, active freshness that that suggests.

The whole of Merleau-Ponty's philosophy of embodied understanding depends, in one way or another, on a fundamental distinction: that between two modes of encountering the world, which he calls '*je pense*' and '*je peux*'.[2] The first deals with a mental representation in which we are quite separate from the world, and the question is, then, how our thoughts can be said to relate to that world; the second is an intuitive embodied awareness

of the world in which we are already fully situated, a field of potential for interaction, something that comes prior to any conscious re-presentation. I believe he was articulating the intuited difference – as have many philosophers, including Bergson, Peirce, James, Heidegger, Scheler, Sartre and Wittgenstein – between the world as understood by the left and right hemisphere, respectively.

Presencing is what the world does less of as we grow older. Wordsworth, the power of whose poetry is, precisely, that it causes the world to presence to us once more, famously lamented that 'shades of the prison-house begin to close upon the growing boy'.[3] The effect is accentuated in an era where so much of our experience comes already conceptualised in such a way that we are shielded from its awe-inspiring reality. So often now it comes in virtual form, second-hand, and pre-digested. Though she was writing more than a hundred years ago, Evelyn Underhill already saw the troubling modern submission to the world of representation, and expressed it, I think, brilliantly:

> It is notorious that the operations of the average human consciousness unite the self, not with things as they really are, but with images, notions, and aspects of things. The verb 'to be', which he uses so lightly, does not truly apply to any of the objects amongst which the practical man supposes himself to dwell. For him, *the hare of Reality is always ready-jugged*:[4] he conceives not the living, lovely, wild, swift-moving creature which has been sacrificed in order that he may be fed on the deplorable dish which he calls 'things as they really are'. So complete, indeed, is the separation of his consciousness from the facts of being, that he feels no sense of loss. He is happy enough 'understanding', garnishing, assimilating the carcass from which the principle of life and growth has been ejected.[5]

One example of this process in action, and one which has already been, and will continue to be, important for the argument of this book, concerns our relation to space and time. The process of *re*-presentation, of (literally) striving to make something present again as it were 'after the event', ignores the significance of time. This is already a considerable step away

from reality. When we think about time, only a massive effort of will can prevent us substituting a one-dimensional representation – time as a line in space – for the full experience that is understood only through our embodied intercourse with the world as it *presences*. Space, too, is reduced to the world's two-dimensional representation – as if projected on a screen. We are so used to giving in to this virtualising and distorting process that we don't even notice that we are doing it. Since space and time are where we live, that is a pretty important fact: I will have much more to say about that in Part III of the book.

If the hemispheres generate different worlds, one that broadly presences and one that is effectively represented, this has consequences for the attempt to make sense of the world, otherwise known as philosophy.

TRUTH: AS A THING OR AS A PROCESS?

From everything we know about the hemispheres, we would expect that, in the left hemisphere's world, truth would be conceived as a thing, rather than a process. (It might be abstract – indeed it would have to be abstract, since that is how the left hemisphere deals with the world – but it would still be the abstraction of a thing.)

Truth, this thing, would be conceived of as existing in the realm of subjectivity (in the mind) as a suitable representation of something conceived of as existing in a realm of objectivity (outside the mind). From this point of view, the way to approach truth would be to start with a secure set of facts, and then work upwards by rules of logic, to a series of other facts, putting one secured item on top of another, to build the pyramid of (represented) truth. In principle, this truth would be impersonal, something that could be transmitted, as it stands, directly to another; timeless and unchanging – and independent therefore of context; ultimately single, in that if the path is rigorously followed, everyone should reach the same conclusion; and ultimately perfect, precise and certain – theoretically attainable goals that are *not yet* achieved, so the argument would go, only because we have not yet concluded our deliberations.

Note the words 'representation', 'fact', 'perfect', 'precise', 'certain', 'concluded'. What do these words have in common?

They all suggest a process that has now stopped. Something that *was*. Motion, time, flow are replaced by stasis, eternity and fixity. Look at the lineage of the words. (I accept, of course, that words change their meaning over time. However, through etymology they disclose to us the patterns of thought that lie at the foundations of our culture and are built into the history of our ideas. As familiar, by now – and as invisible – as the air we breathe, we no longer recognise them for what they are.)

All these words come from Latin roots:

- *Representation* speaks for itself. The word *present* comes from the present participle *præsens* of *præ-esse*, meaning 'to be there in front of' (the speaker). *Re-presentation*, then, is the attempt to

make something appear ‘in front of’ the subject *again*, after the fact: something that is by definition no longer actually there.
- *Fact* is from *factus*, past participle of the verb *facere* ‘to do’ or ‘to make’, and it means a ‘something that has been done (or made)’ – and is now in the past, and no longer there.
- *Perfect* is from *per-fectus*, another past participle of a similar root, *per-facere*, by adding the prefix *per-*, meaning ‘through’: to do (or make) completely or thoroughly (or, as we used to say, ‘throughly’) – thus what is perfect is ‘that which has been done through to completion’.
- *Precise*, as mentioned, is from *præ-*, before, + *cisus*, cut, past participle of *præ-cidere*: literally ‘having been cut off before its time’.
- *Certain* comes from *certus*, originally the past participle of *cernere*, to decide or determine; ‘something that has been determined’.
- And *concluded* is from *con-*[intensifier], + *claudere*, to shut – to ‘shut off’ or ‘lock up’ completely.

My point is not a narrowly grammatical one, that they mainly derive from past tense formations – after all, even the word ‘process’ comes from a Latin past participle. My point is, rather, the intrinsically completed nature of the idea in every case, which the grammar naturally reflects. A ‘process’ is not generally completed at the moment it is alluded to, but is temporally open: it may be continuous, and ever more coming into being. A ‘fact’ is, however, intrinsically finished, or ‘established’, as we say – which means standing firm (cf ‘stable’), unmoving, where it is. A fact is a thing, not a process.

While this view of the world, which characterises the left hemisphere, allows for the possibility of change, that change has to be accomplished by a series of, in themselves static, steps – not a flow. It is the substitution of one, in principle, fixed, static ‘fact’ by another, like the succession of static stills that produce the effect of motion in a ciné film – until the final ‘facts’ are reached. And then the film ends.

So, how would the right hemisphere conceive truth? Rather than conceiving it as a thing, it would experience it as a process, one that, in this case – not just for now, but in principle – has no ending. More importantly,

it would see that truth is a *relationship*. Instead of seeing a subjective realm and an objective realm which should as near as possible mirror one another, it would see a constant *reverberation* between two (never completely distinct) elements within our consciousness – thoughts and experiences – whereby they '*answered'*, or co-responded to, one another; this ever better *accord*, or *attunement*, would *be* the evolving truth. It would be intrinsically incomplete, but constantly in the process of completing itself; and uncertain, though constantly approaching nearer to certainty; incapable of being grasped except through embodied being, through a consciousness that is in the flesh and *engaged* in the world. We would find out what was true only by testing it on the pulse of experience – whether it corresponded with the totality of our experience, not just with one (cognitive) part of it. Because of this it would be unique and necessarily many-stranded.

Please note, nothing about this right hemisphere view suggests that the pursuit of truth becomes pointless – on the contrary, it is demanded. This is not an invitation to give up on something difficult: rather it summons a disciplined attentiveness and an open and active receptivity to the task. Agreement, common ground, can still be, and needs to be, reached, because experience of the world is not random. Truth is emphatically not a free-for-all, a matter of individual whim. Many things – most of the really important things in our lives – can never be proved, but are nonetheless far from being a matter of 'anything goes'. Here Ricoeur comes to mind:

> If it is true that there is always more than one way of construing a text, it is not true that all interpretations are equal … The text is a limited field of possible constructions. The logic of validation allows us to move between the two limits of dogmatism and scepticism. It is always possible to argue for or against an interpretation, to confront interpretations, to arbitrate between them, and to seek for an agreement, even if this agreement remains beyond our reach.[6]

We cannot force an opinion about what is good or beautiful on someone who is not prepared to accept it. Yet, as Edmund Burke noted, there is more likelihood of agreement in such judgments than in reasoned argument:

> There is rather less difference upon matters of taste among mankind, than upon most of those which depend upon the naked reason … men are far better agreed on the excellence of a description in Virgil, than on the truth or falsehood of a theory of Aristotle.[7]

Returning to my description of how the right hemisphere might conceive truth, note the words: ‘reverberation’, ‘answer’, ‘accord’, ‘attunement’, ‘engagement’. In contrast to what we saw earlier, they involve motion, reciprocity, energy.

- *Reverberation* comes from Latin *re-*, again, *+verberare*, to beat, meaning ‘the return of a beat’.
- *Answer* comes from Teutonic roots *and*, + *swara*, and means affirming (as in ‘swearing’) something in *reply* (the force of the old Teutonic word, *and*).
- *Accord* comes from Latin *con-cordare*, from *cor*, the heart: literally ‘to bring heart to heart’.
- *Attunement* means to bring the tune or ‘tone’ of one thing towards (*ad+*) another – the word ‘tone’ itself coming from Latin *tonus*, a ‘stretching, or tension’.
- *Engagement* means a ‘pledge’ or sworn agreement (as in what comes before marriage), from Old French *gage*, something of value given in exchange for action (in its Teutonic form, it is related to the word ‘wed’).

And that leads one to the meaning of the word *truth* itself.

We now tend to think of truth as a matter of propositions. The word ‘truth’ in its origin indicates not a proposition, but a disposition. ‘True’ (cf German *treu*, faithful) is related to ‘trust,’ and is fundamentally a matter of what one believes to be the case. Truth and trust (belief) go together. One cannot have trust in a society where there is no truth; and one cannot be true to a society in which there is no trust. That is of fundamental importance, since, as Confucius told his disciple Tzu-kung, for a stable society a ruler needs three things: weapons, food and trust. If he cannot hold all three, he should forgo weapons first, and food next; for ‘without trust we cannot stand’.[8]

The Latin word *verum* (true) is cognate with a Sanskrit word meaning to choose or believe: like one's loved one, the one in whom one chooses to believe and place one's trust, to whom one is 'true'. We used to speak of plighting one's 'troth' (an older form of the word 'truth'). And we still speak of two surfaces that 'marry' well as being 'true'. They meet and therefore are 'meet'; they fit and therefore are 'fit'. It is a matter of fit – and fidelity.

Belief too is about fidelity (Latin *fides*, faith). The word 'belief' has nowhere buried in it the idea of signing up to a proposition, certain or uncertain. It is not a matter of cognition, but of recognition. The word belief comes from the same root as the word 'love', a sense preserved in the now archaic word 'lief', familiar to us from Shakespeare, with which one once described one's friend, sweetheart, or lord – someone in whom one believed. Similar considerations apply to the German *glauben* (related to *lieben*, to love), and to the French *croire* and other derivatives of Latin *credere*, a word which meant originally to 'entrust to the care of' (the sense lingers, in reduced fashion, in the idea of 'credit'), and originally to 'give your heart to' (possibly from Latin *cor do*; certainly involving Proto-Indo-European root *kerd*, heart). Belief is about a relationship, in which by definition, more than one party is involved. The believer needs to be disposed to love, but the believed-in needs to inspire another's belief or trust. Whether this amounts to being worthy of that belief cannot be fully determined in advance. It emerges only through commitment and experience.

Etymology is hugely revealing. Slippages in meaning tell us about the direction in which we may have drifted without even being aware of the drift, much as rifts in the bedrock speak to us of continental drifts that made the landscape in which we live, but which we cannot perceive. The left hemisphere regards words as tokens that can be manipulated to mean what we like, not living, embodied signs, with a history. That way danger lies: so-called 'post-truth' being one. I repeat, I am not trying to rewrite the meaning of words, but precisely the opposite: in an age when language has become deracinated (which literally means, like a flower uprooted) from its embeddedness in a community of human beings, I am merely showing how we have got where we are now. History is always relevant, because life is not a series of moments, but a continuous flow. One of the most ignorant remarks ever made, representing the machine world view for which we are

now paying, and will continue to pay, a very high price, is Henry Ford's 'history is bunk'.

Be that as it may, I think it possible that some of the disagreements in the debate about truth start with these broad differences in whether we see 'truth-as-correctness', a thing that can be determined, and into which nothing of us enters; or 'truth-as-unconcealing', a process of something revealing itself to us only through our experience. (Heidegger often used the Greek word for truth, *aletheia*, which literally means 'un-forgetting', allowing something to emerge from oblivion.)

How do we decide which way of conceiving truth is truer?

First, notice that a process, unlike a thing, suggests the importance of not just the whatness, but the howness. There are no deep truths that are separate from the manner in which they are expressed. As the philosopher Friedrich Waismann puts it:

> If you ever try to put some rare and subtle experience, or a half forgotten impression, into words, you'll find that truth is intrinsically tied up with the style of your expression: it needs no less than a poet to render fully and faithfully such fragile states of mind.[9]

Which is why we honour poetry as a path to truth. As I will argue, the most fundamental truths, of both a physical and psychical nature, can ultimately be expressed only in terms of poetry. And Waismann points out that the meaning of the word *truth* differs with context, so that it has 'a *systematic ambiguity*', as have deceptively simple sounding words such as *fact*, *statement*, *knowledge*, *law* and many others.[10]

WHO CORRESPONDS WITH WHAT?

There are a number of conventional ‘families’ of approach to truth. I can’t pretend to do justice to the subtle disputations on this theme that have occupied some of the cleverest minds in history (some such disputations, nonetheless, especially in the last century, being more notable for the heat, than the light, they generated, at least in my view). What I offer in the rest of this short chapter are some elementary reflections on the main ways in which truth has been regarded, the bare minimum necessary to act as an introduction to the next few chapters, in which I will discuss the possible *paths to* truth.

The idea of truth always implies *some* sort of correspondence. One major strand in thinking over the centuries is, indeed, known as ‘correspondence theory’: that truth lies in a correspondence between what goes on in our minds and a mind-independent reality. The closer the two come, the more we can speak of truth. According to such a view, understanding is the forging of links between symbols in the mind and that reality, such that it is accurately represented internally. This is intuitively appealing. But, since according to this view we have no direct contact with reality, and we cannot know anything except as we know it, how, according to this view, could we know whether our knowledge is true to what is ‘out there’, before the very fact of our knowledge of it has been substituted for it? Is there, in fact, such a thing as a world that just simply is ‘out there’ – wholly mind-independent – at all? Does this not already set up the left hemisphere’s idea that all we experience is a re-presentation?

The classical counterpoint to correspondence theory is ‘coherence theory’: that truth lies in the cohesion of what it is that goes on in our minds. If something coheres with – and, moreover, mutually sustains – other things that we hold to be true, it may be regarded as itself true. Otherwise it is false. Here there is still a correspondence, but it is not between what ‘goes on in here’ and what ‘goes on out there’, but between the elements that ‘go on in here’.

Coherence also has an intuitive appeal, but has its own problems. A whole set of beliefs could be mutually coherent and entirely false: everything depends on where you start from. How are we to judge the best

place to start? If we believe the world is flat, we can hold a myriad of ideas that are coherent with that – but wrong. What's more, why do we suppose that truths may not conflict? Opposites may both be true. It's possible, I agree, to have amongst your beliefs an overarching belief that contradictory statements may both be true, but this seriously undermines the usefulness of coherence as a criterion of truth.

As the philosopher Anthony Quinton pointed out, a solution that involved the 'close interweaving of the correspondence and coherence theories' would be progress, and would 'explain why the conflict between them has continued for so long'.[11] I will discuss shortly, a way in which I believe something like this hoped for rapprochement can be realised.

There exist, naturally, further possibilities. 'Consensus' theory holds that what is true is what is generally accepted to be the case. The correspondence here is between the views of different individuals. This is beguiling, but hardly convincing. For one thing, if people generally held consensus theory to be false, and many people do, it would be a non-starter, because it would be itself untrue. Leaving that aside, how would one determine in practice the outcome of a potentially infinite series of referenda? Moreover, fairly obviously, the majority can be mistaken: the world is not flat, though at one time the majority may have thought it to be so. And how could any new truths be discoverable? At the outset almost everyone would consider them false – and they would therefore have to *be* false.

There are a number of 'deflationist' – or in my view, more accurately, defeatist – versions of truth. One holds that the whole idea of truth adds nothing to a linguistic assertion that something or other is the case, and should therefore be abandoned. 'Relativist' versions suggest that, since there is no one clear truth, everything being context-dependent, once again the whole idea of truth needs to be abandoned, each of us having our own truth. 'Social constructivism', at least in its strong version, suggests that truth is simply fabricated by society, being in effect what that society holds to be true – an invention that, according to some, is used by a powerful elite to disenfranchise others.

I suggest that both the disappointed hopes for truth here, and the rejections of all hope for truth here, are equally mistaken, and equally based on a belief in truth as a thing: 'truth-as-correctness'. This is what I have suggested is the left hemisphere's path. And we see classic left hemisphere

characteristics: fear of uncertainty, coupled with its black and white ('either/or') manner of conceiving the world, playing an unhelpful role: either truth is certain (at least in principle, even if we never attain it, as in science), or it doesn't exist. Or at any rate, if it does exist, it can't be of any use. Remember the left hemisphere's raison d'être is utility in the service of manipulation. If the matter can't be usefully demonstrated in such a way that it compels a conclusion – if it is in other words, no longer *coercive* – it has no use, no 'function'.

It might be pointed out, however, that two thousand years of insistence, in the West, on the idea of truth as single, timeless and correct has demonstrated only how multiple, contingent and fallible it seems to be, since it has notably failed to coerce the wisdom of philosophers to any one point of view. The ambition of being able finally to demonstrate truth to someone incapable of seeing, or determined not to see, what one means is a complete waste of time. Why should truth have a coercive quality?[12] Truth might be more a matter of something to which we are drawn freely as it were 'from in front' – attracted – rather than compelled inevitably 'from behind' – pushed. Very little that we take for granted as most essential to life – love, energy, matter, consciousness – can be convincingly argued about, or even *described*, without becoming ultimately self-referential. You have to experience it to know it: all we can do is point.

Correspondence theory founders on the unworkable idea that we could know what something is like when we are not knowing it. And all the alternatives compel in one way or another the conclusion that we are like prisoners in a cell, with no window giving directly on the world: it is implicitly assumed that, because we can't know a reality without 'our knowing it' entering into the equation, therefore we can't know reality. As a result, what we decide to be true must be determined by our own minds, as we discuss amongst ourselves what reports we have of where we are and what we know. It's just what makes sense linguistically in relation to how we act. If our image hangs together internally, or is generally agreed to be the case, or makes linguistic sense, that's the best we can hope for. And according to the other theorists truth is not a helpful concept anyway and should be abandoned.

STICKING WITH THE CONCEPT OF TRUTH

I wouldn't give up on truth that easily. After all, truth may rarely be pure and never simple, but it sure as hell exists – even if one sign that we were certainly deluded would be certainty that we were in possession of it. Uncertainty here is not a sign of failure, but lies deep in the nature of what we are trying to grasp. Truth is uncertain not because it is *empty*, but because it is *full* – rich, complex, manifold. (This is related to what I believe to be the mistaken assumption that because we cannot pin down the 'meaning' of the world in which we live, it *has* no meaning: I will argue that this experience comes not from there being no meaning, but from there being a plenitude of meaning, beyond simple articulation.) Some postmodernists leap from the uncertainty of truth to its non-existence, but this assertion is open to the obvious rebuttal that it is a truth statement, which asserts that the assertion that 'there is no truth' is truer than its opposite, that 'truth exists'. If we seriously doubted the *existence* of truth, none of us would get out of bed in the morning, because there would be no point in preferring any one course of action to any other. There'd certainly be no point in writing, or reading, a book. No philosopher that ever lived, whatever his professed creed, behaved as if there were no truth.

But why assume that our experience is not what it seems to be, that is to say direct and real? Open to only a small part of reality, of course, but nonetheless real for that. Just because we midwife it into being, and just because we can never see it whole, it doesn't follow that the world we know is a fantasy.

What I propose here combines elements of the thinking of the American Pragmatists (James, Peirce and Dewey) on the one hand and of the European phenomenologists (particularly Merleau-Ponty, Scheler and Heidegger) on the other, but it would be wrong of me to try to annex their names – and their far from mutually agreed ideas – to my simple reflections. I mention it in case someone should think I am not aware of my intellectual debts.

If we place the emphasis on truth as a relationship, which is where we started, rather than as a 'thing', certain aspects become apparent. In a relationship, both parties count, and the relationship isn't a separate 'thing',

but contains both parties that constitute it. It doesn't lie in one or the other alone. This means that it is necessarily lived; changing and contextual. But it is none the less real for that: on the contrary, it is maximally real precisely *because* of that. It is also something deeply rooted in experience. It doesn't matter what the theory dictates, if it doesn't 'answer' in practice. The proof of the pudding is in the eating. So the Pragmatists such as William James believed. 'The benefit of holding true beliefs, according to James, is that if what one believes is true one is, so to speak, guaranteed against recalcitrance on the part of experience', writes the philosopher Susan Haack. 'No doubt one could get along perfectly well, for a bit, holding false beliefs; but, James thinks, one would eventually be caught out.'[13] Wittgenstein learnt a great deal from William James and his later work is arguably Pragmatist in style.[14] According to one of his pupils, 'Wittgenstein very frequently referred to James in his lectures, even making on one occasion – to everybody's astonishment– a precise reference to a page-number! At one time, furthermore, James's *Principles* was the only philosophical work visible on his bookshelves.'[15]

I should say right away that Pragmatism is not the same as being pragmatic, just believing 'whatever works' to be true, because, as long as the context is carefully defined, almost any view can be said to 'work', even if clearly false. Treating people as objects 'works' if your aim is to be as efficient as possible in sending them to the gas chamber. Treating nature as a heap of resource 'works' if your aim is to make plastic as cheaply as you can. Treating a cell as a machine 'works' if your aim is to find a lock and key mechanism for changing its function. But people are not objects, nature is not a heap of resource, and, as I shall later explain, a cell is not a machine. In a less narrow context each of these 'truths' breaks down. Eventually – or rather quickly – we are, as Haack puts it, caught out. These modes of thinking do not truly answer to our experience at all. Thus, while pragmatic, they are not Pragmatist.[16] Pragmatism is a form of open-mindedness that judges ideas not by their roots but by their fruits.[17]

We should be used to this idea of truth and falsehood, because we are constantly confronting the fact that the world does *not* confirm our modern Western 'take' on it. It doesn't respond, or correspond, to our fantasies. Yet we behave as though our theories about reality were more important than what experience keeps telling us. This is consonant with our world view being skewed towards that of the left hemisphere. Both hemispheres need to

update what they know of the world in the light of experience, and the right hemisphere tends to make changes to its 'version' as it gathers information from experience. The left hemisphere, however, tends to stick to its theory in the face of disconfirming evidence. This has been repeatedly demonstrated.[18]

As usual it is not a matter of the right hemisphere versus the left hemisphere in the sense that one must be right and the other wrong, but the need for a judicious harmonising of them both. Each has its place. Nothing needs to be ruled out in the relationship between the hemispheres. But, as always, *they are not symmetrical in value*.

Let me suggest an analogy. Newtonian mechanics is at one level incompatible with quantum mechanics. It does useful work at the level of day-to-day reality, but at the subatomic level, or at the cosmological level, it no longer applies. But it is not that quantum mechanics applies only at the extremes of magnitude, and Newtonian mechanics, which contradicts it, applies only in the bit in the middle where we normally focus. That would be like saying the earth is curved elsewhere, but flat wherever we happen to be. It's always curved: just for everyday purposes it looks flat, and we don't need to take the curve into account. Similarly, quantum mechanics applies across the whole field; Newtonian mechanics is just a handy approximation that can be overlaid on quantum mechanics for *practical purposes*, provided it is restricted to the day-to-day level. It won't help us understand the underlying reality – in fact it misleads us there. But it has its own, prodigious, usefulness.

Note that it is the precision of Newtonian mechanics that makes it a less good fit, while the intrinsically less precise quantum mechanics is more accurate. I am reminded of the way in which template-driven 'packages of care', now enjoined as good practice by managers of our healthcare system, are always, despite their crispness, a poor fit to the individual case because general, and precise – whereas the fuzzier, personally tailored response is a much better fit, because individual, and accurate.

A further etymological observation: 'accurate' derives from Latin roots *ad- + curare*, 'to exhibit care towards'.

Precision and accuracy are often confused. It is said that a curator at the Natural History Museum was intrigued to hear one of the attendants telling an impressed party of tourists that a dinosaur skeleton was 9 million and 6 years old. When the curator later asked how the attendant knew, he received

the reply: ‘Well, it was 9 million years old when I started working here, and that was six years ago…’ More precise, but less accurate.

Newtonian mechanics is more precise, though less accurate. Our lives would be practically impossible without it. Its contribution is *necessary*. We need its limiting, clarifying logic. Yet it is not of equal status with quantum mechanics when it comes to the disclosure of reality.

So it is with the complementary nature of the contributions of left and right hemispheres: the first is *as necessary as* the second, but not as capable of disclosing reality. Its vision is limited, clear-cut, handy for the everyday. More precise, but less accurate.

Philosophical and cultural disputes often founder on the misunderstanding of opposition (as in this case of the left hemisphere and the right hemisphere). If it is seen as a matter of ‘either/or’, in which one is triumphant and the other destroyed, opposition is misunderstood. But this is already the standpoint of only one hemisphere – the left hemisphere as opposed to the right. Adversaries can both be ‘good’ to and for one another because of their very opposition, which enables each to be more itself, and additionally allows something quite new to arise from their conjunction. In any case, whether we like it or not, they are mutually necessary. Opposites are not to be resolved by eliminating the one we happen to dislike, any more than lopping off the south end of a bar magnet gets rid of the south pole: it just shortens the magnet.

THE ‘SUBJECT-OBJECT DIVIDE’ AND WHERE THAT LEAVES THE CONCEPT OF OBJECTIVITY

Since this matter of the relation between opposites is going to recur, let me say something of the troublesome subject-object divide, since it is in general relevant to the nature of truth.

A representation is by definition removed from the immediacy of what it re-presents. It thus creates the question, what is the relation between the representation and that which it represents – that which *presences*? This is the left hemisphere’s problem, because it is the hemisphere of representation. The hall of mirrors makes the reality of what exists outside that endless circle of reflections problematic. How does the subjective (the world inside the hall of mirrors) relate to the objective (whatever exists outside it)? But this question does not arise for the right hemisphere. What is present to the right hemisphere is just that: *present*, in the very moment of our experience, in our *com*prehension of it, not before, after, or as a consequence of, something ‘in here’ that now has to be related to something ‘out there’. It is a single experience.

It is said that Bashō told a disciple that the problem with most poems was that they were either subjective or objective. The student said, ‘You mean too subjective or too objective?’ Bashō’s reply in full was, ‘No’.

Another way to view the problem is to distinguish the right hemisphere’s view of what we call opposites from the left hemisphere’s view. To see just how misleading the subject-object divide is, one does not need to go to spiritual sages or theoretical physicists, though either would be able to give a much richer and deeper account than the one I can give here. (I will explore their views further in Part III.) For now, let me merely quote one representative passage from Schrödinger:

> It is the same elements that go to compose my mind and the world … The world is given to me only once, not one existing and one perceived. Subject and object are only one. The barrier between them cannot be said to have broken down as a result of recent experience in the physical sciences, for this barrier does not exist.[19]

The problem arises because we jump from an awareness of a distinction to the assumption of a division. The poles of a magnet are clearly distinguishable but are not divided; indeed they are interdependent, mutually necessary, ultimately indivisible parts of the same whole. The most immediately concrete way of understanding this non-dichotomy is in human relationships. A good relationship is one in which each party is maximally fulfilled as a differentiated individual, without this in any way detracting from the relationship, but rather being a condition of the possibility of a good relationship at all – and indeed also a consequence of such a relationship. Equally, we are not atomistic, and cannot be 'ourselves', whatever that would mean, in a cultural or societal vacuum. Thus a good society is not one in which individuality is lost, but one in which it is fulfilled; yet, at the same time, that individuality must not be a threat to the cohesion of the society. There is such a thing as tyranny of individuals over society, as well as society over individuals.

That may seem a considerable way from any consideration of the objectivist position, but it is not as far as it seems. Take a step closer and look at the development of an individual. What has to be negotiated by every child that matures successfully into a human adult is the separation from his or her early state of fusion with the mother, to one in which he or she is aware of being a distinct person, separate from the mother, yet without the close connexion with her being lost; and, through her, connexion with the rest of the experienced world. This is not a matter of a change of quantity (*more* or *less* connexion), but a change of quality in the connexion: equally (arguably more) connected, but now in a different way.

We can have no knowledge of the world without our consciousness being part of that knowledge, which means that whatever our knowledge is, it has a lot of us about it, beginning with whatever it is we mean by knowledge, and the 'having' of it, at all. Then there are all the preconceptions – and pre-perceptions – that go to constituting what we can know in any one particular instance. According to a position that would be supported by some contemporary physicists as well as philosophers in many traditions, both Eastern and Western, consciousness is, in any case, the primary stuff (at least *a* primary stuff) of the universe, in which case the idea of a realm apart from mind is strictly meaningless; but we do not have to go that far in order to be obliged to accept the point that we can't hope for 'objectivity' in the sense of starting from a blank slate. The alternative

is, however, absolutely not a free-for-all, in which we make up whatever we like and call it truth. If the concept of objectivity is mistaken, the striving for truth that lies behind it is still not only honourable and worthwhile, but absolutely essential.

In practice, if not in theory, we can recognise what is required. It is not the adoption of a dehumanising stare, one which reduces living things to objects. It is not even disengagement, since disengagement radically alters what we can see, and there is no logical reason why what is disclosed to us by disengagement should be preferred to what is disclosed to us only by engagement – though it depends, crucially, on the nature and quality of that engagement. In a famous passage, David Hume writes:

> I dine, I play a game of backgammon, I converse, and am merry with my friends; and when after three or four hours' amusement, I would return to these [his philosophical] speculations, they appear so cold, and strained, and ridiculous, that I cannot find in my heart to enter into them any farther.[20]

The implication is not that his post-prandial view is right or wrong – it is merely different and must lack something (because it misses something that was real enough), even if it gains something (because it now sees something that is also true).

The philosopher Michael Polányi, speaking of the reappraisal of man's place in the universe after Copernicus, writes that we have been enjoined 'resolutely and repeatedly' to abandon our egoistic point of view, and 'see ourselves objectively in the true perspective of time and space'. But 'what precisely does this mean?', he asks.

> In a full 'main feature' film, recapitulating faithfully the complete history of the universe, the rise of human beings from the first beginnings of man to the achievements of the twentieth century would flash by in a single second. Alternatively, if we decided to examine the universe objectively in the sense of paying equal attention to portions of equal mass, this would result in a lifelong preoccupation with interstellar dust, relieved only at brief intervals by a survey of incandescent masses of hydrogen – not in a thousand

> million lifetimes would the turn come to give man even a second's notice. It goes without saying that no one – scientists included – looks at the universe in this way, whatever lip-service is given to 'objectivity'. Nor should this surprise us. For, as human beings, we must inevitably see the universe from a centre lying within ourselves and speak about it in terms of a human language shaped by the exigencies of human intercourse. Any attempt rigorously to eliminate our human perspective from our picture of the world must lead to absurdity.[21]

All the same, we could make an imaginative attempt to stand aside from our usual viewpoint. Indeed, one of the crucial functions of the imagination is to enable us to take various perspectives on the world: it enables us to 'see how it looks from over there'. This encourages a certain humility about how it looks from one's own perspective, and yet at the same time provides some reason for confidence in what one takes to be the case. Without imagination there can be no objectivity.

Well, I will need to return to this question in different forms at different points in the book.

OPPOSITION: ‘EITHER/OR’ AND/OR ‘BOTH/AND’

Returning to the problem of the misconception of the relationship of the hemispheres as oppositional, this is as simple as whether one takes a left hemisphere, or right hemisphere, view of opposition: one point of view, that of the primarily analytic left hemisphere, is exclusive (‘either/or’), while the other, that of the primarily synthetic right hemisphere, is inclusive (‘both/and’). Since this is their disposition in general, it also applies to their relationship in particular. To recall the primary myth of the Master (RH) and his emissary (LH), the Master knows he needs the emissary, while the emissary does not know that he needs the Master. The tendency is for the one that sees less (the emissary) to believe that he sees all, while the one that sees more (the Master) sees there are things he doesn’t know; just as those who think they know it all know less than those who know they do not.[22] To the extent that there is a ‘war’ here, it is of the left hemisphere’s making, and stems from its unwarranted self-belief.

The philosopher James Carse makes a distinction that is relevant to understanding the difference between the viewpoints of the two hemispheres. ‘There are at least two kinds of games’, he writes. ‘One could be called finite, the other infinite. A finite game is played for the purpose of winning, an infinite game for the purpose of continuing the play.’[23] The first emphasises an outcome that closes down the process. The second emphasises the process, which *is itself* the desired outcome.

One of the hemispheric approaches, that of the left hemisphere, aims to close down on truth. The game lasts, while it does so, only because the longed for close-down has not yet happened. Once it has, the game is over.

The other, that of the right hemisphere, aims to open up to truth, and sees the truth as a never-finished seeking after, and evolving of, something that is disclosed *by the very process*, which the ‘game’ of life continues.

So it is that one mode of truth is first formulated theoretically, abstractly, conceptually; and then tested, if at all, only afterwards. Meanwhile the other is constantly tested during its formulation – in the process of becoming truth. One is like planning out a journey on the kitchen table in advance; the other like feeling one’s way – testing or tasting, through touch and tact – forwards on the journey. It is wise not to do

without either approach, though if you have to forsake one, the first, never the second, is the one to let go.

We each of us know only our experience, of course, so there is no reason to believe that there should be a way of making truth coercive. What does my experience tell me? That I am strongly seduced by the assurances of the left hemisphere. They appeal to my desire to know, at last – to be *sure*: to construct an argument, to feel confident that I can persuade people that I have something worthwhile to say; to use argumentation to reach, finally, a conclusion. Yet I am also aware that this approach, important as it is, lacks something, when contrasted with what the living of a life tells me. Truth is an encounter: it needs to be 'felt in the blood and felt along the heart', in Wordsworth's famous phrase. But – this is the crucial point – although it can never be demonstrated in such a way as to coerce consent, consent is nonetheless not only possible, but likely, as long as people are being honest with themselves. The problem as always comes from an attempt to be rigid, a left hemisphere demand that inevitably distorts a reality that is in no respect rigid. We can't have correctness, we can only have a maximally attentive, maximally open, testing out of our ideas on the world as we experience it.

Thus, when one speaks truth, one hopes that people will agree, but they can always find reasons not to agree if they are determined enough not to hear. 'That's just your opinion', people say, with the implication that 'my opinion is as good as yours'. And, undoubtedly, it may be – or it may not. That is the point: there *is* still a structure of better and worse, even where better or worse cannot be finally demonstrated so as to avoid dissent. We have become accustomed, in our Western way, to see all exchange of ideas as a kind of battleground in which there will be conquest and defeat. In the East, ancient truths have not commonly been thought such that they can convince (the word comes from Latin *vincere*, to conquer) through argument, but rather that they become appreciated (the word comes from Latin *pretium*, value) through a patient, disciplined opening up of the self to experience. Jan Zwicky puts it like this:

> Truth is the asymptotic limit of sensitive attempts to be responsible to our actual experience of the world … 'sensitive attempts to be responsible' means truth is the result of *attention*. (As opposed to inspection.) Of looking informed by love. Of really looking.[24]

Attention, once again, is the key to what we find; and note that Zwicky refers to a particular kind of attention, looking that is informed by love. Therefore informed by a positive engagement and regard, not by trying to experience it in as far as possible a ‘non-experiential’ way.

I readily accept that there is no cast-iron certainty here, but there isn’t any *anywhere*. So let’s get over it. There are, however, degrees of truth, some of them very great, and carrying increasing conviction with experience. Though truth is always my personal judgment, it is not just possible, but necessary, that my judgment should take into account yours and many others. It is far from random, but is, rather, informed by experiment, perception, reason, intuition and imagination. That doesn’t make it less reliable than being informed by a single source, such as reason, might have done, but more reliable. Acquiring a degree of judgment that can make these elements intelligently cohere is – or used to be – the whole purpose of education. It is why we study the humanities. What history and classics and literature tell us is not to be found in the sciences anywhere. Nowadays we seem to have forgotten this crucial insight, on which the future of our civilisation nonetheless hangs. Judgment used to be the foundation of the idea of reasonableness – a concept you may remember, but which we are in danger of losing, if we have not already done so, in a mechanised, bureaucratic society. The popular reaction to this has been only to intensify the mechanistic vision: no longer seeing complex, unique individuals but only representatives of groups, no longer open to appropriately nuanced, but simple ‘I’m right, you’re wrong’ positions, and shouting more and more loudly. Reasonableness is as far from unbridled emotion as it is from rote rationality, on the worst excesses of which it acts as a much-needed brake.

PORCUPINES AND MONKEYS

As to which model of truth seems more truthful, the best guide will be experience. But are there any grounds, purely in the neuroscience of hemisphere difference, that could help guide our choice? I think there are. In Part I we have already seen that the right hemisphere ‘sees’ and understands more.

These days I am often reminded of a story by Yuri Tynyanov, called *Lieutenant Kizhe*, published in the Soviet Union in 1927. It concerns a mis-transcription of a record in the Tsarist army, whereby someone mistakenly adds a redundant syllable (*zhe*) to the end of the word *poruchiki* (lieutenants), and in doing so creates a ‘Poruchik Kizhe’, a Lieutenant Kizhe – who doesn’t exist. Despite this handicap, Kizhe pursues a distinguished career: he is promoted through the ranks, where he is known for his dependability, marries, fathers a child, is decorated for bravery and is finally promoted by the Tsar to the rank of General. When the Tsar asks to meet this human paragon, Kizhe mysteriously cannot be found. The Tsar, informed that he is dead, is overcome with emotion, and orders the good soldier Kizhe a state funeral. Meanwhile one Lieutenant Sinyukhaev, who was left off the records by mistake, cannot convince anyone that, contrary to report, he is very much alive, and is forced to wander the highways of Russia, relying on the charity of strangers.

This is, of course, a thinly veiled satire on life in Soviet Russia – amusing, you might think, but far-fetched. However, as has often been noted by satirists, reality soon outstrips our attempts at satire. A correspondent reported to me the following real-life incident involving an American friend, who was told that her brother had died in an explosion.

She rushed to the hospital and was taken to the morgue to identify the body. It was indeed her brother. She bent to kiss him on the forehead and felt that he was still slightly warm, although the body had been refrigerated. She felt his hand and thought she detected an infrequent pulse. Amazed and alarmed, she called for a nurse. This nurse felt the body briefly and agreed that it was indeed still warm, but commented, ‘That’s odd, but you needn’t worry about it, dear, because it says here on this chart quite clearly that he’s dead’. This pronouncement delivered, the nurse calmly walked away. The

friend ran into the corridor, and frantically grabbed a passing doctor, who assessed the situation, gave her brother intracardiac adrenalin, and successfully resuscitated him. He still lives.

What, you may ask, has that got to do with hemispheres? Let me explain.

As readers of *The Master and his Emissary* will know, in 1996, in an extraordinary and elegant piece of research, the prominent Anglo-American neurologist Marcel Kinsbourne and a Russian colleague Vadim Deglin conspired to investigate how the two hemispheres of the brain reach conclusions about what is true.[25] To say, as they modestly do, that aspects of the results are 'revealing' and even 'remarkable' is, I believe, an understatement. (I referred obliquely to this experiment in Part I.)

By a procedure that temporarily suppresses one hemisphere at a time, they were able to ask the two halves of one and the same individual's brain the same questions and compare the answers they received.[26] This gave them a window, just for about 15 minutes, into each hemisphere's world. And what they asked was simply whether the conclusion of each of five syllogisms was true. How controversial could that be?

A syllogism is a logical structure whereby two propositions (or 'premisses') taken together lead inevitably to a conclusion. The classic example is:

1. All men are mortal;
2. Socrates is a man;

therefore:

3. Socrates is mortal.

We can imagine this formulated as a question: 'Given 1 and 2, is Socrates mortal or not?' The answer is obviously 'Yes, he is.' This is the way Deglin and Kinsbourne configured their investigation. In the experimental examples, however, there was a cunning twist. In each syllogism, one of the premisses was false. So was the conclusion true, or not?

Here's an example:

1. All monkeys climb trees [so far so good];

2. The porcupine is a monkey [not so good];
3. The porcupine climbs trees.

Is this true? As you can see, the issue is not quite straightforward. So how would you answer?

(Between you and me, there are, annoyingly, porcupines that climb trees. So before someone points it out, I should say that this fact was clearly not known to the investigators or their Russian subjects, and for the present purposes we can put that out of our minds.)

The point at stake is one that is familiar in Western thinking since Aristotle: between a *valid* argument and a *sound* one. An argument is said to be valid if its logical structure, as here, is correct. It is only said to be sound if *both* the structure *and* the premisses are correct, which here one of them clearly is not.

The experiment was carried out using the same five test syllogisms on 10 different subjects, each three times over, first in the normal state and then with just one hemisphere functioning at a time, yielding 150 results overall. And as we can glean from those results, it is clear how most of us normally answer. We normally reply that the conclusion is false, because, fairly obviously, the porcupine is not a monkey.

But what happens when we take one hemisphere on its own?

When the right hemisphere alone is asked, it replies, with some indignation, that the porcupine is ‘not a monkey, it’s prickly like a hedgehog, it is wrong here!’ However, when the isolated left hemisphere alone is asked, ‘the same subjects changed their answers dramatically’.

As the authors point out, the subject’s ‘*attitude to false premises* changed radically’. When the left hemisphere of the very same individual, the one that has previously given the indignant response, is asked if the conclusion is true, it replies that, yes, ‘the porcupine climbs trees, *since it is a monkey*’. When asked by the examiner ‘but is the porcupine a monkey?’, the subject replies that she knows it is not. Nonetheless when asked again, she repeats that ‘since the porcupine is a monkey, then it climbs trees’. Again challenged by the examiner – ‘but you do know that a porcupine is not a monkey?’ – she insists on her answer. Why? Because ‘it’s written so on the card’.

Here is another example, from a different subject, using a different syllogism:

1. Winter is cold in tropical countries [untrue];
2. Ecuador is a tropical country [true];
question:
3. Is it cold in winter in Ecuador, or not?

Right hemisphere response:

Subject: [shrugs her shoulders] Winter is not cold in tropical countries! It's a lie!

Left hemisphere response *of the very same individual*:

Subject: [reads quickly and answers immediately] It's cold in winter in Ecuador, because Ecuador is a tropical country.

Examiner: Oh, is winter really cold in tropical countries?

Subject: I think so. Winter is cold there and summer is warm.

Examiner: Are you sure of this?

Subject: No, I am not.

Examiner: Ecuador is a tropical country, then, can it be cold there?

Subject: No, it can't be since it is a tropical country …
(the same syllogism is presented again):

Subject: It is cold in winter in Ecuador because Ecuador is a tropical country.

Examiner: But you do know that it is not so.

Subject: But it is written here.

The results were consistent across the 10 subjects. In fact one subject answered *all* the questions empirically – by reference to real-world knowledge – when in the normal state, as well as when using only her right hemisphere; and answered them *all* formally – according to the internal logic of the system – when using only her left hemisphere.

It is relevant that 'the right hemisphere … relates the sign to its referent. For the left hemisphere the relation of the sign to its referent is of less importance than for the right hemisphere; the left hemisphere deals with *the interrelation of signs*.'[27] Thus helping us to identify in the thrust of some postmodern philosophy the triumph of the left hemisphere.

As far as the left hemisphere is concerned, truth is fidelity to a closed system which defines its own reality. Internal, theoretical, consistency is more important than truth to experience. The right hemisphere, meanwhile, thinks that it might be worth checking by looking out of the window, where, whatever it may say on the piece of paper, a porcupine is not, actually, a monkey, nor are tropical winters cold.

Note the left hemisphere's take is not to be confused with 'coherence' theory, which implies that a statement is judged true if it coheres with all one's other beliefs. By that standard the assertion that a porcupine is a monkey cannot be held to be true, nor can anything that flows from it. Nor should the right hemisphere's take be confused with 'correspondence' theory, whereby what the mind conceives is an accurate representation of something outside the mind. It is just much more loyal to truth as something that arises through experience than something asserted by an abstract system, the rules of a (finite) game.

CONCLUSION

In this chapter we have considered not what and how each hemisphere might contribute to the main paths humans have followed in their quest for truth – that will come in subsequent chapters; but how each would see the nature of truth itself. I suggest that the left hemisphere would see it as a *thing*, certain, fixed, and independent of our interaction with it, standing outside time and concerned with the consistency of a representation. By contrast, I suggest that the right hemisphere would see it as a *process*, always contextual, forever coming into being through our present interaction with the world in time, but nonetheless real for that – indeed, real *because* of that, because constantly tested against experience. I believe we often behave as though either truth is as the left hemisphere sees it, or else it does not exist. But, crucially, these are not the only options.

Further, let me emphasise that *both* the views currently on offer in so much public debate today – naïve positivism and naïve deconstructionism – are typical left hemisphere fictions. It is not that the first is left hemisphere-congruent, and the second right hemisphere-congruent. Each is an ill-concealed power grab, completely lacking in subtlety, and devoid of any sense of our true connection with the world. The 'betweenness' in which fidelity can operate has been lost: that is only understood properly by the right hemisphere. That there is ultimately no certainty (except in mathematics) is emphatically not an invitation to promulgate your latest theory based on some political ideology: the dangers in this are every bit as great as in adhering too closely to the reductionist materialist picture – possibly greater, since they derive from a position for which every point of view, every statement, is as valid as any other. That brings an end to truth, and hence to civilised discourse: indeed, an end to civilisation. Unfortunately, naïve positivism may ultimately lead there, too.

In Part I of this book I looked at the evidence that each hemisphere is or is not a reliable witness to the truth about reality. I use the term in the Pragmatist sense that, in Susan Haack's formulation, 'if what one believes

is true one is, so to speak, guaranteed against recalcitrance on the part of experience'. I was concerned there with the *means* of this kind of truth, the portals through which it can be discerned.

In Part II I will argue that each hemisphere is indispensable to a proper understanding, and that each makes a contribution, though in the modern West we are often misled by the left hemisphere's inveterate tendency to neglect the right hemisphere's contribution and 'go it alone'. I made the analogy between a pilot avoiding a plane crash and a philosopher coming out of his encounter with reality unbruised. In the modern Western world, we are constantly crashing, and puzzled as to why; constantly faced with paradoxical outcomes to our actions, what particle physicist and quantum theorist David Bohm called 'sustained incoherence'. We often find that we strive for something and achieve its precise opposite. Why is that? I suggest it is because our currently dominant model of reality is mistaken.

As a result, we badly need to rethink.

SCIENCE & TRUTH

It happened to him as it always happens to those who turn to science … simply to get an answer to an everyday question of life. Science answered thousands of other very subtle and ingenious questions … but not the one he was trying to solve.

—*Count Leo Tolstoy*[1]

SCIENCE'S CLAIMS ON TRUTH

> The antagonism between science and metaphysics has, like all family quarrels, been disastrous.
>
> *—Alfred North Whitehead*[1]

> Science and metaphysics are inextricably united, and stand or fall together.
>
> *—RG Collingwood*[2]

WHERE WOULD MOST OF US NOW, IN THE WEST, LOOK FOR TRUTH? SURELY the answer has to be science – science which has taken over from religion as the lodestar of our age. In an era of materialism, where the speed of societal change and the fusion of peoples have made traditional cultural values problematic, science alone holds out the promise of stable knowledge on which we can rely to build our picture of the world. And, within certain important limits, it is a promise that is certainly not in vain. People who ignore science are either afraid of it, because they don't understand it, or find its truths inconvenient. Science is a guiding light: if we put it out, we are in the dark. And precisely because it is so precious, we should be careful to guard it from ever-present dangers – exaggerated claims, models that distort, and institutional pressures, which effectively destroy its power and lead us into error.

In this chapter I want to look at the contribution science can make to our understanding of the world. Note, an *understanding of*, not just *knowledge about*: 'knowledge, as an instrument of human progress', writes physicist Claudio Ronchi, 'can become, like the Gorgon, a goddess that transmutes anyone who gazes upon her into stone.'[3] I will suggest that its contribution is of great value, but that there are intrinsic limits to what it can be expected to tell us, and that these limits all too often go unrecognised.

As someone whose practice and research depends on science, I have only respect for its proper aims and ambitions. Science is an essential part of our enquiring nature, and brings the potential for much that has transformed our lives for the better. No scientist is more frustrated than I am by those who dogmatically disregard its findings, especially where, in my field of medicine, those findings have power to save lives; and no-one could be more conscious of, or grateful for, the interminable scientific labours of others, from which I have hugely benefitted, in my work, in my practice, and in my life.

Yet science cannot possibly fulfil the burdensome role of sole purveyor of truth. This is not a failing in science. Good science is aware of its limitations. Scientism, the belief that science will one day answer all our questions, is not.

Some philosophically naïve individuals become very exercised if they sense that the status of science as sole purveyor of truth is challenged, as some of the less edifying exchanges on the internet testify. So let me make very clear at the outset that my purpose in what follows is to establish ourselves on a firmer footing in relation to science, by drawing attention to the quicksand in which we might otherwise go down. The greatest scientists, as we shall in due course see, have been well aware of these problems, even if they couldn't have couched their warnings in terms of the hemisphere hypothesis. But very often the practice of science is not so self-aware; and then its propaganda about itself – the claims it wishes to make about both the truth of its discoveries and the exclusive validity of its approach to truth ('thou shalt have no other gods before me') – leads not so much to science, as to scientism.

It is obvious that science is heavily dependent on the exercise of what the left hemisphere offers. Science's successes, in explaining how the world works and in helping us to control and manipulate that world to the extraordinary degree to which we now do, are unquestionable, and are

dependent on precisely those specific capacities which the left hemisphere contributes, capacities of analysis and for identifying mechanisms. There is no gainsaying that and I have no wish at all to gainsay it.

But we have seen in Part I what could be called the double problem of the left hemisphere: its inferiority, compared with the right hemisphere, in its receptiveness to and understanding of whatever it encounters; and, more dangerously, its tendency to mistake its re-presentations of reality (its simplified versions of what it encounters and its explanations of how those simplified versions work) for reality itself. It all too often then attempts to deny the right hemisphere any further role in the proceedings and seeks to persuade us that its necessarily partial re-presentations provide us with the wider understanding to which we aspire and to which we like to attach the word ‘truth’. This is the hubris of the left hemisphere, beset with unknown unknowns, overconfident in its own prowess, while taking the upper hand. We have watched this in action in Part I.

In the next chapter I will explain why I am concerned by the harm done to science by the myopic effect of the models it sometimes espouses, by which we are needlessly depriving ourselves of scientific insights. And, finally, in the subsequent chapter, I will demonstrate why the scepticism that science officially espouses needs to be brought to bear on the ‘science industry’ itself, which is a no more infallible instrument of true science than any church establishment is of true spiritual wisdom. But first, in this chapter, I want to look more fundamentally, in the context of the hemisphere hypothesis, at the boundaries of science’s ambitions legitimately to tell us what is truthful.

UNDERSTANDING, EXPLANATION, METAPHOR AND MODELS

Let me begin with some very simple questions. The simplest questions are the trickiest. ‘How?’, ‘what?’, and ‘why?’ are particularly slippery. If I ask ‘how did she respond?’, you could answer ‘using her vocal apparatus’; or, understanding ‘how’ differently, you might say ‘with some scepticism, but not without her usual willingness to help’. Similarly if I ask ‘what causes an apple to drop from a tree?’ you readily reply ‘gravity’; but if I ask ‘what, actually, *is* gravity?’, you (ought to) pause, and will soon find yourself tied up in an infinite maze of self-referring propositions. Science can deal in each case with the first type of question, in which an explicit, mechanistic explanation is enquired about, and the accompanying framework that makes it comprehensible is taken for granted; but not in the second, in which that framework is transcended. And every toddler demonstrates that the question ‘why?’ can be carried on till all frameworks and mechanisms are transcended, and the reply has to be either ‘That’s just the way things are’, or ‘now you go to bed’.

Grasping what ‘with some scepticism, but not without her usual willingness to help’ means cannot be achieved through a framework of mechanical explanation; it requires something much more diffuse and implicit – understanding, the product of human experience. The first, explanation, is the left hemisphere’s mode; the second, understanding, the right hemisphere’s, albeit often enriched by the contribution of the left.

Explanation, science’s forte, is a subset – an explicit, rigorous, disciplined subset, but still a subset – of understanding. All understanding depends on metaphor. What we mean when we say we understand something is that we see it is like something else of which we are already prepared to say ‘I understand that’. That, in turn, we will have understood because we have likened it to something else we had previously understood, and so on. It’s metaphors all the way down.

In science this inescapable role of metaphor is manifest in the model the science uses in order to seek an explanation of the phenomenon it is investigating. Models are simply extended metaphors. The choice of model is crucial here because the problem for seekers after truth is that that choice

governs what we find. We find more or less according to what we put there. Since a model always highlights those aspects of what it is modelling that fit the model, any model soon begins to seem like an uncannily good fit, which means we espouse it with still greater confidence. And, as they say, to a man with a hammer, everything begins to look like a nail.

Even the sense-data that go into selecting the model are not innocent. Perceptions are laden with theory. We never just see something without seeing it *as* a something. We may think that our theories are shaped by observations, but it is as true that our observations are shaped by theories. This means we can be blind to some very obvious things in our immediate environment. We don't look where we don't expect to see, so that our expectations come to govern what we *can* see. This is why the model is crucial. In the past such a model was often something in the natural world – a tree, a river, a family. Nowadays, unless otherwise specified, it is the machine.

That a machine should be attractive as a model to science's helpmate, the left hemisphere, hardly needs – well, explaining. Machines are put together from parts and the left hemisphere's mode of operation is to break phenomena down into parts and then see how they can be put together again. Furthermore, putting parts together to make machines aids the left hemisphere's purpose: manipulation and control. So it is not surprising that for at least the last 250 years, the era in which science has enjoyed its most spectacular successes in explaining how the world works, and enabling us to use those explanations to manipulate and control it according to our purposes, the machine model should have been the default model in science. In the popular mind it remains science's defining paradigm.

Yet the machine model remains only a model, a form of metaphor. However productive it may have been in explaining and manipulating the world, it is still no more than a metaphor. As we shall see, even at the relatively lowly level of explanation it has exhausted its potential, something that was obvious in physics some time ago, and is becoming increasingly obvious in the life sciences. In other words, it doesn't fit with a multitude of important findings that can't be ignored.

The left hemisphere, however, is apt to forget, in the glow of its explanatory and manipulative successes, that in relation to truth, those successes are built on the absolutely necessary but inevitably shaky foundations of metaphor. Scientists often try to brush aside what they seem

to regard as this embarrassing fact. Models, which are extended metaphors, partial though they inevitably are, cannot be dispensed with, since understanding always involves seeing similarities to and difference from something else we think we understand. For example, Philip Ball (whose writings I generally admire), writing in *Nature*, opines that metaphors 'at the very least, should be admitted into science only after strict examination.'[4] Leaving aside the fact that the criteria by which any metaphor could be examined are themselves already derived from the application of a model, so that what one would be examining would be – not the intrinsic merit of the metaphor, but – whether it accorded with one's already unexamined and taken-for-granted metaphor; and leaving aside the question how metaphors could be 'admitted into' science in a way that makes any such entry examination feasible; and leaving aside the issue of who we are going to entrust with the task of appraising them, since opinions about the applicability of individual metaphors will always differ, the whole idea is incoherent. Does he think that somehow we could get by for an instant without metaphors? Like many others he quotes the 'warning' attributed to cyberneticists Arturo Rosenblueth and Norbert Wiener: 'The price of metaphor is eternal vigilance', as if shaking his head over those who haven't the strength of mind to divest themselves of the metaphor habit, and muttering 'this will end in tears, you know'.

As a matter of fact, I cannot find that Rosenblueth & Wiener ever said this,[5] but the sentiments are surely correct, even if not as Ball seems to have read them. That's because the price of the pursuit of knowledge by any means whatever is eternal vigilance. However, the price of trying to think without metaphor would not only be eternal vigilance, but eternal vacuity. It's as if someone were to say, the price of having tyres on your car is eternal vigilance. True, but there are risks in life that can't be avoided if we are to get anywhere at all.[6] The price of *doing science* is eternal vigilance, and not just because it can never avoid using metaphor.

What Rosenblueth & Wiener definitely do say is that since 'the best material model for a cat is another, or preferably the same cat … partial models, imperfect as they may be, are the only means developed by science for understanding the universe'. We can't do without them, but we need to be sure the ones we have – this is the real point – are as little misleading as possible.[7] And it's the type of scientist who thinks he is not *inevitably* using metaphors and models that is most worrying, because unaware of the

pitfalls. We need to be vigilant in our use of metaphors, not because there is something dodgy about metaphor in general, but because there is something dodgy about many of the ones currently espoused by mainstream science. There I am in wholehearted agreement. We don't see what our metaphors blind us towards. This is the subject of Chapter 12.

All models are in this way a partial fit, giving a selective view of the matter. As the mathematician and philosopher Alfred North Whitehead puts it in *The Function of Reason*:

> The man with a method good for purposes of his dominant interests, is a pathological case in respect to his wider judgment on the coordination of this method with a more complete experience. Priests and scientists, statesmen and men of business, philosophers and mathematicians, are all alike in this respect. We all start by being empiricists. But our empiricism is confined within our immediate interests. The more clearly we grasp the intellectual analysis of a way [of?] regulating procedure for the sake of those interests, the more decidedly we reject the inclusion of evidence which refuses to be immediately harmonized with the method before us. *Some of the major disasters of mankind have been produced by the narrowness of men with a good methodology*.[8]

Whitehead makes a distinction between what he calls 'the authority of science in the determination of its methodology' and its lack of authority in determining what counts as an explanation, let alone an understanding. And he points to the 'natural reaction of men with a useful methodology' against any evidence tending to limit the scope of that methodology:

> Science has always suffered from the vice of overstatement. In this way conclusions true within strict limitations have been generalized dogmatically into a fallacious universality.[9]

Dogmatism inevitably obscures the nature of truth. He continues:

> Obscurantism is the refusal to speculate freely on the limitations of traditional methods. It is more than that: it is the negation of the

> importance of such speculation … A few generations ago the clergy, or to speak more accurately, large sections of the clergy were the standing examples of obscurantism. Today their place has been taken by scientists … The obscurantists of any generation are in the main constituted by the greater part of the practitioners of the dominant methodology. Today scientific methods are dominant, and scientists are the obscurantists.

The point is that we cannot discover whatever aspect of truth is revealed by a certain approach unless we commit ourselves to it sufficiently to find out; but by the very act of doing so, other aspects of truth become concealed, aspects which, when pointed out by others, will tend to be unrecognised, or ultimately dismissed.

'In our time', wrote the distinguished biochemist Erwin Chargaff, whose discoveries paved the way for Crick and Watson, and whose intellectual autobiography *Heraclitean Fire* should be read by every scientist,

> so-called laws of nature are being fabricated on the assembly line. But how often is the regularity of these 'laws of nature' only the reflection of the regularity of the method employed in their formulation! … Science is still faced with the age-old predicament, the lack of ultimate verification. [10]

And he continues, in wise words,

> In general, it is hoped that our road will lead to understanding; mostly it leads only to explanations. The difference between these two terms is also being forgotten … These are two very different things, for we understand very little about nature. Even the most exact of our exact sciences float above axiomatic abysses that cannot be explored. It is true, when one's reason runs a fever, one believes, as in a dream, that this understanding can be grasped; but when one wakes up and the fever is gone, all one is left with are litanies of shallowness. [11]

OBJECTIVITY

It would, of course, be absurd to dismiss the vast library of scientific knowledge as ‘litanies of shallowness’, and that is not what Chargaff intends. Rather, he is insisting on the vital difference between explanation and understanding. And, in speaking of ‘axiomatic abysses’ he is referring to aspects of scientific knowledge which we tend to take for granted but which need examining. None is in greater need of such examination than the notion of objectivity, a concept which we probably cannot do without, but which it is all too easy to misinterpret.

The popular, received view of objectivity goes something like this. We are here and the world is there. We are ‘subject’ and it is ‘object’. We want to have knowledge of how, in itself, the world really is. Science provides us with that objective knowledge by taking ‘us’ out of the picture, so removing subjective distortion from its objective presentation of how, in itself, the world actually is. This account of objectivity goes back at least as far as Descartes and underpins the popular view of why, since Descartes’ time, science has enjoyed such extraordinary prestige.

We have already seen, however, that this aspiration to take ‘us’ out of the picture is compromised by the fact that science can’t get going without metaphor and metaphor is something from which ‘we’ cannot possibly be divorced. But that is only a specific case of a more general point about how we cannot remove ourselves from the picture in the way this crude and misleading interpretation of objectivity requires. To put it bluntly, science, at least since the time of Descartes, has attempted to excise the most important part of any understanding, namely that, obviously enough, it is grounded in, takes place in, and is meaningless without, the human mind, and its capacity to understand.

To the extent that we have knowledge or experience of the world on which to base an understanding, we cannot know what it is like when *we* don’t know it. The existence of a distinct practice known as physics (which was not the case until the last few hundred years) alters what we see and take notice of, what we see but ignore, and what we may entirely fail to see; and it alters how we interpret out results, and their ultimate meaning, which is inevitably determined both by the individual doing the physics, and, since

no individual exists separate from a culture, by the often hidden assumptions of that culture. Human knowledge can only be more or less true – though, to be *absolutely* clear, this does nothing whatever to diminish the importance of truth. What we know cannot escape the fact that it is human knowledge; and we could fully know the qualities and limitations of *that* only by getting outside it, and having something else to compare it with – which is a logical impossibility.[12] As Max Planck, one of the founding fathers of quantum mechanics, pointed out, 'science cannot solve the ultimate mystery of nature. And that is because, in the last analysis, we ourselves are part of nature and therefore part of the mystery that we are trying to solve.'[13]

Objectivity is always someone's position, situated somewhere, and making some assumptions. There is no such thing as the 'view from nowhere'. But there is such a thing as a view derived from considering as many positions as possible. We must not forget that scientists – like philosophers – are human beings, with personalities, temperaments, and experiences of life, all of which they do not hang up in the locker room when they put on their white coats. Although objectivity, in the sense of a fair consideration of all possibilities, is an honourable and necessary aim, objectivity in the sense of adopting a viewpoint that makes no presuppositions is intrinsically impossible to achieve. 'We all, scientists and non-scientists, live on some inclined plane of credulity', wrote William James. 'The plane tips one way in one man, another way in another; and may he whose plane tips in no way be the first to cast a stone'.[14]

The Russian film-maker Andrei Tarkovsky pointed out that 'objectivity can only be the author's, and therefore subjective, even if he is editing a newsreel'. Any statement about anything is always both an inclusion and an exclusion, its meaning derived both from what is said and what is not: choices are always involved. This is not a point about documentary film-making, but about life. Ideas, including scientific ideas, do not live suspended in a vacuum, but have relationships across time, and at a point in time, with others, forming out of observed regularities the 'models', 'laws' and 'principles' which are our own creations, shaped as much by what they do *not* include as by what they do.

Adding to their contingency is a simple and very obvious point, the limitation imposed by our sense organs – and our brains. We can't detect what our sense organs do not permit us to detect: there may be senses that

we could have had, but don't, which would have revealed other aspects of the world to our understanding and which we are incapable of imagining – could we have imagined what it is like to hear, if we had only sight, smell and touch to go on? When aboriginal people say that they can hear, or see, or sense things that we cannot, how do we know they are wrong? And the senses we do have are limited in extent: we can't hear what bats and bears take for granted in their world. It would be irrational to suppose we are directly aware of more than a little of what exists. Why assume that our cognition is capable of more than a few limited forays into the vastness of reality? Evolution is a process. We know more than mice (though there must also be things they know that we don't). A more highly evolved creature may one day regard our understanding of the world much as we now view that of the mouse.

'The wise scientist', wrote Chargaff, 'will be aware of the eternal predicament that between him and the world there always is the barrier of the human brain.'[15] That is one way of looking at it. Another would be that, like every shared boundary, it can act to separate or unite, act as a barrier *or* as point of contact: the ear drum is a boundary, but one essential to hearing. It's just that we need to be aware, as Chargaff suggests, that we can only know the world as our brains construe it; and in every brain there are at least two internally coherent versions of the world that conflict. Science must take this into account when it talks of objectivity.

Observations are not as simple as they are conceived to be, even if there is apparently complete agreement between a number of them. 'Whether you can observe a thing or not depends on the theory which you use', as Einstein pointed out.[16] According to philosopher of science Norwood Hanson, referring to a famous optical illusion in which figure and ground are reversible, two 'drawings might be indistinguishable. I see a goblet, however, and you see two men staring at one another. Do we see the same thing? Of course we do. But then again we do not.' Note, by the way, that though the image can be seen as two quite different things, it can't be seen as just any old thing. It can't be seen as a rabbit, not even a duck-rabbit. Our alternatives are not single truth or chaos. And Hanson continues that to conclude that scientists

> make the same observations but use them differently is too easy … Were there no sense in which they were different observations they

> could not be used differently … There is a sense, then, in which seeing is a ‘theory-laden’ undertaking.[17]

He uses the example of Tycho Brahe and Johannes Kepler registering the same sense-data on seeing the sun rise, but seeing something quite different – since Brahe, unlike Kepler, believed the position of the earth was fixed. Advocates of different scientific theories clash because they see the same sense-data differently and use the same words to refer to what are in fact distinct conceptions: competing theories lead to differing observations as much as differing observations lead to competing theories.

If this is fatal to objectivity as it is commonly, and naïvely, understood, it is absolutely not fatal to the best motives that lie behind the wish to claim objective status. As scientists or citizens, we rightly fear the loss of a hierarchy of value, the loss of grounds for believing that some judgments are to be preferred to others, that some statements are inevitably truer than others. Indeed, the flawed fact-value distinction is itself an *appeal* to value – the value of ‘facts’ – and is in turn *based* on value – inevitably and rightly – not on fact. And it stems from an honourable, noble urge: an allegiance to truth. It’s just that it ends up in the mistaken assumption of a subject-object divide.

According to Polányi scholar CP Goodman,

> [Michael Polányi] notes that all methods, even the most formalised, rely upon our judgements. It is not possible to absent ourselves, and nor should we try. If all knowing involves the participation of a knower, then it follows that all knowing is a form of valuation. We make judgements about what we ought to believe. Our beliefs may be mistaken, but they are not arbitrary. They are guided by our tacit awareness. In his analysis of the structure of tacit knowing – his key contribution to philosophy – Polányi seeks to reconcile fact and value (which in the modern period have been broken apart).[18]

Just because we can’t measure values, they are neither less important, nor less rightly operative, in science: the confusion comes from science’s reluctance to accept as real what cannot be pinned down and measured. It therefore unwittingly drives itself into a cul-de-sac: the false divorce of fact

from value. Note that the *distinction* is valid: it is the *divorce* that, as so often, causes the problem. Science frequently passes over entities, however important they may be, that cannot be measured. Attempts to evaluate systems often end up measuring what can easily be measured, rather than what actually matters, but can't be measured.

Science places a very high value, too, on precision and consistency. But what about those things that are either intrinsically imprecise, can't be generalised, change their nature when made explicit, alter with the very fact of observation, or tend to fluctuate widely in their manifestations? They are still real, and some of them are very important. I don't say there are no scientific ways of dealing with them, just that in practice it is much harder – and it often doesn't happen. As biochemist Addy Pross remarks:

> Some characteristics of undeniable scientific interest are inherently difficult to quantify, or are even unquantifiable. Attempts to quantify the unquantifiable will be unrewarding and may only lead to confusion.[19]

And what about those cases where apparent opposites come together, where light is both wave and particle, or where, as in the human sciences, to be wholly rationalistic may well be irrational?

What we should conclude is not that the unimpeachable drive behind the crudely interpreted concept of objectivity is mistaken, but that we should be more nuanced in our interpretation. It is an enterprise, a continuing process, not a 'thing' that could ever be finally achieved. It involves a habit of mind and spirit, not the following of external procedures or rules. Put another way, the 'objectivity' lies not in propositions, but in a disciplined disposition; in a modest recognition that our existing answers are inadequate, and in a constant awareness of limitations in handling the possible alternative, always provisional, answers. The foundations of physical reality can never be known with any certainty: as Gleiser puts it, 'in the quantum realm the very question of trying to know more, of trying to go beyond the limits imposed by uncertainty, doesn't make sense … Final theories are incompatible with the scientific method. Given that we can only accrue scientific knowledge from measurements of natural processes,

it is by definition impossible to be certain that we know all the forces of Nature or the fundamental particles that exist.'[20]

This has nothing to do with the deeply pernicious – not to say incoherent – view that anything goes. Pernicious, because it effortlessly exalts any cracked ideology to the same level as the distilled wisdom of a civilisation, and thereby debases the distilled wisdom of a civilisation to the level of any cracked ideology. Incoherent, because, if anything goes, nothing goes: we no longer have any purchase on reality. My position is that almost nothing goes: the whole purpose of education, self-discipline and scholarship being the honest, open and humble attempt to find whatever lies in that space closest to the truth, in the knowledge that success is always a matter of degree. But that degree is of the utmost significance.

From experience we know that our own views can be more or less faithful accounts of what, from everything we know, we can reasonably claim to be the case. The 'more or less' depends on a range of circumstances, all tending to converge on the degree to which we are inclined to consider *different* points of view. Generally we get better at this with maturity, though both temperament and intelligence are bound to play a part in inter-individual differences. This process could be thought of as the habit of tempering truths with their true opposites. Truth is a matter not merely of quantity, but of quality; not just of degree, but of the manner of its holding.

As John Stuart Mill so wisely said (speaking about social science, but it applies more widely):

> All students of man and society who possess that first requisite for so difficult a study, a due sense of its difficulties, are aware that the *besetting danger is not so much of embracing falsehood for truth, as of mistaking part of the truth for the whole*. It might be plausibly maintained that in almost every one of the leading controversies, past or present, in social philosophy, both sides were in the right in what they affirmed, though wrong in what they denied; and that if either could have been made to take the other's views in addition to its own, little more would have been needed to make its doctrine correct.[21]

Mill's point about 'mistaking part of the truth for the whole' is echoed by Whitehead: 'There are no whole truths; all truths are half-truths. It is trying to treat them as whole truths that plays the devil.'[22] And, with particular relevance to science:

> In scientific investigations the question, True or False?, is usually irrelevant. The important question is, In what circumstances is this formula true, and in what circumstances is it false?[23]

The neglect of context or circumstance sacrifices subtlety to 'all or nothing' answers. Science tends to take things out of context – in fact, many would say that this is exactly what is special about a genuinely scientific explanation. I have written about the problem of decontextualisation elsewhere, and the significance of this fallacy in every aspect of life.[24] John Dewey thought it the most serious mistake philosophy can make, and it inevitably results in a distorted account of whatever it aims to illuminate.[25]

Science is the stronger for being freed from the superstitious beliefs that are foisted on her by her false friends, those who are in love with certainty and need to know they are right (there are many of these in religion, and in politics, too, so science is not alone). There is among many of the public, as Nassim Nicholas Taleb points out, 'a religious belief in the unconditional power of organised science, one that has replaced unconditional religious belief in organised religion …We have managed to transfer religious belief into gullibility for whatever can masquerade as science.'[26] No good is done to science by making the inflated claims that, unfortunately, some naïve scientists do make on her behalf – thinking that they thereby do her a favour. Obvious discrepancies between the excessive claims of any culture and human experience lead eventually to a countermovement that ends in disaster: the baby gets thrown out with the bathwater.

The danger of the claim that science provides full and 'objective' truth, in the crude sense of that word, is that as soon as it becomes apparent, as it readily does, that this way of understanding objectivity is not watertight, the whole ship is in danger of sinking: its apparent robustness – a hard and fast, all or nothing, supposedly cast-iron concept – renders it fragile. A Titanic claim invites disaster when the ship collides with the inevitable iceberg of philosophical reflection. For then, the only options become total

impregnability or a shipwreck: science is either high and mighty or ‘just a matter of opinion’, like any other. Neither of these positions is supportable: each is dangerous. And so it is that another untruth triumphs in their place: the malign idea that science cannot be distinguished from claptrap.

HIDDEN ASSUMPTIONS

'Science doesn't think', as Heidegger put it. '*Science* doesn't venture into the *realm of philosophy*. It is a realm, however, on which, without her knowing it, she is *dependent*.' [27]

Earlier I quoted Erwin Chargaff's remark that even the most exact sciences float above 'axiomatic abysses': unexamined assumptions. It is a tenet of science that its basic intellectual aim is to improve knowledge about the world, nothing being permanently presupposed about the world independently of evidence. But 'to say, with the radical empiricist, that only factual statements have validity is to be not only dogmatic but self-contradictory, since the statement itself is not factual.'[28] Its 'truth' is an assumption based on intuition, not on any kind of fact, logic or science in itself. That is fine, but it needs to be acknowledged. So does the assumption that contraries are incompatible. After all, one of the greatest scientists of all time, Niels Bohr, adopted the opposite assertion – *contraria sunt complementa* – as his motto.

The philosopher of science Nicholas Maxwell has demonstrated at some length that the claim that science presupposes nothing about the world independently of evidence is untenable.[29] For a start, it is not only presupposed by science that the universe is fully comprehensible (which means, inevitably, comprehensible by a human being), but presupposed that it is fully comprehensible *physically*. Thus matter, according to convention, can be assumed, but consciousness cannot – indeed, as is well known, there are philosophers who deny the very existence of consciousness.

'To many working scientists', writes philosopher Bryan Magee,

> science seems very obviously to suggest an ultimate explanation, namely a materialist one; but a materialist view of total reality is a metaphysics, not a scientific theory. There is no possibility whatever of scientifically proving, or disproving, it. The fact that it is held by many scientists no more makes it a scientific theory than it can be said to be an economic theory because it is held (no doubt) by many economists.[30]

An element of faith is necessarily involved in the scientific process. That is in no way to the discredit of science, since all paths to knowledge whatever have to involve assumptions built into the model, as well as certain axioms, 'truths' that cannot be proven, but are taken for granted. Science requires a degree of commitment to an idea for a while until one finds out whether or not it works: without engagement many truths will escape us, which is why, inside or outside science, it is not an option to sit on the side-lines of life, waiting for 'objective' evidence to accumulate before making a commitment. Speaking of the elementary laws from which the rest of physics must be deduced, Einstein had this to say: 'To these elementary laws there leads no logical path, but only intuition, supported by being sympathetically in touch with experience.'[31] This is Pragmatism, pure and simple: and, as the reader will know, I agree that we cannot do better than Pragmatism in any approach to truth.

Furthermore, science depends on the idea of cause and effect mechanisms, a phenomenon that parallels the logic whereby the left hemisphere puts back together the bits and pieces. But the concept of a cause is not transparently obvious. As used by scientists, the term 'causation' admits of at least seven, possibly more, meanings.[32] According to the anthropologist Pascal Boyer, in scientific thinking 'the only stable "principles" are vague, unconstraining generalisations that', he argues, 'do not rule out magical connections'.[33] I would not go so far myself, but the point that when we construct formal relations of a causative nature these may issue in different kinds of understanding that are not necessarily explicit is well taken.

It is also assumed that the same principles that govern the part of the cosmos that we observe obtain everywhere and for all time; to abandon that tenet would be to threaten the terms on which an understanding of the universe as a whole could be achieved. But in fact, as Max Planck observed, 'we have no right to assume that any physical laws exist, or if they have existed up to now, that they will continue to exist in a similar manner in the future.'[34] All we know is that there are local habits in the part of the universe we inhabit.[35] Newton may have said *hypotheses non fingo* ('I don't make up hypotheses'), but at the same time his so-called 'Universal Law' of gravity was just that: a brilliant hypothesis.[36] That it was a law, let alone a universal one, he did not know then, nor do we know now.

As Pross writes in his interesting book *What is Life*?

> In contrast to terms such as ‘theories’ and ‘laws’ which radiate some sense of absolute truth, the term ‘pattern’ is more subtle, less committed, less definitive, more open to modification. Even Newton’s laws, those pertaining to gravity and motion, have had to undergo revision following Einstein’s revolutionary insights. If we keep in mind that every hypothesis, theory, or law is ultimately just a pattern, the day that theory or law is modified or revoked will be less surprising, less disconcerting.[37]

A further questionable assumption is that there is nothing purposive about the cosmos: something which we cannot know, requires the making of further assumptions, and in the end fits the findings no better than – arguably not as well as – the assumption of purpose (a complex issue to which I will return in Chapter 27). This does not exhaust the assumptions science makes.

My point here is simply to show that there are many assumptions built into science, for good or ill. These may be reasonable assumptions, but they are undoubtedly metaphysical assumptions, not deductions from evidence. The first of these assumptions, that the world is humanly comprehensible, is necessary for the great project of science to get off the ground, so it is an entirely reasonable assumption. But it is still an assumption, for all that, one that is usually forgotten, and it has consequences. If you assume that the world must be comprehensible in purely physical terms, that there are no purposes in Nature or the cosmos, and that contraries exclude one another, what you end up seeing and calling ‘truth’ will be different from what you see if you make no such assumptions.

Since one cannot become aware of what it is one is not aware of, the fact that a system or model works for certain purposes indicates only *that* – that it works – and no more. As the physicist and mathematician John von Neumann put it:

> The sciences do not try to explain, they hardly even try to interpret, they mainly make models … The justification of such a

> mathematical construct is solely and precisely that it is expected to work.[38]

It shows us what that model can show, but cannot help us see what it obscures. Science's explanations both reveal and conceal. Reducing assumptions to a minimum, as science certainly aspires to do, is a good principle; but we shouldn't run away with the idea that that minimum is very small, let alone that science has managed to dispense with assumptions altogether. And if reducing assumptions to a minimum is the goal, why is the greater assumption, that the world is physically understandable, preferable to the lesser assumption, that it is simply understandable? The assumed primacy of matter is something to which I shall return in Chapters 24 and 25.

THE MYTH OF THE SCIENTIFIC METHOD

One of the consequences of the post-Cartesian notion of scientific objectivity, of a world ‘out there’ that we ‘in here’ can gain objective knowledge of, is that ‘we’ must keep out of the method of enquiry. This has generated the reductive myth of the scientific method, an account of science operating in a deeply impersonal manner such that the scientist’s imagination almost entirely disappears from view. According to the myth, scientific knowledge arises from the rigorous, logically sequential unfolding of whatever follows securely from predictable procedures by calculation according to fixed laws. But this myth utterly fails to do justice to what the work of science actually involves. The sheer, staggering work of imagination and inspiration that is science, its discoveries unpredictable and recalcitrant to compulsion by laws or procedures – real, living science – is swept away in this myth, this representation of science as something pedestrian, uninspired, essentially bureaucratic – and dead. It renders science something that a computer could do better than human beings. The distinction between these two accounts of science is the one Chargaff makes between rare, genuine scientists and drudges in the vast institutional machinery of science. Readers will spot, in the myth’s deathly re-presentation of scientific life as merely following procedures, the signature of the left hemisphere, and its grandiose aspirations to certainty. ‘Science is no longer identified with certitude and probability with ignorance,’[39] wrote Ilya Prigogine. In fact, science is a matter of probability and certitude a matter of ignorance.

Oddly, despite so much evidence to the contrary, it still needs emphasising that in practice science progresses by many more fruitful routes than the fabled ‘scientific method’. After describing the textbook version, George Gaylord Simpson, one of the most influential contributors to the reigning ‘Modern Synthesis’ in genetics, observes:

> It quite ignores the most difficult, most creative, and most important elements of scientific endeavour. How does one discern a problem, or decide what kinds of questions are to be asked? How does one determine what observations are relevant? And especially, what kind

> of hypothetical solutions are acceptable and where do they come from? Perhaps the most cogent objection of all is that important basic research has seldom really followed the ‘method’ just as it is stated.[40]

In other words, you can’t even start on the scientific method without making assumptions, using judgment and having insights, insights that are not part of the method, and do not follow any kind of formal principles – and the method is in any case unlikely to produce ‘important’ results.

The process of science has much less to do with logic than has classically been assumed.[41] ‘Science-in-practice is often driven by hunches and vague impressions’, according to Yale psychologists, Leonid Rozenblit and Frank Keil, who have studied how much we know and how we come by such knowledge in various settings.[42] For a start, science depends on good hypotheses. Not only is there nothing wrong with that, but it is essential to the nature of science that it imaginatively selects its assumptions, which it discards only when they don’t work. Newton need not have been so defensive about dealing in hypotheses.

Science could never get off the ground if untold numbers of fruitless hypotheses had to be taken equally seriously and subjected to the same procedure so that they could be systematically eliminated. It therefore requires the exercise of imagination from the outset, which alone can supply interesting and potentially fruitful hypotheses, and eliminate intuitively unfruitful ones. While respecting the data out of which they emerge, good hypotheses always ‘go beyond’ the immediate facts.

As the biologist Peter Medawar wrote,

> Scientists should not be ashamed to admit, as many of them apparently are ashamed to admit, that hypotheses appear in their minds along uncharted by-ways of thought; that they are imaginative and inspirational in character; that they are indeed adventures of the mind.[43]

Anna Sfard, a professor of mathematics, has studied the ways in which scientists and mathematicians reach their conclusions. From interviewing them at length, she concluded that

> it was quite clear that, for them, one of the best indications of understanding is the ability to sense that something is true in an immediate manner, without having recourse to a formal proof … 'Having a result' without knowing how it was obtained is perhaps the most striking phenomenon in the work of a mathematician.[44]

This could be seen as a direct account from experience of how the right hemisphere first intuits something as a *Gestalt* before the left hemisphere sets about systematising it. 'I hope no one still thinks that theories are deduced by strict logical conclusions from lab records', wrote Wolfgang Pauli, a pioneer of quantum physics, in 1957, 'a view which was still all the rage in my student days. Theories arise from *seeing* something inspired by empirical data'.[45] Scientists who think science consists of unprejudiced data-gathering without speculation aspire, in Medawar's phrase, merely to 'browse over the field of nature like cows at pasture'.[46]

That results precede arguments 'was a commonplace for ancient mathematicians … The Greeks did not think much of propositions they happened to hit upon in the deductive direction without having previously guessed them'.[47] Carl Friedrich Gauss, one of the most fertile mathematical minds of all time, remarked 'I have had my results for a long time; but I do not know yet how I am to arrive at them'. To pick two famous mathematicians out of many, Johann Euler, who was also an astronomer, stated that arithmetical theorems are 'discovered long before their truth has been confirmed by rigid demonstration'; and George Pólya that 'you have to guess a mathematical theorem before you prove it'. The philosopher of science and mathematics Imre Lakatos emphasised that science is effectively a *dynamic* process in which results are never final, unchanging 'nuggets' of truth.[48]

Karin Knorr interviewed scientists about their work and found that when they described the origin of an innovative piece of research, they talked about having grasped a 'similarity between hitherto unrelated problems and contexts'.[49] In other words, they proceeded by analogy rather than analysis. It is no surprise, therefore, that it is often through images – metaphors – rather than supposed chains of logic, that scientists and mathematicians make their greatest discoveries. 'The words or the language, as they are written or spoken', wrote Einstein, 'do not seem to

play any role in my mechanism of thought. The psychical entities which seem to serve as elements in thought are certain signs and more or less clear images which can be “voluntarily” reproduced and combined … The above mentioned elements are, in my case, of visual and some of muscular type.’[50] It is said that Kekulé seized the shape of the benzene ring, the foundation of organic chemistry, when the image of a snake biting its tail arose from the embers of his fire;[51] Mendeleev saw the structure of the periodic table of the elements in a dream.[52] The seminal mathematician Solomon Lefschetz

> saw mathematics not as logic but as pictures. His insights were great, but his ‘proofs’ were almost always wrong.[53]

Michael Faraday is one of the most influential scientists in history, who made hugely important advances in our understanding of magnetism and electricity. According to Helmholtz,

> with quite a wonderful sagacity and intellectual precision, Faraday performed in his brain the work of a great mathematician without using a single mathematical formula … it is in the highest degree astonishing to see what a large number of general theorems, the methodical deduction of which requires the highest powers of mathematical analysis, he found by a kind of intuition, with the security of instinct, without the help of a single mathematical formula.[54]

Some people might be surprised to learn that Niels Bohr’s research notebooks contained only pictures and words, no mathematical formulae.[55] Heisenberg writes of Bohr, arguably the greatest physicist of the last century: ‘We could clearly sense that he had reached his results not so much by calculation and demonstration as by intuition and inspiration, and that he found it difficult to justify his findings before Göttingen’s famous school of mathematics’.[56]

It is not, moreover, just that a few gifted geniuses who rock the foundations need imagination to make their discoveries. The whole enterprise of science as she is practised is dependent on imagination in

order to interpret what it is one is seeing. The problem is not that it is hard to rule out the human element, but that by attempting to rule it out – especially by ignoring the role of interpretation – we misrepresent the situation we describe. A particularly striking example is given by the economist Robert Chambers: 22 different studies of soil erosion in one catchment area in Sri Lanka yielded figures that differed by a factor of 8,000. 'The scary part', comments David Boyle, 'is that all the figures were probably correct, but the one thing they failed to provide was objective information. For that you need interpretation, quality, imagination.'[57] Better still would be to accept that objective is a relative term, and that truth is, too: complex, multifaceted, rarely if ever single, never simple. Which, to repeat, since the point is so vital, does not for an instant imply giving up on it altogether.

In all science, moreover, chance plays as prominent a role as any method. Alexander Fleming's chance discovery of the antibiotic applications of penicillin is too well known to need relating, but to take a few examples out of many from my own field, almost every treatment for bipolar disorder was discovered 'by mistake', not by scientific method. Lithium's effect as a mood stabiliser was discovered indirectly: urea was initially thought to be a mood stabiliser (it is not), and it just happened that the lithium salt of urea was used. Later it was found that it was not the urea, but the lithium, that worked.[58] Another mood stabiliser, carbamazepine, was discovered during a search for antihistamines. Valproate was developed in Germany during the war as a butter substitute – it was used in pills as a diluent: it turned out that the diluent was what did the trick. Serendipity is the scientist's friend; but it is a reciprocal relationship, as friendships are. As Pasteur put it, 'in the field of observation chance favours only the prepared mind'.[59]

Once again, this does not discredit science in any way: it shows, instead, what an exciting and humbling business science is. We *collaborate* with nature, and with fortune, pay attention and learn from her. We neither withdraw the human element, as the myth of the scientific method implies, nor *force* nature to our preconceived ends. With our limited understanding, and limited capacity to understand, that would be foolishness indeed. As Bacon, who is reputed to be the one who wanted to put Nature on the rack, nevertheless put it, 'Nature to be commanded must be obeyed … The

subtlety of Nature is greater many times over than the subtlety of the senses and understanding.'[60]

So, far from being the impersonal, robotic business that the myth of the scientific method would imply, the actual practice of science in pursuit of truth is profoundly human. And at its core lies a human attribute to which no robot or computer could make any claim. As Max Planck put it:

> Anybody who has been seriously engaged in scientific work of any kind realizes that over the entrance to the gates of the temple of science are written the words: *Ye must have faith*. It is a quality which the scientists cannot dispense with.[61]

SCIENCE'S AWARENESS OF ITS OWN LIMITS

In drawing attention to a widely held, but false, view of objectivity, to hidden assumptions that are blithely made, and to a misleading account of how science is practised, I am not, of course, suggesting that every scientist is in thrall to these misconceptions. Far from it. Many scientists are well aware of the inescapable limitations attending upon what they do and, consequently, of how qualified must be science's claims to truth and how false is any meta-claim that science has exclusive access to truth. Humility is not unknown in the scientific world.

Science has shown itself perfectly capable – at certain tipping points in its history – of recognising that it may be barking up the wrong tree or, at least, that the particular sort of barking it has been engaged in has run its course and that quite different trees merit attention. For example, it was physicists who definitively jettisoned the machine model around the time of the First World War, when their findings could no longer be made to fit the assumptions the model makes. The fundamental structure of the cosmos, they discovered, simply had few of the qualities of a machine. Revising the model has revealed further conundrums that require to be solved. Physics being the most philosophically sophisticated branch of science, it is only to be expected that it will recognise how very far it is from having all the answers, since the hallmark of a greater understanding is awareness of one's own limits. Promises from physics' more zealous exponents that a 'Theory of Everything' is just around the corner should be treated with caution: it has been just around the corner for over a century.

One of the most sharp-eyed observers of the current situation in physics is cosmologist and theoretical physicist Lee Smolin. 'Those scientists who work on the foundations of any given field', he points out, 'are fully aware that the building blocks are never as solid as their colleagues' – and, *a fortiori*, the general public – 'tend to believe.'[62]

For example, to return to the question of how rooted in evidence science needs to be, but how hard a criterion that is, in practice, to fulfil, he comments on the idea of extra dimensions: 'in fact, neither theory nor experiment offers any evidence at all that extra dimensions exist.'[63] Neither is there any evidence whatever that there is an infinity of universes –

another popular theoretical gambit, driven by the desire to avoid the clearly unpalatable conclusion that intelligence might be intrinsic to the one universe of which we know something. It is another version of ‘anything goes’ (in an infinite number of universes, everything is as true as anything else), this time coming, alarmingly, from scientists who should know better.

My point is not here to argue that there are, or are not, a multitude of universes, something I am unqualified to do, but to suggest that the public idea of science as securely rooted in fact is a half-truth.

Of string theory, Smolin comments, ‘despite the absence of experimental support and precise formulation, the theory is believed by some of its adherents with a certainty that seems emotional rather than rational.’[64] Pouring cold water on the fervour, he quotes the physicist Brian Greene:

> Even today, more than three decades after its initial articulation, most string practitioners believe we still don’t have a comprehensive answer to the rudimentary question, What is string theory?[65]

This comes, not from someone out of touch with scientific thinking on the issue, but from the Professor of Physics and Co-Director of Columbia University’s Institute for … Strings, Cosmology, and Astroparticle Physics.

I suspect Smolin may not be entirely impartial here; and certainly I can have no personal view on string theory, which, within the considerable limits of my understanding of it, is in some ways highly congenial to my philosophy that processes are more fundamental than particles. I have nothing to say against it. Behaving as if string theory were true helps to explain things otherwise not apparently explicable. But that is what we are doing: making an assumption, one that to many people is elegant and helpful, but is unproven and may be intrinsically incapable of proof other than the excellent Pragmatist one that it works better than alternatives. No-one has been, and maybe no-one ever will be, able to detect a string (or the existence of the six extra dimensions the equations of string theory require). My point is not about string theory: it is that science is, and must be, alive, provisional and uncertain, not, as many non-scientists are led to assume, laid out cold on a slab.

Smolin continues:

> We must be careful to present the failures along with the successes. Indeed, being honest about failures is likely to help rather than hurt our cause … In recent years, many books and magazine articles for the general public have described the amazing new ideas that theoretical physicists have been working on. Some of these chronicles have been less than careful about explaining just how far the new ideas are from both experimental test and mathematical proof.[66]

In quantum mechanics the picture is considerably better, but even there clarity and certainty cannot be claimed, according to Anton Zeilinger and colleagues:

> Quantum theory is based on a clear mathematical apparatus, has enormous significance for the natural sciences, enjoys phenomenal predictive success, and plays a critical role in modern technological developments. Yet, nearly 90 years after the theory's development, there is still no consensus in the scientific community regarding the interpretation of the theory's foundational building blocks.[67]

Great scientists tend to be very cautious about the claims that can be made for science. J.B.S. Haldane's famous remark that the universe is probably not just queerer than we suppose, but queerer than we *can* suppose, puts its finger firmly on the point at issue. Humility of approach displays insight. 'How shallow, puny, and imperfect are efforts to sound the depths in the nature of things', wrote Whitehead. 'In philosophical discussion, the merest hint of dogmatic certainty as to finality of statement is an exhibition of folly.'[68]

And, finally, there is an obvious point that still needs to be made despite its being so obvious. There are realms of human experience, vast realms of the reality that constitute 'the world' as human beings encounter it, that are beyond the methods of science to investigate in anything other than a trivial way. Erwin Schrödinger put his finger on it when he graphically described the process involved in trying to comprehend (rather than explain) the world in a scientific way, and what then ensued:

> I actually do cut out my mind when I construct the real world around me. And I am not aware of this cutting out. And then I am very astonished that the scientific picture of the real world around me is very deficient. It gives a lot of factual information, puts all our experience in a magnificently consistent order, but it is ghastly silent about all and sundry that is really near to our heart, that really matters to us … Science sometimes pretends to answer questions in these domains, but the answers are very often so silly that we are not inclined to take them seriously.[69]

Some scientists have become rather famous through promoting their 'discovery' of the purposelessness of life. But science could never discover any such thing. According to its own assumption, its method excludes questions of teleology altogether. Science understandably does not find a purpose, because purpose is not something its way of thinking recognises. That is not a criticism of science *per se*. At most it is a criticism of a certain 'philosophy' of science, rarely critically examined, or even challenged; more generally it is a criticism of those who want to take the methodology of science into realms where it has no purchase on reality. When it comes to the really big questions – such as the nature, meaning or purpose of life, consciousness, time, love, energy, matter, beauty, truth or goodness – science encounters the limitations inherent in its dependence on models as the necessary means of proceeding, for in these cases there not only isn't an appropriate model, there can't be one, because each of them is completely *sui generis*. The ultimate nature of reality, as well as the origin of values, meaning and purpose in life, lie beyond the remit of science, though they continue to be of supreme importance for living. To quote Bertrand Russell: 'Almost all the questions of most interest to speculative minds are such as science cannot answer … Science tells us what we can know, but what we can know is little, and if we forget how much we cannot know we become insensitive to many things of great importance.'[70]

CONCLUSION

In conclusion, the point I wish to make – and I cannot emphasise it strongly enough – is that just because what we rightly take to be scientific truths are not 'objective' in the sense that nothing human, contingent and fallible enters into them, this does *not* mean they have no legitimate claim to be called true. Such a position would be trivial and absurd. My point is that truth is *never* objective in this, artificially limited, sense. But, important as it is to recognise that, it is every bit as important to validate science's attempt to respond as fairly and fully to the reality with which it engages. Fairly, like fully, means inhabiting a number of points of view, not fruitlessly attempting to inhabit none. All knowledge whatsoever is contextual and contingent. The observer inevitably alters what is observed. Yes, OK. But that tells us about the nature of truth, not about the undiminished value of science.

I also want to emphasise that the scientific process cannot be free from assumptions, or values; that its advance requires imagination, as well as serendipity – not merely the stolid adherence to a procedure; and that it represents a rich creative process, always provisional, requiring breadth and depth of thinking, and that that is why we rightly value it so highly. Here again one sees the contrast between how the left hemisphere would conceive science and how the right hemisphere would do so, a subject I will explore further in the next two chapters. In science we need a balance between what *each* hemisphere provides, not just the contribution of one, be it left or right. However, there is no question that there is currently an imbalance. As Roger Sperry's colleague Jerre Levy put it: 'One gets the suspicion that 18 or so years of formal schooling in the sciences may functionally ablate the right hemisphere.'[71]

Bear in mind, moreover, that the left hemisphere is the manipulator: it presumes that the purpose of science is to help us exploit the world. In the Introduction, I quoted Erwin Schrödinger's important words, from *Science and Humanism*, that the value of science lies in forming part of the knowledge humanity can bring to bear on the ultimate question, the question of Plotinus': 'who are we?' That, of course, requires a much broader scope, more typical of the right hemisphere's understanding.

Wendell Berry points out that ‘the modern university is organised to divide the disciplines; that universities pay little or no attention to the local and earthly effects of the work that is done in them; and that in the universities one discipline is rarely called upon to answer the questions that might be asked of it by another discipline.’[72] These are serious problems, and I hope the path taken by this book will play a part in redressing them, even if only a little. But to address Plotinus’ question from within the discipline of science rather than the humanities, we would need especially to turn to the science of life. That forms the subject of the next chapter.

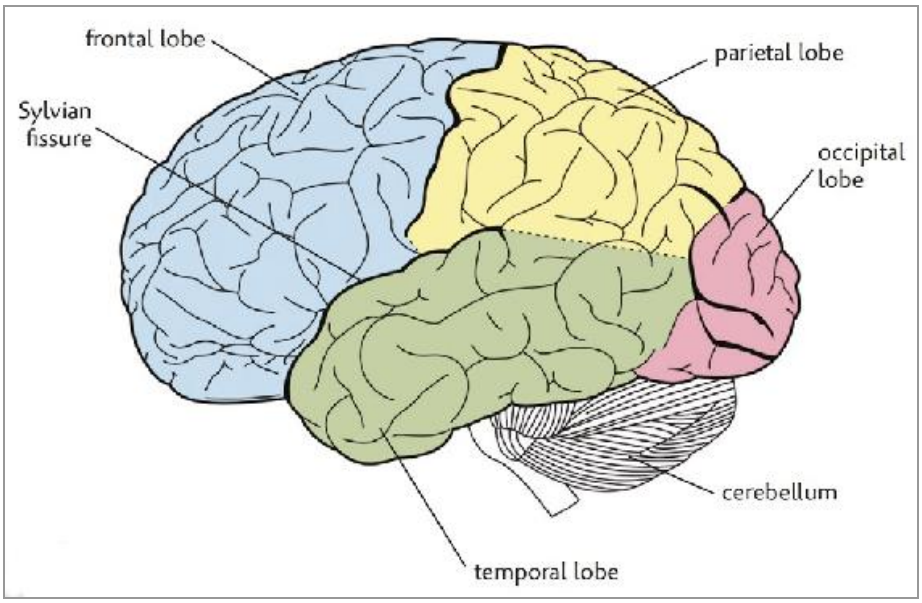


Plate 1[a] Lobes of the brain

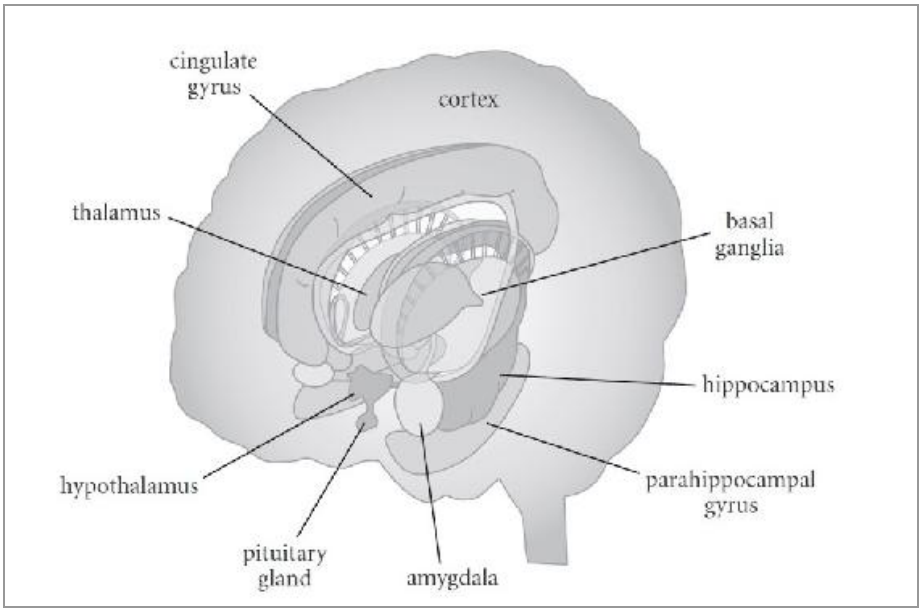


Plate 1[b] · Diencephalon, basal ganglia and limbic system

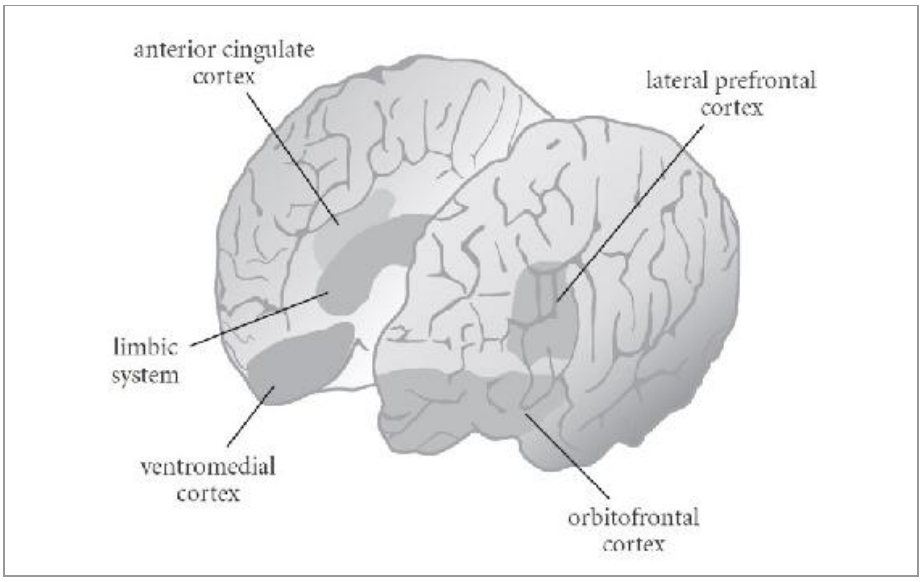


Plate 1[c] · Prefrontal cortex and limbic system

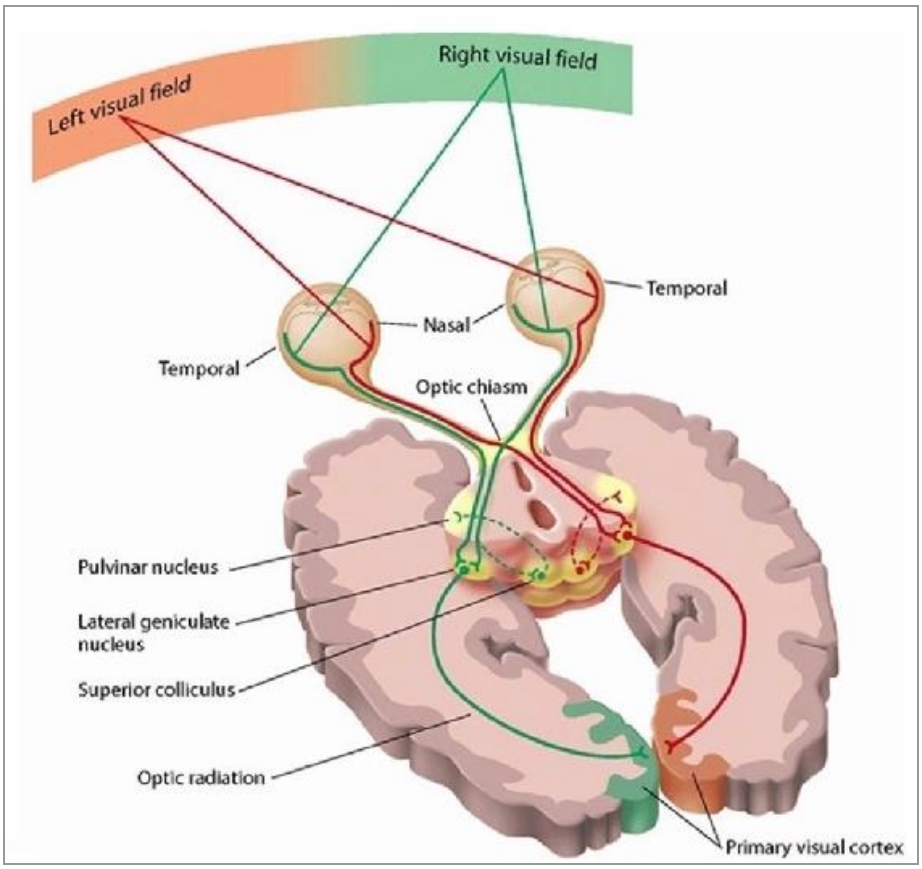


Plate 1[d] · Optic pathways

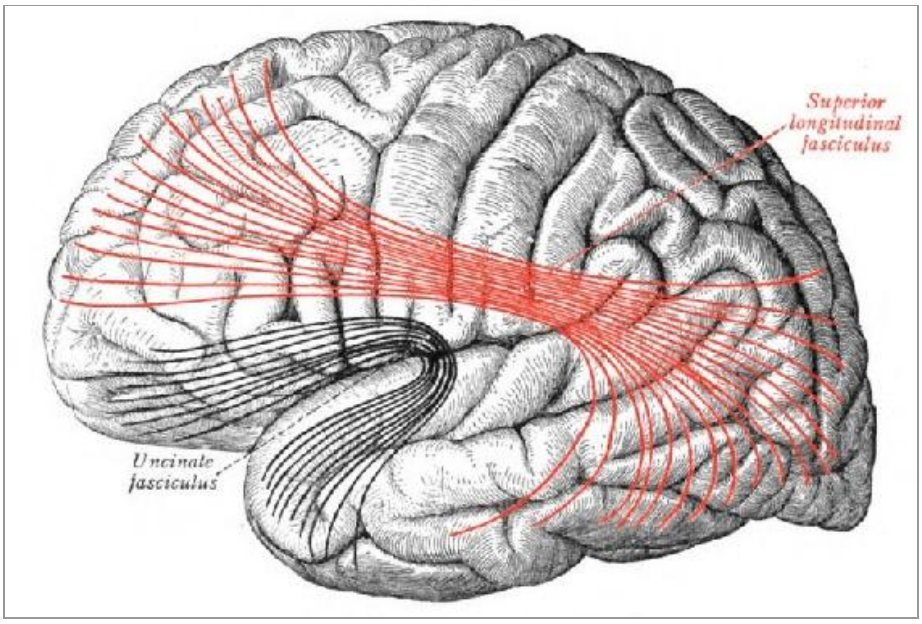


Plate 2[a] · Superior longitudinal and uncinate fasciculi. See Chapter 6 et passim.

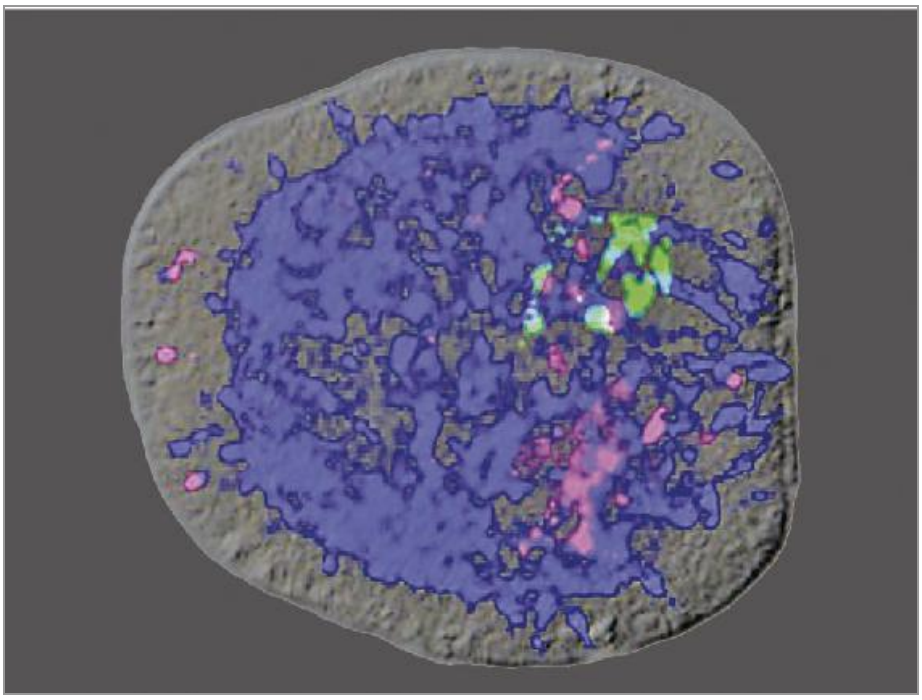


Plate 2[b] · Neural network of Nematostella vectensis. Two signal paths, Wnt and BNP, that are instrumental in the centralization of nerve cells in vertebrates, are already asymmetrically distributed in the nerve net of a sea anemone 700 million years old. See Chapter 1.

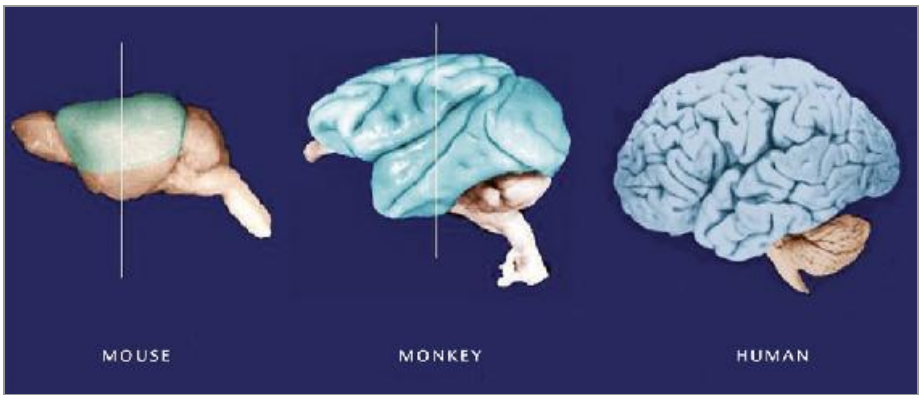


Plate 2[c] · Comparative anatomy of neocortex in mouse, monkey and man. The neocortex is shown in blue-green. See Chapter 1.

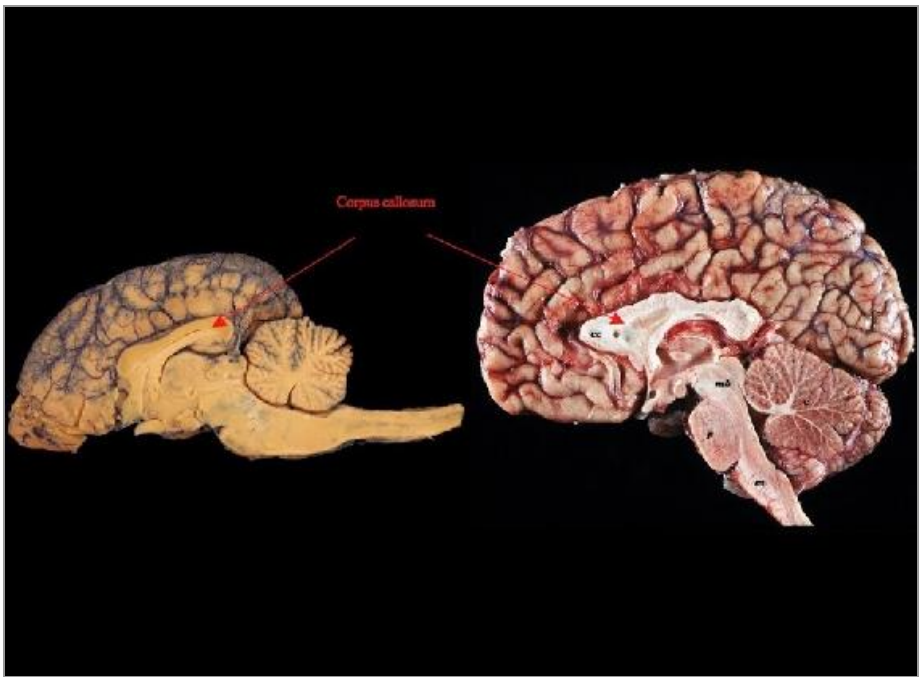


Plate 3[a] · Sagittal section of the brain of a dog and of a human brain (cc = corpus callosum; mb = midbrain; p = pons; m = medulla). Note that the relative size of the corpus callosum has diminished with cortical expansion. See Chapter 1.

Plate 3[b] Simulation of palinopsia/ akinetopsia. See Chapter 2.

Plate 4 · The Garden of Earthly Delights, by Hieronymus Bosch, oil on board, c 1505. Features in common with right hemisphere dysfunction include not merely hallucinatory transformations, harsh dislocations of bodily form, and an emphasis on sharp, penetrating elements, but the isolation of elements, a triumph of disjunction over flow, the rejection of natural harmony of form or colour, and the deluge of detail threatening to overwhelm our sense of the whole. It has been suggested that Bosch suffered from ergotism, a condition caused by eating rye affected by ergot mould, which was accompanied by hallucinations: LSD was first synthesised from ergot fungus. Whether or not this is the case, it is interesting that ergotism would appear to affect more particularly the right hemisphere of the brain (see Senter et al 1976). See Chapter 3.

Plate 5[a] · Hemiprosopometamorphopsia: representation of a patient's perception of faces. See Chapter 3.

Plate 5[b] · Head of a Woman, by Pablo Picasso, oil on canvas, 1960. 'Faces resembled the paintings of Picasso.' See Chapter 3.

Plate 6[a] · The Persistence of Memory, by Salvador Dalí, oil on canvas, 1931. Faces, in the left field of vision, melt away 'like clocks in a Dali painting'. See Chapter 3.

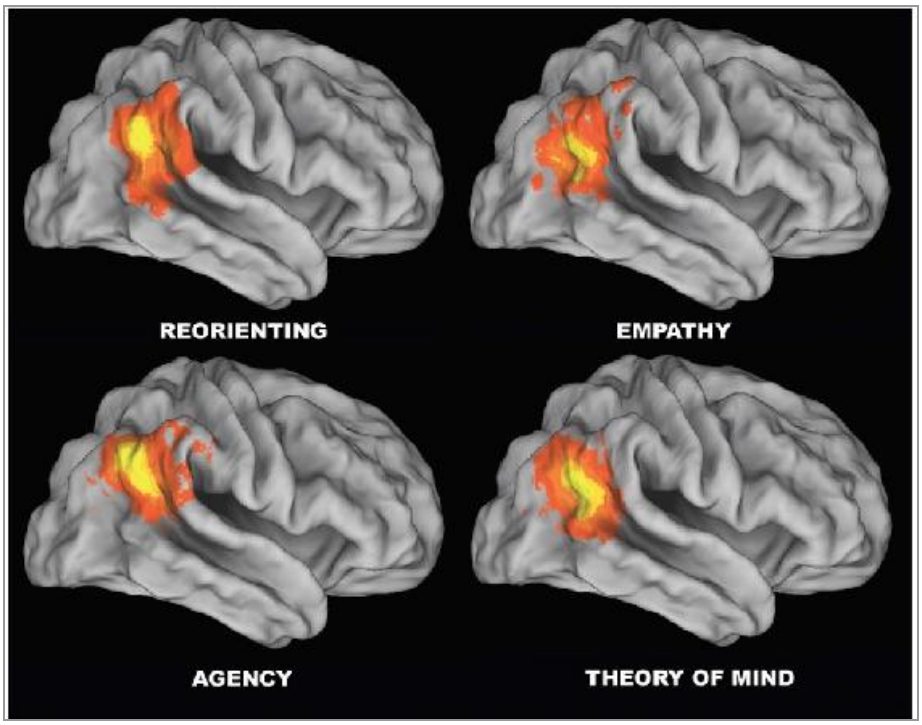


Plate 6[b] The right temporoparietal junction in social interaction (from Decety & Lamm 2007). See Chapter 6.

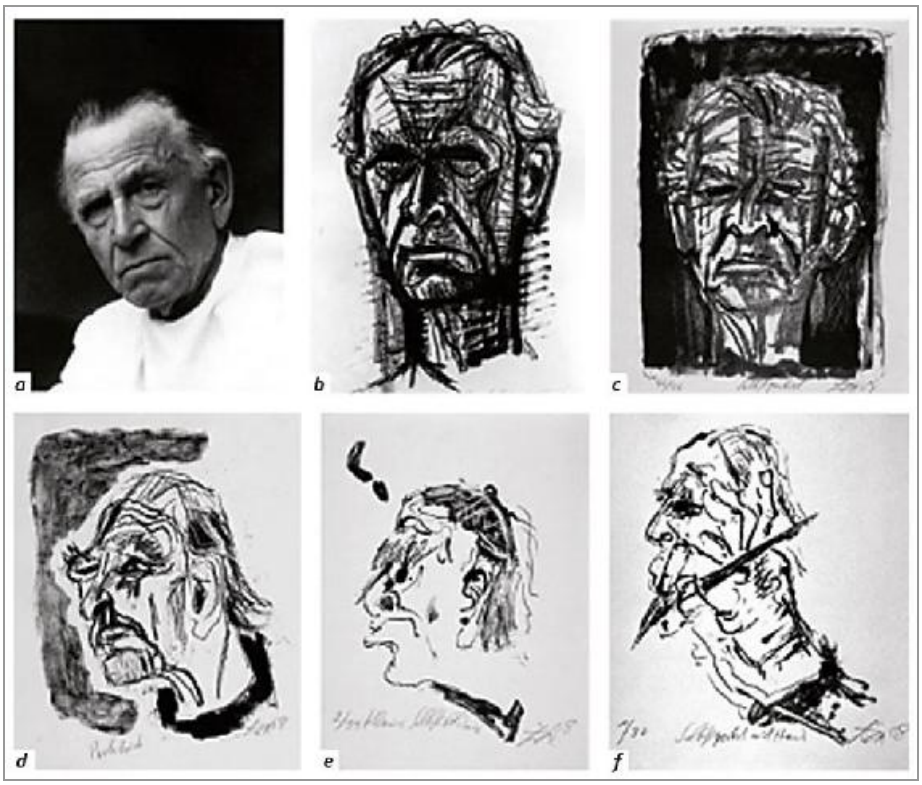


Plate 7 · The top row shows a photograph of Otto Dix, and two self-portraits from before his RH stroke. The bottom row shows three self-portraits from the period after his stroke. By comparison these are sketchy – almost cartoon-like (cf Fig. 20, p 262); they lack vitality, and above all the impression of Dix's character, when compared with the pre-stroke drawings and the photograph. Note in particular that, in the last frame (f), the painting hand obtrudes in the painting and threatens to obscure the face. It also has six fingers, as did the hand in his last selfportrait with his grand-daughter, Marcella. See Chapter 8; for supernumerary body-parts, see Chapter 4.

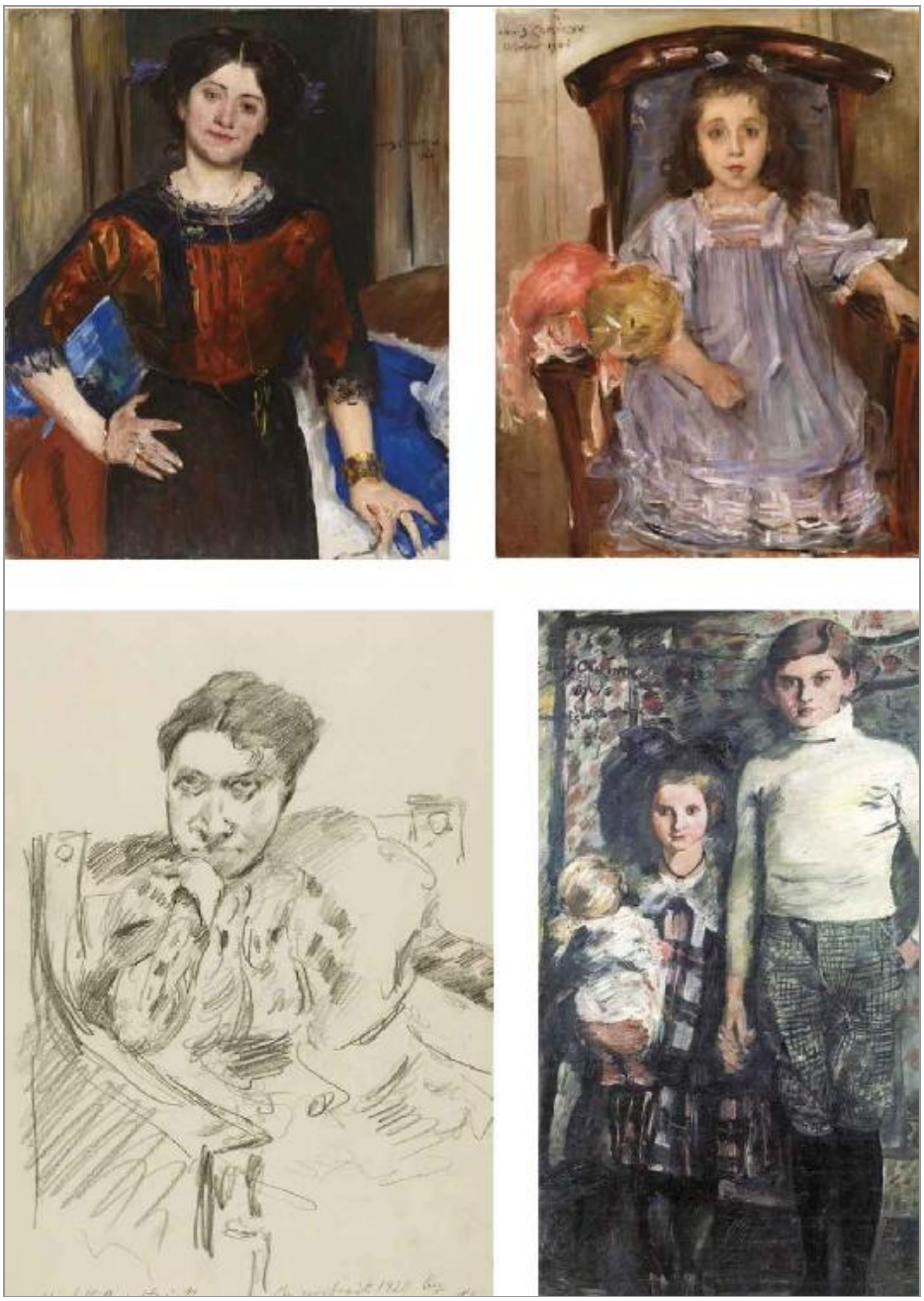


Plate 8 · Lovis Corinth suffered a RH stroke in 1911. Compare (top row) a portrait of his wife in 1910, and of a friend's daughter, Sophie Cassirer, in 1906, with (bottom row) a portrait of his wife in 1920, and of his own children in 1916 (oil on canvas, and graphite on paper).

Plate 9 · Lovis Corinth (continued). Compare, from before his stroke (top row), Laughing girl, 1883, and Black Othello, 1884, with, from after his stroke (bottom row), The beautiful Imperia, 1925, and Mrs Hedwig Berend, 1923 (oil on canvas, and graphite on paper). For discussion, see Chapter 8.

Plate 10[a] · The Puppetmaster (from Bethlem Royal Hospital Archive), anon, watercolour on paper. See Chapter 9.

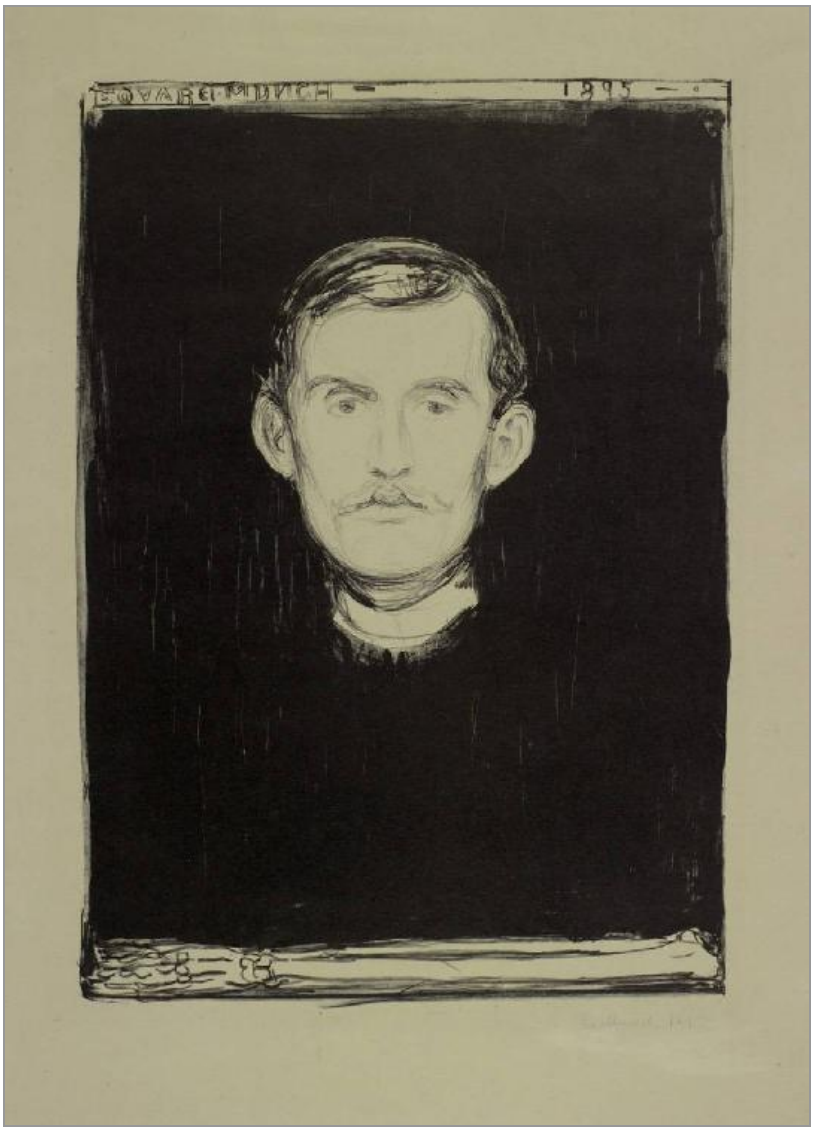


Plate 10[b] · Self-portrait with Skeleton Arm, by Edvard Munch, lithograph, 1895. See Chapter 9.

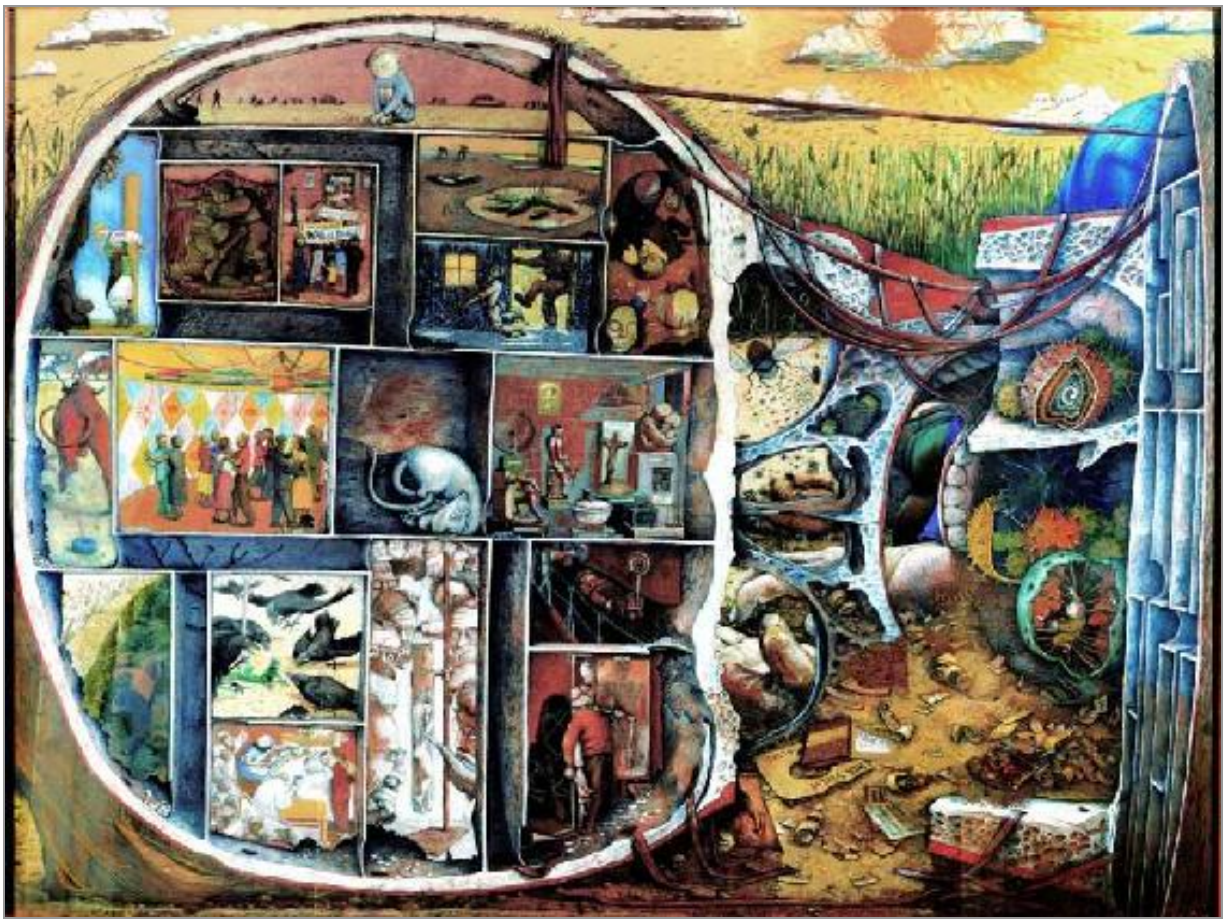
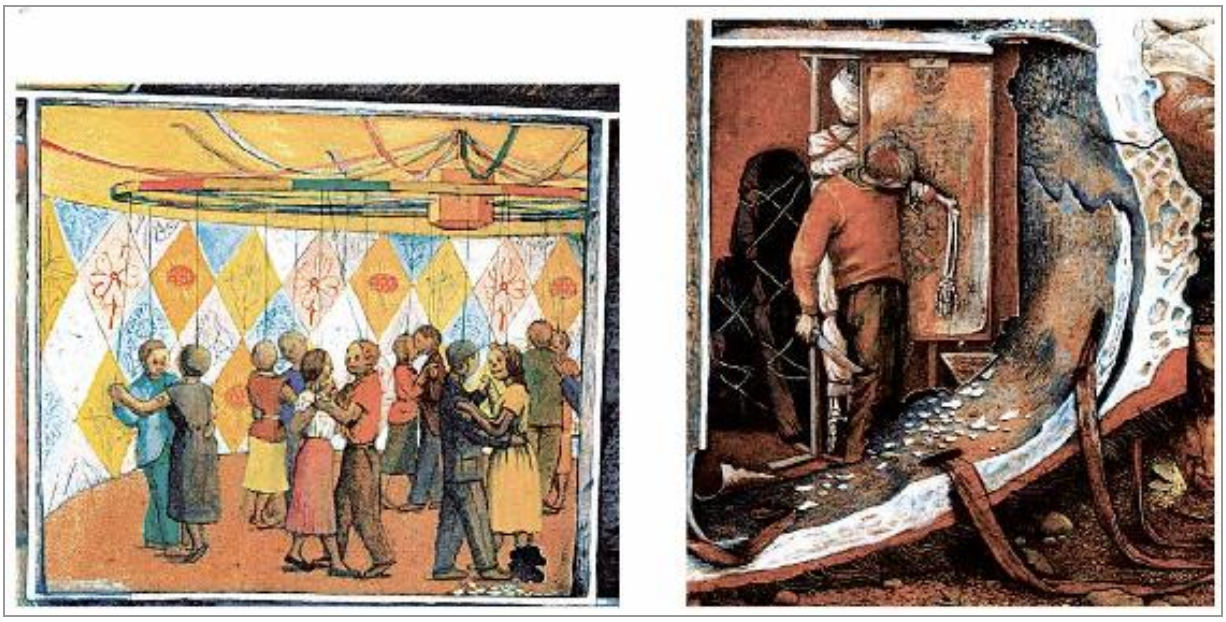


Plate 11 · The Maze, by William Kurelek, gouache on board, 1953. This extraordinary artwork by a former patient of Bethlem Hospital is almost unparalleled for its portrayal of the mental world of schizophrenia, and rewards close scrutiny. Of immediate relevance is the depiction (left middle) of couples dancing, as if puppets on a string; and (bottom right) of a man slicing his flesh away to reveal the left forearm as mere bone (see the enlargements on the next page). See Chapter 9.



Enlargements of The Maze, by William Kurelek

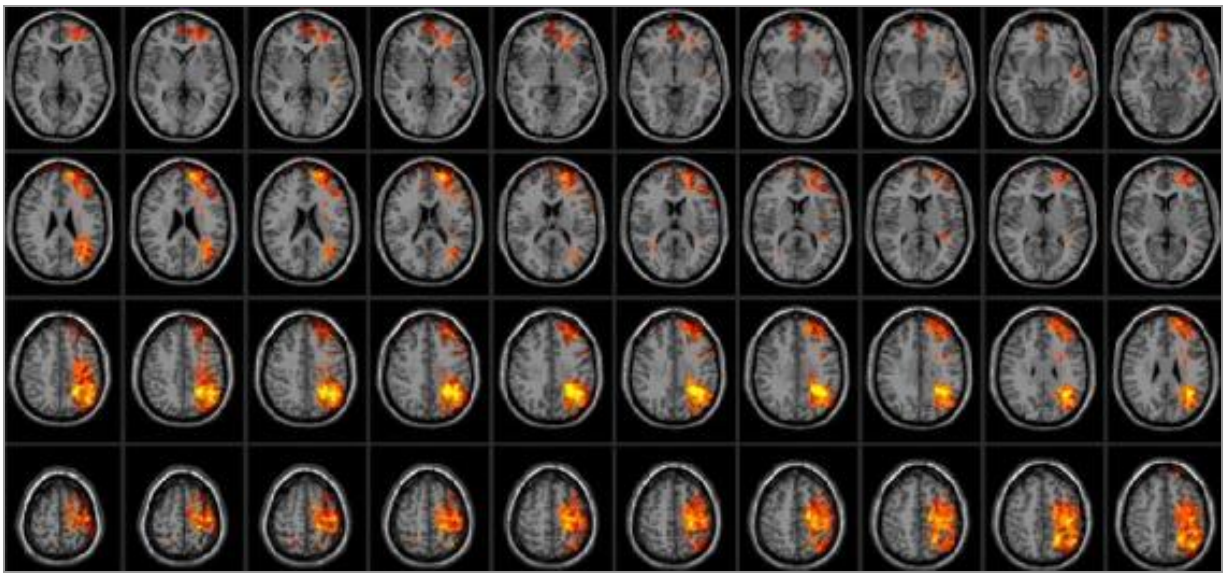


Plate 12[a] · Areas of significance for fluid intelligence. The areas of significance for fluid intelligence are illuminated; as will be seen, they lie almost exclusively in the right hemisphere of the brain (NB the right hemisphere, according to radiological convention, is on the viewer's left). (from Barbey, Colom, Paul et al 2014). See Chapter 7.

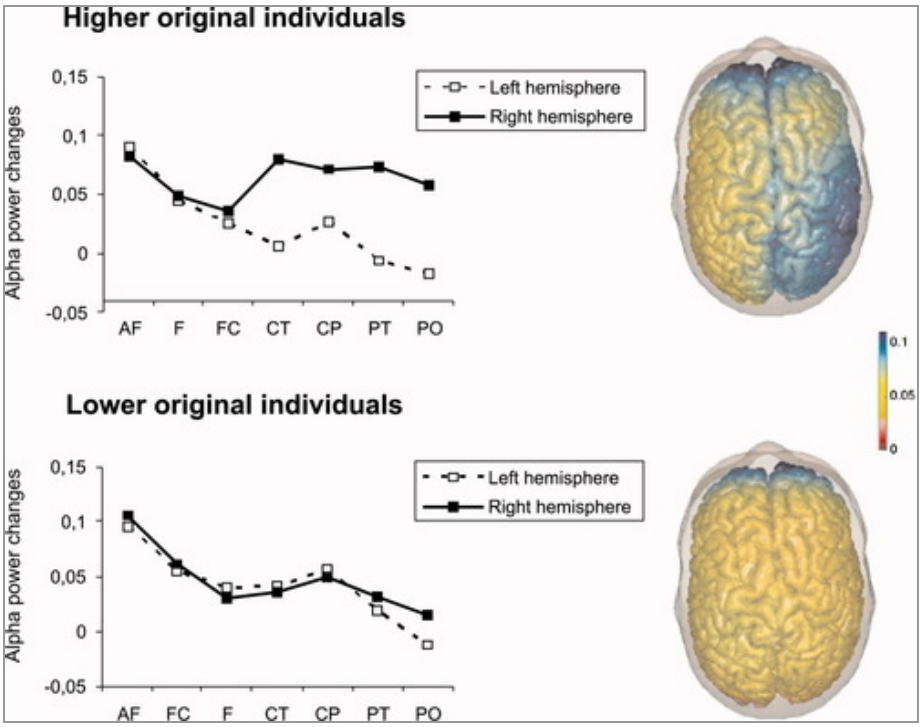


Plate 12[b] · Highly original subjects show stronger alpha power increases in the right posterior hemisphere; less original subjects show no hemisphere difference. (from Fink, Grabner, Benedek et al 2009). See Appendix 1.

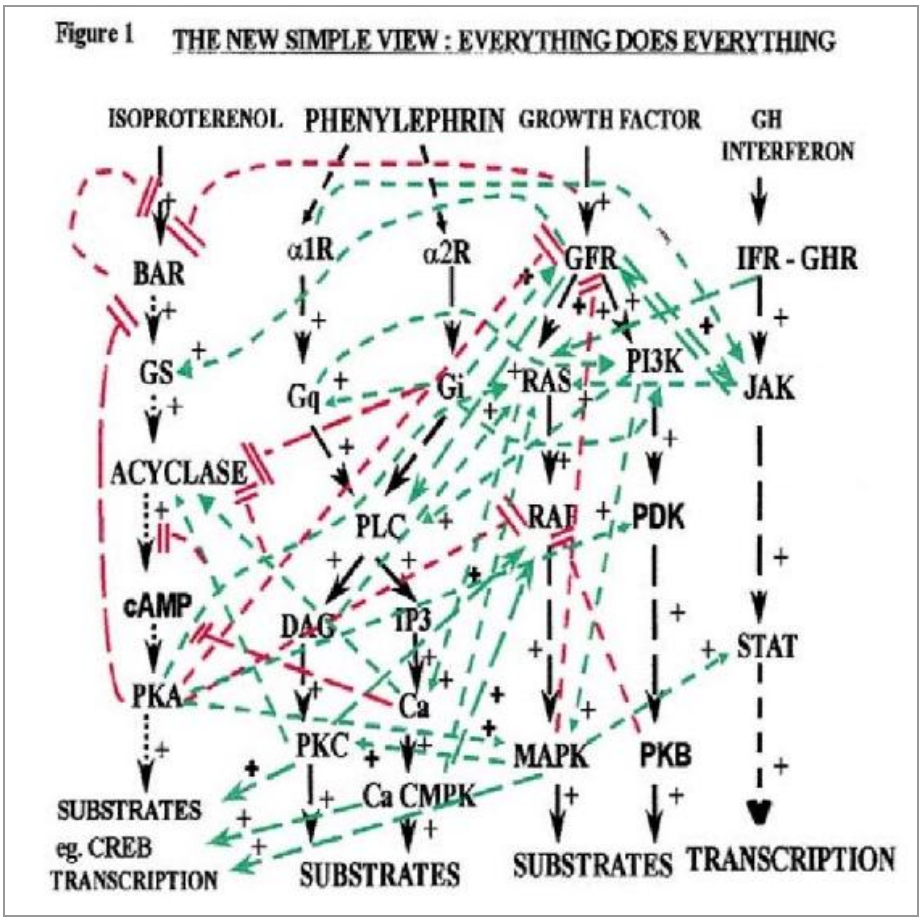


Plate 13[a] · 'Horror graph' of the cross-signalling between just five intracellular signal transduction cascades: inhibitory flows in red, facilitatory flows in green (from Dumont, Pécasse & Maenhaut 2001). See Chapter 12.

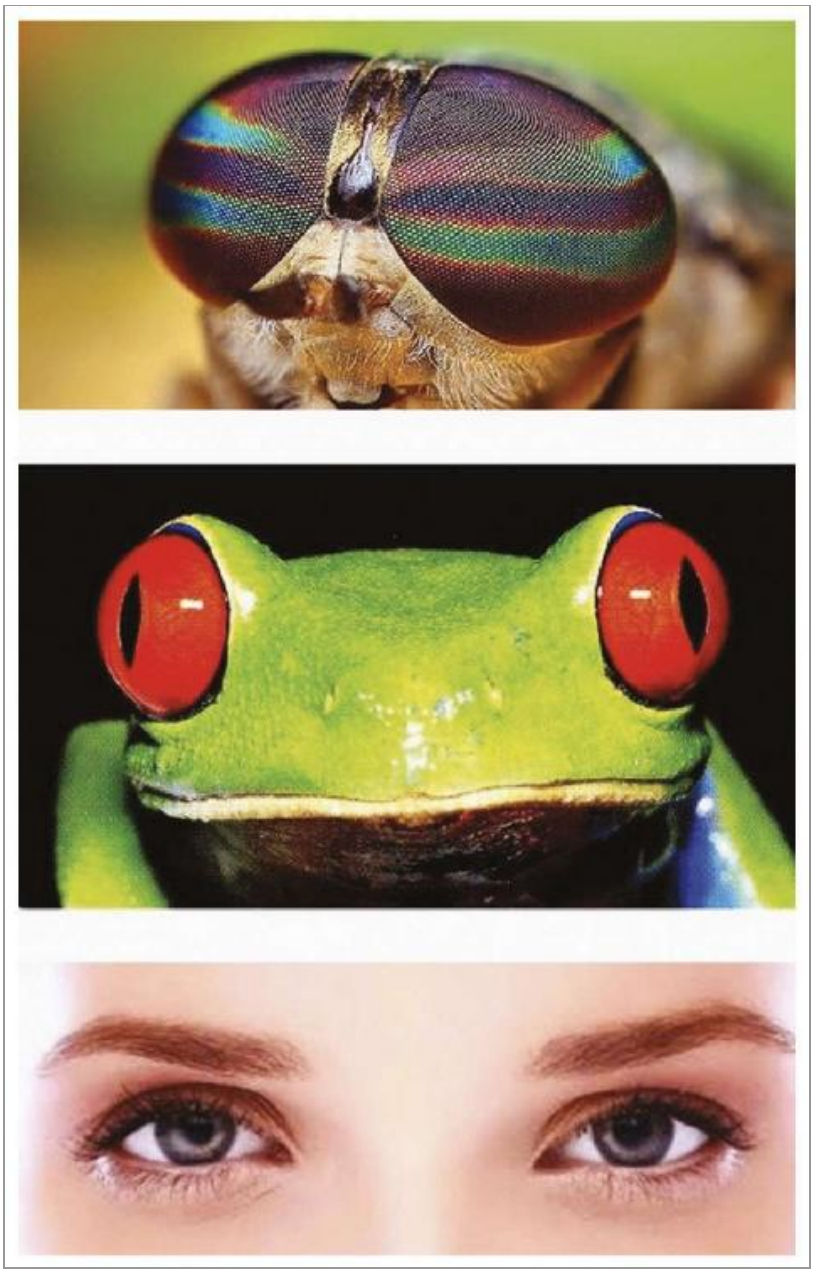


Plate 13[b] · Eyes of a fly, a frog and a human. See Chapter 12.

Plates 13[c] & [d] · Norfolk Island pine and eagle feathers: note the precision of overall form observed by the needles of the pine and the barbs of each feather. See Chapter 12.

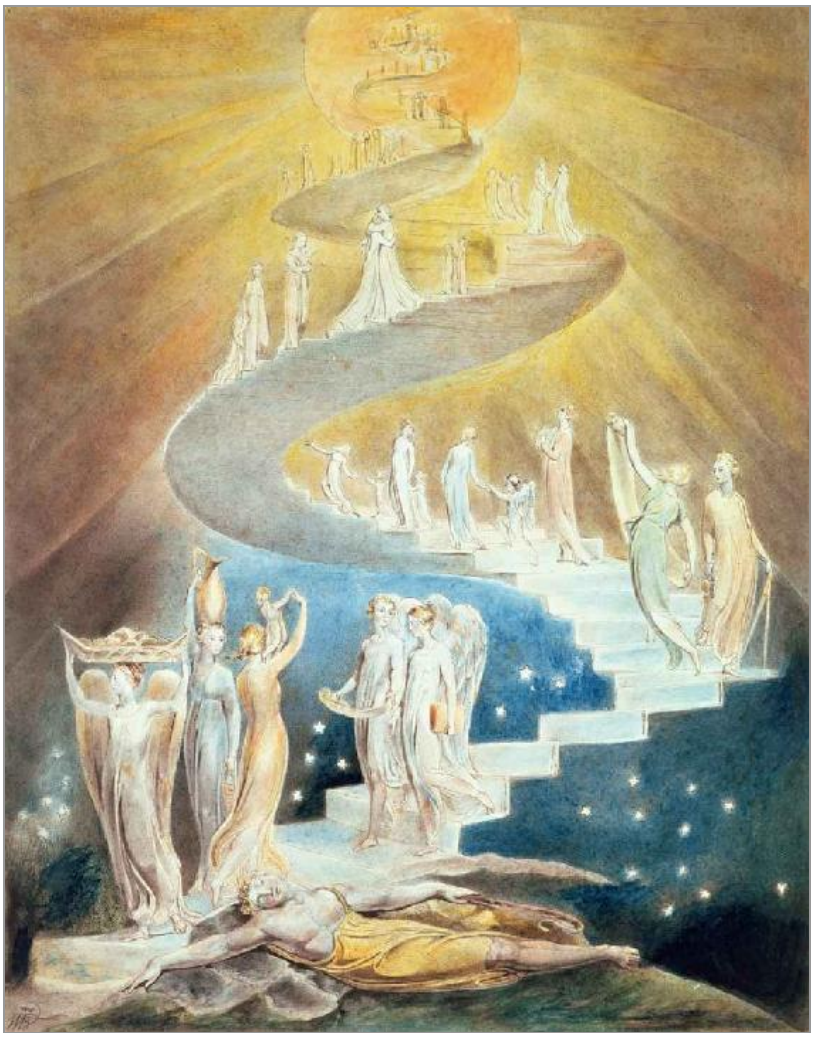
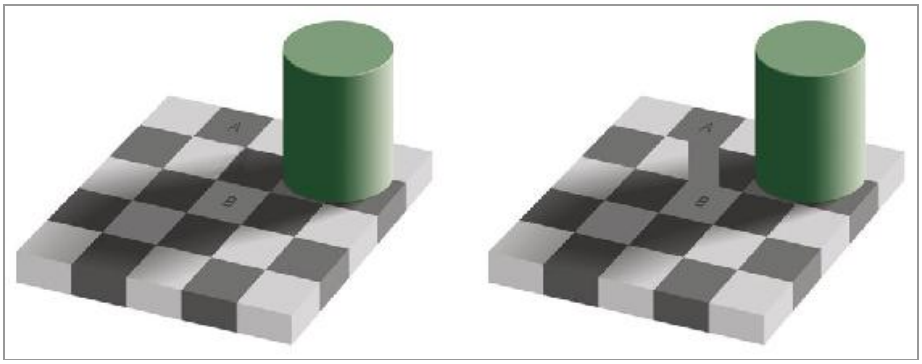


Plate 14 · Jacob's Ladder, by William Blake, pen, ink and watercolour, c 1799–1807. See Chapter 16.

Plate 15 · La belle captive, by René Magritte, oil on canvas, 1948. The glow of fire on an area within the frame suggests that this is neither merely presence, nor merely representation, but, like glass, a plane that we need to see through. See Chapter 16.



Plates 16[a] & [b] · The chequerboard illusion. The image on the right shows, by the addition of a bar, that A and B are in fact the same colour. See Chapter 17.

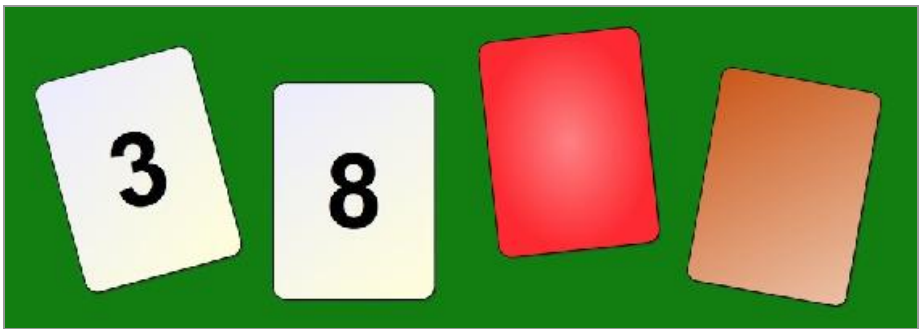


Plate 16[c] · The Wason test (1). Each card has a number on one side, and a colour on the other. Which card(s) must be turned over to test the idea that if a card shows an even number on one face, then its opposite face is red? See Chapter 18.

Plate 16[d] · The Wason test (2). Each card has an age on one side, and a drink on the other. Which card(s) must be turned over to test the idea that if you are drinking alcohol then you must be over 18? See Chapter 18.

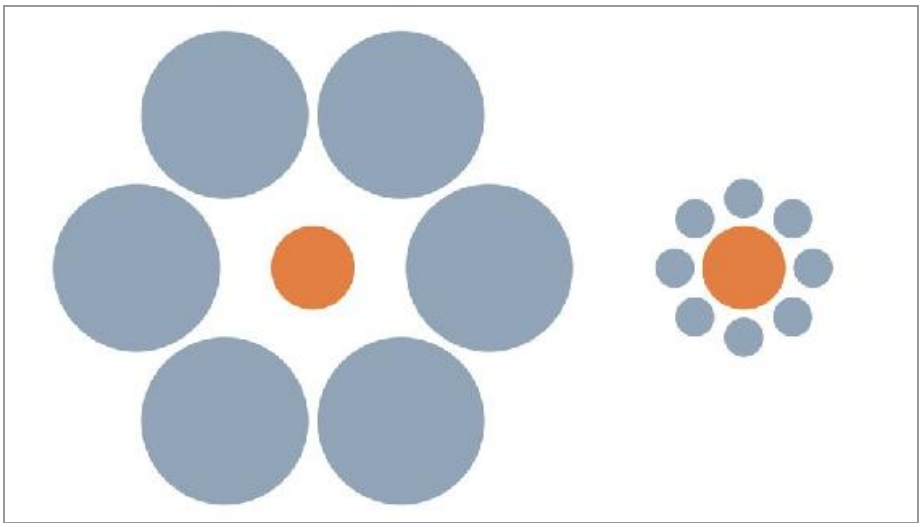


Plate 16[e] · The Ebbinghaus illusion. Context alters perception: the orange circle is the same size in each configuration. See Chapter 19.

THE SCIENCE OF LIFE: A STUDY IN LEFT HEMISPHERE CAPTURE

> Movement is the cause of all life.
>
> *—Leonardo da Vinci*[1]

> It is nonsense to conceive of nature as a static fact, even for an instant devoid of duration. There is no nature apart from transition, and there is no transition apart from temporal duration.
>
> *—Alfred North Whitehead*[2]

> For all bodies are in perpetual flux, like rivers, and parts are constantly entering into and leaving them.
>
> *—Gottfried Wilhelm Leibniz*[3]

> By changing, it remains the same.
>
> *—Heraclitus*[4]

‘In the living world, at least,’ writes philosopher of science John Dupré, ‘a metaphysics of “things” is hard to sustain.’[5] Nonetheless it would appear to be the only realm of science in which it still holds sway. While the thinking of physicists has been obliged to jettison many of its old

assumptions, the thinking of most biological scientists does not seem to have kept pace – which is odd, if only because most contemporary biologists seem to believe that biology should be reducible to physics. (I'd say that, while it could never be reduced to physics, it should certainly be compatible with physics.) It has, at least until very recently, been stuck in a mid-Victorian mechanistic vision that physics abandoned over a hundred years ago. Cognitive scientist Donald Hoffman considers this a problem (as do I):

> Not only are they ignoring the progress in fundamental physics, they are often explicit about it. They'll say openly that quantum physics is not relevant to the aspects of brain function that are causally involved in consciousness … They don't avail themselves of the incredible insights and breakthroughs that physics has made. Those insights are out there for us to use, and yet my field says, 'We'll stick with Newton, thank you. We'll stay 300 years behind in our physics.'[6]

The problem is not just that biology has not availed itself of the insights of quantum physics. It's that its dogged adherence to the Newtonian mechanistic model persists in the teeth of the evidence of its incompatibility with the phenomena it is trying to explain. It is an egregious instance, I would suggest, of the sort of thing we have seen before when the left hemisphere insists that its re-presentations provide an adequate and complete account of reality – that a porcupine is a monkey because that's what the theory tells us. And it alerts us to the need to handle science's claims to truth with care.

Please don't get me wrong. I have nothing but respect and admiration for the ingenuity and hard work of my colleagues in the life sciences, and am exhilarated by the ever-growing body of knowledge about the natural world. It manifestly proves itself to be useful in myriad ways and, fairly obviously, my thinking too depends heavily on the broad reliability of recent scientific evidence about the brain and mind. Nonetheless, there is a problem.

Science's view of the world is always shaped by the philosophy it happens to adopt, whether consciously or (more usually) unconsciously. For physicists, as we have seen, it is more or less impossible to avoid

confronting philosophical issues head on. For biologists, however, confrontation with reality is tempered by the nature of their subject matter, which is more forgiving of a fudge. The evolutionary biologist and palaeontologist George Gaylord Simpson remarked that ‘not many biologists are given to exploring the philosophical implications of their science.’[7] More trenchantly, the theoretical biologist and philosopher Joseph Henry Woodger wrote in 1929 that

> physiologists in general never trouble themselves about such things because they suppose themselves to be above ‘metaphysics’ when in fact they are only a very little above it – being up to the neck in it.[8]

As David Bohm commented in the 1960s, it is an odd fact that, just when physics was moving away from mechanism, biology and psychology were moving closer to it. ‘If the trend continues’, he wrote, ‘scientists will be regarding living and intelligent beings as mechanical, while they suppose that inanimate matter is too complex and subtle to fit into the limited categories of mechanism.’[9] He was not mistaken.

Nonetheless, in the first half of the twentieth century, many philosophically minded biologists, including such eminent British figures as John Scott Haldane and his better-known son, J.B.S. Haldane, as well as Conrad Hal Waddington, moved decisively, like the physicists, away from the machine model. Less renowned, largely by his own choice, but no less distinguished, was Ludwig von Bertalanffy, the great Austrian biologist and polymath who originated general system theory. In 1933 he wrote: ‘we cannot speak of a machine “theory” of the organism, but at most of a machine fiction’.[10]

Despite this encouraging development, a more or less abrupt reversion to the seventeenth-century Cartesian model came over the life sciences with the rise of molecular biology, and its language of ‘programmes’, ‘codes’, and so forth, in the twentieth century’s second half. According to Carl Woese, writing in 2004, ‘biology today is little more than an engineering discipline’.[11] And Woese was no embittered outsider. His pioneering work revolutionised mainstream biology; he was one of the most influential and widely honoured microbiologists of all time, described by a colleague as

having ‘done more for biology writ large than any biologist in history, including Darwin’.[12] But he was disturbed by what he saw.

BIOLOGY AND MACHINES: A MISMATCH OF LANGUAGE

We now live in a world in which everything, including the human brain, is considered to be understandable in the same way – at a hugely different level of complexity, of course, but still in the same way – that we understand a pop-up toaster. 'Before we can fully understand how our brains work, we need to understand how the parts work', says Francis Collins, the director of the US National Institutes of Health.[13] Reasonable enough, you may say – if you assume that 'fully understanding how our brains work' is something any scientist should even be talking about. But enquiring after how the 'parts work', already imports a host of assumptions, as we have seen. The answers one gets from Nature depend on how one frames the question.

'There is little doubt about the biologist's declared obsession with mechanisms of every sort', writes Stephen Talbott, a philosopher of biology; these include widespread references to

> 'genetic mechanisms', 'epigenetic mechanisms', 'regulatory mechanisms', 'signalling mechanisms', 'oncogenic mechanisms', 'immune mechanisms', 'circadian clock mechanisms', 'DNA repair mechanisms', 'RNA splicing mechanisms', and even 'molecular mechanisms of plasticity' … no cellular entity or process is exempt; everything has been or will be baptised a 'mechanism' … The odd thing is that I have yet to find a single technical paper in molecular biology whose author thought it necessary to define *mechanism* or any of the related terms.[14]

Yet what is even odder is that, having made this ritual obeisance to the machine, biologists carry on to describe the organism in language wholly incompatible with mechanism, a language that would be neither required, nor permitted, in chemistry or physics.

It will no doubt be said by some that such language is just a *façon de parler*, such as when I say that my car engine 'labours', or 'struggles' to get up the hill in third gear. But that is not an adequate response to the sheer ubiquity, scope and inescapability of such language – or, more significantly,

the nature of the phenomena it is called on to describe. As Whitehead pointed out, ‘it is notable that no biological science has been able to express itself apart from phraseology which is meaningless unless it refers to ideals proper to the organism in question.’[15]

I would suggest that there are broadly six features that stand out in the language inevitably used by biologists, rather than by physicists or chemists, time and time again, year after year, decade after decade, century after century, Darwin and Dawkins included – language used to describe what they actually see, but which stands in blatant contradiction to the metaphor of the machine. What are they? References to (1) *actively co-ordinated processes*, expressing a sense of (2) *wholeness*, inextricably linked with (3) *values*, (4) *meaning* and (5) *purpose* – each leading separately and together, to the phenomenon of (6) *self-realisation.* None of these get to be applied to my car.

Let me give some examples. First, ‘actively co-ordinated processes’. Apart from, directly, ‘co-ordinating’ functions, processes, developments, and so on, elements of the organism are said to ‘regulate’, ‘control’, ‘guide’, ‘induce’, ‘impose’ order on, and at times ‘disorder’, ‘arrange’, ‘restructure themselves’, ‘develop’, ‘adapt’, ‘respond’, ‘attempt’, ‘instigate’, ‘stimulate’, ‘inhibit’, ‘suppress’, ‘transmit’, and ‘receive’ or ‘extract’ information from other elements of the whole.

Then ‘wholeness’. References to ‘rhythm’ and ‘harmony’ aside, elements of the organism are said to ‘inherit’ information, modes of action or modes of expression, from other organisms from which they are neither structurally nor functionally wholly distinct; they are said to ‘exhibit plasticity’, involving transformation not of a part or parts, but of the whole; they ‘modify themselves’, ‘integrate’, ‘unify’, ‘co-ordinate’, ‘organise’, and ‘interpret’ *contextually*, that is to say, with regard to the whole organism, not just a part.

Or ‘values’. Organisms are normative. They exhibit what is termed ‘normal’, or ‘proper’, development; they may exhibit ‘errors’ or ‘mishaps’; ‘suffer injury’; engage in ‘healing’; attempt ‘correction’, or instigate ‘repair’; perform actions in a ‘timely’ fashion (or not); exhibit ‘aberrant’ or ‘corrective’ reactions; promote ‘health’, suffer ‘disease’ and eventually die.

What about ‘meaning’? How else to understand the talk of ‘giving and receiving information’, the ‘recognising’ and ‘interpreting’ of signals, the ‘distinguishing’ of ‘relevant’ from ‘irrelevant’ information, the ‘adoption’,

‘erasing’ or ‘extraction’ of a code, the ability to ‘communicate’, ‘respond’, exhibit ‘intention’, or ‘directed activity’, and the ability to – in some way we do not understand – ‘sense’ that something, some disturbance, say, is present. For example, an influential paper refers, not inappropriately, to ‘decision-making’ by single cell bacteria.[16] I will come onto such decision-making by single cells in due course.

And ‘purpose’? However you may toss her out with a pitchfork, as Horace said, nature hurries back in by the door;[17] and it is impossible to describe the living world at any level without references to aims, purposes or drives. Biological molecular interactions have ‘targets’, ‘recruit’ other molecules for an end, ‘assist’ in processes, ‘aim’ at certain outcomes, have ‘goals’ and ‘achieve tasks’: they act ‘in order to’ secure certain ends by certain means. Single cells are constantly described as ‘behaving’ in certain ways.

Each of these five characteristics singly – and *a fortiori* together – suggests the sixth: a process of ‘self-realisation’. The organism *as a whole* acts in a *co-ordinated* fashion to create and respond to *meaning* in the pursuit of *value-laden goals*, whereby it is fully realised and fulfilled as an organism. ‘Living cells do not operate blindly’, writes James Shapiro, professor in the Department of Biochemistry and Molecular Biology at the University of Chicago: ‘life requires cognition at all levels.’[18]

We humans, obviously, exhibit these same qualities, behaviours and purposes. It is conventionally assumed that when we describe them in non-human organisms, we are simply projecting our own onto them. But why? Even in our case, it almost all goes on effortlessly outside of awareness: being aware consciously is not a requirement at any point. The array of descriptors I have just outlined is the same as those we would use in describing a dog’s behaviour at every level, and that includes those of which it is and is not aware, those under its conscious control and those that are not, those in its brain and those in its tail. And the same, *mutatis mutandis*, operates in the case of a frog or a bird. When we see cells within the bird – or the frog or the dog – exhibit the same characteristics as the creature as a whole, why should we make an arbitrary distinction at some level? On what principle and at what point?

You might well be tempted to think that language is one thing, but the actual biological findings another. If you are, read on.

The model of a mechanism, it seems, presents a problem in describing what biologists actually see, otherwise machine language would suffice. And this very fact, in turn, according to Talbott,

> immediately raises a suspicion of vitalism in the minds of many scientists. Who, after all, is this organism? And by what special powers does it 'regulate', 'integrate', 'respond', and 'communicate'? Bear in mind, however, that these questions press just as urgently upon the conventional molecular biologist as on the suspected vitalist. After all, the loaded terminology comes straight from the laboratory, where researchers are trying to make sense of what they see … a lot of experiment and observation has led to this language.[19]

If descriptions of organisms cannot avoid the suggestion of meaning, I would like to suggest that that is not because of the inevitably sloppy thinking of generations of highly intelligent, dedicated and observant biologists, but because they are onto something. Organisms are said to perceive or know things because they do: they are said to respond appropriately to changing circumstances, because that is exactly what happens.

Just so that you don't think that speaking of cells as being able to sense, perceive or know is something that no serious biologist could entertain, let me quote Barbara McClintock, the founder of the field of cytogenetics, from her Nobel Prize acceptance speech in 1984:

> some *sensing* mechanism must be present … to *alert* the cell to imminent *danger*… the conclusion seems inescapable that cells are able to *sense* the presence in their nuclei of ruptured ends of chromosomes and then to activate a mechanism that will bring together and then unite these ends, one with another … the *sensing* devices and the signals that initiate these adjustments are beyond our present ability to fathom. A goal for the future would be to determine the extent of *knowledge* the cell has of itself and how it utilises this knowledge in a '*thoughtful'* manner when challenged …

> We know nothing, however, about how the cell *senses* danger and instigates responses to it that often are truly remarkable.[20]

Responses that are, as well, sometimes wholly original and in no way pre-programmed – a marker of intelligent response – as we shall see.

Put simply, if you ask biologists explicitly, they will, with a few exceptions, cleave to the machine model; but when you listen to what they are saying, implicitly they abjure it. Yet despite this manifest dissonance at the core of biology today, the machine model is the one that is peddled to children, students, and the general public wishing to learn more about biology, the fascinating study of the nature of life. Any suggestion otherwise is pounced on as evidence of heresy and denounced.

FROM ROBOTS TO COMPUTERS – BYPASSING ALL THAT MATTERS ON THE WAY

‘Today, the genetic program is everywhere’, writes philosopher of biology Daniel Nicholson:

> It appears in biology textbooks, such as when organisms are said to be ‘governed by the laws of physics and chemistry as well as a genetic program’.[21] It is present in the technical literature, such as when claims are made that ‘a cell can be seen as a computer (a machine expressing a program)’.[22] And it is also prominently featured in works of popular science. In one of the most memorable phrases of Richard Dawkins’ hugely influential *The Selfish Gene*, organisms are described as ‘survival machines – robot vehicles blindly programmed to preserve the selfish molecules known as genes’.[23] Even some philosophers of biology, who should probably know better, have enthusiastically defended the reality of the genetic program.[24]

And Nicholson adverts to an egregious example:

> The genes program the embryo in the same way that the hardware in an automobile assembly plant’s robots’ central processing units realize a program that enable [*sic*] them to weld chassis without human supervision and more accurately than any human can perform this task. This latter thesis requires no philosophical defence. It is obvious to anyone who examines the available accounts of the embryological development of, say, the *Drosophila* [fruit fly].[25]

There are many problems with this (and some of them, as I will show, are illuminated precisely by examining the development of *Drosophila*). ‘In reality’, writes Nicholson, ‘DNA is only functional when it is embedded in the context of an already present, intricately organized cell’:

> It is only in the presence of a pre-existing cellular apparatus that any talk of ‘gene action’ can even make sense. And what is more, the origin of that cellular apparatus cannot be traced back to the genes … many cellular structures such as membrane-bound organelles, as well as the plasma membrane itself, are the only template for their own replication; that is, they are the only source of ‘information’ for their own three-dimensional structure.[26]

And the distinguished Harvard geneticist Richard Lewontin comments:

> Genes are said to be ‘self-replicating’, they engage in ‘gene action’, they ‘make’ proteins, they are ‘turned on’ or ‘turned off’ by ‘regulatory’ DNA. But none of this is true … Genes ‘do’ nothing, they ‘make’ nothing … DNA is among the most inert and nonreactive of organic molecules.[27]

Indeed, it’s not just what genes don’t ‘do’: it’s what they don’t ‘know’. There is not anything like the necessary set of instructions in them. ‘It is commonly stated that the genome incorporates a *Bauplan*, an architectural plan or blueprint of the body’, writes immunologist Werner Müller in his classic textbook, *Developmental Biology*. ‘Actually, this is not the case: the genome is not a sketch or design of the finished body.’[28]

Many, many other elements than the genotype go to make the phenotype – the organism we can see. As well as DNA, it is obvious that chromatin, RNA, cellular signalling pathways, selective modes of protein translation, and the membrane architecture of the cell all contribute, for a start. The proper response to the news that we share 98–99% of our genes with a chimpanzee, or 50% with a banana, is not that we must be barely distinguishable from chimps and not far from being bananas, but that the determining role of genes *as such* is more limited than we thought.[29]

Please note, I am not for one moment denying the importance of heredity: it is very important indeed. I am merely suggesting that it is far more complex than we are led to believe. You cannot consider *genes* in isolation from many other aspects of the organism. ‘Genetic change’, writes Shapiro, himself a geneticist, ‘is almost always the result of cellular action on the genome.’[30] Not, then, solely, or even principally, the action of the

genome on the *cell*. But more importantly, heredity is more than genetics: it passes from whole organism to whole organism, not just via DNA – exactly how, we do not know.

It is quite impossible for genes to 'programme' the making of an embryo. For a start, there is nowhere near enough information contained in genes. Consider the human brain, never mind the whole human body. With an estimated 100 billion neurones, a quarter of a million of them are created on average during every *minute* of the nine months of gestation, at times more. Each of these neurones, needless to say, must then make thousands of connexions with other neurones, and all this must end up in a minutely specific, hugely complex architecture with every part of the whole in exactly its required location. Where was that information in the 'programme' that DNA is said to enshrine?

We have an estimated 26,000–30,000 genes (what counts as a gene is not a cut and dried matter, but to a certain extent a human convention, and involves elements of judgment). But a blind, millimetre-long roundworm, *Cænorhabditis elegans*, with only 959 cells in total already has over 19,000. Indeed the pea aphid has 34,600 genes; and *Daphnia pulex*, a water flea common in lakes and ponds around the world, and about the size of a full stop on this page, has 39,000.[31] A species of amoeba has the largest recorded genome, 670 billion base pairs, roughly 200 times the size of the human genome.[32]

And then, only a tiny fraction, about 2%, of our DNA consists of exons, those regions of a gene that actually contain the information required to encode a protein.[33] With 1,200,000 proteins being produced, it is quite clear that any one gene must code for many different proteins, depending on the context.[34] The 'same' DNA proteins, with the same amino acid sequences, can, in different environments, 'be viewed as totally different molecules', with distinct physical and chemical properties.[35] Protein synthesis is subject to epigenetic influences to such an extent that the same gene 'blueprint' can create 2,000 or more variations.[36] Epigenetic changes are those that are acquired during the lifetime of individuals – from particular experience – and alter gene expression in any one of a number of ways in the next generation. This means that evolution is much smarter than often portrayed. It doesn't have to wait millions of years, drumming its fingers, waiting for randomness to catch up with experience.[37]

The other 98% of the genome used to be referred to as junk DNA, because it seemed meaningless, consisting of endlessly repeated sequences that code for nothing. These sequences are no longer considered junk, simply by deduction from the fact that they make a difference – but how they make a difference is not yet known.

Indeed, what is a gene? According to the geneticist Rick Young at MIT, when he first started teaching in the mid-1980s it took him about two hours to teach raw undergraduates what a gene was and how it worked. Today he and his colleagues need three months of lectures to convey the concept of the gene to graduates. Karola Stotz and Paul Griffiths collected 14 atypical but real genetic arrangements and asked biologists to decide whether each represents one, or more than one, gene.[38] For example, in one case a protein is assembled when four different RNA molecules, made from DNA scattered over 40,000 base pairs, are assembled into one transcript. They found that though the biologists were fairly evenly split, 'hardly any confess that they don't know'.[39] Instead of discrete genes mass-producing identical RNA transcripts, 'a teeming mass of transcription' converts many segments of the genome into multiple RNA ribbons of differing lengths. Some of these transcripts come from regions of DNA previously thought not to contain protein-coding genes. The genome contains many overlapping transcripts, genes within genes, and even genes that seem to be controlled by regulatory regions from another chromosome.[40] 'Discrete genes are starting to vanish', according to Roderic Guigó, Director of the European Research Council's Centre for Genomic Regulation.[41]

In sum, the extraordinary fidelity and robustness of organismal development is not attributable to a programme, an algorithmic sequence of predetermined steps that must be carried out in a certain order, as with a machine. The cell is constantly monitoring, promoting, inhibiting (including, as necessary, inhibiting its inhibitors), repairing, splicing and rewriting DNA. Each 'step', as we are accustomed to think of it, is not computed from the immediately preceding one, but is part of a process in which information comes from many sources, a process that can't properly be thought of as decomposable into steps at all. The development of an embryo requires an unimaginably intricate series of local interactions, not specifiable by a single global control mechanism. 'The genetic program does not explain development', writes Nicholson; 'it merely black boxes it':

> Embryogenesis is much too complex and much too reliable in its outcome to be specified by a program. If development were a program, the fertilized egg (not to mention the genome) would never succeed in computing its output.[42]

That a purely deterministic programme would be prone to error might seem counterintuitive; but when one takes into account the degrees of freedom involved in the process when compared with the rigidity of a manmade machine, and the degree of complexity involved in constructing an embryo, it becomes apparent. Dupré explains why any such deterministic programme would fail, using an analogy. He points out that the precision with which fantastically complex processes are carried out, often by different paths on different occasions and under different circumstances, necessitates an overall goal, not a set of deterministic steps – which would be far too likely to go wrong:

> If I ask someone to go to the shop and buy me a loaf of bread, and they agree, I am fairly confident that the outcome will be as I intend. If I provide a deterministic programme – take 12 paces north-west, raise hand, turn knob, push, etc, there are too many unanticipated interventions that can derail the process for me to have much hope of success. Teleology is much better than deterministic causation at getting things done, and development is much too reliable to be seen as anything but teleological.[43]

I will return to teleology in due course. Certainly, the levels of accuracy achieved in the replication of the genome are awe-inspiring and attest to a complex and active process of monitoring of the genome by the cell, resulting in a three stage programme: (i) selection of the correct DNA nucleotide by the replicative DNA polymerase; (ii) removal of any mis-inserted nucleotides by a proofreading activity associated with the polymerase; and (iii) post-replicative correction of polymerase errors that have escaped proofreading by the DNA mismatch repair system.[44] This reduces errors in the transcription of an entire genome of 3 billion base pairs from a few million to less than 1. This is achieved not by the genome but by the *system as a whole* operating at several levels. According to the

biologist Denis Noble, ‘the order at the molecular (DNA) level is actually imposed by higher level constraints’.[45] Top-down causation is not supposed to happen in the reductionist model.

Nicholson speaks of the genetic program not explaining development, but merely ‘black boxing’ it. Current biology is littered with such ‘black boxes’. Take the concept of ‘emergence’: it is a perfectly useful term for pointing to what Bergson called creative evolution – the extraordinary coming into being of completely novel qualities as a system grows in complexity. The problem arises when we use it not just to point, but as though offering an explanation. This is like Molière’s doctor grandly explaining that opium makes one sleep because of its ‘dormitive properties’. Speaking gravely of emergence is fine as long as you do not imagine you have explained anything thereby. You have merely sidestepped another problem for reductionism. The rabbit ‘just did’ emerge from the hat. What was to be explained has just been rephrased, and *voilà* – another mystery solved.

The idea that the development of an individual organism is the unfolding or execution of a genetic program suggests a kind of simultaneous myopia and tunnel vision, lacking both depth and breadth of insight. As Levins and Lewontin point out,

> The organism is the consequence of a historical process that goes on from the moment of conception until the moment of death; at every moment gene, environment, chance, and the organism as a whole are all participating … Natural selection is not a consequence of how well the organism solves a set of fixed problems posed by the environment; on the contrary, the environment and the organisms actively co-determine each other.[46]

The shape that an organism takes emerges from its own physiological states, as much as from genes, and these are as much under the influence of apparently ‘foreign’ organisms as of the organism itself. Referring to the impossibility of distinguishing neatly the intestines from their exceedingly numerous and complex inhabitants, biologist J Scott Turner points out that ‘it is physiology more than genetics that forges the designed gut.’[47]

Even within the organism, genes are only one part of a bigger picture. The cell context – which so radically changes the way in which DNA will act, and which itself reads, interprets, and deploys, according to need, whatever there is in the DNA to read – is not itself specified by the DNA. [48] The assumption that it was would be like Chomsky asserting nonsensically that language springs from the child's brain without interaction with the environment. Philosopher of science Richard Burian writes:

> Without knowing an enormous amount about the contexts in which a sequence and its products are placed – contexts that vary enormously in ways that cannot be predicted from complete knowledge of the genome – there is, in general, no determinate answer to the question, 'What does this sequence of nucleotides do for this organism?' Thus, if one tries to proceed strictly from the genome up, one cannot predict, in general, what effects sequence-identified genes will have on the organism and how they will affect its fitness.[49]

DNA is itself a complex that is twisted in three-dimensions in a way so intricate, and economic in achieving multiple ends simultaneously, that it almost defies belief, so as to promote, bring together, or alternatively shelter from contact, regions of the molecule and their encoding capacity. The structure and its manipulation are at least as informative as the string of DNA itself. The molecule is a three-dimensional entity, not just an abstract two-dimensional string of symbols such as a computer might read, a fact which tends to be overlooked when speaking of 'code'.

The cell nucleus, which is around six millionths of a metre in diameter, contains two metres of DNA, a feat which is 'geometrically equivalent to packing 40 km (24 miles) of extremely fine thread into a tennis ball.'[50] That's not all, since the 46 separate chromosomes (each averaging, if we continue the analogy, the equivalent of over half a mile long), have to be kept distinct and functional, not hopelessly entangled.

Enzymes known as topoisomerases, whose task is to help resolve complexities in the over-winding or under-winding of the chromosome, demonstrate 'a spatial insight and dexterity that might amaze those of us

who have struggled to sort out tangled masses of thread', comments Talbott. He continues:

> these enzymes manage to make just the right local cuts to the strands in order to relieve strain, allow necessary movement of genes or regions of the chromosome, and prevent a hopeless mass of knots. Some topoisomerases cut just one strand of the double helix, allow it to wind or unwind around the other strand, and then reconnect the severed ends. This alters the supercoiling of the DNA. Other topoisomerases cut both strands, pass a loop of the chromosome through the gap thus created, and then seal the gap again. (Imagine trying this with miles of string crammed into a tennis ball!) I don't think anyone would claim to have the faintest idea how this is actually managed in a meaningful, overall, contextual sense, although great and fruitful efforts are being made to analyse isolated local forces and 'mechanisms'.[51]

Don't forget that this is not something that DNA itself can programme: it depends on the interaction of a large number of factors. Even then, according to a genetics research group at Holland's Hubrecht Institute,

> not only active, but also inactive, genomic regions can transiently interact over large distances with many loci in the nuclear space. The data strongly suggest that each DNA segment has its own preferred set of interactions. This implies that it is impossible to predict the long-range interaction partners of a given DNA locus without knowing the characteristics of its neighbouring segments and, by extrapolation, the whole chromosome.[52]

Note, the *whole* chromosome: and not only that, but the *whole* cell. And ultimately the whole organism. None of this is reminiscent of how a machine works, nor is any of a whole bunch of factors I will now come on to consider.

In doing so, I have been enormously inspired by, and am greatly indebted to, the illuminating work of philosophers of science John Dupré and Daniel Nicholson – especially, but by no means only, by their edition of

a collection of papers by over 20 scientists and philosophers, the most thorough examination of processual philosophy in relation to biology to date, *Everything Flows: Towards a Processual Philosophy of Biology*, which the editors generously allowed me to read ahead of publication.[53]

1. On-off

First, a machine is static until switched on, and may be switched off without ceasing to exist. Organisms, as Nicholson points out, much like waterfalls or tornadoes, do not have an off switch.[54] The very existence of an organism is, from beginning to end, one unceasing flow of matter and energy. For it to stop, even for an instant, would mean immediate death. As J.B.S. Haldane put it, using the image of fire – pure energy – rather than water, 'a flame is like an animal in that you cannot stop it, examine the parts, and start it again, like a machine. Change is part of its very being.'[55] As he hints, analysis – examining its supposed 'parts' – would stop it and kill it. Yet the biologist endlessly, and for some purposes necessarily, relies on taking slices from the seamless flow of life. Just consider the conventional anatomical techniques (anatomy, the study of living form, literally means 'cutting up') for examining nature: dissecting, slicing, desiccating, pickling, staining, fixing, and freezing, not to mention vivisection.[56] Organisms may be taken apart, but they are not put together; they are not made –they become. And such entities as we can identify (genes, molecules) cannot take precedence over the relationships which *go to constitute them.*

In biology all is becoming, never just being:

> in the biological world, at least – activity and being necessarily presuppose one another. Being is neither ontologically nor temporally prior to activity, as the very existence of living beings is only possible by means of continuous activity.[57]

No machine model can make sense of this, since a machine must be built before it can be set in motion. This alone should alert us to its misleading nature. The machine, the thing, takes priority over the process: it comes first in time, and its existence grounds what it does. For living beings – perhaps they should be called living 'becomings' – this is not the case:

they are what they do, and come into being through their very movement. In this they are like streams that flow. Their being, their form, their becoming, *is* their movement; and their movement *is* their being.

2. Motion vs stasis

This leads seamlessly to the next obvious distinction. What has to be explained about a machine is how it changes at all. This is because it is a system that exists close to dynamic equilibrium. When power is applied, one otherwise static and self-contained component transmits energy to another static and self-contained component, and so on, in a linear chain. Then it is switched off, and it returns to equilibrium, where it can remain indefinitely.

In an organism, by contrast, what has to be explained is, not how it changes, but how it *remains stable*, despite constant change on an unimaginable scale. The stable continuance of a stream is owed to change. It depends on the flow of water molecules through it, entering and passing on elsewhere, and if the water ever stopped steadily flowing and replacing itself the stream would cease to exist. In this way, as Nicholson points out, the idea of an organism as a stream of life rather than a machine captures two essential and complementary elements: 'the continuous exchange of matter that defines metabolism on the one hand, and the stability of form that is maintained in spite of it on the other.'[58]

If we pay attention to what is disclosed by biological organisms, we cannot but see process and flow at its core. 'Whatever else organisms may be, what cannot be denied at an ontological level is that they are stable metabolic flows of energy and matter.'[59] We know this intuitively. Most of the cells in your body were not there a few years ago: the form of the flow has persisted, but its original substance has utterly vanished. As the German poet Novalis observed in the late eighteenth century, 'there is no doubt that our body is a moulded river'.[60] But this is not an intuition only. It is the best metaphor we have for the proper physiological understanding of living tissue. John Scott Haldane saw organisms as highly dynamic eddies of matter, which nonetheless had the power to remain stable over time – not things, but stabilised *processes*: 'they are constantly taking up and giving

off material of many sorts, and their "structure" is nothing but the appearance taken by this flow of material through them.'[61]

Structure is the static element we illegitimately extrapolate from the flow of time. Individual organisms, and the evolutionary process in which they inhere, are *extended* in time – not a sequence of timeless structures, without extension, that replace one another. Structure is function once time has been excluded; function is structure once included in time.[62]

Moreover, in as much as the organism can be said to have 'fixed' structures at all, they are themselves as much the *result* of flow, as the *cause* of it. Biologist Craig Holdrege gives this thought-provoking example, from human foetal development:

> Before the heart has developed walls (septa) separating the four chambers from each other, the blood already flows in two distinct 'currents' through the heart. The blood flowing through the right and left sides of the heart do not mix, but stream and loop by each other, just as two currents in a body of water. In the 'still water zone' between the two currents, the septum dividing the two chambers forms. Thus the movement of the blood gives the parameters for the inner differentiation of the heart, just as the looping heart redirects the flow of blood.[63]

Above I mentioned that change in a living organism takes place on an unimaginable scale. Let me give some idea of that scale. There are an estimated 37.2 trillion cells in the human body.[64] Each one of these cells performs many millions of complex reactions every *second*.[65] In doing so the cell does not act atomistically but within complex feedback systems with other cells. Biological enzymes promote extraordinary rates of change. In the absence of catalytic enzymes, the decarboxylation of amino acids would proceed with a typical half-life of about a billion years: in the presence of enzymes these half-lives are reduced to less than a thousandth of a second.[66] And a single molecule such as carbonic anhydrase – of which the body contains unimaginable numbers – can catalyse upwards of a million reactions per second.[67] Each protein may combine with 'several hundred different modifier molecules, leading to practically infinite combinatorial possibilities' and each 'protein itself is an infinitesimal point

in the vast heaving and churning molecular sea of continual exchange that is the cell'.[68]

One research team writes that in an organism we see a collaborative process that can be 'pictured as a table around which decision-makers debate a question and respond collectively to information put to them.'[69] But if that is the case, we must remember that, as Talbott points out,

> the collaborative process mentioned above involves not just one table with 'negotiators' gathered around it, but countless tables with countless participants, and with messages flying back and forth in countless patterns as countless 'decisions' are made in a manner somehow subordinated to the unity and multidimensioned interests of the organism as a whole.[70]

The human organism, it is clear, exists in a state of stable, patterned flux that we cannot even begin to conceive.

All living things metabolise, that is to say exist in a constant energetic exchange with their surroundings. The word 'metabolism', from Greek *metabolē*, means simply 'change'. Homoeostasis, growth, and reproduction are the three most fundamental characteristics of cells and all living things – and they are all processes.[71] 'One decisive reason for taking organisms to be processes', writes Dupré, is that they are

> open systems that must constantly exchange energy and matter with their surroundings in order to keep themselves far from equilibrium. The persistence of an organism is dependent on its ability continuously to maintain a low-entropic 'steady state' in which there is a perfectly balanced import and export of materials. When this exchange ceases, the steady state is irretrievably lost and the organism succumbs to equilibrium, resulting in death … You can leave your typewriter in an empty loft and return a decade later and start using it again. But if you accidentally leave your hamster in the loft, you will not have a hamster for very long.[72]

At the cellular level, Dupré points out, 'the persistence of the human organism over the life cycle requires an almost inconceivably precise

balance of division, differentiation and destruction of cells.'[73] And at the molecular level, according to biochemist Ross Stein, proteins are not inert, but 'dynamic entities that negotiate complex energy landscapes'.[74] Biochemistry, the chemistry of life, is endlessly dynamic, changing, creating, repairing, transforming. 'The great challenge for the life sciences today', writes Shapiro,

> is to understand how all the regulatory processes and control circuits operate to make indescribably complex reproductive, repair and morphogenetic processes come out right in the face of changing circumstances.[75]

To the left hemisphere's linear habit of mind, and its predilection for 'things', there is something paradoxical about stability depending on change. But the joint action of two forces tending to counteract one another is one of the best recipes for stability, found throughout the natural world: it is the essence of homoeostasis.[76] Examples are everywhere in animal and human bodies, in the regulation of temperature, blood pressure, muscle tone, hydration, cell renewal, and many, many other equilibria, which are stable because they are dynamic, not static (the balanced functioning of the asymmetrical brain, being, of course, another): they involve the harmony of opposing tendencies. A tightrope walker balances by making and responding to myriad tiny movements in the rope: completely stabilise the rope and the performer falls off. (Equally let it go too slack and the same happens.) The right hemisphere view is more inclusive than that of the left: stability can be explained by dynamism alone, but dynamic processes cannot be explained by static 'things' alone.

One very important element in all life is, of course, evolution. Many problems arise from seeing evolution as effectively the replacement of one element (a species) by another: as a chain, not a flow. 'Organisms do not, of course, evolve', writes Dupré. 'Evolution relates to the distribution of the properties of organisms over time.'[77] Evolution is a flow that seamlessly connects all life. What seem like species are just our way of reifying that flow ('thingifying' it) at any one moment in time. As geneticist Charles Birch put it, 'nuts and bolts cannot evolve! They can only be rearranged.'[78]

Life is not a rearrangement of already known nuts and bolts, but the constant creation of something radically *new*.

Once one understands that one is dealing with flow, natural selection can be seen for what it is: a *stabiliser, not an agent of change*. Indeed, and fairly obviously, natural selection is never the originator of change at the gene level; it acts only to stabilise an already existing change. By selecting the most adaptive phenotypes, the lineage is stabilised over longer periods of time.[79] Equally, as we shall shortly see, genes are not stable elements in the story, unchanging unless by blind accident: they are themselves constantly changing or being changed, in highly adaptive ways.

3. Non-linearity

A serious problem for adherents to the machine model is that, while they are obliged by the model to explain organisms from the bottom up only, the deeper they go the less of anything remotely machine-like can be found. The scarcely material entities that physicists have grappled with over the last hundred years offer little reassurance that, if only we go to a more basic level, we are going to find a mechanism. As the biologists try to account for mind in purely material terms, physicists have increasingly been inclined to account for matter by appealing to mind.

However, long before we get down to the quantum level, things show no signs of getting simpler: they remain stubbornly as complex and animate as we go down in scale.

Here I'd like to pick up the observation that no organism develops as the result of the execution of a sequence of predetermined steps. Each developmental 'step' is not simply computable from the immediately preceding one. In a classical mechanism, causation is linear and can be clearly outlined. However, in biological systems, causation tends to follow not straight lines, but spirals, involving recursive loops, and multiple causes leading to multiple effects across a network, with sometimes competing factors cross-regulating one another, reciprocally interacting, and in ways we do not understand taking information from the whole. All this makes the classic idea of a two-element, cause and effect sequence unhelpful. 'The standard two-event model', according to philosophers of science Rani Lill Anjum and Stephen Mumford, 'does not handle this complexity well,

offering us just more and more of the same discrete two-events causally related.'[80] A mechanism, in other words.

The geneticist Philip Gell, speaking about his area of research, considers that 'the heart of the problem lies in the fact that we are dealing not with a chain of causation but with a network', something like a spider's web, in which a perturbation at any point of the web changes the tension of every fibre in it.[81] Context is everything. Which means we cannot simply account for organisms from the bottom up, but must do so *at least as much from the top down*. Not to mention from the sides, as in a web. We might be accustomed to thinking of biological processes in the abstract, isolated artificially by our mode of attention. But each element in each process is likely to be involved in several other 'causative chains', more like an unimaginably complex piece of choreography, where members of one group pass in and through another, for a while belonging to both or neither – each process having its own apparent end. According to Nobel Prize-winning geneticist Sydney Brenner, development 'is not a neat, sequential process … It's everything going on at the same time.' And, he continues, in words that strike at the core of the reductionist enterprise, 'there is hardly a shorter way of giving a rule for what goes on than just describing what there is.'[82]

This puts me in mind of some words of Marcelo Gleiser, here speaking of the whole material world: 'When it comes to physical reality, there are no final explanations but ever more efficient descriptions.'[83] Not understanding – not even, necessarily, explanation; but description.

Until recently it was assumed that signalling pathways in cells were linear sequences, beginning from a defined starting point and progressing by an orderly sequence of steps to a defined conclusion. Somehow it was overlooked that each of these theoretically abstractable sequences was in practice interlocked at different points with other dynamically evolving sequences. A team of molecular biologists from Brussels decided to plot the interactions between just four cascades, each consisting of only five steps. The result, as they put it, is a 'horror graph' (see Plate 13[a]):

> With four cascades of five steps, the number of possible positive and negative interactions is 760. This does not take into account the multiplicity of different isoforms of proteins at the different levels of the cascades, the multiplicity of effects of each intermediate in each cascade, the stimulation by a cascade of the secretion of

> extracellular signals, or feedback or feedforward controls within cascades. In fact, so many interactions are now described (everything does everything to everything) that it is difficult to reconcile this concept with the known specificity of action of signals in each cell.[84]

‘Everything does everything to everything’: interlocking, reciprocal and interpenetrating processes on such a scale show chains of causation to provide limited insight into cell responses.

But that’s not all. It’s not just that steps are related in a more complicated fashion than the machine model leads us to assume. It’s that the idea of there being *steps at all* (even if useful when focussing on the minuscule and the time-sliced) is misleading when looking at the whole over a duration of time. This is an idea that I mentioned in an earlier chapter, and will return to at various points in this book. It might not seem at first sight that significant. I hope to show that it is a crucial insight into what is peculiar about the way we in the West now tend to view the world. It is the difference between a sequence – a concatenation, a chain – and a single, indivisible movement, a flow. Flow is a process: a chain is a series of things, that are static until one is given a push or a pull by the thing next to it. An organism is a flow, and is alive. A machine is a chain, and is dead.

Can one even talk about causation in a flow? There are certainly temporal regularities, but does the earlier part of a stream *cause* the latter, in any conventional sense? For that, the two parts would have to be distinct entities. Alan Watts describes someone who has never seen a cat, squinting through a crack in a fence, and seeing a cat’s head appear, followed moments later by its tail. The cat turns round and comes back: first the head appears, then the tail. Later he sees another such event, and another. Eventually he draws the conclusion that the event ‘head’ causes the event ‘tail’, which is its invariable effect.[85] Causation could be seen as an artefact – a useful one – of time-slicing, slicing the flow. (It might be objected that, while it is true that no one part of a waterfall or a tornado causes another, it is surely possible to say that each, as a whole – the waterfall and the tornado – has a cause, or, at any rate, causes. But that depends on seeing the world at large as a collection of things, not processes. For where does the precipitation of rainwater, the configuration of the land, the air pressure, the wind speed that would be said to be their causes begin and end? I appreciate

that one argument might be that that is precisely why we need to think in terms of ‘things’; and it’s no doubt one reason why we do. But my claim is not that ‘thing-thinking’ has no uses – just that thinking in that way imports a whole set of assumptions that are, to say the least, open to challenge; and makes it difficult or impossible to see elements of the picture that we would be wrong to ignore.)

Similarly molecules, whether in an organic system or not, are ‘a part of a continuum of relational interactions’, more like a flow than a chain.[86] Beyond this, we have known since the 1960s that the behaviour of proteins cannot be fully described using linear, classical mechanics; and more recent research even demonstrates quantum entanglement between particles in two wholly distinct (as we would normally think) organisms, widely separated in space. Behaviour at the cellular level requires a quantum mechanical account in order to be understood, even if Newtonian mechanics is for most practical purposes an adequate, if approximate, fit.[87]

Incidentally, this seems like a good moment to gloss the unfortunate expression ‘quantum mechanics’. After all, I am arguing that the machine model is misleading: what’s achieved by substituting one kind of mechanics – ‘quantum’ – for another – ‘Newtonian’? David Bohm puts it well:

> The entire universe must, on a very accurate level, be regarded as a single indivisible unit in which separate parts appear as idealisations permissible only on a classical level of accuracy of description. This means that the view of the world being analogous to a huge machine, the predominant view from the sixteenth to nineteenth centuries, is now shown to be only approximately correct. The underlying structure of matter, however, is not mechanical … This means that the term ‘quantum mechanics’ is very much of a misnomer. It should, perhaps, be called ‘quantum nonmechanics’.[88]

Or, perhaps even, ‘non-quantum non-mechanics.’ I will discuss the model of quantum mechanics, and the related and even more powerful model, quantum field theory, in Chapter 24. It turns out that not only the word ‘mechanics’, but the word ‘quantum’, while certainly having a meaning, needs significant qualification.

Finally, unlike organisms, machines, including computers, do not operate in *Gestalt* fashion: when they are engineered so as to give the appearance of doing so – eg, facial recognition software – they do so still via rules and procedures applied to measurements, depending on trawling blindly and laboriously through vast heaps of data, in a process that speaks not of intelligence but its opposite. The linearity of this approach can no more reach the curve of true intelligence than straight lines, however many they be, can describe the circumference of a circle, though they may give the illusion of doing so. According to microbiologist Brian Ford,

> the essential processes of cognition, response and decision-making inherent in living cells transcend conventional modelling, and … reveal a level of cellular intelligence that is unrecognized by science and is not amenable to computer analysis … biological systems are non-linear systems that are not amenable to digital modelling. As [the physicist Alex] Hankey has reminded us,[89] many are founded on unfathomable complexity. [90]

4. Not one-way action – maybe not even interaction?

A further problem with a machine model is that it suggests a direction of action of one thing on another. I have just suggested that it is usually myriads of 'things' having an action on myriads of other things. But even that is wrong. In organisms there is never just action without both *inter*action and *mutual construction*. Cause and effect in organisms, if it can safely be applied, is never unidirectional, but reciprocal. When an organism interacts with its environment, both parties change; each influences the other. And not in some minor, incidental fashion, either. When DNA is 'active' (as Lewontin points out, it is largely inert), most of the work is done by the cell environment. This, crucially, includes *the provision of information*, which is conventionally thought of as the role of DNA. Both cell and genome depend on their mutual interaction. As Schrödinger put it: 'physical action always is *inter*-action, it always *is* mutual.'[91]

Research over the last 80 years or more demonstrates that it is not true that genetic change is simply due to accidents or damage to the DNA. Organisms actively reconstruct their genomes in response to their

conditions.[92] Shapiro points out that the genome is actively shaped by the cell, as conditions change, over three distinct time-scales: first during cell reproduction, involving the formation of nucleoprotein complexes; then during multicellular development, involving epigenetic formatting; and ultimately in evolutionary change, involving changes in DNA sequence structure:

> one of the main adaptive features of DNA-based heredity is that DNA is a highly malleable storage medium, permitting rapid and major changes to complex organisms without disrupting their functional integrity.[93]

This has interesting consequences that may surprise some readers. C.H. Waddington found that heat-shocking pupae of the fruit fly *Drosophila* in some cases led to abnormal patterns of veining on the wings of the adult fly. If one continued to breed such cases together, heat-shocking the offspring, a point was soon reached where not only virtually all flies were abnormal, but their offspring continued to be abnormal *even without heat-shocking*. The number of generations necessary for the abnormal patterning to become fixed in the population was only 14 – too few for this to be supposed a coincident chance novel mutation. The gene expression had, it seems, been altered directly, and quickly, by the environment. [94]

It is a standing joke among mechanists that cutting off the tail of a mouse does not produce tailless mice. However, scientists have developed microsurgery techniques that can alter the pattern of cilia on the surface of *Paramecium aurelia* (a unicellular organism). They found in a series of striking experiments that these changes were transmitted permanently to their offspring through the normal processes of cell division.[95] Similar phenomena have been demonstrated in other ciliates.[96]

‘Today’s biologists’, writes the physicist Evelyn Fox Keller,

> recognise that however crucial the role of DNA in development and evolution is, it does not do anything by itself. It does not make a trait; it doesn’t even include a ‘program’ for development. Rather, it is more accurate to think of a cell’s DNA as a standing resource on which a cell can draw for survival and reproduction … it is always

> and necessarily embedded in an immensely complex and entangled system of interacting resources that collectively are what give rise to the development of traits.[97]

Let us just pause there for a second. DNA is ‘a standing resource on which the cell can draw for survival and reproduction’. Hardly surprising, of course – unless you had been led to believe, somewhat improbably, that organisms were ‘robot vehicles blindly programmed to preserve the selfish molecules known as genes’.

Another instance of reciprocal rather than unidirectional action, writes Dupré, is that of an enzyme, often described as working like a lock and key, ‘fitting just-so into whatever it’s acting on. Yet increasingly it looks as if the two actually accommodate one another, less a key in a lock than a negotiation on the fly.’[98] As one research group put it, ‘in reality, the activated receptor looks less like a machine and more like a … probability cloud of an almost infinite number of possible states, each of which may differ in its biological activity.’[99]

On another level, all multicellular organisms are involved in mutual, symbiotic relationships of various kinds with a host of microorganisms.[100] And the organisms, similarly, with the environment. Indeed, it is a good question whether the distinction between organism and environment can ever be other than approximate. In 1966, the experimental psychologist James Gibson coined the term ‘affordances’, referring to the opportunities afforded by an environment to an organism. The important point is that an affordance is not a thing, but resides in the relationship between an organism and its environment: the affordance requires both.[101] What provides an affordance to one animal clearly may not to another, and may cease to be an affordance even for that animal at another moment in time. In this sense, affordances are emergent phenomena: they are opportunities for action that arise from a relationship and thereby define the organism as an agent.[102]

Microbiologist Kriti Sharma, in her fascinating book, *Interdependence*, writes that ‘the cell is not exactly reacting *to* an environment, but is reacting *with* an environment, as oxygen reacts *with* iron and where *both are transformed.*’[103] Niche construction is often thought of as what Dawkins refers to as the ‘extended phenotype’ of the organism, a one-way process,

encoded in its genes and expressed through the animal creating external structures; yet, according to Dupré, this is to overlook that, equally, 'the altered niche affects the behaviour and ultimately drives the evolution of the organism'. As he comments: 'The difference in these perspectives nicely illustrates the difference between a thing- and a process-centred ontology.'[104] But we might go further: Sharma's formulation of interdependence is not just one of interaction, but of *mutual constitution*. Organisms and environments do not

> co-construct one another *sequentially*, as when an organism digests food from the environment and excretes wastes into the environment, which in turn change the organism's metabolism, and so forth. Such a view still separates organism from environment and makes one the causal agent, and then the other, and so forth, so that agency shuttles between the two. The 'reactivity' view suggests that organism and environment are transformed *simultaneously*, and at each moment … Rather, they arise *new* in each instant … Moreover, this 'arising anew' occurs *dependently*– that is, phenomena bring each other newly into being in each instant.[105]

The orthodoxy is that DNA affects the fate of the cell, the cell affects the organism, and the organism the environment. This is the bottom-up view. At least as true is the top-down view: that the environment affects the organism, the organism accordingly restructures the cell, and the cell makes appropriate use of DNA in doing so. In a letter to Moritz Wagner, Darwin wrote, on 13 October 1876: 'In my opinion the greatest error which I have committed, has been not allowing sufficient weight to the direct action of the environment, i.e., food, climate, &c, *independently of natural selection* … When I wrote the 'Origin', and for some years afterwards, I could find little good evidence of the direct action of the environment; now there is a large body of evidence'.[106] As Fred Nijhout, Professor of Biology at Duke, makes clear: 'When a gene product is needed, a signal from its environment, not an emergent property of the gene itself, activates expression of that gene.'[107]

Sharma asks for a radical shift in the way we conceive of living systems. She suggests that not one, but two, steps are needed:

> The first is a shift from considering things in isolation to considering things in interaction. This is an important and nontrivial move; it is also a relatively popular and intuitive concept … [But] to get to a thoroughgoing view of interdependence, I argue that a second shift is required: one from considering things in interaction to considering things as *mutually constituted*, that is, viewing things as existing at all only due to their dependence on other things. This second shift is potentially more subtle and difficult than the first, because though the first requires considering the mutual relations and influences *between* things, it does not actually require a change in the many habits and assumptions that usually commit us to viewing *things* as fundamentally independent.[108]

One after another, causes that we conceived of as giving rise to an effect are shown to be at least to some extent, and in some cases to an even greater extent, themselves caused by the very effect to which they were supposed to give rise. We are used to thinking of metabolic processes as regulated by a cellular clock, though metabolic cycles can not only operate independently from such a clock, but themselves influence the circadian rhythms of that 'clock'.[109] In general, according to one researcher, 'it seems that connections between the circadian clock and most (if not all) physiological processes are bidirectional.'[110] It also seems that while some gene mutations clearly do cause cancer, the majority of mutations found in cancer are the consequences, rather than the causes, of disruption of intercellular communication.[111] (The situation is made still more complex by the fact that, depending on context, the *same gene* can either promote or suppress the formation and growth of a tumour.)[112]

The activity of individual genes reflects the choreography of chromosomes, which reflects the larger choreography of the nucleus, which reflects the choreography of the cell and organism as a whole with the environment. Who, then, is sculpting whom? How can we know the dancer from the dance?

5. The 'parts' are themselves changing

A machine is made of parts that do not typically alter with their context. A tappet, a widget or a gasket continues its existence effectively unaltered wherever it is put. In an organism, unlike a machine, the ‘parts’ are continually engaged in changing themselves, sometimes radically, depending on context. One of the most obvious examples is that each cell has precisely the same DNA, yet that same DNA results in dramatically different kinds of cells arising, and hence different kinds of tissue, depending on context. While we assume a mutated gene to explain a malignant trait, write Sui Huang and colleagues,

> nobody will doubt that normal cells as distinct as a stem cell, a mature neuron, a blood cell or an epithelial cell all share the very same genome. No mutations are invoked to explain the vastly different phenotypes and their inheritance within a lineage. This opens the first fundamental question: *how can the same set of genetic instructions produce a variety of discrete, persistent (non-genetically inherited) cell phenotypes?*[113]

The same ‘parts’ respond to quite different environments to produce utterly different effects.

An apparently ubiquitous phenomenon called ‘developmental system drift’ ensures flexibility in what a gene specifies.[114] The result is that the same ends are repeatedly reached by quite distinct genetic means.[115] In two species of roundworm, for example, ‘similar sexual structures arise from marked differences in signalling pathways, differences involving both novel wiring and novel protein modifications.’ [116] Different species of insects achieve segmentation using different mechanisms involving different genes, but with little overt difference in the outcomes.[117] Detailed mechanisms can, of course, be identified for these developmental processes, but that’s not the point: ‘their details seem less important than the higher-level morphological “attractors” that exert a kind of downward causation … on their permissible variation, which is rather prolific.’[118] Whole outcomes may determine how ‘parts’ behave in order to reach them, at least as much as any of the ‘parts’ determines an outcome. Thus many paths involving ‘wide-ranging differences in the number, order, and kind of molecular events’ may lead to the same reliable outcome, and considerable variations

in genetic makeup can result in the expression of an identical phenotype, or form. Conversely, as we saw, identical genetic makeup does not necessarily result in identical outcomes in morphology; much depends on the context.[119]

I have already referred to another instance, that there are far more proteins coded for by DNA than there are genes to make them: what those genes make depends on the context and what is required in it. We saw that epigenetic 'dials' can create 2,000 or more variations of proteins from the same gene blueprint.[120] That the same genes can take on a number of roles provides a form of 'belt and braces' provision, ensuring that processes necessary to survival are preserved.[121]

Similarly, some genes are widely conserved across species. Pax6, the gene playing the critical role in the development of an eye, occurs in almost identical form in a range of species, enabling the development of a fly's eye, a frog's eye or your eye: yet the types of eye, how they are structured, and how they function, are very widely different (see Plate 13[b]).

And it's by no means just genes that are so malleable in their function. What *any* molecule does changes according to what is required by the context, and at many levels throughout the organism. The enzyme phosphoglucose isomerase is 'best known for its role in the process that releases energy inside cells, for example – but when outside the cell, it can perform at least four distinct functions, such as promoting nerve growth.'[122] Similarly with neurotransmitters: for example, serotonin (5-hydroxytryptamine, or 5-HT for short), like other neurotransmitters, has remarkably diverse effects. It is widely known for its effects on mood, which partly explain the action of many antidepressants. But it also has many other uses: in cell division, blood clotting, bone metabolism, breast-milk production, liver regeneration, bowel function, appetite regulation, and sexual function – depending on the context.

Enzymes are notorious for their shape-shifting qualities, but proteins more generally are not the static structures they are popularly conceived to be, but continually cycle through different conformations.[123] Their structures and functions vary among cell types and change over the course of evolution. We now know that probably 30–50% of all proteins, the majority of which are not even enzymes, are so-called 'intrinsically disordered' proteins, lacking a fixed structure, and able to shift shape in a virtually unlimited field of possibilities (note the loaded language, which

speaks of the left hemisphere preference for stasis and fixity: not ‘maximally flexible’, but ‘intrinsically disordered’).[124]

Since structure and function are inseparable, it is not just the molecule’s function that changes, but its very structure. So it is with DNA. Genes are not things, not ‘batons’ to be handed on in the relay race of life. There is no such thing as Dawkins’s ruthlessly selfish gene, determined to pass on its lineage unscathed, in the process dominating and exploiting that poor, blind robotic vehicle, the organism, to which it belongs. ‘As genomes evolve, new genes are born and older genes may adopt novel functions, fuse, or disappear altogether,’ writes systems biologist Adrian Verster.[125] Genes are malleable processes, subservient to the needs of the organism in which they happen for the time being to inhere.[126]

This can be seen at two levels: changes in conformation, which affect gene expression of the same ‘line of code’; and changes in the ‘line of code’ itself.

An example of the former is that something as simple as the degree of licking and grooming of her pups by a mother rat leads to changes in gene conformation, and therefore expression, in her offspring.[127] An example of the latter is the single-celled organism *Oxytrichia trifallax*, which gets rid of over 90% of its somatic genome, and re-organises the rest.[128] This is certainly an extreme case, but, according to philosopher of science Denis Walsh,

> not an especially exotic one. The engineering of the genome by the organism is commonplace. Cells actively cut, transpose, copy and fix their genomes. They do so in highly sensitive, *adaptive* ways.[129]

What that means is that *cells use DNA* to adapt to new ends; it is not a matter of *DNA using cells* to further its own ‘selfish’ ones. The idea that genes are somehow (how?) ‘programmed’ to pass on their DNA does not sit well with the fact that cells are constantly acting on it to change it or to repair it; and such persistence as there is depends on ‘elaborate editing and correcting processes in the cell’.[130] These include anything from point mutations to large-scale genome rearrangements and whole genome duplications.[131] There are ‘massive levels of genomic rearrangement during development’.[132]

It should not surprise us that the ‘parts’ of an organism change themselves, consume energy and turn over rapidly even though the whole structure persists, since life is *at every level* a dynamic process.[133] ‘Logically, the elements of a process can be only elementary processes, and not elementary particles or any other static units’, wrote biologist Paul Weiss.[134] One cannot explain a changing process by unchanging elements, though our extraordinary bias towards ‘thingness’, rather than forms or processes, encourages us to think that we could.

Sometimes biologists, says Dupré, talk as though they believe that organisms are put together

> from bits of Lego … Rather, living things are processes that are capable of assuming many protean forms: dynamic, ever-changing, but balancing, for a time, on just the right side of chaos.[135]

‘Just the right side of chaos’: they are, in other words, what Naseem Nicholas Taleb calls ‘antifragile’ systems.[136] Taleb makes a distinction between robustness, which relies on resistance to change, but is susceptible to catastrophe when it finally can resist no more; and antifragility, which thrives on flexibility, makes small adjustments and thereby not only survives but *evolves*. All evolutionary processes are in this sense antifragile, constantly adapting, and because of their ability to permit constant small ‘errors’ (as they seem at the time) able to preserve themselves against final destruction. The expression ‘the right side of chaos’ reminds us that a system that is capable of flexible and rapid response to a multitude of possible occurrences must have inbuilt *instability*, as well as stability: the classic case of this is the Eurofighter Typhoon jet, a supremely agile fighter plane, which was built deliberately unstable so as to make it highly responsive. Because of this it can make swift and abrupt changes in direction that a more stable plane could accomplish only over many miles.

An organism must be capable of a vast repertoire of available responses, and some of them, unbelievably enough, are invented by organisms ‘on the hoof’, as we shall shortly see. Stuart Kaufmann writes that

> genomic systems lie in the ordered regime near the phase transition to chaos. Were such systems deeply into the frozen ordered regime,

> they would be too rigid to coordinate the complex sequence of genetic activities necessary for development. Were they too far into the gaseous chaotic regime, they would not be orderly enough. Networks in the regime near the edge of chaos – this compromise between order and surprise – appear best able to coordinate complex activities and best able to evolve as well.[137]

Ultimately, even what we conceive to be the 'solid' parts of cells are actually flows. The living cell is mainly fluid, principally water. Even surfaces, cell membranes, the cytoskeleton, and the various fibre systems, that look relatively solid, are 'subject to more or less continuous dissolution and reconstitution.'[138] We imagine the organism contains fixed structures because of the nature of left hemispheric attention, which replaces flow with frozen slices removed from time: our static diagrams, or photomicrographs.

6. The influence of the whole

While a machine has clearly defined parts, this is not, then, the case in an organism.[139] A process arguably has no parts and is, in reality, an indivisible unity. As Scott Turner puts it, 'integrity and seamlessness seem to be the essence of an organism'.[140] To the extent that one can speak of an organism as having 'parts' at all, we find them by dismantling the whole in an inevitably somewhat arbitrary fashion. They are ultimately a product of human attention, a function of the way we choose to attend to the organism for a particular end of our own, and the parts we choose to define change depending on our focus of interest at the time.

Let us assume, however, for the sake of argument, that there are identifiable parts. These parts are unlike machine parts – and not just because they constantly change. For such parts do not, as those of a machine do, exist prior to the whole that they make up, but come about *at the same time* as the making of the whole. They are further examples of 'mutual constitution'. They are not pre-existing entities put together, but instead distinguish themselves in the process of self-differentiation of a living whole: thus the liver, the heart, the kidneys are not assembled, but come into ever more defined being as the whole living organism grows.

And the relationships between the parts don't go to *make up* the whole, but *derive from* the existence of the whole. They are handy *post factum* mental representations. 'Parts' are inextricably involved with their context, without which they are both impotent and unpredictable; and neither the parts, nor even the local interactions of the parts on their own, account for the qualities of the whole organism that we observe.[141]

Lower levels of an organism are not straightforwardly explanatory of the higher levels. Microscopic findings do not predict macroscopic outcomes, nor vice versa. Walsh writes that 'as physical systems take on new configurations, they bring new phenomena into existence'.[142] These phenomena are not easily accounted for in terms of phenomena at some more reduced level. Examples given by him include atomic nuclei, magnets, superconductors, excitable media, fluids and tissues, and organic agents.[143] As always, we are dealing with *Gestalten*, not with constructions.

In explaining a multicellular organism's stability, the intrinsic properties of what we see as the parts are of little significance compared with 'the dynamic relationships among parts at different levels of the organisational hierarchy.'[144] Note, dynamic relationships among parts *at different levels*. The existence of emergent properties at every level throughout the natural world suggests, too, that we are on the wrong track when we try to account for what we find in terms of things rather than processes. It would be like trying to account for the unique quality, the power and, yes, the *life* of a piece of music by examining each note, or at most a phrase, in ever greater detail, outside the flow of the whole work, in the hope that by this 'drilling down', as we say, there at last we will find the secret. We cannot account for a phenomenon at the topmost level merely by a concatenation of elements at the lowest level. We are dealing with a *Gestalt*. That is to say the 'betweenness' is more important than the 'things' we believe we discern within it. Relationships are prior to *relata*, a topic I will return to in Part III.

An aside on terminology. When I use the word 'betweenness', I refer, not just to what happens between two or more 'things', but to the unique whole in which we might later come to identify 'things' and the relationship between them. Thus an electrical current resides not in the negative pole or the positive pole, nor the space between the poles, but in the sum of all of these, *plus*, crucially, the wholly new element that comes about from 'adding them together' (which, of course, never happens except in our theoretical *post factum* reconstruction). There is no hitherto existing

adequate word for this idea in English, but the concept is important, so ‘betweenness’ will have to do. It is close to Sharma’s ‘interdependent mutual constitution’.

Molecular structures are good examples of entities that cannot be reduced to their parts: according to biochemist Ross Stein, ‘the essential nature of the compound subject transcends, and cannot be reduced to, the simples from which it is composed … Complex objects are no mere aggregates, but possess a defining unity.’[145] And at the phenomenological level we see this all the time. As molecules form new wholes, utterly new qualities, unpredictable from the apparent constituent parts, emerge: so a tasty white crystalline substance – table salt – emerges from the compound of sodium, a dullish grey, malleable metal, and chlorine, an evil-smelling, poisonous, greenish-yellow gas.

Writing about the ways in which living systems display characteristics not to be found in their constituent parts, cell biologists Sophie Dumont and Manu Prakash observe that:

> subtle variations in parameters (energy expenditure, architecture, and temporal dynamics) can dramatically change the mechanics of the resulting structure in ways we do not understand … Emergent structures exhibit properties that their smaller building blocks (air molecules or sand grains) do not … It is very likely the case that these mechanical design principles will be fundamentally new and as such may not have a known analogue in nonliving physical systems.[146]

The expected conventional terminology of mechanics here seems awkward, and with good reason. For, if ‘mechanics’ are dramatically changed in ways we do not understand – and I have no doubt that they are – in what sense are they still mechanics? If the ‘mechanical design principles’ are ‘fundamentally new’, and have no ‘known analogue in non-living physical systems’, surely the comparison of organisms with machines (still implicit in the language with which, I quite understand, the researchers must write their paper if they wish to get it published) is self-confuting.

‘The astonishing plasticity of organisms contrasts with the brittleness of machines’, writes Nicholson,

> which tend to stop working when their parts break or are damaged. Of course, redundancy and self-repair can be built into the design of machines to some extent, and although this can make their operation more robust and more reliable, the inherent limitations of their fixed architecture remain.[147]

Here the question arises, how the part can have that sense of the whole to which it belongs, of which Barbara McClintock spoke. A machine as a whole typically does not adapt in response to parts becoming worn or defective, nor invent a solution at a local level that will further the purpose of the overall machine.

Carl Woese again:

> Machines are stable and accurate because they are designed and built to be so. The stability of an organism lies in resilience, the homoeostatic capacity to re-establish itself. While a machine is a mere collection of parts, some sort of 'sense of the whole' inheres in the organism, a quality that becomes particularly apparent in phenomena such as regeneration in amphibians and certain invertebrates and in the homoeorhesis [see note] exhibited by developing embryos.[148]

To quote Ford, 'Although we now recognise that experiential input can bring about epigenetic modification of the cell nucleus, there must be undivined mechanisms that relate the experiences of the entire multicellular organism back to the cell.'[149] And even the single cell seems to have what the biochemist Jesper Hoffmeyer describes as 'tacit knowledge' that is 'inherent within the cellular organization and must be presupposed by, rather than materially built into, the DNA description.'[150] Hence Shapiro's claim that 'life requires cognition at all levels'.

As yet, we have little idea of how the 'parts' seem to 'know' what whole they belong to, and how it should be shaped: it is an ancient question, to which no-one has ever given a satisfactory answer. One answer worth considering is that the part quite simply does not exist: the being can *only* be considered as a whole. As John Haldane noted:

> From a consideration of the general characteristics which distinguish a living organism from a machine I had become convinced that a living organism cannot be correctly studied piece by piece separately as the parts of a machine can be studied, the working of the whole machine being deduced synthetically from the separate study of each of the parts. A living organism is constantly showing itself to be a self-maintaining whole, and each part must therefore always be *behaving as a part of such a self-maintaining whole*.[151]

The question, by the way, is not 'by what immediate mechanism?' – to be answered at the molecular level by speaking of, say, electrical gradients affecting the direction of diffusion of polarised molecules; an account which is at best a first step towards a description, hardly itself an explanation, let alone an understanding.[152] That is like trying to understand a ballet by measuring the impact of ATP hydrolysis on myosin in the dancer's skeletal muscle fibres. In the words of Ford,

> Knowing how the intricate mechanisms within the cell perform tells us nothing of the entire cell, just as studying the hormone fluctuations and changes of blood pressure in a human subject would reveal little of why they were late for work in the first place … It is as though we have clamoured for the most intimate insights into the minutest workings of the telephone exchange, while disregarding the subscribers – who they are, why they choose to speak, or what they are saying.[153]

When they are injured, organisms – from simple bacteria, to trees, to complex vertebrates – are often able to heal themselves and repair the damage, regaining the form that was lost. Some organisms (eg, axolotls and salamanders) can regenerate entire body parts, including limbs, parts of the brain, and even the heart. Lobsters can regrow claws, spiders can regrow legs, and rabbits and certain species of mice can regenerate a number of their organs.[154] Although antler growth is peculiarly shielded from environmental influences, and although no two sets of antlers are the same, any one animal's antlers are perfect mirror images of one another, and, if

both are cut off, will regain the same shape from memory.[155] Trees and plants, of course, have a multitude of individual and characteristic forms of their own, which are not principally moulded by the environment, and which they will strive to regain if their form is damaged (see Plates 13[c] & 13[d]).

Indeed, some relatively complex creatures, such as flatworms, can regenerate the entire body including their centralised brain, from a fragment of the original animal.[156] This was noted by Charles Darwin's grandfather Erasmus Darwin.[157] In one case a planarian, a type of flatworm, was cut into 279 pieces, each of which proved capable of generating a new body within a few weeks.[158] Each part appears to know what it lacks, and can thus regenerate a new whole. What is still more extraordinary is that if flatworms – the 'first' class of organism to have a centralised brain with true synaptic transmission,[159] and to share the majority of neurotransmitters that occur in vertebrate brains[160] – are decapitated, they not only regrow a head, but retain their memories; for example, which way to turn in a maze they had previously 'solved' before their heads were chopped off.[161] A body is a moulded river indeed.

The preservation of form does not depend on trotting out 'pre-programmed' developmental blueprints.[162] For example, the face of a tadpole is quite different from that of a frog; in order to produce the typical adult frog's face, a series of deformations must be carried out, and, along with it, various organs and tissues relocated. Surely, then, it follows the steps of a programme? Not in any obvious sense of the word. When developmental defects were artificially induced in a tadpole, subsequent development was able to adjust accordingly, apparently making corrections towards what it seemed to sense was its ultimate goal, the adult frog's face, despite there being no 'programme' or previously known mechanism to direct it.[163] Michael Levin, a prominent geneticist at Tufts, writes:

> Most organs were still placed into the right final positions, using movements quite unlike the normal events of metamorphosis, showing that what is encoded is not a hardwired set of tissue movements but rather a flexible, dynamic program that is able to recognize deviations, perform appropriate actions to minimize those deviations, and stop rearranging at the right time.[164]

The question is ‘where is the information?’ That is to say, the in-*form*-ation. Where is the overall *form* or shape of the being stored, as a whole, in service of which any mechanisms we can detect and measure would be acting?

We should remember that evolution, and indeed the reproduction of organisms, is not a flow of ‘information’ only in the abstract sense of that word – that of, eg, ‘information technology’. We should remember that information is not a *thing*: it is the capacity for a channel to create a new link between two processes. Evolution is a physical, embodied process, not reducible to pieces of data. Organisms flow down the ages by reproduction and by evolution, literally mingling bodies – their forms – at a moment in time and from generation to generation, something no machine does: every embodied reproduction is evolution in action, and every evolutionary advance is an embodied reproduction. Offspring of organisms, from single cell to *homo sapiens*, are not separately engineered from new material externally, but emerge as new whole forms from the material forms of the bodies of their parents. The flow is embodied and seamless.

Barbara McClintock discovered, in experiments conducted in the 1940s, and therefore before the structure of DNA had been determined, that the genome is not a static entity, but subject to rearrangement, and moreover that there were heritable changes in gene expression not caused by changes to DNA sequences: what we now call epigenetics. She reflected that a genome must repeatedly face ‘shocks’ of various kinds, for some of which it is prepared and to which it can respond in a ‘pre-programmed manner’. As she says, some sensing mechanism must be present in these instances to alert the cell to imminent danger, and to set in motion the orderly sequence of events that will mitigate this danger. That is in itself remarkable. But she saw something still more remarkable:

> there are also responses of genomes to unanticipated challenges that are not so precisely programmed. The genome is unprepared for these shocks. Nevertheless, they are sensed, and the genome responds in a discernible but initially unforeseen manner … in most known instances of such challenges the types of response are not predictable in advance of initial observations of them.[165]

These responses appear to be, as C.H. Waddington believed they were, due to information in the organism as a whole, not just localised to specific pre-existing, temporarily silenced, genetic mutations.[166] To quote Noble, 'organisms seem to be very resourceful when challenged with knockouts, blockers or absence of nutrients. If we look for that ingenuity at the molecular level we may not find it.' On McClintock's discoveries, he comments:

> She could not have anticipated the extent to which her idea would be confirmed by the sequencing of whole genomes … [implying] the movement of whole functional domains. This is far from the idea of slow progressive accumulation of point mutations … the rearrangement of whole domains including the functionality of those domains in response to stress could have been the origin of creativity in the evolutionary process … This is why McClintock characterised the genome as a *highly sensitive organ of the cell*. [167]

From all of this it would seem that an organism is not just driven from the bottom up. Decisions seem to be taken by the organism – even a single cell – as a whole; what's more, intelligent decisions – ones that are creative and 'hand-tailored', not just selected from a predetermined repertoire – which in itself would require a (lower) level of intelligence. Considering a number of accounts of intelligence, Ford writes that common to the 'different definitions of intelligence there is one concept on which all seem to focus: the ability to deal constructively with the unforeseen':

> The definitive demonstration of intelligence, must observe the cell encountering a situation which it cannot have previously experienced; it needs to demonstrate abnormal behaviour specifically in response; and the cell must act remedially to restore normality to its abnormal predicament.[168]

Cells pass each of these tests with flying colours. And they do so, often, in an awe-inspiring balance between autonomy and co-operation that a human society might envy.

> Everywhere we can observe this proclivity for ingenuity. When a surgical suture is secured with staples, the resulting repair is conspicuous and crude. Within weeks, the scar is healed, smooth, and scarcely visible. The cells at the site of the incision have identified the nature of the surgical trauma and have initiated manoeuvres to restore it. Capillaries re-form so that the microcirculation is restored, innervation is reinstated, and the many epidermal layers are properly reconstituted. None of this we understand. These complex processes are invisible to the brain, and are not controlled by cerebral activity, neither are they subject to regulatory intervention by circulating hormones. The cells are the decision-makers … No computer model comes close to emulating the mechanisms manifested by an amoeba, as it seeks its way ahead, selects which food substances are suitable for ingestion, modifies its cell membrane to accommodate the situation and moves on in a direction it has motivationally selected. A team based at Sapporo, Japan, have even shown that amoebae have memory for events.[169] This takes us deeper into the realities of living cells than current conceptions of memory as the propensity only of cell aggregates. Single cells can take decisions; single cells can plan responses; single cells contain memory.[170]

I will have more to say about all this in Chapter 25.

Another interesting example relates to the nervous system of animals, and concerns the well-known principle that ‘what fires together wires together’. Such plasticity (known as Hebbian, after Donald Hebb, the Canadian psychologist, who posited it) is widely considered to be the mechanism by which information can be coded and retained in neurones in the brain. ‘The general idea is an old one’, wrote Hebb, ‘that any two cells or systems of cells that are repeatedly active at the same time will tend to become “associated”, so that activity in one facilitates activity in the other.’[171] With continued use, changes at the synaptic cleft mean that such neuronal sequences are preferred, and may even become semi-automatic, in a process known as kindling. This is well established, and is a process of positive feedback: more leads to more. So far, so good. Recently, however, we have become aware that Hebbian adaptations are just one of three possible changes that may occur with use. A second is the opposite. It is

homoeostatic: in other words, up-regulation causes a compensatory down-regulation – negative feedback: more leads to less. But even more interestingly, we now know there is a process called neurotransmitter switching, whereby the neurotransmitter involved at the synapse is swapped for another:

> Significantly, transmitter switching often reverses the sign of the synapse: an excitatory transmitter is replaced by an inhibitory one or vice versa. These reversals in synaptic sign change the function of the circuits in which they occur, complicating the interpretation of the connectome … 'Neurons that fire together, wire together' encapsulates Hebbian plasticity. 'Neurons with chronic firing, reverse wiring' summarizes the impact of transmitter switching.[172]

'Complicating the interpretation of the connectome' looks like an understatement. Not for the first time we are brought to ask, what is causality? Certainly we cannot just close our eyes to what we are seeing and hold to conventional bottom-up (ie, from parts to whole) causation only, as the machine model suggests. (A bottom-up approach starts, in any case, only from what is *presumed* to be 'the bottom'.) In organisms the whole is also necessary for the functioning of the parts: the part is apparently able to access information about the whole, and act on it in service of the whole. We may not know how, but that is not grounds for denying that it happens. One solution might be to accept that there are no parts as such, and that what we see is simply the action of a whole, as a whole: the problem lies in our perception.

If a cell is placed in a slightly acid medium, its mitochondria break up into small spherical beads. But, amazingly, on return of the cell to a normal medium, they merge again into strings, and eventually take on once more the appearance and internal structure of normal mitochondria.[173] Further, let us suppose you cut a developing limb bud out of an amphibian embryo, shake the cells loose from each other, and then allow them to aggregate once more into a random lump. You then replace the random lump in the embryo. What happens? A normal leg develops. The form of the limb as a whole dictates, according to Lewontin, the rearrangement of the cells:

> Unlike a machine whose totality is created by the juxtaposition of bits and pieces with different functions and properties, the bits and pieces of a developing organism seem to come into existence as a consequence of their spatial position at critical moments in the embryo's development. Such an object is less like a machine than it is like a language whose elements … take unique meaning from their context.[174]

Or like a dynamic *field*. 'If the organism was simply its substance we would not be able to recognise it from one day to another', wrote Lawrence Edwards, an expert in plant morphology. 'Yet its being and largely its form are invariant from one moment to another, and from one day to another. The *form* can live within the flux. Something greater than the substance takes it up, moulds it, uses it, and then casts it away.'[175]

Again, unlike in a machine, no two limb buds in a developing embryo are ever exactly the same; the buds of formative, mesenchymal cells develop each in their own way. The result is in each case a normal, fully formed limb of the kind dictated by its position. But not just its 'predestined' position: the same cell group in a limb bud can *nonetheless*, though destined to form the pattern of, say, a right limb, give rise to the mirror image, a left limb, with the opposite symmetry, simply by being transplanted to the opposite side of the embryo.[176]

Another example of the whole somehow overruling the parts comes from fascinating experiments on the fruit fly, *Drosophila*. The absence of a gene, homologous to Pax6 (see above), causes the fly to develop without eyes. However, if such flies are interbred, they have been found soon to develop eyes – despite not having the gene in question.[177] Indeed, after 'knocking out' (disabling) both copies of a gene that had a normally important role in the development of a mouse, molecular biologists found that in many cases the mouse seemed unimpaired, and functioned normally.[178] In certain strains of mice, mutations in the *Kit* gene cause white patches on the tail and feet; if a mouse has one normal *Kit* gene and one mutated one, it will have the patches. Yet some of the offspring of such mice, who inherit two normal *Kit* genes, still have the white tail.[179] Resistance to viral infection in a nematode worm was achieved by some of the population having DNA that produced a viral-silencing RNA sequence;

when cross-bred with worms who lacked this DNA, some of the offspring inherited the antiviral mechanism and some didn't. All as one might expect. However, subsequent generations inherited the antiviral mechanism even if they lacked the required DNA. This non-DNA inheritance was followed successfully for 100 generations.[180] Similarly 'adaptive mutation' dictates that if a strain of bacteria is unable to utilise lactose, and is placed in a lactose-rich medium, 20% of its cells will quickly mutate into a form that enables them to process lactose: the mutation is then inherited by subsequent generations.[181]

Organisms don't just passively wait, then, for a lucky accident or resign themselves to dying out, but actively remodel themselves in response to changes in their environment.

As mentioned, changes in DNA are no longer thought to be mere accidents.[182] Indeed Darwin himself wrote:

> I have hitherto sometimes spoken as if the variations … were due to chance. This, of course is a wholly incorrect expression … Some authors believe it to be as much the function of the reproductive system to produce individual differences, or slight deviations of structure, as to make the child like its parents.[183]

Another idea that perhaps does not square too well with the idea of genes bent on preserving themselves at all costs.

Everything depends on an organism's capacity to be flexible and responsive to its environment, just as the environment, both living and non-living, is responsive to organisms. It is this combination of interlocking responses that ensures stability. 'There is now good experimental evidence', write Jablonka and Lamb, 'as well as theoretical reasons, for thinking that the generation of mutations and other types of genetic variation is not a totally unregulated process.'[184] A seminal paper asserts that 'not all genome changes occur at random and that cells possess specific mechanisms to *optimize their genome* in response to the environment'[185] – not even the gene actively optimising the cell, but the cell actively optimising its genes. In a now famous paper in *Nature* it was claimed that 'cells may have ways of choosing which mutations occur', and they can 'learn from experience'.[186] Another has shown that 'bacteria that have lost their flagella

through deletion of the relevant DNA sequence can evolve the regulatory networks required to restore flagella and so restore motility in response to a stressful environment within just four days'.[187]

In Shapiro's phrase, cells and organisms have evolved to become, 'cognitive (sentient) entities that act and interact purposefully to ensure survival, growth and proliferation'.[188] Evolution itself is an 'intelligent' process (he describes it as not only 'cognitive' and 'sentient', but 'thoughtful'). According to him, a twenty-first-century view of evolution implies

> a shift from thinking about gradual selection of localized random changes to sudden genome structuring by sensory network-influenced cell systems … It replaces the 'invisible hands' of geological time and natural selection with cognitive networks and cellular functions of self-modification. The emphasis is systemic rather than atomistic, and information-based rather than stochastic [random].[189]

This is not only plausible, but no form of 'heresy'. According to Denis Noble, Darwin 'was concerned that he did not know the origin of variation and he acknowledged the existence of other mechanisms, including the inheritance of acquired characteristics.'[190] In *The Origin of Species*, he had written:

> I placed in a most conspicuous position – namely, at the close of the Introduction – the following words: 'I am convinced that natural selection has been the main but not the exclusive means of modification.' This has been of no avail. Great is the power of steady misrepresentation; but the history of science shows that fortunately this power does not long endure.[191]

On the last point, however, he was sadly mistaken.

Cell biologist Bruce Lipton writes of the immune system, producing antibodies, that it

> employs an amazing mechanism called *affinity maturation*, that enables the cell to perfectly adjust the final shape of its antibody protein. Activated immune cells make hundreds of copies of the original antibody gene. However, each new version of the gene is slightly mutated so that it will encode a slightly different shaped antibody protein. The cell selects the variant gene that makes the best fitting antibody.[192]

This is further sculpted (by a mechanism known as somatic hypermutation) to become the perfect physical complement of the virus that it is to neutralise. What's more, the cell remembers this antibody shape and passes on the memory to its daughter cells.

In the late nineteenth century, Hans Driesch separated the two cells produced by the first division of a fertilised sea urchin egg and observed that each of these, which would normally have produced half of an organism, actually produced a complete *Pluteus* larva, the initial free-living form of the species. Each of these larvae was half the size of the normal *Pluteus*, but was complete in every detail and grew into perfectly normal adults.[193] 'How', asks Brian Goodwin, 'is the system organised so that when these two cells remain part of one embryo each produces half the future organism, but when they are separated, each produces a whole?'[194] Interestingly, Driesch compared the phenomenon with the bar magnet, which if divided produces two magnets, each with two poles.

One way of looking at multicellular organisms, including, of course, ourselves, is that we are historically an aggregate of single cell organisms that gave up their autonomy and co-operated, so as better to survive: we are ancient societies. Signals released by cells into the environment allowed for the co-ordination of a dispersed population of unicellular organisms. This enhanced the survival of single cells by providing them with the opportunity to live as a primitive 'community'.[195] Even the individual cell is itself the result of collaboration of many parts, including elements such as mitochondria which were originally bacteria that took up residence in the intracellular environment. The trillions of cells that go to compose our bodies, like the millions of people who live in a large city, share common purposes served by the adoption of widely different roles. And so do the trillions of commensal organisms – bacteria, mainly, on which our bodies

depend for healthy functioning. Until recently, bacteria were largely viewed as opportunistic inhabitants of the comfortable environment offered by the gut, but they are now known not just to be vital for digestion, but for the nervous system, the immune system and even for normal development at all.[196] They belong to the wider conception of ourselves as organisms: 'commensal' means sitting at a shared table: we couldn't dine without their company. What counts as an individual – not just a part – depends on the question being asked, and the focus of our interest.

As has often been pointed out, bees, ants and termites behave like parts of a whole so tightly organised that they seem to act as if parts of one large organism. 'A single termite is unintelligible', writes Brian Henning,

> apart from the collective organism of which it is a member … as a single superorganism, the termite colony is extended in space and time, without clearly defined boundaries or a skin to define where the environment stops and the superorganism begins … a single termite is no more an individual than a single cell in a petri dish solution.'[197]

7. Imprecise boundaries

That leads to the next issue. A machine has clear boundaries; a natural system does not. The machine model involves being able to identify viably distinct, stable things as parts, and a viably distinct, stable thing – the machine – as the product of their combination. Processes, by contrast, can overlap in a way that 'things' typically do not. Processes 'have boundaries that are fuzzy or indeterminate', write Dupré and Nicholson:

> Processes are individuated not so much by where they are as by what they do … At no level in the biological hierarchy do we find entities with hard boundaries and a fixed repertoire of properties. Instead, both organisms and their parts are exquisitely regulated conglomerates of nested streams of matter and energy.[198]

They liken organisms to Jupiter's Red Spot, which, 'by means of its continuous activity … demarcates itself from the flux of its surroundings'.[199] Organisms are not tightly defined entities: neither even, as we saw, are some kinds of genes.[200] The genome itself is not as defined as we imagine: 'it is not even clear that there is any unique entity that qualifies as the genome of an organism.'[201]

Whitehead pointed out the artificiality of drawing boundaries to organisms:

> The truth is that the brain is continuous with the body, and the body is continuous with the rest of the natural world. Human experience is an act of self-origination including the whole of nature, limited to the *perspective* of a focal region.[202]

We have seen that the environment is, in a concrete fashion, partially constituted by, and constitutive of, interdependent organisms, in which each is involved in the evolution of the other. 'Some of these interactions', according to Dupré, 'are so intimate and so fundamental to the survival of the organism that it has been hotly debated whether the interacting entities are distinct at all, or should rather be understood as constituting a single life.'[203] The philosopher of science Argyris Arnellos writes that 'collaboration is one of the main characteristics of life and its evolution … it is very hard to imagine life (both at the intra- and the inter-cellular level) that is not collaborative.'[204]

What he means by this can be illuminated by biochemist and philosopher Stephan Guttinger, who writes that 'symbiotic life forms are the rule rather than the exception in the biological realm':[205]

> the significance of symbiosis examples in general is the realisation that the entities we used to refer to as single living things … turn out to be less autonomous than we might have thought them to be … it is not just the termite that shapes the mound and that has the power to digest, reproduce and survive, but a *system* of interconnected entities that has to be treated as the centre and/or origin of these capacities or powers.[206]

Too narrow a focus means that we conventionally think of organisms as sharply delineated individual entities, with linear causative relations. If, instead, we conceived them as systems, in which causation is both distributed and reciprocal, and these systems themselves nested in other, larger systems, and so on upwards and outwards, we would see a quite different picture unfold. We would then see, not just competition – that we would still, of course, see – but a combination of competition with *co-operation*. Such a relationship, in which division and union are fruitfully balanced, is what we mean by collaboration.

A superannuated myth of pop science has it that human beings evolved to be fundamentally selfish, striving to maximise their inclusive fitness by aggression and nepotism. As the anthropologist Christopher Hallpike reminds us, 'studies of actual human behaviour, especially that of children show that, whatever evolutionary theory may say, while we must obviously act for our own preservation and well-being, we also have highly developed capacities for sympathy, co-operation, and group loyalty'.[207]

Ultimately we have common ancestors. As I suggested, evolution becomes problematic when species are thought of as one sharply defined thing replacing another. However, 'this is no problem at all for a process. No-one expects a thunderstorm or a battle to have precisely delineated boundaries.'[208] Living organisms integrate their cellular communities by mingling their bodies and sharing their genes. In this way they can acquire learnt experiences from other organisms.[209] The boundaries of species are, in reality, blurred. In the words of Daniel Drell, Programme Manager of the US Government's Joint Genome Institute: 'We can no longer comfortably say what is a species any more'.[210]

8. Boot-strapping

In the case of a machine, the instructions for making the machine cannot themselves be the product of the very machine they are designed to make. Even in a computer, the software is separate from the hardware: the hardware has to be finished, before the software can be extrinsically inserted into it. The code for making the machine is not being *simultaneously* written by the machine *in the very process of beginning to form itself as a computer*. By contrast, as philosophers of science Paul

Griffiths and Karola Stotz put it, with reference to the work of Susan Oyama,

> the developmental information expressed in the organism is not present in the starting point of development, but is itself created by the process of development, through feedback from the current state of the organism to the states of the resources that will influence future development.[211]

Even if computers can be brought to a point where they make apparently autonomous decisions, they can do so only because the capacity for them to do so depends on previous acts of human intelligence and human will. The ‘parts’ of an organism that are claimed to account for emerging phenomena lack adequate explanatory power, since the way in which those parts act when and where they do, and even their continued existence, cannot be understood without invoking the process they are supposed to explain, and, in something of an infinite regress, the processes to which, in turn, that process leads. A machine’s functioning is linear, whereas the process of living things is of entities that mutually co-arise.

WHY HAS THE MACHINE MODEL PROVED SO ATTRACTIVE?

In the face of such overwhelming evidence of the inadequacy of the machine model to the study of living organisms, why, then, does this product of the mid-Victorian mindset persist?

One reason is its simplicity. We are familiar with machines, and because they are what we are used to making, taking apart and putting together, it is perhaps a natural assumption that other systems, ones that we didn't make, will work in a similar way. This is particularly the source of the appeal in *molecular* biology, a discipline that necessarily concerns itself primarily with events that appear highly circumscribed in both space and time. Here chains of cause and effect tend to be abstracted from their wider context, and therefore seem to function in a broadly mechanical fashion. Molecular biology places 'the entire explanatory burden on a relatively stable, epistemically tractable entity: a one-dimensional digital code that can be replicated, modified, and transplanted from one individual to another'.[212]

Regular and reliable patterns of behaviour discoverable in an organism are unreflectively assumed to demonstrate mechanisms. But regularities do not always mean there is a mechanism; nor do they imply determinism. Random events can cause predictable outcomes. The rain that falls at a random moment in time in a random distribution on a landscape encounters potential stored in the landscape; that potential is actualised in the predictable flow of water down to a river mouth into the sea. Similarly, accidental deaths are by definition unplanned. Yet roughly the same number of accidental deaths, around 17,000, occurs in the UK every year. There is not an emergency team of bungee jumpers on standby to make sure the statistics remain steady. It cannot be overemphasised that regularities in nature do not imply mechanisms, nor do they imply determinism.

Christopher Hallpike makes the point that convergent patterns of social evolution do not imply determinism. 'It is rather like the game of Monopoly', he writes:

> the players are all different and the throws of the dice produce a completely different game each time, yet the underlying constraints

> produce essentially the same result – a single player who owns everything and has driven all the others into bankruptcy. This is a good illustration that unique events, even randomness, and free will, are quite compatible with broadly predictable outcomes.[213]

This is true without reference to the quantum nature of reality. But when one takes that into account, the case is strengthened. 'Quantum physics showed that even the causal mode of description is only one very special way of tying together natural phenomena, and thus lawfulness in nature is not equivalent to mechanical causality', wrote Bohr's assistant Aage Petersen. 'We have had to learn that the causal mode of description is a limiting case that encompasses only the simplest features of nature.'[214] Physicist David Oliver puts it like this:

> Nature is neither inevitably random nor completely lawful and predictable … Think of the universe as fabric woven on a loom. The warp threads are the laws of motion – rigid, and invariant, the weft, the emergent random strands that weave within the ordered warp. Together order and randomness form a creative whole … There exist physical events the randomness of which cannot be dispelled by the most determined efforts to expose 'a deterministic cause' … a stream of unpredictable information constantly enters the stream of definite information, a source of novelty, creativity, vitality…[215]

Living things superficially exhibit some of the reliability and stability we associate with clockwork, though nothing about them in any way resembles clockwork, and they are, by many orders of magnitude, both much *less* stable, and at the same time much *more* reliable, than any machine.

I imagine some readers are thinking that, for all it may be a fiction, the machine model has persisted precisely because it has proved a very useful one. That is true enough. But that it can often prove useful does not mean it is true. In daily life, and even for most engineering purposes, we find it practical to assume that the earth is flat. If, however, we want not just to build a new garage, but to navigate the seas, the flat earth model is going to prove a serious handicap. In a conversation at the Niels Bohr Institute,

David Bohm was asked if ‘science has shown us something that scientists do not want to see?’ He replied:

> Well, they have become so used to their way of seeing it, that they don’t want to change, you see they feel uncomfortable about changing. And they feel there’s no reason to change, they say we’re doing so well now, why should we change. In one sense it looks as if we’re doing very well, but if you look at the broader view, it looks very dangerous.[216]

The purpose of science is not utility: it can never be reduced to ‘how can I most effectively exploit the world?’ Schrödinger was right: science’s aim is nobler than that. It is to understand nothing less than who we are. So the truth matters, and matters greatly. Furthermore, in the context of evaluating science as a path to truth – the purpose of this section of the book – it is, of course, the central issue. And the machine model is found wanting. As von Bertalanffy put it, ‘even as a fiction the machine idea does not attain its goal, because … it proves to be inadequate in the face of a large and important section of biological data.’[217]

It’s not even as though the fiction of the machine is harmless. It can be seen behind many of the more inhuman consequences of our technological society: our attitudes to both what human life is and to the living world at large. So, again: why does the model persist?

Probably not *just* because of familiarity or utility. The drive behind the machine model is, fascinatingly, much stronger and much less cold-blooded than an explanation on either ground would suggest. The sheer fanaticism of its advocates, and the *animus* directed at those who question the machine model, suggests a more impassioned investment, having little to do with science at its best.[218] I am inclined to think that one element in the model’s popularity is that it encourages the sense that we can easily understand what life is and learn to control it – Faustian fantasies, in other words, of omniscience and omnipotence, that reductionists quite rightly dislike when they see them attributed to a God (I share their qualms).[219]

Here the attentive reader will hear bells ringing from Part I. Breaking down an entity into its parts to see how it works and attempting to build it up again so as to manipulate and control it are familiar proclivities of the

left hemisphere. So too is the phenomenon of denial, refusing even to countenance that a living organism might not be a machine when the evidence stares us in the face. It is reminiscent of the exclusively left hemisphere-dependent subject in Deglin and Kinsbourne's experiments insisting that a porcupine is a monkey, because 'it says so on the card'. Suggestive of left hemisphere dependency, too, is the facetious dismissal when its account of reality is challenged, something we saw in the cases of patients with right hemisphere dysfunction in Part I; and ultimately so is the anger which is ultimately provoked. The left hemisphere insists on its own vision, thereby interrupting the process whereby that vision needs to be referred back to the right hemisphere, so as to be taken up into the whole, as just one part – a valuable one, without doubt – of an understanding in context. Metaphorically speaking, it is as though many biologists now reside in the left hemisphere's hall of mirrors, and not only cannot find the way out, but have stopped being aware there is a world outside to attain.

The left hemisphere's serial, analytic approach is better equipped to deal with a system that is closed, static, linear and predictable – like a machine; not one that is open, constantly flowing, becoming and changing, and ultimately complex and indeterminate – like life. In the left hemisphere's vision, things take priority over processes. It is good at understanding linear cause and effect, not so much reciprocal interaction, let alone a process of co-creation. It understands a whole as simply the assemblage of parts, and causation as from bottom up only, not from many directions at once within the whole. It is at home when it can follow procedures; less so when it comes to recognising new forms, or fields, at work. It prefers what is clearly defined, to what has imprecise boundaries. It doesn't see *Gestalten*, of which life provides the pre-eminent examples.

This allegiance to the left hemisphere is, then, another reason why, however efficacious biology may have become in terms of manipulating the world, its claims to truth should be treated with care. But clearly a further question arises. If the hemisphere hypothesis, by positing the notion of left hemisphere capture, helps illuminate why biology has found itself in the strange predicament of claiming that black is white, why is it that physics, a science with the same pedigree of attachment to the machine model, should have escaped capture, as we saw in the last chapter that it had?

I think that the answer has much to do with the particular nature of Life. There are a number of aspects to this.

The reader will remember from Part I the difficulty the left hemisphere has with dealing with living things: its preference for inanimacy, its tendency to see parts of the body as lifeless ‘things’, its believing living beings (including the self) to be dead, its seeing people as machines or zombies, and its more general tendency to devitalisation. Then there is its tendency to halt the living flow of natural processes, substituting a succession of static representations, something I will say much more about in Part III. Encountering life, it needs to break it down into bits which can be manipulated and controlled; but life is ultimately recalcitrant to any such process. And, on top of all this, and most important, the left hemisphere can’t handle the concept of something with manifest intrinsic purpose (its own, inner, purposiveness), rather than something manifesting extrinsic purpose, engaged in instrumentalising or being instrumentalised by, its environment and other existing beings – the only kind of purpose the left hemisphere understands, and which is indeed its raison d’être.

In Part I, I quoted the philosopher Hans Jonas to the effect that the scientist assumes humans to be subject to causal laws from which the scientist himself is exempt. More than that, however, he saw that in this process inevitably ‘man-the-knower apprehends man-*qua*-lower-than-himself … since all scientific theory is of things lower than man the knower’:

> It is on that condition that they can be subjected to ‘theory’, hence to control, hence to use. Then man-lower-than-man explained by the human sciences – man reified – can by the instructions of these sciences be controlled (even ‘engineered’) and thus used.[220]

Philosopher of biology Stephen Talbott sent a draft book chapter to ‘a first-rank molecular biologist’; Talbott quotes from his response:

> After describing my views as ‘very interesting, provocative, and necessary’, and before offering his support for much of what I had to say, he voiced this concern: ‘You very explicitly dispense with vitalism. Nevertheless, your piece is permeated by an atmosphere that says “There is something special about living things”.’

‘So I believe there is’, Talbott continues. ‘Animals and plants are a long way from rocks and clouds, and also from automobiles and computers. The need to point this out today is one of the startling aspects of the current scientific landscape.’[221]

I agree with Talbott that, while there is no need for some ‘vital substance’ to be added for life to come about, there is obviously something special about living ‘things’. It borders on the absurd to deny it: and, as I have argued, organisms are just not machines. In a later chapter I will, however, argue that there is no absolutely hard and fast line to be drawn between the animate and what we call the inanimate. Not, of course, for the sort of reasons that usually lie behind such claims, those of the School of Nothing Buttery. Not, then, that the living is best seen by likening it to the inanimate; but, on the contrary, that the inanimate is best seen, as biophysicist Robert Rosen eloquently explained, as a limit case of the animate. That discussion will have to wait for now. What I want to draw attention to here is the curious phenomenon whereby scientists are made desperately uncomfortable by even the whisper of there being something special about living beings, or of their having intrinsic purposes of their own.

THE ‘DREADFUL’ QUESTION OF PURPOSE

The problem biology faces, but physics doesn’t, is that the phenomena it is trying to explain require it to ask not one question, but two. This has been succinctly pointed out by George Gaylord Simpson:

> ‘How?’ is the typical, and only meaningful, question in the physical sciences. But biology can and must go on from there. Here, ‘What for?’ – *the dreadful teleological question – not only is legitimate but also must eventually be asked of every vital phenomenon* … In biology, then, a second kind of explanation must be added to the first, or reductionist, explanation made in terms of physical, chemical, and mechanical principles. This second form of explanation, which can be called compositionist in contrast with reductionist, is in terms of the adaptive usefulness of structures and processes to the whole organism.[222]

Biology has a problem with teleology. In J.B.S. Haldane’s oft-quoted words, ‘teleology is like a mistress to a biologist; he cannot live without her but he’s unwilling to be seen with her in public’.[223] However, avoiding teleology results in vacuity, as the evolutionary biologist Ernst Mayr trenchantly observed:

> Teleonomic statements have often been maligned as stultifying and obscurantist. This is simply not true. Actually, the nonteleological translation is invariably a meaningless platitude, while it is the teleonomic statement which leads to biologically interesting inquiries …’ [224]

Mayr is thinking principally of those scientists – and they exist – who want us to avoid making specific teleological observations of behaviour, such as ‘a turtle comes ashore *in order to* lay her eggs’, by saying ‘a turtle comes ashore *and* lays her eggs’. This seems like a hangover from the bad old days of behaviourism, where all inner life is denied, even in humans.

Yet, as Oxford professor of physics Andrew Steane says, ‘the structure of science is not one which dismisses the higher-level categories and “explains them away”. That is not what “scientific” means.’ Even Jacques Monod, an ardent reductionist, who is said (probably wrongly) to have said that ‘nature does not have any intention or goal’, wrote:

> one of the fundamental characteristics common to all living beings without exception [is] that of being *objects endowed with a purpose or project*, which at the same time they show in their structure and execute through their performances … Rather than reject this idea (as certain biologists have tried to do), it must be recognised as essential to the very definition of living beings.[225]

Are we talking of the purpose of a single cell, or a single organism, or an evolutionary strain to which the organism belongs? All three: separating them out is to a large extent artificial, since they are different aspects of one process. At the macro level, according to palaeobiologist Simon Conway Morris, the development of the eye – improbably complex as it is – has happened independently 10 times (the camera eye six times and the compound eye four times) over the course of evolution.[226] At an intermediate level, a strain of flies, genetically manipulated so as to prevent eye formation, within a few generations produces eyes. At the micro level, a single cell of the creature is capable of reacting to unforeseeable circumstances so as to preserve its function in the whole organism, in ways that suggest intelligence.

In a parallel situation, where the same mechanisms of echolocation in bats and whales were found to have evolved entirely separately, and depending in either case on the same complex co-occurring genetic changes, the first author, Dr Joe Parker of Queen Mary’s School of Biological and Chemical Sciences, London, commented: ‘We had expected to find identical changes in maybe a dozen or so genes but to see nearly 200 is incredible. We know natural selection is a potent driver of gene sequence evolution, but identifying so many examples where it produces nearly identical results in the genetic sequences of totally unrelated animals is astonishing.’[227]

Importantly, the idea of teleology, or purpose, does not entail determination: no prior plan, involving a sequence of predetermined steps to bring it about, is required. It is exactly that that is avoided. For example, a young woman may purpose to be a mother, and this purpose may be the most important thing in her life, yet it does not entail a series of steps, nor can its path be predicted. Nonetheless, if it is important, it will tend to happen. A purpose here is not a plan. It is a *tendency* inseparable from – woven into, as it were, the fabric of – a life, which leaves all the detail, and even the final outcome, undetermined. Like 'at-tending', tending alters the world and makes it what it is for us. The root, in either case, is Latin *tendere*, to reach out to something – something, then, in front or above. Nothing to do with being pushed, mechanically, from behind or below.

The example can be usefully taken further. It would be easy to see how to *prevent* the purpose succeeding: for it to have a chance of succeeding, the woman must put herself in the way of its coming about. However, that leaves when, where, and with whom, completely undetermined and undeterminable. By doing or not doing certain things, the desired outcome can be made more likely. Both at the individual and universal level, purpose exists through what one might call a shaping of the probability landscape. Thus we tend towards certain ends, while leaving exactly what happens, and how, in any one case, undetermined.

To move from a focus on things as the ultimately important constituents of reality, to one in which processes are the important entities, requires a shift in our perception of space. We relinquish the idea of causation as strictly 'bottom up', from parts to wholes: we come to accept that whole systems contribute to the properties of their parts.[228] The first is the only one that makes sense to the left hemisphere; in its view the whole can be understood only if we understand the parts. It takes the right hemisphere to understand that the parts can be understood only in the light of the whole.

But it also involves a shift in our perception of time. It is not just that chains of causation work from the past towards the future: the future, in the sense of internalised potential, pattern or *telos* – may be as important a driver in the emergence of phenomena as the past. As Joseph Woodger says, 'in regard to the explanation, a knowledge of the *outcome* of a biological process is often more illuminating than knowledge of what went before.'[229]

Form in living creatures is, despite appearances, another aspect of the question about purpose: both imply a tendency, a direction of intent, an

overall attractive outline. Some ‘sense’ of this, as Woese and McClintock would say, is what enables the organism to repair, or correct, itself. In other words, to correct itself is an inclination towards a form that is its goal, towards a goal that is its form.

The purpose I am talking about is nothing extrinsic, but rather intrinsic potential that is fulfilled within a process as the process unfolds. ‘Latent within the polymeric sequence of amino acids that constitutes the enzyme’s primary structure’, writes Stein, ‘is directionality and potential for its correct folding into a catalyst of remarkable power and selectivity.’[230] The forms that are required in the enzyme, in the cell, in the tree, may not be achieved by pushing from behind, but by drawing from in front, towards certain ends, certain conformations, certain attractors, much as a valley ‘draws’ water that falls evenly on the surrounding hills to one clear end: the mouth of just one river. There is stored attractive energy in the formation of the landscape.[231]

So a system, including a cell or a multicellular organism, can be free and undetermined, yet despite the occurrence of random events, exhibit patterned and purposeful behaviour. To quote Paul Weiss:

> Small molecules go in and out, macromolecules break down and are replaced, particles lose and gain macromolecular constituents, divide and merge, and all parts move at one time or another, unpredictably, so that it is safe to state that at no time in the history of a given cell, much less in comparable stages of different cells, will precisely the same constellation of parts ever recur . . . [yet] their joint behavior converges upon a nonrandom resultant, keeping the state of the population as a whole relatively invariant.[232]

Mutations have been supposed to be random with respect to fitness: those that bring benefit persist, those that do not die out. But such a claim requires clarity about how to judge fitness. This is far from straightforward. There is no clear way of determining fitness except in that a thing *does survive*, which is circular. The geneticist Theodosius Dobzhansky – the same man who said that ‘nothing in biology makes sense except in the light of evolution’ – wrote that no biologist ‘can judge reliably which “characters” are useful, neutral, or harmful in a given species’ (see note).[233]

Geneticist Henrik Kaessmann points to the recent discovery of protein-coding genes being composed *de novo* ('from scratch'), ie, from non-protein-coding genomic sequences altogether unrelated to pre-existing genes or transposable sequences. Such creation was widely thought to be virtually impossible: indeed, according to the famous French biologist François Jacob the probability for creation of new protein-coding genes *de novo* by random processes 'is practically zero'.[234] And yet 'recent work has uncovered a number of new protein-coding genes that apparently arose from previously noncoding (and nonrepetitive) DNA sequences'.[235] What is more, according to another research team, there is 'accumulating evidence that *de novo* evolution of genes from noncoding sequences could have an important role' in a class of genes representing 'up to *one third* of the genes in all genomes'.[236]

As Talbott points out, there has, until recently, been what looks like a doctrinaire assumption of randomness projected onto 'a descriptive biological literature that, from the molecular level on up, remains almost *nothing but* a documentation of the meaningfully organized, goal-directed stories of living creatures.' And he continues:

> Here, then, is what the advocates of evolutionary mindlessness and meaninglessness would have us overlook. We must overlook, first of all, the fact that organisms are masterful participants in, and revisers of, their own genomes, taking a leading position in the most intricate, subtle, and intentional genomic 'dance' one could possibly imagine. And then we must overlook the way the organism responds intelligently, and in accord with its own purposes, to whatever it encounters in its environment, including the environment of its own body, and including what we may prefer to view as 'accidents'. Then, too, we are asked to ignore not only the living, reproducing creatures whose intensely *directed* lives provide the only basis we have ever known for the dynamic processes of evolution, but also all the meaning of the larger environment in which these creatures participate – an environment compounded of all the infinitely complex ecological interactions that play out in significant balances, imbalances, competition, cooperation, symbioses, and all the rest, yielding the marvellously varied and interwoven *living communities* we find in savannah and rainforest, desert and meadow, stream and

> ocean, mountain and valley. And then, finally, we must be sure to pay no heed to the fact that the fitness, against which we have assumed our notion of randomness could be defined, is one of the most obscure, ill-formed concepts in all of science.[237]

In an earlier chapter I suggested that attempting to break down the *Gestalt* of the cat into a host of useful separate adaptations that enable it to hunt well, and then being faced with the question of what started the process and what led to what, creates its own problems. It is the linear, serial processing which the left hemisphere imposes on what is a complex whole. Similarly,

> the evolution of complex adaptations requires coordination between an organism's various developmental systems. For example, the adaptive evolution of tetrapod limb structures requires coordination between the development of bone, muscle, nervous, circulatory, and integumentary systems (at least). If each system had to wait for a fortuitous mutation in order to produce the appropriate accommodation, complex evolutionary adaptations might never arise.[238]

There are aspects of the evolutionary process, as Scott Turner puts it, that 'make little sense without intentionality of some form guiding them'.[239]

To return to purposive behaviour in an individual organism. According to Ford, 'our conviction that these phenomena become manifest only through cell communities is a fundamental misconception. Ingenious, perceptive and intelligent behaviour is apparent in a single living cell.'[240] No-one who has ever done such a homely thing as look at drops of pond water under a microscope would ever fall for the idea that purposive, intelligent behaviour is not exhibited at the level of a single cell. 'Single cells truly can consider their options', writes Ford, 'and modify their responses in the light of contingency':

> Under the microscope, we can observe a predatory single-celled ciliated microorganism as it inspect its prey from a distance. The

> ciliate can then select a specific microbial cell, pause, and then swoop upon its prey and capture it within a second. The coordination of this activity is similar to watching a cat catch a sparrow on the lawn, yet it is done within the confines of a single cell. Living cells are smart: the ciliate *Spirostomum* has been shown to possess memory.[241] It can be trained.[242]

Describing how cells often act apparently as individuals, so as to 'seek out and destroy an invading pathogen without external mediation', if necessary altering conventional behaviour to pursue it, and 'maintain pursuit relentlessly until the organism is consumed and eliminated', Ford reminds us that the human polymorph, a white blood cell that forms an important part of the body's immune defences,

> is an amoeba, although a constituent part of our bodies. This is a cell with a mind of its own. Conceptualising the human body as a cooperative community of essentially autonomous entities gives us a more reasonable understanding than our modern models, which see the body as a collection of mechanical organs enclosed in skin.[243]

Such behaviour, 'including the continual and carefully choreographed machinations of mitochondria, the endless migration of granules and voiding of vacuoles, the conduction of discrete particles in two-way streams of cytoplasm like traffic on a highway, the meticulous changes of position of the nucleus in diatoms during division, and the cautious inspection of prey by a predatory ciliate',[244] leads us to see something inexpressibly more complex than we can explain, never mind understand. 'Our failure to appreciate the majesty of the cell is astonishing, and our sublime confidence that we are close to an understanding [of] it is an embarrassment'.[245]

Slime moulds are amoeba-like organisms found on moist decaying organic matter. Clearly they have no neurones, each consisting of just a single, giant cell. They are, however, capable of behaviour that looks intelligent. They are attracted to one another and fuse, creating a plasmodium, which may be up to several metres long – the slime mould that is visible to human eyes. This plasmodium is essentially a flat, liquid-filled sac, but it behaves like an organised colony:

> Every part rhythmically expands and contracts, pushing around the fluid inside. If one part of the plasmodium touches something attractive, like food, it pulses more quickly and widens. If another part meets something repulsive, like light, it pulses more slowly and shrinks. By adding up all of these effects, the plasmodium flows in the best possible direction without a single conscious thought. It is the ultimate in crowdsourcing.[246]

These plasmodia can make decisions, comparing different options (for example, food sources) and selecting the best one: the plasmodium touches all the potential meals and then either 'decides' to move towards one, or splits itself among many. It can even balance its diet.[247] A mould can forage while making decisions with more than one objective, and it can be persuaded experimentally, as can humans, to behave irrationally at times.[248] It even turns out that moulds make better decisions if they are not rushed.[249]

Plasmodia regularly break out of Petri dishes in laboratories, and can escape from traps and solve mazes.[250] Slime mould colonies can learn to avoid certain paths that lead to a noxious stimulus, and moulds that have so learnt can transfer this memory of the adaptive response by cell fusion to new colonies that have never encountered the noxious stimulus. Even in cases where three out of four moulds in the fused organism were 'naïve' and had had no opportunity to learn, the information was transferred to the resulting fused slime mould from the one that had had the noxious encounter.[251]

Does a slime mould have awareness? If it does, and I suspect it does, the awareness cannot be much like ours. It does have memories and would seem to act intentionally upon them. According to Scott Turner, 'arguably, the roots of our own intentionality permeate deeply through the living world: the living world may be rife with intentionality.'[252] I believe this to be a reasonable deduction, and will have more to say about it in Chapter 27.

It seems to me that an explanation in terms of a whole that follows attractive formal patterns or fields – *Gestalten* – is better than an explanation in terms of chains of causation of parts. That we cannot as yet 'see' or measure such patterns or fields should not be a definitive argument against entertaining the possibility of their presence. Many physical forces

cannot be directly visualised or measured: we posit their existence only on the basis of their apparent effects.

Such is the case with a magnetic field. We visualise it through its effects on metallic bodies. Below is a simple illustration from D'Arcy Thompson, showing cytokinesis (a phase of cell reproduction) in a fish egg. The similarity to iron filings in the magnetic field of a bar magnet is so striking that it has been remarked on for 150 years.[253]

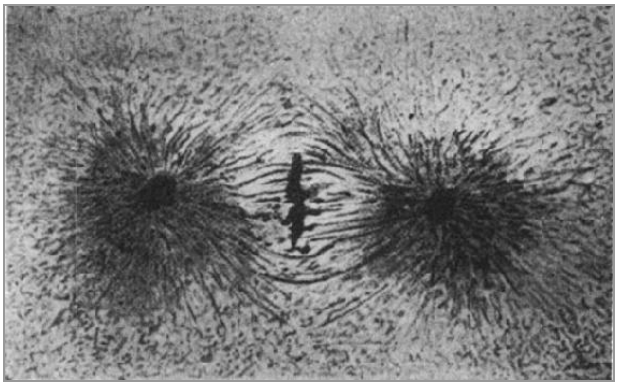


Fig. 28. 'Caryokinetic figure in a dividing cell (or blastomere) of a trout's egg. After Prenant, from a preparation by Prof Bouin.' (from Thompson 1992, 299)

ATTEMPTS TO SAVE THE MACHINE MODEL IN BIOLOGY

Allowing in the notion of purpose may seem ‘dreadful’ to most orthodox biologists clinging to the machine model, but of course that model itself does not dispense with the issue of purpose: it merely tries to brush it under the carpet. Every machine we know of is designed by an intelligent mind that is external to the machine, conceives the design before building it, and creates it for his own utility, a purpose that is extrinsic to the machine itself. Even a machine that makes another machine does so only because an intelligent mind that is external to both machines programmed, and purposed, the first to make the second. The machine is an embodiment in the external world of human will (whose residence is largely the left hemisphere) to some purpose, and the trail of causation inevitably returns, ultimately, to that source.

Clearly, if organisms are seen as mechanisms, there is a problem here. Because machines do not make themselves. Obviously one machine can make another, but no machine simply makes itself. Saying that this one ‘just does’ – La Mettrie’s ‘clock that winds itself’[254] – is to say that it is, blatantly, not helpful to compare it to a machine. As Nicholson says,

> the trouble with design-talk in biology is that, as we have already discussed, organisms are not extrinsically purposive objects … The very idea of ‘design without a designer’ is not only deceptive – it is also logically contradictory: ‘design’ means made by a designer.[255]

On the one hand, biologists speaking the language of mechanics do not want to invoke a heavenly engineer (nor do I); but on the other, as I have already suggested, few biologists any longer believe that just waiting for the right sequence of accidents – random mutations – is how nature works.

One solution to this conundrum is genetic animism – Dawkins’s genes with an agenda. Externality and instrumentality are inescapable logical requirements in whatever it is that one claims drives the machine model. So for genes to do the necessary work to support the machine model, they must both carry the idea of instrumentality, and be in some way external to – ontologically, causally and temporally *prior* to – what they are making (the

rest of the organism). But this gambit ‘promotes the misunderstanding that DNA stands in contradistinction to the rest of the components in a cell by virtue of its ability to exert executive power over cellular operations’.[256] We have seen that this falls down on every count. DNA is not ontologically, causally or temporally prior to the cell, nor does it stand over against the cell in any sense, bring it into being for a purpose, or simply exert power over it.

The other possible gambit to save the machine model is really just to reinvent God, put his eyes out, and call him by another name.[257] The analogy of the world to a watch, which implied the existence somewhere of a watchmaker, was used by the English clergyman William Paley to buttress his argument for a God. Dawkins, the author of *The Blind Watchmaker*, used the same analogy to buttress his argument against God. He writes that ‘I suppose people like me might be labelled neo-Paleyists, or perhaps “transformed Paleyists”.’[258] However, this does not help, for two substantial reasons: organisms are not at all like a watch; and evolution ‘simply does not proceed like a watchmaker, blind or otherwise’, as Nicholson points out.[259] Both Dawkins and Paley make the same mistake, as Dawkins himself hints.

It has been argued that there might be a way out: that there is no need of a watchmaker, blind or otherwise, since complex structures can arise ‘naturally’ without a will that already conceives what it is that is being built. They ‘just do’. Fair enough: as I say, I am not arguing for an external mechanic, either. But, although the statement may well be true, it is in itself no form of explanation. It merely states as a fact the very thing that was required to be explained and remains to be explained. It simply kicks the can down the road. This would not matter (after all, no sane person thinks they can ‘explain’ the workings of life or the universe), if it were not offered in the spirit of having settled something at last.

The principle relied on in such accounts is that of self-organisation. As to what exactly self-organisation means, let me quote an authoritative source:

> To express as clearly as possible what we mean by self-organisation in the context of pattern formation in biological systems, we provide the following definition: *self-organisation is a process in which pattern at the global level of a system emerges solely from numerous*

> *interactions among the lower-level components of the system. Moreover, the rules specifying interactions among the system's components are executed using only local information, without reference to the global pattern.*[260]

On the basis of what we have considered so far, never mind what we are to consider later in the book, this looks like a deeply problematic claim. Since it is impossible to rule anything out definitively, I will not say 'impossible', but, all things fairly considered, 'improbable'. It seems merely an expression of a dogma, that of reductionism.

Turner writes: 'To honestly deal with the question at hand here – where does design come from? – there is no way of avoiding the problem of intentionality: it is the 800-pound gorilla sitting in the corner.'[261] This is surely wrong: the gorilla is sitting, not in the corner, but in the middle of the room. 'The living world is not only a designed place', he concludes, 'it is, in its peculiar way, an *intentionally* designed place … a living phenomenon replete with the purposefulness and intentionality that is the fundamental attribute of life itself.'[262] Let me say, before the howls begin, that neither he nor I are arguing for an engineering God. What we have to explain is how there is order, complexity, beauty and purpose, while at the same time accepting that what we are dealing with is not a machine, and it has no *extrinsic* purpose, such as a machine has – it does not fulfil, in what would have to be an instrumental fashion, the purposes of something external to it.

There's a good deal more to say on purpose and design, and it's something I will return to towards the end of the book (see Chapter 27).

In a last ditch attempt to save the machine model, it may be objected that some machines can, or could potentially, be so programmed as to simulate some of the behaviours of organisms. With the growth of expertise in artificial intelligence it might in theory become possible for machines to simulate some of the operations of an organism less approximately, although the sheer scale of complexity involved in simulating the growth, regulation and development of a single cell – or part of a cell – is so daunting that I wouldn't be inclined to hold my breath. 'A single neuron would be more than enough for us to tackle, and even that is probably not amenable to our primitive methodologies', wrote Ford in 2017:[263]

> For centuries, we have been led to envision life as machinery. The simplistic belief that the brain is a computer, and can be analysed through electrochemical means, is no longer sustainable … The unfathomable complexity of a living cell is not generally appreciated; even a simulation of the way a mitochondrion moves would be beyond our current conventions. Emulating fragments of our trivial understanding does not explain their intricacy, for cells are intelligent, and they live lives that we have hardly begun to address.[264]

Often mentioned in this context are servomechanisms, whereby feedback is employed to make a system self-regulating: like a thermostat, the machine incorporates elements that enable it to achieve an equilibrium. However, organisms are open, far-from equilibrium systems; and as Nicholson points out, 'servomechanisms are closed, near-equilibrium systems and consequently they are not capable of truly adaptive self-maintenance.'[265] Adaptive: remember McClintock's unpredictable adaptations to unforeseen circumstances?

But suppose for the sake of argument that such machines could be made: what then? Once the machine model is so transformed that it is no longer in any recognisable sense mechanical, it has lost its point. If, in order to make humans appear like machines, you have to posit machines that appear like humans, the metaphor is no longer doing any work. Nicholson takes the example of a paper by Reginald Kapp entitled 'Living and lifeless machines', in which

> Kapp notes that 'the living body is analogous to a motor car in which the chassis, brakes, cylinders, pistons, connecting rods, valves and bearings all contained combustible material, some of which was burnt whenever the driver placed his foot on the accelerator'.[266] The question we must ask is this: how is such a bizarre imaginary motor car still analogous to an actual motor car? … what is the point of clinging on to the [machine concept of the organism] if the price to be paid is that our understanding of machines has to be completely distorted in order to accommodate the characteristic attributes of organisms?[267]

Kapp is by no means the only author to stretch the machine concept beyond breaking point. The history of biology is, according to Nicholson, ‘littered with memorable examples’. The attempt is reminiscent of an old joke:

> What’s green, hangs on the wall and whistles?
> *I give up*.
> A kipper.
> *But a kipper isn’t green!*
> Well, you could paint it green …
> *And it doesn’t hang on the wall!*
> Well, you could hang it on the wall, couldn’t you?
> *Anyway, it certainly can’t whistle!*
> Look, what do you expect – to have the answer handed you on a plate?

All attempts at stretching the machine model in one form or another come down to repeating de La Mettrie’s absurdity, that of a ‘clock that winds itself’.[268] The correct conclusion to draw is not that some watchmaker, blind or otherwise, did or does wind the machine, but that it is not a machine.

THE STREAM OF LIFE – A BETTER MODEL?

The words for Nature in Chinese, *tzu-jan* (*ziran*), and in Japanese, *shizen*, mean whatever is ‘of itself’, exists ‘spontaneously’, is ‘just what it is’. They are, in origin, adverbs, not nouns – ways of being, not things.[269] If there is anything in this ancient perception, and I believe there is great wisdom in it, a vision of the natural world as a thing, and a mechanical one at that, is bound to restrict our understanding of what we are dealing with to a certain rather alienating perspective. A machine implies existence of an external creating force with its own purpose: Nature delights in her own.

In the history of Western philosophy there is a distinction between nature considered as *natura naturans* (nature ‘naturing’) and as *natura naturata* (nature ‘natured’), a distinction which, in that form, probably goes back to the early thirteenth-century polymath and scholar Michael Scotus, but is derivable from Aristotle.[270] Famously, it was later taken up by Spinoza and Coleridge. It is the distinction between an eternally becoming, never completed, self-creating Nature, on the one hand, and an already finished, passive Nature, created by a cause external to herself, on the other. The second of these, *natura naturata*, suggests reification (‘thingification’), and, I submit, the view of the left hemisphere; the first, *natura naturans*, suggests flow, and the view of the right hemisphere. (As Arran Gare points out, Friedrich von Schelling, a late eighteenth- and early nineteenth-century philosopher whom we will encounter repeatedly at key points on the path ahead, foresaw many of the developments that have taken place in the post-mechanical science of the twentieth century: his influence was acknowledged by the physicist Hermann Weyl;[271] he was the first to describe the central concept of homeostasis, as well as process biology and was an influence on Haldane and Waddington; and laid foundations for both complexity theory and evolutionary epistemology, as well as the idea of the Earth as a living organism, which we now think of as the Gaia hypothesis.)[272]

Our troubles in this area, as in so many others, begin with the tendency to start from *things*, as though they were the important underlying elements in what we are looking at. Physicists have come to realise that the phenomena they are dealing with, though they may have some thing-like

properties when viewed from a certain perspective, are better seen as processes. The ‘building blocks’ of the supposedly mechanical universe behave like patterned flows of energy, or force fields: they are constantly moving and changing, have no precise boundaries, overlap and mingle with other equally elusive entities, cannot be precisely predicted or specified, change their nature and behaviour depending on circumstances and context, including whether or not they are observed, and exhibit behaviour that defies any mechanical principles – for instance, a ‘particle’ showing interdependency, or entanglement, with another too far removed across the universe for information of any kind to have had time to travel between them. Matter, it seems, is just, as Einstein confirmed, a particular manifestation of energy; not static and substance-like, but constantly in a state of flow.

Thingness places the emphasis on distinctness and stability; the problem then is to explain how things come to change, to move, to be connected, to overlap with other things, to change their nature when observed, or when the context changes. On the other hand, thinking in terms of patterned flow places the emphasis on interconnectedness and change; the problem then is to explain how apparently distinct entities arise for a while, and how it is they contrive to remain temporarily stable.

John Haldane went so far as to say ‘the conception of a “thing”, or material unit, is … useless in the interpretation of distinctively biological facts’.[273] But his point applies not only to organisms, and it is not just confined to descriptions at any one particular scale. Science always deals with processes, everywhere, and at all scales. That is its nature, and it is why science is such a wonderfully living business. ‘Classical science emphasized order and stability’, wrote the chemist and Nobel Laureate Ilya Prigogine. ‘Now in contrast, we see fluctuations, instability, multiple choices, and limited predictability at all levels of observation.’[274]

The most static of sciences might appear to be geology; yet its subject matter is, as philosopher Peter Simons points out, eruptions, earthquakes, the formation and erosion of rock and soil, the movement of tectonic plates, the dynamics of precipitation, the formation of rivers and much else. Astronomy deals with the explosion of supernovae, bursts of gamma radiation, the formation and decay of stars and planetary systems, and the rotation of galaxies.[275]

In chemistry, too, the fundamental entities are processes. According to Ross Stein, the molecule endures through time, maintaining its identity, like a macro-system, 'not because it is static and unchanging, but rather because it is a dynamic system': molecules are 'dynamic entities that negotiate complex energy landscapes.'[276] In physics, nothing rests even for a moment: electromagnetic radiation is emitted, propagated and absorbed; there are constant fluctuations in field values.[277] As philosopher of science Mark Bickhard writes:

> the best contemporary physics demonstrates that there are no particles at all. The fundamental constituents of the world, according to quantum field theory, are dynamic quantum fields in a dynamic space-time. Quantum fields manifest *particle-like* properties in virtue of their interactions being constrained to occur in multiples of fixed quanta, and the conservations of those quantised properties. The quantisation is *reminiscent* of particles, but it is in fact a quantisation of wave-like processes, not particles … *there are no physical particles* …[278]

Dupré and Nicholson take the argument further by positing that particles are the product of a way of attending:

> Quantum fields, which are dynamic organizations of energy distributed in space-time, appear to have purged classical notions of elementary particles from the ontological picture … Although contemporary physicists still routinely speak of 'particles', these no longer refer to solid micro-entities or tiny impenetrable granules, but to quantised excitations of particular fields. Quantum fields, in other words, are primary, and the various kinds of particles that physicists refer to are derivative entities, appearing only after quantisation.[279]

Niels Bohr thought it would be a step forward to eliminate the term 'particle' altogether.[280] It was too much like a thing. Thus what were formerly considered the primary 'building blocks' of matter have been replaced by 'statistical patterns, or stability waves, in a sea of background activity.'[281] And in the early 1950s von Bertalanffy, in a beautiful and

succinct formulation, made an explicit analogy between physics and biology:

> As in modern physics there is no matter in the sense of rigid and inert particles, but rather atoms are node-points of a wave dynamic, so in biology there is no rigid organic form as a bearer of the processes of life; rather there is a flow of processes, manifesting itself in apparently persistent forms.[282]

It seems to me that the reason that the world looks different at the very small scale from how it looks at the level of the everyday has as much to do with time as it does with space. When we are looking at the molecular, and much more at the subatomic, level, processes are happening very fast indeed compared to the period of human observation. At the macroscopic level processes are generally slower. And this makes a crucial difference to what we seem to see. To quote John Dupré again:

> Mechanistic explanations will be successful only to the extent that the constituents identified are sufficiently stable on the timescale of the phenomenon under investigation … their success should not be taken as a sufficient reason for inferring that the organism really is an interlocking system of mechanisms. It is not.[283]

From where I am sitting I see the mountains of Skye, and Uist over the water. If a time-lapse camera had been set up to record this scene from the origins of the world to the earth's eventual destruction, we would see these emblems of enduring facticity rise quickly like waves and then, more slowly, fall away into nothingness.[284] The most solid-looking manmade objects in the world, say the pyramids of Giza, are quicker, smaller waves – but waves they are. They look static only because relative to our period of possible observation they are flowing slowly. And so it is with everything. Whether something is considered static or flowing is only a matter of scale.

Both in time *and* in space. If we stand on the mountains, instead of looking at them afar off, we see that, at the level of the stone and earth and dust beneath our feet, the mountains are changing and flowing to some extent all the time; go on down to the level of the atom and beyond, and we

find that all is, once again, wholly a matter of flux. Stasis is just an illusion of observational scale, both spatial and temporal.

Scale – quantity – also changes quality in a broader way. This is something we seem inclined to forget: we often seem to believe that if something is good as it is, more of it must be better still. But quantity, always and everywhere, changes quality. And though this fact is nowhere more important than in the realm of human everyday experience, human society and human civilisation, it is also true of all systems. *Qualities* that obtain at the small scale disappear, and others come into being, emerging as the scale and the degree of complexity changes.

Importantly the left hemisphere and the right hemisphere have different takes on both space and time. It is something I will deal with at greater length in Part III. In brief, the narrow, piecemeal scope of the left hemisphere, together with its desire for precise targeting, aims to freeze its object, and hold it motionless in a slice of time; the broad, sustained scope of the right hemisphere, and its desire to see the whole, allows it to appreciate flow, what one might call the depth of time. Similarly the left hemisphere flattens space, so as to produce, once again, a slice, while the right hemisphere, seeing the whole of the world in the round, appreciates depth in space.

A single peripheral nerve acts as a seamless functional unit, every part contributing to the same goal. Yet if we take a slice across it, as if interrupting flow in time, it looks like this:

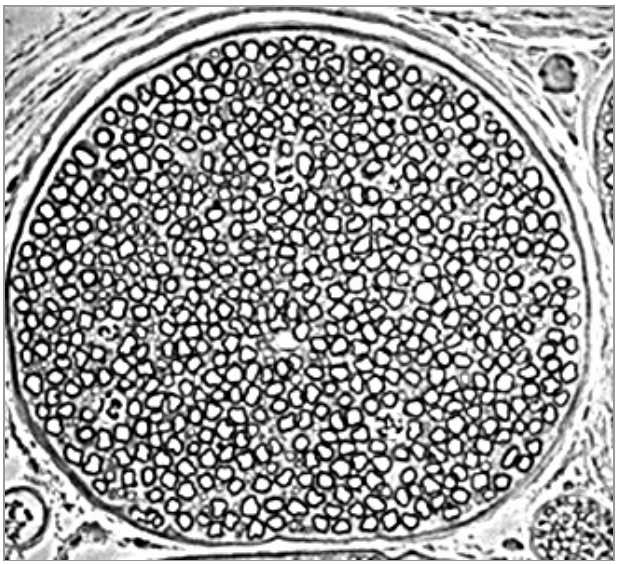


Fig. 29. Transverse section of a peripheral nerve

It seems to consist of a lot of separate units: how does it come about that they are they related? However, if viewed along its length, the nerve looks like this:

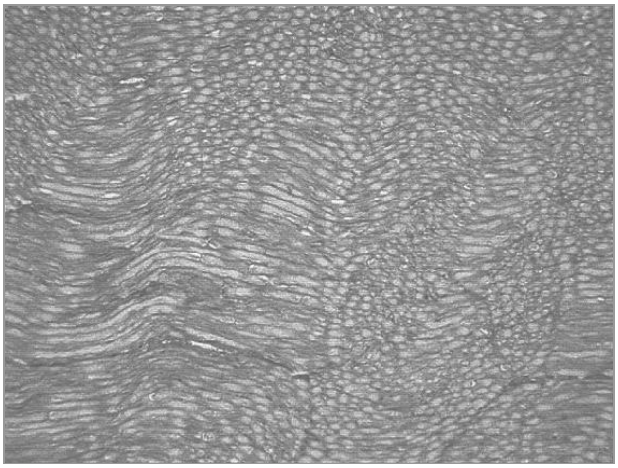


Fig. 30. Longitudinal section of a peripheral nerve

What were previously separate particles are now seen to be interlocking waves.

The ancient Chinese saw this problem, and expressed it as the way one looks at grain in bamboo: ‘on the straight it is of one kind, on the transverse it is of another kind. So the mind-heart possesses numerous principles.’[285]

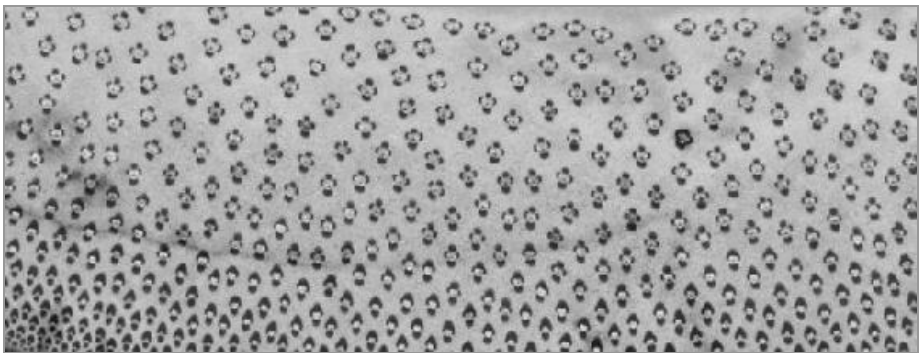
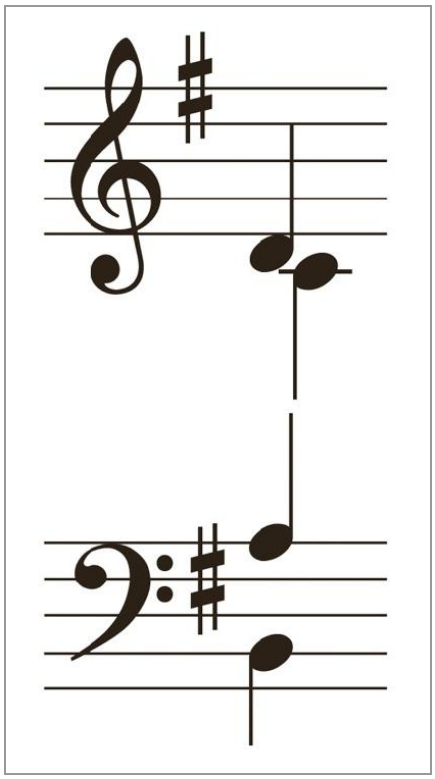


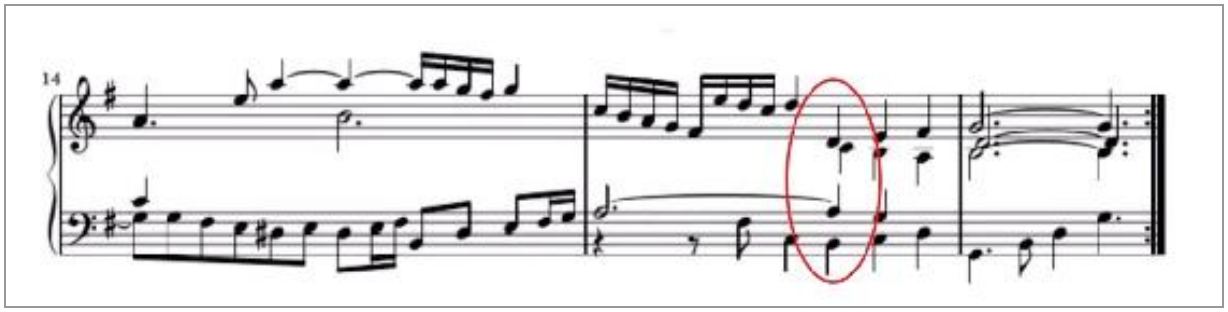
Fig. 31. Transverse structure of bamboo

Fig. 32. Longitudinal structure of bamboo

The best analogy is with music. Take this chord from the end of the *loure*, the sixth movement of Bach's French suite no 5 in G major:



This constellation of notes makes no sense at all on its own and is a howling discord: the notes A, B, C and D are sounded simultaneously. Try it, if you have a keyboard to hand. However, in the context of the flowing lines that harmonise together, it does not sound discordant, but takes its place in a pleasing resolution of lines designed to be heard together, and making sense only in relation to one another:



Once the left hemisphere has frozen its object in time, and decontextualised it in space, it is left with fixed, clear, distinct but inert parts, which then have to be reconnected and reanimated; the building

blocks have to be put together again, and the power, as it were, switched on. To the right hemisphere these ‘objects’ are already connected, animate, and in motion: the power was never switched off.

The left hemisphere’s take on change is that it must consist of the rapid succession of one static element by another. This may look like flow, but it is in fact its opposite: a concatenation – a chain of elements that are themselves static, and distinct – which do not merge one with another. There are always gaps, however infinitesimal, between the entities we imagine as things. This stasis and disconnexion is nowhere to be found in flow.

Discreteness and flow are both aspects of reality, but the latter is ontologically prior to the former. What quantum field theory has to say about this I will postpone to Chapter 24; for now I will content myself with quoting David Tong, Professor of Theoretical Physics at Cambridge:

> At a fundamental level is nature discrete or continuous? I see no evidence whatever for discreteness. All the discreteness we see in the world is something which emerges from an underlying continuum … Quanta are emergent … they are not built into the heart of Nature.’[286]

Analysis never stops until it reaches unchanging particles: if these parts took to changing (and they do), it would have to split them up in their turn.[287] It can end only once separation and stasis have been achieved. The difference between flow and the rapid substitution of static elements may sound no big deal, especially since the invention of ciné film, and subsequent digitised media. But it changes a whole host of things.

Living beings cannot be understood simply by reducing them to an aggregation of parts. Knowledge of the parts can often bring useful information, but that is not the same thing. And in today’s science establishment what is most highly rewarded is seeing minutiae in the whole – the more minute the better – not the whole in which the minutiae inhere. Both exercises are important: according to Schrödinger, much more the latter.

Models are very powerful predictors of the path science will take, and the findings it will encounter. If it is true that each science progresses from

an initial conception of its relevant phenomena as *things* – substances such as phlogiston or vital fluid – to one in which they are seen as *processes*; and if it is true that, as Mark Bickhard asserts, process is now 'the dominant language of science', exceptions remain. What are they? Oddly, as he points out, 'the sciences and philosophies of mind and persons. Here substance and structural views are still dominant.'[288] This is just as David Bohm predicted.

Trying the stream of life model would be worth it, just to see what it revealed, even if it didn't look like a much closer fit – as it seems to me it clearly does. The stream of life model is more capacious than, and is able to accommodate, the strengths of the machine model for what it is worth, where it helps: it maintains what Dupré calls 'as much analytical sharpness as reality allows', while giving full acknowledgment to fluidity and flexibility.[289]

But seeing life as a stream is also a model, just as the seventeenth-century Cartesian machine is. And a model is only truer than another if it explains more of the phenomena we see – or have *failed* to see, because of the tyranny of the formerly ruling model. The new model, too, can be jettisoned, when the time comes, once it has done its work. But to judge it fairly does require deploying it, and mentally inhabiting it for long enough to see what difference it makes to the observed world. In other words, you won't even be in a position to see what it has to offer without first making a leap of imagination.[290] Dismissing it just because it isn't the model you now hold is senseless. In a well-known formulation, 'you don't see something until you have the right metaphor to perceive it'.[291]

In 2004, Carl Woese, whose work revolutionised microbiology, wrote of the complacency he saw in biology at that point in history:

> Look back a hundred years. Didn't a similar sense of a science coming to completion pervade physics at the nineteenth century's end – the big problems were all solved; from here on out it was just a matter of working out the details? *Déjà vu*! Biology today is no more fully understood in principle than physics was a century or so ago. In both cases the guiding vision has (or had) reached its end, and in both, a new, deeper, more invigorating representation of reality is (or was) called for. A society that permits biology to become an engineering discipline, that allows that science to slip

> into the role of changing the living world without trying to understand it, is a danger to itself.[292]

And he concludes, in an image that should resonate in the mind of the reader: ‘molecular biology could read notes in the score, but it couldn’t hear the music’.[293]

Let us return to our overarching context, which is, after all, the examination of science’s claims on truth. I am a believer in Pragmatism. Science is Pragmatist, or should be; not merely pragmatic. The machine model may be useful at times, but it is not accurate, because, as I have tried to show, it does not answer to what we know of organisms from observation, examination, and experiment – in other words from science as she should be practised. This trade-off between truth and utility is also that between the dispositions of, respectively, the right (more truthful, but more complex) and left (less truthful, but simpler) hemispheres. Unfortunately, science’s claims on truth are compromised if they are hijacked by the left hemisphere refusal to acknowledge the limitations of its chosen model of re-presentation (here, the machine model). And, as I say, it is not as if this hijack has no consequences in the world of every day: the consequences are of the most serious nature.

How would a paradigm shift, such as the one I believe we need, change the way we thought of ourselves – influence, in other words, how we answered Plotinus’s question?

In the first place, it would help us, quite simply, to avoid viewing ourselves as machines, the most crippling possible distortion of what it means to be a human being. Believe it or not, in the Royal Institution Christmas Lectures for 2013 (‘the UK’s flagship science series’, according to its website, aimed at aspiring young scientists), an Oxford biology lecturer used the very specially human act of two people gazing at one another to impress on her indeed impressionable audience of 11–18 year olds that ‘you’re amazing, we’re all amazing, because we’re all hugely complicated *machines*…’[294] Perhaps it had slipped her mind that machines are not social beings; that they don’t have consciousness, feelings, personality, will or individuality; that they have no appreciation of music, dance, poetry, art or nature; that they have no sense of humour and they do not have the ability to change their minds, to sorrow over the past or project a delighted future. And that’s not even taking into account the far more

complex issues entailed in human consciousness, including imagination, morality, creativity, the capacity for spiritual awe, and an allegiance to beauty, truth and goodness. And in case that should sound the slightest bit rarefied, I'd like to mention that they don't have bodies either. And they do not die. It is true, of course, that you're amazing, we're all amazing; but it's precisely because we are *not* just hugely complicated machines. If we carry on talking like this to the aspiring young, we will get no better scientists than we will deserve.

As biochemist Addy Pross writes, this dire process begins at the cellular level:

> There is a growing awareness of an elephant in the room. Life is more complicated than a representation provided by a string of 3 billion letters. The gap between the elucidation of the human genome sequence and understanding the significance of that sequence is cavernous. The uncovering of more and more structural and mechanistic information within the living cell hasn't clarified what life actually is … Our attempts to view biological systems as mechanical–materialistic machines have failed dismally.[295]

And those attempts are encouraged by the fact that scientific research into the human being, and specifically into the brain, is almost exclusively carried out using the model, and the language, of the machine. Neurospeak is replete with references to 'wiring', 'circuitry', 'modules', 'switches', 'signals', 'data banks', 'inputs', 'outputs', and to the brain 'encoding', 'computing', and having 'mechanisms' of every conceivable kind: and no-one knows better than I do from personal experience how hard such terms are to avoid, given the existence of the culture. Yet Berry is surely right to say that 'we should banish from our speech and writing any use of the word "machine" as an explanation or definition of anything that is not a machine. Our understanding of creatures and our use of them are not improved by calling them machines.' It is to be expected that the hermetic response of the left hemisphere will be that living creatures are machines. But we do not know that: we only see the mechanical aspects revealed by our model, and I hope in the course of this book to give the reader some insight into how limiting and damaging this habit has become. The language we use is

hugely important: it determines what we can understand. ‘Over the past fifty years or so’, wrote David Mermin in 1990,

> scientists have allowed the conventions of expression available to them to become entirely too confining. The insistence on bland impersonality and the widespread indifference to anything like the display of a unique human author in scientific exposition, have not only transformed the reading of most scientific papers into an act of tedious drudgery, but have also deprived scientists of some powerful tools for enhancing their clarity in communicating matters of great complexity. Scientists wrote beautifully through the nineteenth century and into the early twentieth. But somewhere after that, coincident with the explosive growth of research, the art of writing science suffered a grave setback, and the stultifying convention descended that the best scientific prose should sound like a non-human author addressing a mechanical reader.[296]

Sadly, these words are yet truer today.

In the second place, we have been taught to regard ourselves as selfish, and the natural world out of which we emerge as essentially a field of ruthless competition. This has truth. But it is very much a half-truth. Its opposite is also true. We are moral beings, capable of selflessness, fulfilled through our interconnectedness with one another and the natural world at large. We are not atomistic. And the story of life on earth is not therefore one of competition only. It is at least as much, and arguably more, as I have already suggested, a story of co-operation and collaboration. In fact collaboration might be seen as, *sensu stricto*, ‘one of the central characteristics of life’.[297]

‘Complexity’, says Pross,

> facilitates the replicative process … in [a recent] experiment it was found that a single replicating RNA molecule was relatively ineffective at self-replication, but a pair of similar RNA molecules, neither self-replicating but each helping the other replicate, worked way better. Conceptually one can think of that step as the first on a thousand-mile journey toward that biological cell – a highly

> complex cooperative entity, highly effective at making more of itself.[298]

Multicellular organisms appear to have arisen from single cells numerous times independently in the course of evolution.[299] This alone implies that collaboration is a fundamental element in the evolution of life. According to Dupré and microbiologist colleague Maureen O'Malley, 'single animal or plant cells are only truly alive when they are collaborating with other cells … in a great variety of ways.' [300] Though it is part of our idea of living beings that they are autonomous entities, the very integrity of their function as a whole, on which such an idea of autonomy depends, *itself already* involves a host of other organisms.[301]

This does not at all rule out competition: in fact the combination of competition and co-operation is just what collaboration means – and needs. As always, the forces for division must be balanced by those for union, and vice versa, though ultimately the two tendencies must be fruitfully unified, not divided. A collaborative team requires difference, not sameness, of types, strengths and roles; and every *society* – a form which life from its earliest origins approximates, even within the single cell – contains, and must contain in order to be healthy, elements of both difference and sameness. Communities of cells, according to Dupré and O'Malley,

> exhibit well-defined cell organization and a functional division of labour that includes specialised cell-to-cell interactions, the suppression of cellular autonomy and competition, metabolic collaboration, combined defence and attack strategies, and the coordination of movement, growth and reproduction.[302]

And, as they go on to say,

> whatever sense we might try to make of the Dawkinsian idea of selfish genes, molecular replication is always, and has always been from the pre-cellular molecular community to the present, the achievement of ensembles of molecules, not of individual molecules.[303]

And the entities that are seen to compete are already collaborations of ‘many different lineage-forming entities.’[304]

They see competition as a necessary stage in collaboration, ‘transitional’ rather than ‘terminal’:

> temporarily competitive wholes will exhibit a strong tendency ultimately to compete most successfully by engaging in new levels of collaboration with similar or different entities … our concept of collaboration assumes no sharp boundary between selfish and cooperative interactions, something surely to be expected *if the former is inclined to evolve into the latter*.[305]

I would also add here: on the whole, evolution has led to greater genuine collaboration, greater empathy, greater beauty and greater harmony. When reductionists want to demonstrate the brutality of nature, they are generally reduced – fittingly – to citing creatures such as the ichneumon wasp that lays its eggs in the larvae or pupae of another species, and the fascinating and, I agree troubling, lives of parasites (on which see Chapter 27). I don’t say that all is sweetness and light as we ascend the evolutionary tree, far from it: man, in particular, is a deeply flawed being – as well to remember that, when we pretend to be able to peer into the nature of the cosmos and find ready answers. But the very reason we are capable of deliberate harm is bound up with our special power to do deliberate good. (Social evolution, on the other hand, is another matter: I do not agree with Stephen Pinker that we are becoming better human beings. Though I fully understand his argument, I believe we are becoming less fully human, as we sacrifice what we could have learnt from attending to our right hemisphere’s understanding of the world.)

CONCLUSION

In the longer term many of our present assumptions about Nature, in both the broader and the more restricted sense of that term, may need to be revised, which is why at the largest possible scale it is still ultimately unpredictable: ‘Surprise is inherent in the structure of the world’, says Lee Smolin. ‘Nature can throw us surprises for which no amount of knowledge would have prepared us.’[306] Jacob Bronowski once commented: ‘The physical scientists have more fun. Their theories are more eccentric; they live in a world in which the unexpected is everyday.’[307] But *all* is unexpected if we could just see it. It’s just that physicists have learnt to expect the unexpected; many biologists are still in a preceding phase, in which the unexpected is dismissed, covered up, or simply not seen at all.

Things are changing, if slowly. Even one of the world’s most influential professors of mainstream bioengineering, Jay Keasling at Berkeley, together with three of his distinguished colleagues, wrote in a collaborative review published in the high-impact journal *Cell*:

> An open question is whether biology is genuinely modular in an engineering sense or whether modularity is only a human construct that helps us understand biology … In the context of biological engineering, it is still an open question whether abstraction is a useful tool or a necessary evil.[308]

It is both a useful tool, *and* it is an evil – how necessary depends on what you want science to do for you. Ultimately, it is not that the machine model does not have a role. There does not have to be just one model here. But, crucially, as in all hemispheric differences, one is more widely and fundamentally applicable than the other. Low-level analyses versus portrayal of the whole: it’s not an either-or matter, but if you want to *understand* the whole, it’s clear which is more important. Mechanism is a perfectly useful way of looking at tiny details in a complex picture so as to be in a position to manipulate them. There it has had spectacular successes. But we mustn’t be blinded by them. The problem is thinking that the same thinking will help you understand the whole: it can’t. ‘In its prime each

system is a triumphant success', wrote Whitehead: 'in its decay it is an obstructive nuisance. The transitions to new fruitfulness of understanding are achieved by recurrence to the utmost depths of intuition for the refreshment of imagination.'[309] That is what we now need.

Haldane wryly noted of Pasteur that his work

> appealed most strongly to those who desired to stress the contrast between mind and matter … It is perhaps not quite irrelevant that he worked in his later years with half a brain. His right cerebral hemisphere had been extensively wrecked by the bursting of an artery when he was only forty-five years old; and the united brain power of the microbiologists who succeeded him has barely compensated for that accident.[310]

Because *understanding* is more than providing a low-level description, the similarity to the understanding of a text is not accidental. To quote Lewontin again: 'An organism is less like a machine than it is like a language whose elements … take unique meaning from their context'. Analyses of individual words and their possibilities of meaning can be an essential first step: without a knowledge of the words, we cannot grasp the whole. But at the same time, it is only the meaning of the whole that gives the individual words their full and proper significance. This, in a nutshell, is the truth that has for so long been ignored within biology.

As always, what the left hemisphere sees *must* serve the more inclusive vision of the right hemisphere, not come to dominate it. It makes an invaluable servant, but a tyrannical master. Failure to observe this principle leads to the neglect and obscuration of the most fundamental insights into the question posed by Plotinus, addressing which, according to Schrödinger, is the only justification for science: 'and we – who are *we*, anyway?'

INSTITUTIONAL SCIENCE AND TRUTH

> Most human institutions, by the purely technical and professional manner in which they come to be administered, end by becoming obstacles to the very purposes which their founders had in view.
>
> —*William James* [1]

> Specialization is for insects.
>
> —*Robert Heinlein* [2]

SINCE SCIENCE, UNLIKE, SAY, REASON OR INTUITION, IS NOT JUST A FACULTY of mind, a way of approaching the world, but a vast edifice of human individuals working on projects, forging careers and shaping a culture, we need to look at the institution of science itself in order fully to assess science's claims on truth. For most people this is science's most evident manifestation, and one without the mediation of which they can have no knowledge of science, and therefore no access to whatever truth it may hold.

No-one these days is in a position to evaluate the validity of science's myriad pronouncements across more than the tiniest part of the whole range of what it treats. Even the most eminent scientist in his or her limited field, must rely, as we do, on authority, on the pronouncements of others. In fact every published paper is an instance of taking something on someone else's authority, on the understanding that peer review can vouch for its validity.

In answer to the all-important question at the core of this part of the book, ‘Where should we go for truth?’, the limitations imposed by the institution of science, are, whether we like it or not, almost as important as the limitations imposed by the nature of science itself. Whenever someone says ‘science teaches that …’, they are relying, at best, on a broad knowledge of the published literature – most often not even that. Essentially, they are arguing from authority. So the question inevitably arises, how reliable is that authority?

The thrust of this chapter will be slightly different from the path we have been following, one which relates the hemisphere hypothesis to our approaches to truth. This chapter is necessary because science’s claims to truth cannot be assessed independently of an examination of the institutions of science; but I don’t wish to overstate the connexion with the hypothesis. There are indeed echoes, even resounding ones, and I shall point them out. But I think it is important that people should be aware of the degree to which the institution of science may fall short of the ideal in its pursuit of truth, without also having to be too concerned with the question of how much this can be attributed to the behaviour of our brain hemispheres. The phenomena are staring us in the face without the need of any hypothesis to illuminate them.

I imagine that most people who are not practising scientists have a view of how the institution of science operates that goes something like this. Research is carried out as a collective, collaborative enterprise in which everyone is disinterestedly doing his or her specialist bit in pursuit of the wider goal; bright young scientists are hired because they’re clever and original, then given their head, but supervised by wise professors who’ve been around, and whose broad grasp of the subject sensibly tempers their juniors’ lack of experience. Findings are published only after rigorous examination by peers, who act as objective arbiters of worth in their specialist area. Public science draws on such evidence in a balanced way to come up with policies promulgated to the population at large, based on a suitably extensive base of sound knowledge.

No doubt examples of such model scientific enterprise exist and we are all the beneficiaries of them. But the actual practice of science often falls far short of this and it is worth anatomising the various ways in which this happens, to the detriment of both science and truth, and of the public at large – that’s us all.

SPECIALISATION AND ITS IMPACT ON ORIGINAL THINKING

Science is the victim of its own extraordinary success. Such has been the exponential growth – the explosion – of scientific knowledge in the last three centuries, that all scientific enquiry has now to be highly specialist in nature. This means that many scientists are now so specialised that they often fail to understand the significance of anything outside their own narrow field, or how the work they do fits into the broader project of science as a whole, never mind into the field of philosophy and the humanities in general, and hence the lives of human beings – as Schrödinger saw that a scientist's work ultimately must, if it is to mean anything.

On this important matter it is worth quoting the historian and polymath Arnold Toynbee. He objected to what he called the importation of the 'bureaucratic state of mind', essentially the view of the left hemisphere, into the field of intellectual enquiry: he saw it as both out of place and obstructive, since 'in intellectual enquiry, freedom is the breath of life … debate is the source of advances in knowledge and understanding, and … the wider the field of discussion, the greater the chance of striking out fruitful new ideas.' He pleads for a demolition of the 'interdisciplinary dividing walls' to be replaced, in a striking image, by a structure

> not like a Western house, but like a Japanese house, in which the internal arrangements can be given any number of alternative configurations, interchangeable at a moment's notice, because the interior is divided up by movable screens, not by walls that are 'permanent fixtures'.

He concludes, in an evocation of the necessary balance involved, that

> This means that the panoramic and myopic approaches do not only benefit, both alike, by being made concurrently, but need each other's complementary services so much that no inquirer can afford to neglect either of them … This, in turn, means that inquirers who

> concentrate on the bird's-eye view and those who concentrate on the fly's-eye view are, not natural enemies but natural, and indeed indispensable, allies …

Much as the right hemisphere understands the need for the left, but the left does not understand the need for the right, generalists appreciate the need for specialists, while the specialist is less able to see the need for the generalist. And Toynbee continues, later,

> specialisation has become an indispensable intellectual tool. But being indispensable is not the same thing as being all-sufficient … the farther that specialization is carried, the more of the meaning of the phenomena is left unplumbed in the unexplored gaps between the specialists' deep but narrowly constricted borings. This method leaves critical questions not only unanswered but unasked. And they will remain unasked if the microscopic approach is not supplemented by a panoramic one. Without a combination of the two, there can be no stereoscopic vision.[3]

This I believe goes to the nub of the matter: 'both/and', not 'either/or'. At present we have largely just one. We need to see with *both* eyes.

In an era where not just every organ, but every organelle, has its journal, and in which the jargon of each speciality becomes increasingly intimidating to outsiders, there is little incentive to look beyond the boundaries of your own ever narrower specialism. Indeed, the way to get on is to dig deeper in the hole you are already in, not to look around you to work out what all this spadework is about. For that way lies career death: you will cease to be an expert – one who has been defined as knowing more and more about less and less. As the physicist John Archibald Wheeler memorably observed, 'if you're working on something new, then you are necessarily an amateur.'[4]

Astronomer Jack Eddy reflected:

> Entering a new field with a degree in another is not unlike Lewis and Clark walking into the camp of the Mandans. You are not one of them. They distrust you. Your degree means nothing and your name

> is not recognized. You have to learn it all from scratch, earn their respect, and learn a lot on your own. But I also think that many of the most significant discoveries in science will be found not in but between the rigid boundaries of the disciplines: the terra incognita where much remains to be learned. It's not a place that's hidebound by practice and ritual. I have always tried to keep moving between fields of study…[5]

If perceiving shapes is how maths and science progress, as I believe it is, you will see those shapes only by rising above the hole where you are digging. The view in the valley floor is good, but if you never climb, you will not know that there are many other valleys, and mountain ranges nearby, which are not only beautiful in themselves, but help you see *why* good work needs to be done down in the valley floor at all. To quote Smolin, science gets reduced to technical problem-solving, and 'it is a fantasy to imagine that foundational problems can be solved by technical problem-solving within existing theories'.[6]

'General ideas, hypotheses, are necessary in science itself', wrote the philosopher John Dewey:

> They serve an indispensable purpose. They open new points of view; they liberate us from the bondage of habit which is always closing in on us, restricting our vision both of what is and of what the actual may become. They direct operations that reveal new truths and new possibilities. They enable us to escape from the pressure of immediate circumstance and provincial boundaries. Knowledge falters when imagination clips its wings or fears to use them. Every great advance in science has issued from a new audacity of imagination.[7]

For those who would rather hear a scientist on science than a philosopher, here is the palaeontologist George Gaylord Simpson:

> Science, truly to be such, must centre not on descriptions and names but on principles – that is, generalizations, theories, relationships, interconnections, explanations about and among the facts.[8]

Science can never be merely the extension of technique, as it often now seems to be. Knowing how to do something is not the same as understanding it; expanding know-how, our power to control, exponentially, without any concomitant advance in wisdom, is dangerous. It's like putting machine guns in the hands of toddlers. In 1991 Jonas Salk, who developed the polio vaccine, said: 'At one time we had wisdom, but little knowledge. Now we have a great deal of knowledge, but do we have enough wisdom to deal with that knowledge?'[9]

I have mentioned Erwin Chargaff before. He was a distinguished professor of biochemistry at Columbia. His researches, which he freely shared with Crick and Watson, led to what are known as Chargaff's rules, which made the discovery of the structure of DNA possible. He noted how extraordinarily different the world of science had become during his lifetime:

> The world of science was open before us to a degree that has become inconceivable now, when pages and pages of application papers must justify the plan of investigating, 'in depth', the thirty-fifth foot of the centipede; and one is judged by a jury of one's peers who are all centipedists or molecular podiatrists. I would say that most of the great scientists of the past could not have arisen, that, in fact, most sciences could not have been founded, if the present utility-drunk and goal-directed attitude had prevailed. [10]

He writes of a real fear that seems to me well-grounded: that there is no vision of what we are doing in science, and that, most worryingly, our inevitable ignorance of all but a small part has been forgotten. He relates this to changes in the way we think: from a broad, creative process in which the open pursuit of knowledge for its own sake was valued, to the narrow, deterministic, 'utility-drunk' and 'goal-directed' attitude of the left hemisphere mindset. In Carse's terms what should be an infinite game, has become a finite one. Chargaff likens the effect to the piecemeal destruction of a great work of art:

> The wonderful, inconceivably intricate tapestry is being taken apart strand by strand; each thread is being pulled out, torn up, and

> analysed; and at the end even the memory of the design is lost and can no longer be recalled.[11]

He continues that there has been

> an outright change in the types of individuals entering the various disciplines. Science has become a hard and pitiless and, what is even worse, a thoroughly humourless master … The profound Lichtenberg [the eighteenth-century German physicist and philosopher] had taught me that for people to find something they must first know that it exists. This was an assurance that I have never lacked during my entire life. What became weaker as I grew older was the conviction that the way of searching which we had chosen was the right one. The feeling that there is always more than he can find, that he is only pulling shreds out of an unfathomable continuum, forms part of my definition of a scientist. [12]

He comments that in the world in which young people now have to learn science, keeping in with one's boss and following fashion are so important that 'a few of these young people may, in the course of their apprenticeship, become scientists, but most never will. They will turn into specialists.'[13] And, he observes, specialism drives the scientific disciplines further and further apart, as well as leading to 'an enormous rise in the costs required to maintain and expand the scientific establishment, with a concomitantly increasing gap between claims and achievement.'[14]

Chargaff lamented what he called the 'overfragmentation of the vision of nature – or actually its complete disappearance among the majority of scientists'. In its place was

> a Humpty-Dumpty world that must become increasingly unmanageable as more and tinier pieces are broken off, 'for closer inspection', from the continuum of nature.[15]

It is salutary to remember that much great science of the past was done by people who were broad-ranging thinkers, often working alone, and often

outside the walls of any academic institution. Even into the modern era, three of its intellectual giants, whose influence ranges well outside of any speciality – Darwin, Freud and Einstein – did the work for which they are mainly remembered alone, and often without the support (or the straitjacket, depending on how you look at it) of conventional academic institutions.

It is worth noting also that, like other intellectual giants such as Russell, Whitehead and Wittgenstein, much (indeed, with the exception of Einstein, almost all) of their influence comes, not through papers, but through lectures or books. A book gives time and space for ideas to be properly developed. The scientific paper, in particular the conventional contemporary science paper, is best suited to the dissemination of data, rather less well to the exposition of seminal ideas, though it does happen. Nowadays career scientists don't write books. Books have no career value, because they have no 'impact factor' associated with them, and they take (or should take) a long time to write, time which could be more usefully applied to producing papers. The parts are more valuable than the whole: salami slicing rules. What counts, as usual, doesn't get counted.

Furthermore, books are also likely to be addressed to the 'laity', which as I say turns out to be anyone – even another scientist – not specialising in whatever area is under discussion: and 'how can *they* be expected to understand real science'? My worry is that even the descriptions of human behaviour on which neurology, psychiatry and psychology depend are becoming further and further from any experience of a human being, and as a result further and further from the purview of an intelligent non-specialist reader. As the reader of Part I will know, the in-depth case studies of the early twentieth-century German and French literature, particularly, provide fascinating insights into human experience that leap from the page – treasure troves of, at the same time, both detailed information and a broad human understanding. Even research papers written in the 1970s and '80s, and well into the 1990s, seem for the most part, to be written for a human being, and understandable by any intelligent reader with a basic science background. At some point in the last 20–30 years, however, that sense has been lost. The terminology is a significant part of the problem. All human description but the most limited kind is excluded: subjects are selected by the application of a 'tool', the 'cohort' is put through a scanner, and the data then submitted to computer analysis, the technical data on this replacing any account of human behaviour or experience. Increasingly, the heavily

acronymic jargon of research papers seems to me to present an almost impenetrable barrier to anyone other than the most highly specialised reader, and even then, if they are to get anything out of the exercise, they must have a huge capacity to tolerate boredom.

An analysis of the language of research publications over time confirms my impression that there is what the author calls a ‘drift towards inaccessibility’ that took off in the last decades of the twentieth century:

> The broad consequences are that ideas flow less freely across and within the sciences, and the public’s access to (and maybe trust in) science is diminished … To scientists this trend represents a narrowing of their range of expertise, even while the depth of their knowledge grows. So they may change specialities less often as the costs of becoming expert in another area grow … This erection of higher and higher barriers to the comprehension of scientific affairs must surely diminish science itself. Above all, it is a threat to an essential characteristic of the endeavour – its openness to outside examination and appraisal.[16]

And that was just in 1992, some 30 years ago.

Of course I am particularly concerned with neuroscience; and it is a problem that today’s neuroscientists and psychologists are themselves increasingly focussed on mechanisms and increasingly unused to seeing what they do as having much to do with *persons*. Yet, if you stop thinking of the brain as just a mechanism, it becomes possible, once more, to see it for what it most assuredly is: part of a person. In an era that, at least in name, embraces embodied philosophy, that should be a very important step. In the film *The Divided Brain*, Michael Gazzaniga says of *The Master and his Emissary*: ‘This book is taking a selected set of neuroscience findings and trying to relate them to the clinical psychiatric experience, telling us a story that tries to mesh those two things. I’m not comfortable with that.’ What is implied by the word ‘selected’ is another matter (there are over 2,000 findings referred to). But what is surely fascinating is that a prominent research psychologist, working on how the brain functions in a lab, should not be comfortable with relating brain research to actual *people* with brain conditions outside the lab: what he calls ‘clinical psychiatric experience’. Such research is *ipso facto* ‘related’ to real people. I had,

further, assumed the point of such research was to apply it to their benefit, if not at least to help us understand Plotinus's question, 'who are we?' Or as the great neurosurgeon Wilder Penfield put it: 'The problem of neurology is to understand man himself.' Gazzaniga continues: 'I think here's how you think about it. The brain is as mechanical as clockwork … Let's just get over that – that's the way it is.'[17]

I am reminded of the words of Jonas Salk, when asked about how brain science can help us understand the world and lead better lives: **'**It's in the human dimension, as distinct from the molecular-cellular, if I could make this contrast, trying to understand the whole, which is far greater than the sum of the parts. That is where I sense the need for a new kind of mind, for individuals who are integrators, as distinct from the reductionists, or reductionists who could integrate as well.'[18]

One sees many factors here that do indeed align with the hemisphere hypothesis: narrowness, technicalisation and fragmentation, at the expense of breadth, humanity and synthesis; the familiar at the expense of the original; a suspicion of all forms of judgment based on quality, and their replacement by those based on quantity; and we will see more as we go on.

Unfortunately, many scientists are not comfortable with philosophy. They see it as an area in which they cannot have precise answers and access to the 'truth'. That there could be a place where they might have certainty is, of course, an illusion, as I have emphasised. And not only can science not divorce itself from philosophy, but it doesn't get closer to the truth by the attempt. Quite the reverse.

It is all too understandable that scientists don't want to think philosophically about what their research tells us. But they can't avoid it. And because they can't avoid it, but too often don't think about it, they impose a default, naïve form of materialism on anyone who will listen. It seems to be assumed that, just because someone is a good astrophysicist or evolutionary biologist, that fact in itself qualifies him or her to lay down the law on subjects such as the existence or otherwise of a God. 'Now that science has most successfully resisted theology', wrote Nietzsche,

> whose 'hand maid' it was for too long, it is now, with great high spirits and a plentiful lack of understanding, taking it upon itself to lay down laws for philosophy, and for once to play the 'master' – what am I saying? to play the *philosopher* itself.[19]

HOW RELIABLE IS SCIENTIFIC EVIDENCE?

Good scientists themselves do not make the sorts of claims for certainty that are sometimes made on their behalf.

Preliminary remarks on neuroimaging

Clearly the argument of this book depends on research into the brain: increasingly brain research relies on forms of functional neuroimaging, from which much useful information can be gathered. As one might expect, it has its strengths and weaknesses. Since knowing how it can inform and how it can obfuscate is central to the way we should evaluate it, I cannot avoid some brief preliminary remarks on the topic. Then I will turn to the issue of reliability more generally in science.

Scanning generates hugely complex data sets. There are understandable problems involved in the interpretation of such data sets by software packages. It was suggested in a much publicised paper in 2016 that ‘a bug in software’ might have invalidated 15 years of fMRI (functional magnetic resonance imaging) research.[20] The point at issue was that such packages carry out over 100,000 independent statistical tests on the results, inflating the number of false positive results. That is to say, if you do enough comparisons, you will find some that come up trumps by chance alone.

However, the suggestion that this problem goes mainly uncorrected is not accurate. Certainly one published rebuttal suggests that the claim is based on an erroneous conclusion about the resting state with which results are conventionally compared, and provides ‘no basis to question the validity of the thousands of published fMRI studies that have corrected for multiple comparisons or the commonly employed methods to correct for multiple comparisons’.[21]

Whether that is where the matter rests, or not – and I suspect it is not the end of the story – only time, and the debate of expert statisticians, will decide. The point I am making is that, in a healthy science, such debate is intrinsic to the process of science; and which are the correct inferences to draw from complex computer-generated data sets is not above such debate.

Structural imaging of the brain is more or less unimpeachable: it effectively enables one to conduct a living post-mortem. Though what to make of one's findings may be problematic (an abnormally enlarged region may be as dysfunctional as one that is abnormally reduced in size, for example), what one is seeing is not. As a research tool, *functional* imaging, however, is fraught with difficulties; and wherever there is another source of information about brain function, functional scanning should be treated in concert with it, as providing, at best, confirmation. And when it is in conflict with other sources of information, we should be appropriately circumspect. This is because interpretation of such data is peculiarly uncertain, for a number of reasons.

Experimental science often takes not just data and ideas out of context, but takes people out of one context and puts them in another. Many lab situations are extremely unusual contexts from which to generalise. Lying in a scanner is one of them. 'It is known that changes in experimental conditions can lead to large changes in the patterns of regional metabolic activity', writes Bruce Wexler, a proponent of positron emission tomography (PET), a type of functional metabolic imaging; adding that 'with this in mind I must note that special and unusual conditions are unavoidable concomitants of all PET studies.' Small variations in the way the task is presented may make a large difference to the results. Changes in novelty or complexity can mask relevant structures – or falsely identify irrelevant ones.[22] Subtraction paradigms, where two sets of conditions are compared so as to isolate the element of interest, are associated with their own problems.[23]

And there's more. Functional imaging is deceptively attractive because it appears to localise: that is much of its appeal. But for a number of reasons outlined earlier [*schizophrenia and autism ch – search Monakow*], the brain does not function in local modules but in widely distributed networks. An area that 'lights up' hides as much as it reveals. In Elkhonon Goldberg's phrase,

> trying to surmise the brain activation pattern of a cognitive task based on functional neuroimaging data may be like Noah trying to surmise the landscape of Mesopotamia after the Great Flood by staring at the peak of Mount Ararat protruding above the water.[24]

One cannot assume that the areas that ‘light up’ are those fundamentally responsible for the ‘function’ being imaged, or that areas that do not ‘light up’ are not involved.[25] Areas that show activity may be doing so in *response* to activity somewhere else in the brain which is not showing up, but is the primary link with the activity in which we are interested. Metabolic activity may be great in one part of the system, eg, in the basal ganglia, because this is a regulatory constituent of a system whose other parts (neocortex) are where the activity we are interested in measuring is probably best understood as ‘going on’. Wexler continues that ‘the assumption is that areas with increased or decreased metabolic activity are in some ways dysfunctional (areas with normal metabolic rates might also be dysfunctional)’:

> These uncertainties can be illustrated by analogy with the fuel consumption and electrical activity in an automobile. In a car a variety of functional changes can result in similar levels of fuel consumption. A total lack of fuel use is consistent with mechanical failure, but could also result from a sick or vacationing driver who never starts the car. Increased fuel consumption could be found in a high-performance sports car, a poorly tuned old clunker, or an ordinary car moving at normal speed with an emergency brake on. A change in electrical patterns could be due to the use of windshield wipers or defrosters, the activation by loss of oil of an indicator light, or use of the audio system.[26]

Imaging has become more sophisticated since this was written, but most of these considerations are still as applicable, since data still require *interpretation*: it can’t just be ‘read off’ in some assumed to be objective, and therefore truthful, fashion.

A further complication is that only effortful tasks tend to register: this means that the more expert we are at something, the *less* we will see brain activity. An expert will show lower levels of activation than someone unfamiliar with the task: equally a part of the brain that is normally not particularly significant in a certain task may show up as ‘highly active’ if, for reasons of experimental design or brain abnormality, it ends up inexpertly dealing with it. In keeping with this, people with higher IQs have

lower cerebral metabolic rates during mentally active conditions;[27] as do those with bigger brain size,[28] which is also correlated with IQ.[29] If you allow yourself to take in the full import of this principle, a degree of hesitancy should encumber naïve enthusiasm.

We have, too, to remember that the activations we visualise in the brain may actually be inhibitory in nature – inhibition may be indistinguishable from activation using current fMRI methods.[30] That's a pretty important distinction when it comes to interpreting what you see: especially in the human brain, where, as we saw in Chapter 1, so much activity is inhibitory.

As if that is not enough, many variables are involved in any experiment involving human beings. Male and female subjects respond differently – so differently, in terms of laterality, as we have seen, that it may destroy the validity of findings by suggesting a null result where the reality is that there are significant, but opposite, lateralising tendencies between sexes which, once aggregated, cancel one another out.[31] Not only left- and right-handedness may make a difference, but more importantly, strongly lateralised handedness (whether right or left) may give a quite different picture from more mixed handedness; race and age also make differences. Individual cases may be different because the way we experience the world individually is different; even the same brain varies in its response to the same task depending on the context – for example, what's happened previously.

The upshot of all this is that many studies lack statistical power to reach the conclusions they would like to claim. This is of especial relevance to *brain laterality*. On top of the problems already mentioned, according to Nikki Marinsek and colleagues,

> neuroimaging studies may especially fail to shed light on hemispheric lateralization: contrasts designed to find the neural correlates of one process may be contaminated by the neural fingerprints of another, which may in turn make a truly lateralized process appear bilateral. We also necessarily make the neuroimager's fallacy in almost every case, as the vast majority of studies – even those that report lateralization results – only report clusters of activation, not direct contrasts across hemispheres.[32]

In any case, activity in both hemispheres doesn't make the contribution equal. It depends what the activation signifies. Whenever you start a car engine, the fan comes on, but it doesn't propel the car.

Scanners require task simplification, and the more the task is simplified, the less it is like anything that happens in the real world. Yet the more complex the task, the more widely distributed the networks involved are likely to be, and the harder it will be to know what it is that one is measuring, and how it correlates to any one human activity. And broader activation brings a further problem. If one hemisphere makes a limited contribution to a process, but shows a single persistently activated area throughout a scan, it will falsely appear much more strongly correlated with the activity than the other hemisphere, in which, though the involvement covers a much larger area, the focus of maximum activity continually varies. No one focus in this hemisphere will seem as correlated with the activity in question as a much less significant (but confined and persistent) focus appearing in the other hemisphere. This is especially true where the results from numerous studies are aggregated in an attempt to locate the 'key' area.[33]

Hence the vitally illuminating power of deficit literature – studies of those who have an acute loss of one hemisphere's input to a process, through stroke, injury or tumour – to reveal the individual contribution of one brain region at a time. Such studies tend to be more consistent, as you might imagine, than neuroimaging literature.[34] They have their problems, too, and they cannot avoid some of the same issues that bedevil the imaging literature; but almost all the drawbacks to lesion studies tend in the direction of false negatives – missing something that is there – not false positives – finding something that isn't; so that when you find a clear result, repeatedly, it is relatively reliable. And it is now possible experimentally to suppress for a while a particular hemisphere or part of a hemisphere, and observe what happens to the person whose brain it is. It is true that Hughlings Jackson warned that 'to locate the damage which destroys speech and to locate speech are two different things'.[35] But there were no scans in his era, and this criticism of simple mapping applies, *mutatis mutandis*, to all localisation techniques, most particularly to functional imaging: seeing a spot on a scan 'light up' when you speak is, also, not to locate speech. As Justine Sergent cautioned, the benefits of functional neuroimaging 'should not mask its inherent limitations nor the risk of

promoting a modern type of phrenology that would disregard evidence of interactive and distributed processing carried out in cerebral structures'.[36]

The long and short is that lesion studies are a vital ingredient in a mix which includes imaging studies and EEG studies of normal brains, and a combination of approaches is best.[37] To quote one prominent neuroimaging specialist: 'Some people believe that psychology is just being replaced by brain imaging, but I don't think that's the case at all … It's the confrontation of all these different methods that creates knowledge.'[38]

Replication of results

Now to turn to more general considerations applicable to science research across the board. A large collaborative study published in *Science* in 2015 found that repeating experiments in psychology produced significant results in only half of cases, with the combined results yielding a significance rate of 68%, down from 97%.[39] Given how complex and variable human beings are, this is not too surprising, but it is worth bearing in mind. The study concluded that results were generally unreliable, because not easily reproducible. However, a subsequent response in *Science* claimed that this paper itself contained three statistical errors, and that it 'provides no support for such a conclusion … the data are consistent with the opposite conclusion, namely, that the reproducibility of psychological science is quite high'.[40] To which the original research team responded by suggesting that 'both optimistic and pessimistic conclusions about reproducibility are possible, and neither are warranted'.[41]

You might be forgiven for thinking that this result illustrates the difficulty of measurement specifically in psychology. But that is not the case. Two of the best-known analyses, from psychology[42] and cancer biology,[43] found reproducibility rates of around 40% and 10%, respectively. A survey of 1,576 researchers across scientific disciplines published in *Nature* revealed that more than 70% of researchers had tried and failed to reproduce another scientist's experiments, and more than half had failed to reproduce their own experiment.[44] In fact, more than half thought there was a significant crisis in research reproducibility and only 3% thought there wasn't a crisis at all. Yet 73% nonetheless went on to say that they thought that at least half of the papers in their field could be trusted, with physicists

and chemists generally showing the most confidence. And although the vast majority of respondents had failed to reproduce an experiment, less than 20% said that they had ever been contacted by another researcher unable to reproduce their work. The results of this study were ‘strikingly similar’ to another online survey of nearly 900 members of the American Society for Cell Biology.[45]

Take something about as far removed as can be from human biology – the measurement of fundamental physical constants, such as the speed of light (*c*), the Planck constant (*h*), and the gravitational constant (*G*). According to Henrion & Fischhoff,

> assessing the uncertainty due to possible systematic errors in a physical measurement unavoidably involves an element of subjective judgment. Examination of historical measurements and recommended values for the fundamental physical constants shows that the reported uncertainties have a consistent bias towards underestimating the actual errors. These findings are comparable to findings of persistent overconfidence in psychological research on the assessment of subjective probability distributions.

They conclude: ‘The underestimation of uncertainty in measurement of physical constants and compilations of recommended values seems to be pervasive.’ [46]

One might assume that, while replication was an issue across the board, it was much less likely to affect widely cited work published in the more prestigious journals. But is that a valid assumption?

A problem for the general public is that the heavy-hitting articles with catchy titles make headlines in the popular press, while the more measured responses, that create a more nuanced picture, do not. So the public is served up two competing fantasies: that anything that comes from science is irreproachable, and that most of it is irredeemably flawed. This kind of polarisation makes rational debate about the true (therefore limited) value of science very difficult indeed.

Marcus Munafò, a biological psychologist, and Jonathan Flint, a prominent geneticist, warn that genetic ‘breakthroughs’ in medicine are often nothing of the sort. The discovery of genes for depression or

schizophrenia – or for happiness – get good press coverage, usually based on publication in a respected scientific journal such as *Science* or *Nature*. Less prestigious journals often subsequently publish reports that contradict the original claim, some suggesting that the findings are quite compatible with chance. These reports, usually with larger samples, are rarely newsworthy.[47] On the face of it unexpectedly, the authors found that studies published in journals such as *Nature* or *Science* with a high 'impact factor' (IF), a measure of the frequency with which the average paper in a journal is cited in a year (typically taken to indicate higher prestige or quality), are *less* likely to give an accurate estimate of effect size than those published in journals with a lower impact factor.[48]

To the credit of science, one of the most cited papers in the last decade of science publishing is by a professor of medicine and statistics at Stanford called John Ioannidis.[49] Its title, 'Why most published research findings are false', gives an inkling of its conclusion. Its point is that much – apparently most – research is not adequately designed to prove what it claims to show. Many studies in the area of neuroscience, for example, will miss genuine effects, and 'find' false effects, because of low statistical power. This is partly a result of the huge expense involved in carrying out scanning studies on a large scale.[50] Yet, of course, spending less (but a still not inconsiderable amount) on producing invalid data is a waste of time, money and human effort.

Ioannidis casts light on the see-sawing of research findings that we have observed. 'The hotter a scientific field (with more scientific teams involved), the less likely the research findings are to be true', he warns:

> With many teams working on the same field and with massive experimental data being produced, timing is of the essence in beating competition. Thus, each team may prioritise pursuing and disseminating its most impressive 'positive' results. 'Negative' results may become attractive for dissemination only if some other team has found a 'positive' association on the same question. In that case, it may be attractive to refute a claim made in some prestigious journal. The term Proteus phenomenon has been coined [by Ioannidis himself] to describe this phenomenon of rapidly

> alternating extreme research claims and extremely opposite refutations.[51]

Ioannidis continues, with a further point that is ethically more troubling, but will hardly surprise anyone who understands human nature: ‘the greater the financial and other interests and prejudices in a scientific field the less likely the research findings are to be true’. He continues:

> Many otherwise seemingly independent, university-based studies may be conducted for no other reason than to give physicians and researchers qualifications for promotion or tenure. Such non-financial conflicts may also lead to distorted reported results and interpretations. [52]

Publication in a learned journal brings a huge temptation. Those who have published breakthrough results in prestigious journals get offered extremely attractive packages at major universities. This process has ‘cut a swathe through scientific thinking like a forest fire, turning our thoughts and efforts away from scientific problems and solutions, and towards the process of submission, reviewing and publication.’ [53] In order to achieve this desirable outcome, researchers may keep analysing the results in slightly different ways (known as ‘data mining’) until they get a significant *p*-value (a measure of statistical significance, conventionally less than 0.05). This makes one’s research much more likely to be published.

Though this is misleading, it is more what would normally be considered a misdemeanour than actual fraud. Yet its cumulative impact may be great. In a survey of 3,200 scientists, 33% said they had engaged in at least one of the 10 most common research ‘misdemeanours’ during the previous three years.[54] Since this finding is based on a questionnaire survey, with a response rate of about 45%, the figure may be a serious underestimate, since more corrupt scientists are less likely to participate in a survey of this kind. Another study which involved inducements to be honest, found that ‘even raw self-admission rates [frank admissions of guilt] were surprisingly high, and for certain practices, the inferred actual estimates approached 100%, which suggests that these practices may constitute the *de facto* scientific norm’.[55] Ginny Barbour, a senior editor

with the *PLoS* group of journals, reports that one-third of authors could not find the original data to back up figures in scientific papers when these were questioned.[56]

Turning to recognisable fraud, in 2012, the *BMJ* reported that a survey of more than 2,700 researchers showed that

> one in seven UK-based scientists or doctors has witnessed colleagues intentionally altering or fabricating data during their research for the purposes of publication … 13% of these researchers admitted knowledge of colleagues 'inappropriately adjusting, excluding, altering, or fabricating data' for the purpose of publication … The *BMJ* has been told of junior academics being advised to keep concerns to themselves to protect their careers, being bullied into not publishing their findings, or having their contracts terminated when they spoke out.[57]

THE PROBLEMS OF PUBLICATION

The pressure to publish or perish, typical of a world in which quantity is more important than quality, and where, if it can't be measured, it isn't real, means that universities insist that their academic staff produce papers, whether or not they have anything to say. This process is inimical to free thinking, a topic to which I will return. Scientific *thinking* gets crystallised too early, before it has had a chance to broaden and deepen; there is no longer a chance for ideas to evolve, to enter the necessary fallow period of unconscious gestation, without being prematurely forced into explicit form, and worse still in sliced form, so that what might have come to be a dawning new *Gestalt* is forever lost. And in the end, science is not about producing data so much as *thinking*, to which the acquisition of data can be only a prelude or addendum. This seems sometimes to be forgotten.

But the pressure also skews science badly. Positive findings are considered more prestigious than negative ones, which are, however, equally valuable and equally significant. It is much harder to get negative outcomes – such as finding that a medical intervention does not work – published (unless it is a non-mainstream intervention). Richard Smith, former editor of the *BMJ*, claims that as a result it is 'clear that authors often do not even bother to write up such studies. This matters because it biases the information base of medicine.'[58] In 1998 a review of trials published in England found that only one in four did not give positive results. More troublingly, not a single trial published in China or Russia (and across the former USSR) found a test treatment to be ineffective.[59]

Pressure results in corners being cut, and claims being inflated. According to Cambridge biologist Peter Lawrence, what you need to do in order to succeed is

> hype your work, slice the findings up as much as possible (four papers good, two papers bad), compress the results (most top journals have little space, a typical *Nature* letter now has the density of a black hole), simplify your conclusions but complexify the material (more difficult for reviewers to fault it!) …[60]

The result is the usual effect of hypertrophic growth: it becomes harder and harder to cut a path through the tediously luxuriant thicket of science publishing to find the clearing where truly excellent, thoughtful science resides.

The way in which research is now evaluated corrupts the data and is a fertile source of confusion on its own. It is also incidentally just another example of how when we try to introduce ‘objective’ measuring systems, we often make things worse than allowing people to use their judgment. The impact factor has become an omnipresent distorting factor. As we have seen, journals with higher IF have been found to be less reliable than some of those with a lower IF. But that’s just the beginning. If a journal publishes few articles, but one of those gets to be cited many times, the IF is immediately raised.[61] The process is inevitably open to corruption. For example, a journal could commission a literature review on a topic that was dealt with by an earlier publication or publications in the same journal. This would result in its articles being repeatedly cited, with the result that its IF is artificially inflated.[62]

According to Peter Lawrence, ‘the use of both the H-index [an alternative to IF] and impact factors to evaluate scientists has increased unethical behaviour: it rewards those who gate-crash their names on to author lists.’ Being a name on a paper does not require that you are more than dimly aware of the research. This has the advantage that when a paper is heavily criticised you can claim distance, something that, as Lawrence tartly points out, has never been pleaded when it is time to dish out the prizes.[63]

The IF also exerts a baleful influence on journal content in other ways. Case reports, which were once the lifeblood of medical journals, are seldom published these days, except as occasional letters. The point is that case reports, by their nature, deal with rare events, which means they are less likely to be cited than other types of article, and so, it is feared, will drag down the IF.[64] This leads to a huge impoverishment in the field of medicine, as one can easily discover by going back into the beautifully detailed journal reports of an earlier era, and comparing them with the thin aggregated data from subjects who have been selected by an assessment tool, put through a scanner, and then subjected to an array of statistical tests. Note, though, that – yet again – this is not an ‘either/or’ matter. We need

both kinds of study, not just one. At the moment the former kind is an endangered species.

The primary purpose of the IF may be to rank journals, but it is now often used as a proxy measure to evaluate the quality of individual researchers. This is bad enough, but remember it is not even the impact factor of the researcher's paper that is counted, but that of the journal in which it was published. The actual paper may prove to have been a waste of many people's time, but it will still count favourably towards getting the next job. The need to publish in high-IF journals may force researchers to do their work in already 'highly populated' areas of science, as there is a readily available, large cohort of fellow researchers in the same field, who could potentially cite each other's works (even if only negatively), as has been recently pointed out.[65] To coin a phrase, in science there is only one thing worse than being talked about, and that is not being talked about.

But being cited doesn't mean being read. The pressure to produce paper after paper means that other papers are often cited without the citation even being verified, never mind the paper, or even the abstract, read. Occasionally, as I have discovered after looking it up, the main finding of a cited paper was the precise opposite of the one it has been repeatedly cited in the literature as offering. Peter Lawrence estimates that of the 48 citations of one of his papers, only eight were appropriate, 37 being irrelevant and three plain wrong.[66] It is estimated that only 20% of cited papers have actually been read, where the word 'read' means 'at the very least consulted a trusted source (eg, the original paper or heavily-used and authenticated databases) in putting together the citation list.'[67] (For the record, I did read the paper: I even went so far – my preferred method – as to read it in the more conventional sense, though I cannot claim to have understood all the statistical formulae.) The authors of the paper looked at propagation of misprints by blind copying, and found one misprint that 'propagated' in the literature 78 times. I have found numerous others, which are occasionally adverted to in the notes throughout this book.

And sometimes it's not even a matter of laziness – more like desperation. With disarming honesty, one of the authors of a paper on melanism in fish included the remark, 'Should we cite the crappy Gabor paper here?', a comment which slipped undetected into the published article.[68]

A whole new level of unreliability has been reached through a process whereby authors pay to have their work published. This is well-intentioned, in that it puts the burden on (the institution of) the researcher rather than the reader, enabling the journal to become ‘open access’. But since publishing a paper makes money for the journal, whereas declining it neglects an opportunity, it is clearly open to corruption. Some journals take papers for no better reason than because the authors pay to have them published: in China it is even possible to arrange to have your name put on someone else’s paper, or to have prestigious authors attached to your own, for a fee.[69]

In 2014, Peter Vamplew, an Australian computer scientist, submitted a paper to the *International Journal of Advanced Computer Technology* after receiving dozens of unsolicited emails from the publication, and from other journals of dubious moral standards. The paper, entitled ‘Get Me Off Your Fucking Mailing List’, consisted simply of the seven words of the title repeated over and over again for several pages. Nothing else. He even added a helpful diagram:

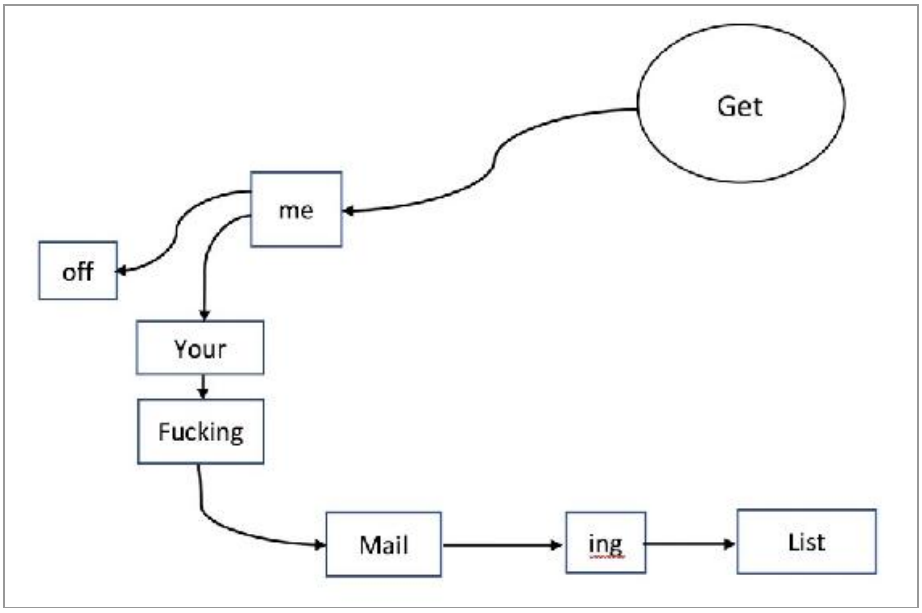


Fig. 33. ‘Flow diagram’ from spoof paper sent to International Journal of Advanced Computer Technology *by Peter Vamplew, 2014*

He expected that the journal’s editors would ‘read it, ignore it, and at best take me off their mailing list’. Weeks later, he received good news. It

was accepted for publication: ‘I pretty much fell off my chair.’ In line with the highest academic standards, ‘Get Me Off Your Fucking Mailing List’ had reportedly been subjected to rigorous, anonymous peer review. ‘They told me to add some more recent references and do a bit of reformatting’, he said. ‘But otherwise they said its suitability for the journal was excellent.’ Vamplew was required to pay a $150 fee to have the paper published, but he declined. The scheme earned Vamplew some online recognition, but at the time of reporting, his main aim remained unfulfilled. ‘They still haven’t taken me off their mailing list’, he said.[70]

An academic librarian at the University of Colorado, Jeffrey Beall, reported in *Nature* that up to 10% of open-access journals were exploiting the model by charging a fee to proofread, peer-review and edit a research paper without actually carrying out the work. His blog, entitled Scholarly Open Access, listed questionable, scholarly open-access publishers, that showed signs of being unethical or even predatory. By the time it closed down, it listed 1,155 publishing houses, with respectable-sounding names such as ‘Academic Research Journals’, ‘Scientific & Academic Publishing’, ‘Science and Education’, ‘Open Science Publications’, ‘International Science & Research Journals’, ‘Global Scientific Research Journals’, ‘Frontiers in Bioscience’ and ‘Advancements in Science’. On 15 January 2017, however, his blog was suddenly wiped clean and subsequently closed down. Initially he refused to say anything about the reason, but, according to the *Nature* blog,[71] he later referred, in a piece for *Biomedia Medica*, to ‘threats and politics’. That piece makes gripping reading, and every reader of this book is recommended to read it in full.[72] Arguing that ‘predatory publishers pose the biggest threat to science since the Inquisition’, and that ‘the once-proud scholarly publishing industry is in a state of rapid decline’, he attacks those at the heart of academe who connive at the destruction of scientific integrity:

> facing intense pressure from my employer, the University of Colorado Denver, and fearing for my job, I shut down the blog … I think that since the advent of predatory publishing, there have been tens of thousands of researchers who have earned Masters and PhD degrees, been awarded other credentials and certifications, received tenure and promotion, and gotten employment – that they otherwise would not have been able to achieve – all because of the easy article

> acceptance that the pay-to-publish journals offer … Universities in the United States are far along in the process of corporatizing themselves, and, in doing so, their public relations departments prefer that all university output be positive and aimed at attracting new customers, tuition-paying students. So if you are a faculty member at a university and you publish a blacklist, you will likely face much opposition and even harassment from the university, despite assurances of academic freedom … Over the five years I tracked and listed predatory publishers and journals, those who attacked me the most were other academic librarians. The attacks were often personal and unrelated to the ideas I was sharing or to the discoveries I was making about predatory publishers … Librarianship slavishly follows political correctness and trendiness …

Beall's list importantly remains, at the time of writing, archived on the web.[73] That it is no longer live, however, means that publishers have no opportunity or incentive to improve their track record in order to get their name removed, and new journals can appear like mushrooms on a dunghill, with impunity. Beall, in a spirit of admirable transparency, lists his criteria for inclusion on the list,[74] but sadly he undermines his argument by including as one criterion, among many valid ones, the 'exclusion of any female members' on the board. Needless to say, that cannot possibly be a criterion of scientific integrity and in fact encourages science to become further mixed up with politics. That's how badly the waters of academic science are muddied. In his defence, perhaps he would not just have had to fear for his job, but would actually have lost it had that criterion not been included. (Perhaps if I had one, I'd lose mine for pointing this out.)

The same corrupt model may operate in 'selecting' speakers for profit-seeking conferences. Christoph Bartneck, an IT lecturer from New Zealand, knows, by his own account, next to nothing about nuclear physics, but decided to submit the abstract of a paper for consideration to the International Conference on Atomic and Nuclear Physics to be held in Atlanta, Georgia, in 2016. The paper was accepted. How on earth did he manage that? Simple. He got the autocomplete function on his iPhone to compose nonsense sentences, which he would trigger with a vaguely appropriate word. A typical sample follows:

> Molecular diagnostics will have been available for the rest by a single day and a good day to the rest have a wonderful time and aggravation for the rest day at home time for the two of us will have a great place for the rest to be great for you tomorrow and tomorrow after all and I am a very happy boy to the great day and I hope he is wonderful.

He then sent it in under the name ‘Iris Pear’, a jokey reconfiguration of Siri Apple, complete with a fetching photo of ‘Iris’.[75] The fact that it was accepted within three hours of submission, along with a request for payment of a $1,099 registration fee, tells you what you need to know.

Plagiarism is a further problem, but in practice hard to spot without much close scrutiny. As Charles Seife found out when he subjected the 16 papers in one issue of *Diagnostic Pathology* to detailed examination, and found suspicious irregularities in six of them,

> the dubious papers aren’t easy to spot. Taken individually each research article seems legitimate. But in an investigation by *Scientific American* that analysed the language used in more than 100 scientific articles, we found evidence of some worrisome patterns [indicating plagiarism of language rather than results].

As one editor put it, ‘obviously, it’s a matter of great concern. I’m distraught to think of this going on and flooding the market.’ [76]

In some cases, the data are completely fabricated, as the case of a paper, published in the prestigious journal *Science* in 2015, and with the name of a world-renowned political science professor at Columbia attached to it, demonstrated.[77] But it’s not just, of course, in political science, which is inherently imprecise. Take, for example, anaesthetics, which is about as far as medicine gets from psychological human variables. Scott Reuben, while Professor of Anaesthesiology at Tufts, fabricated every clinical trial he reported over a prolific publishing career, and was jailed in 2009.[78] Joachim Boldt, another anaesthetist and a professor at Giessen, was suspended in 2010: 88 out of the 102 studies published by him over a 10-year period have now been retracted after data were found to be fabricated and other ‘ethical misdemeanours’ were found in his work.[79] But no-one quite

matches another anaesthetist, Yoshitaka Fujii, a former associate professor of anaesthetics at Toho, who was found to have falsified 183 papers, netting the world record for retracted science papers.[80] What is it about anaesthetists? I imagine that anaesthetists are no more corrupt than anyone else: it's just that they have long spells of boredom, which can be fruitfully employed in casting a critical eye over one's rivals' papers.

I remarked earlier that it increasingly seems that papers are not written for the human reader. This may be because they are not written by a human author. One of the most highly reputable science publishers in the world, Springer Verlag, had to withdraw 120 papers from its various publications after they were found, literally, to be gibberish that had been created by computer programs that simulate science writing.

Cyril Labbé, a computer scientist in Grenoble, went one better, and, as well as generating 102 fake papers, invented an author by the name of Ike Antkare (pun presumably intended), and entered them on Google Scholar, bringing the non-existent Antkare's H-index, a measure of productivity and impact, to 94, making him the 21st most cited scientist in the world.[81]

Of course such successful hoaxes are not confined to science. Indeed, it is particularly in the humanities that they first became notorious. I discuss some particularly nice ones in Appendix 2. The point is not that corruption is especially prevalent in science (although, to be entirely fair, that equally cannot be excluded, if only on the grounds that the intensity of competition to be first in achieving a 'breakthrough', the colossal available prestige, and the sheer volumes of cash at stake in such research programmes, act as potent inducements – none of which operate to the same extent in the humanities). No, the point is just this: that science is not *immune* from corruption on a fairly significant scale, and the significance is directly proportionate to the claims that are ritually made on science's behalf. After all, some science-naïve observers often seem gullible enough to believe that scientific pronouncements, *ipso facto*, represent 'the truth' with a capital T – not a problem usually experienced by authors of papers in the humanities.

In a sting operation, slightly differing versions of a deliberately flawed paper whose method, according to its author, should have been rejected by a high-school chemistry student, and whose results were meaningless, were submitted to 304 journals worldwide. The *majority* accepted it for publication, frequently asking for minor changes to format or layout. Only 36 of the 304 submissions generated review comments recognising any of

the paper's scientific problems. And 16 of *those* were accepted by the editors, despite the damning reviews. The fact that it came from a non-existent biologist, a Mr Ocorrafoo Cobange, at the non-existent Wassee Institute of Medicine in Asmara, didn't cause a hair to be turned.[82] All of which leads to the question: what happened to peer review?

PEER REVIEW

Peer review may manifestly not take place, but at times even what appears to be peer review isn't. In November 2014 it was reported that

> in the past 2 years, journals have been forced to retract more than 110 papers in at least 6 instances of peer review rigging. What all these cases had in common was that researchers exploited vulnerabilities in the publishers' computerized systems to dupe editors into accepting manuscripts, often by doing their own reviews. The cases involved publishing behemoths Elsevier, Springer, Taylor & Francis, SAGE and Wiley, as well as Informa… 'As you make the system more technical and more automated, there are more ways to game it', says Bruce Schneier, a computer-security expert at Harvard Law School's Berkman Center for Internet and Society in Cambridge, Massachusetts. 'There are almost never technical solutions to social problems.'[83]

Nine months later Springer Verlag had to retract 64 articles in 10 journals, after an internal investigation discovered fabricated peer review reports linked to their publication. BioMed Central, an arm of Springer, retracted 43 articles when it found that researchers submitting a paper for publication had suggested suitable reviewers, but supplied contact details for them that actually routed requests for review back to the researchers themselves. [84]

So peer review may be absent, or it may turn out to be self-administered. But what are we to think of peer review when it is functioning relatively normally? Few views are likely to be more informed than that of Richard Smith, since he is a scientist himself, and spent his life dealing with peer review as the editor of one of the most prestigious medical journals in the world, the *BMJ*. In a now famous article he drew attention to its pitfalls.[85] According to Smith, peer review is impossible even to define, and is 'thus like poetry, love, or justice'. For a start, he asks, who is a peer?

> Somebody doing exactly the same kind of research (in which case he or she is probably a direct competitor)? Somebody in the same discipline? Somebody who is an expert on methodology? And what is review? Somebody saying 'The paper looks all right to me', which is sadly what peer review sometimes seems to be.

'People have a great many fantasies about peer review', he continues, 'and one of the most powerful is that it is a highly objective, reliable, and consistent process'. Rather, he suggests, peer review is 'a subjective and, therefore, inconsistent process … something of a lottery':

> You submit a study to a journal. It enters a system that is effectively a black box, and then a more or less sensible answer comes out at the other end. The black box is like the roulette wheel, and the prizes and the losses can be big. For an academic, publication in a major journal like *Nature* or *Cell* is to win the jackpot.

How to assess peer review's value? 'The most important step on the journey was realizing that peer review could be studied just like anything else', writes Smith. 'At the time it was a radical idea, and still seems radical to some – rather like conducting experiments with God or love.'

A systematic review of all the available evidence on peer review concluded that 'the practice of peer review is based on faith in its effects, rather than on facts'.[86] The evidence is that reviewers agree only slightly more than they would by chance, and that 'sometimes the inconsistency can be laughable.' Noting that it is 'slow, expensive, profligate of academic time, highly subjective, prone to bias, and easily abused', Smith points out that asking authors to pay for peer review, as they increasingly are, is 'ironic'. Peer review, according to Smith, is

> a flawed process, full of easily identified defects with little evidence that it works. Nevertheless … scientists and editors have a continuing belief in peer review. How odd that science should be rooted in belief.[87]

For hundreds of years during the great age of Western science, papers were reviewed by the editor or editors alone. Early attempts at a form of peer review in the nineteenth century already found that referees were soon overwhelmed, that the problem of bias was intractable, and that it had become an obstacle to scientific progress, because it made it almost impossible to say something not already accepted by the establishment. Outside Britain and America it was therefore not widely accepted till relatively recently. Indeed even there: *Nature* did not establish a formal peer review process until 1967. Of Albert Einstein's 301 publications there is evidence that only one underwent peer review (in 1932): 'interestingly, he told the editor of that journal that he would take his study elsewhere!'[88]

The point about the laboriousness of the process – possibly worth it if it works, certainly not if it doesn't – reminds one of the physicist Leo Szilard's visionary satire, 'The Mark Gable Foundation', published in 1961. The story described the creation of an endowed not-for-profit foundation for the specific purpose of *slowing the pace of scientific progress*. The originator of this plan was a physicist who had emerged from a cryogenic coma 200 years into the future to find that most of his training was obsolete and that science was progressing altogether too fast. He therefore enlisted the help of the world's wealthiest man in creating a non-profit organisation to retard scientific progress.

> His method of achieving this worthwhile objective was to create for each major field of scientific investigation a panel of distinguished scientists which would meet monthly to award prizes and grants for the best recent scientific work. This technique, it was explained, would keep the best of the older scientists away from their laboratories and busy with unproductive meetings and travel, and would cause the younger scientists in need of funds to go for the 'sure thing' which would be certain to lead to publishable results, thereby channelling research in the direction of the safe, the fashionable, and the obvious and away from more risky innovations and seeking for breakthroughs at the frontiers of knowledge.[89]

'By going after the obvious', he wrote, 'pretty soon science would dry out. Science would become something like a parlour game … There would

be fashions. Those who followed the fashions would get grants. Those who wouldn't would not.'[90]

Peer review may be a real break on progress. A paper signed by 200 academics argued that, despite the potential benefits of peer review, 'the process of peer review can be prone to bias towards ideas that affirm the prior convictions of reviewers and against innovation and radical new ideas. Innovative hypotheses are thus highly vulnerable to being "filtered out" or made to accord with conventional wisdom by the peer review process.'[91] A further serious problem is flagged up by the philosopher JL Auspitz: 'There are never peers to review unique work, and the very bureaucratisation of intellectual labour entrenches the conventional'.[92] A process clearly inimical to science and the life of the mind – as is the extreme pressure put on scientists, *not* by the science establishment, but by the conventional press and academics in non-scientific subjects, who often know little or nothing about the research findings to date in the area, not to research, publish or even *discuss* areas in which it is feared findings might show their politically motivated beliefs to be unfounded. That, too, distorts what science can teach us.

The *BMJ* carried out several studies in which major errors were deliberately inserted into papers and then sent to many reviewers.[93] 'Nobody ever spotted all of the errors: some reviewers did not spot any, and most reviewers spotted only about a quarter.'[94] The studies concluded that peer review was not a reliable method of eliminating error or fraud, something of which we have already noted ample evidence. 'Robbie Fox, the great twentieth-century editor of the *Lancet*', Smith notes, 'joked that the *Lancet* had a system of throwing a pile of papers down the stairs and publishing those that reached the bottom.'[95]

It is also obviously a process that is open to pretty gross bias. As science research has shown, the same paper with high-recognition names attached may be accepted for publication, when without them it is rejected.[96] Worse, papers by prestigious authors previously accepted may be turned down when re-presented to the *same journals* with unknown names and institutional affiliations. In one famous study by Steve Ceci and Douglas Peters, 12 papers from prestigious institutions, papers that had already been published, were faithfully retyped, except that the names of the authors and institutions were changed to fictional ones, such as Dove Ceters (a

conflation of the researchers' names) from the 'Northern Plains Center for Human Growth and Potential'. The papers were then resubmitted to the same journals that had first published them.[97]

Of the sample of 38 editors and reviewers, only three detected the resubmissions. The other nine out of the 12 articles continued to receive evaluation, and eight of those nine were rejected; 16 of the 18 referees recommended against publication and the editors concurred. The grounds for rejection were in many cases described as 'serious methodological flaws' (remember, these were papers from prestigious institutions already published *in the same journals*). Elsewhere the authors comment:

> None of the twenty reviewers who recommended rejection even hinted at the possibility that a manuscript might be acceptable for publication pending revision or rewriting. These findings were a convincing demonstration of the unreliability of peer-review.[98]

Since by 1982 the correlation between dollars granted to institutions and the numbers of biomedical publications was already 95% (it is higher today), this corrupt process has a serious impact on research.

> Funding which is so crucial for various types of research is available only in greatly reduced amounts to individuals at low status institutions. In the long run these individuals end up teaching heavier loads and having less graduate and undergraduate support to aid them in their research interests … These data, however, provide absolutely no support for the belief that federal tax dollars are best spent by awarding grants to researchers at the largest and most prestigious universities.[99]

For saying this, the researchers could not go unpunished.

> Upon collection of the data we entered a period lasting approximately two years during which we experienced an intense and negative reaction from many powerful individuals in our profession for having conducted our study. One editor in the study wrote a letter threatening a lawsuit … Other negative repercussions

> included several threats to professionally censure us, and threats to reject the work of our colleagues, supposedly because they had been part of a department that had approved such ethically bankrupt research …

'Obviously', they continue, 'the journal review system has become a "sacred cow" to some'. They go on to describe how things unfolded:

> These personal attacks took their toll … Finally, after two unsuccessful attempts to publish our findings, replete with personally insulting *ad hominem* reviews, we found a publisher and positive reviews. Soon press releases were telling a diverse audience of our findings. Letters of support (over a thousand) came pouring in. Every one of them was complimentary …[100]

Ceci and Peters were not, however, alone. Canadian researcher Cannie Stark-Adamec had recently documented the successful resubmission of her own non-funded grant proposal to the same granting agency, unchanged except for the addition of a prestigious co-author and the tripling of its budget.[101]

Ceci and Peters were effectively whistle-blowers. It is worthy of note that those who act in defence of the proper principles of science are attacked by the corporate science establishment for being *traitors*. The only *traitors* here are those who are not faithful to science herself: their accusers. This kind of angry projection of your own failings onto others is almost always to be found when corporate employees blow the whistle.

Most worryingly, peer review is a process that is obviously open to fraud of the most heinous kind. Ioannidis writes: 'Prestigious investigators may suppress via the peer review process the appearance and dissemination of findings that refute their findings, thus condemning their field to perpetuate false dogma.'[102] It is clearly also possible to produce an unjustly harsh review to block or delay a competing publication and even to steal a competitor's ideas:

> Drummond Rennie tells the story of a paper he sent, when deputy editor of the *New England Journal of Medicine*, for review to Vijay

> Soman.[103] Having produced a critical review of the paper, Soman copied some of the paragraphs and submitted it to another journal, the *American Journal of Medicine*. This journal, by coincidence, sent it for review to the boss of the author of the plagiarized paper. She realized that she had been plagiarized and objected strongly. She threatened to denounce Soman but was advised against it. Eventually, however, Soman was discovered to have invented data and patients, and left the country.

The reader might be forgiven for thinking Soman must have been a minor figure in an obscure institution. However, he had won a fellowship in endocrinology at the Yale School of Medicine, was appointed to its faculty the next year, and had publications in journals such as *Nature* and *The New England Journal of Medicine*. His senior collaborator on the paper under attack was Dr Philip Felig, a highly respected medical researcher, the occupant of an endowed chair and chief of endocrinology research at Yale. Lawrence suggests that ‘anonymous referees who murder papers for gain, who take advantage of privileged information or who share the contents of reviewed papers with others should be held to account’.[104] They rarely are.

Such human misdemeanours are not an indictment of science, any more than misbehaviour by clergy is an indictment of religion. But it complicates the idea that a paper’s having been peer-reviewed and published in a leading journal is a test of its integrity as science. And there is no other test available for most of us. Worse, since misdemeanours in the representation of science reflect not just on the moral stature of the individual but on the status of what is claimed in the name of science, they have a further toxic reach.

Attempts to improve the process by blinding reviewers to authors, making their names openly available to authors, and training reviewers have met with little success, as Smith reports.[105] What to put in its place? Research done at the *BMJ* itself indicates that having the value of a paper judged by the editor, or at least a small group of editorial staff, would be likely to produce just as good results, while obviously being much quicker, much less expensive, completely transparent, less open to malpractice, no more prone to bias, and no longer wasteful of the massive amount of potential research time currently lost to the process.[106] Impervious to any

such argument, the left hemisphere-dominated mindset insists that there is no viable alternative to the current system, and that it is working fine anyway.

This situation is reminiscent of science departments having to assess the ‘score’ of a researcher, rather than take the person they want. That is open to bias, certainly. But it’s not as if the alternatives are any less open to bias of other kinds. Bias is intrinsic to human life. We just waste a lot of time and money pretending we’re avoiding it, and then kid ourselves that the outcome was ‘objective’ – a more dangerous position, because it introduces complacency and is a much more difficult thing to fight, precisely because of its appearance of objectivity. As often in life, it is not what you know, but who you know that counts. Scientists are under pressure to show their faces at conferences, ‘network’ successfully there, befriend and make up to journal editors. Leaving your desk to network is, from the point of view of those who love science not the science institution, a dispiritingly rewarding career move.

And, just as in practice people will get on better with people they want to work with, a journal might have much more character if the editor chose what to publish. Competition means that someone who believes a paper chosen by the editor is mistaken will soon find another journal to accept their counterargument (or the same journal might well do so). A poor editor would soon find himself sitting on a depreciating asset, just as an employer who routinely made bad decisions would go out of business. And there would be more openness.

Serious scientists and science publishers are rightly concerned by the difficulty in policing a rapidly changing market in which trust has to an extent broken down, and in which pressures to succeed and inducements to distort truth or commit fraud are large. It is true that reports of gross fraud are not common given the vast number of articles published annually, but its full extent is clearly not known – we only hear about the cases that are exposed, and exposing deceit is hard compared with its commission.

The well-worn response that the problems are small and that being concerned about them is an ‘attack on science’ simply won’t do any more. Yet, naturally, one continues to hear it. An example is the contribution to *The Oxford Handbook of the Science of Science Communication* by Joseph Hilgard and Kathleen Hall Jamieson in which the media are blamed for an ‘attack on science’ in reporting publishing scandals, and in which the

authors recommend in future that such news be projected as examples of the success of science (supposedly succeeding in correcting itself). Nowhere in their piece is the true extent of the problem acknowledged or genuine concern about it expressed. Instead it is assumed to be a largely manufactured problem rooted in prejudice; instead of some serious soul-searching, we find only the usual symptoms of a failing establishment, defensiveness and complacency.[107] Meanwhile, those who defend science from bad scientists are, of course, to be treated as traitors.

PUBLIC HEALTH POLICY (SEE APPENDIX 3)

Finally here, let me very briefly address a slightly different question: how reliable is public health policy – advice on how to lead healthy lives? If the answer should turn out to be ‘not very’, this would be less damaging to the status of science itself as a path to truth, since it is less a matter of the reliability of the evidence, more of the uses to which it is put. However, it is still promulgated by scientists and scientifically trained officials who advise governments, so they cannot abjure responsibility altogether; and for most of the population it is the most obvious way in which the impact of the science establishment is felt in their lives.

I cannot report good news. Much of what is promulgated has little, or in some cases no, basis in evidence. The public would be deeply shocked if they knew the truth. On smoking, above all, and obesity to a great extent, it is generally reasonable and valuable; and there it has saved and will continue to save lives. But on fat, salt, alcohol and water consumption the distortions are so egregious as to court ridicule. At times, as I will point out, it has the potential to be actively damaging. I discuss the issues in Appendix 3, to which the interested reader is recommended. Overall we see in public health advice the hallmarks of the left hemisphere mindset at work: the triumph of theory over fact; denial when the evidence does not fit what one already just ‘knows’ to be the case; a refusal to see health in the round; disregard of context; cut and dried positions; and an obvious desire to control.

As readers of Appendix 3 will see, large vested interests badly interfere with objectivity. Industry funding of research distorts the publication of findings. It may be tempting to some to say that while behind these fallacious public policies masquerading as science there were financial pressures (eg, the sugar industry), pressure groups (eg, the anti-alcohol lobby), and a desire to fall in with received ‘wisdom’, even if it is received folly, none of this could operate in ‘real science’. But that would be complacent. Financial pressures operate throughout the world of academic science just as they do in public science. To begin with, and perhaps unsurprisingly, how much money is spent on a science project, and how many papers result from it, often substitute as measures of worth, skewing

the evolution of scientific thinking. Or big business can bully. The distinguished psychiatrist and psychopharmacology expert David Healy was offered a post as Director of Toronto's Centre for Addiction and Mental Health, and a Chair in the Department of Psychiatry at the University: after giving a lecture in which he suggested that fluoxetine (Prozac) might increase the risk of suicide, the offer was rescinded. Lilly, the manufacturer of Prozac, was a major contributor to the Centre at the time.

Since science is actually carried out by real people with all their complicated motivations, it is subject to all those human fallibilities, hardly peculiar to science, but from which science is not exempt. It would be kind, but wrong, to assume that no axes are being ground, and there's no boss to please, no prestigious grant to justify, no publication dependent on the outcome and no previously published views to vindicate. The fiercely competitive empires of ambitious academics involve huge grants on which they, their acolytes, and often whole universities depend for prestige and income. Only a very brave or foolish person will sacrifice a lucrative career by saying something unorthodox merely for the sake of scientific progress.

Such human corruption has nothing to do with the hemisphere hypothesis. But narrowness of vision, lack of creativity and imagination, excessive confidence in one's position and a tendency to get fixed in set ways of thinking potentially do – along with anger and denial when challenged.

TIME FOR A NEW PARADIGM?

Originality, branching away from the conventional path, challenging received wisdom, is the essence of good science. Without it, science fossilises: it loses intellectual power, and purchase on reality. Yet truly original work usually takes years to develop and years to be appreciated. To strike out in a new direction has everything against it from the personal point of view. Original thinking takes time – a lot of it – when, if it is to grow, it must not be crystallised too soon. It will be slower in emerging, more likely to be rejected by editors, and, if it gets that far, opposed by reviewers. It will take time to catch on – your 'impact factor' will suffer. Perhaps the most important paper in biology of the twentieth century, Crick and Watson's paper on the double helix structure of DNA, which appeared in *Nature* in 1953, was cited rarely for the first 10 years, and indeed the number of citations actually declined over time (from about seven in the first year).[108] Ernest Rutherford discovered the structure of the atom in May 1911. According to Freeman Dyson, 'the clear evidence for an atomic nucleus was long ignored by Rutherford's contemporaries'. His book *Radioactive Substances and Their Radiations*, in which the structure of the atom is for the first time clearly spelt out, was reviewed in *Nature* in 1913 by Lord Rayleigh, 'surely as broad-minded and versatile a physicist as one could find'; the review did not even mention the subject of atomic structure.[109]

The individual researcher is less independent these days. When Rutherford discovered the nucleus of the atom, he published it in a paper with just a single author: himself. By contrast, the two 2012 papers announcing the discovery of the Higgs particle had roughly a thousand authors each. This is a recognisable trend. Many kinds of scientific research, especially those that rely on machines that are expensive to buy and expensive to run, require small empires, in which getting large research grants is the name of the game, bringing power and prestige to those at the top of the pyramid. Rutherford made his discovery with the simplest equipment: he had wanted a big, water-cooled magnet, but is said to have 'dropped it like a hot cake' when he learnt its cost.[110] Gone are the days when good research was regularly done with the aid of one's wits and a

pencil and paper – and where, partly because of this, people were given more freedom to pursue interesting ideas of their own that might or might not lead to a breakthrough. Researchers must now show ahead of time the value and likely outcome of their research, an approach which is adverse to the life of the mind. As we saw, tripling your budget increases your chance of publication. The whole process of research is now so predicted and monitored that originality, imagination and serendipity – all essential ingredients in new scientific work – cannot thrive. If we were to stop trying to micro-control the process, some research, it is true, would go slowly nowhere; but if we don't free up the process from such control, we'll all be going nowhere fast.

After analysing more than 65 million papers, patents and software products that span the period 1954–2014, the authors of a paper in *Nature* conclude that:

> Experimental and observational research on groups reveals that individuals in large groups … generate fewer ideas, recall less learned information, reject external perspectives more often and tend to neutralize each other's viewpoints … Small teams disrupt science and technology by exploring and amplifying promising ideas from older and less popular work.[111]

That last phrase resonates particularly with me, since I have found enormous riches in now neglected works produced in a freer and more untrammelled intellectual climate that is not actually so very long – less than a century – ago. Historically, many steps forward – the Renaissance is an obvious example – were taken by rediscovering what certain original scholars saw we had lost sight of, but cast in a new form.

The authors of the *Nature* paper draw attention to the attractions of large research budgets. Scientists, they say, 'like to portray science in a positive light, emphasizing benefits and minimizing negatives. While understandable, the evidence is that science has slowed enormously per dollar or hour spent'. They point out that there has been a falling away of Nobel Prizes awarded in physics for recent work since 1990: 'The 1990s and 2000s have the dubious distinction of being the decades over which the Nobel Committee has most strongly preferred to skip, and instead award prizes for earlier work. Given that the 1980s and 1970s themselves don't

look so good, that's bad news for physics.'[112] They found similar results in Nobels for chemistry, and physiology (which includes medicine).

Here we see the results of the left hemisphere mindset at work: profit must be maximised by making sure that everyone is maximally efficient. Thus, through the pursuit of efficiency, effectiveness is destroyed.

Competition for places in the steep hierarchies of the science establishment is fierce, and those who want to get on have no incentive to question, to step out of line in any way, or to think for themselves. There develops what Smolin refers to as a 'swaggering' and 'arrogant' style, which is used to intimidate and discourage anyone who questions the conventional wisdom.[113] Yet

> science requires a delicate balance between conformity and variety … if science is to move forward, the scientific community must support a variety of approaches to any one problem … While few would disagree with the rhetoric of diverse views, it is being practised less and less …[114]

The point about diversity of approach is not primarily about giving everyone a fair deal. It is not about individuals at all. It is about the viability of the *communal* business of science.

Although objectivity, in the sense of a fair consideration of all possibilities, is a fine aim, objectivity in the sense of adopting a viewpoint that makes no presuppositions is, as I have suggested, intrinsically impossible to achieve. Fortunately science does not require objectivity. 'One of the strengths of science', writes historian of science David Hull, 'is that it does not require that scientists are unbiased, only that different scientists have different biases.'[115] There's wisdom in that: but for that to be the case, one needs science to be open to as many different points of view as possible.

Smolin continues:

> There are fewer corners where a creative person can hide, secure in some kind of academic job, and pursue risky and original ideas … Whereas university faculties have stopped growing, there has been a marked increase in the number and power of administrators. Thus,

> in hiring, there is less reliance on the judgment of individual professors and more on statistical measures of achievement, such as funding and citation levels. This also makes it harder for young scientists to buck the mainstream and devote themselves to the invention of new research programs … It often seems as though achievements requiring nothing more than cleverness and hard work are valued more highly than probing thought or imagination. Intellectual fads are far too important, and people who ignore them have dicey academic careers … universities don't function well as vehicles for innovation, even when nothing more is at stake than modernising a curriculum that is eight decades behind the science … good ideas are not taken seriously enough when they come from people of low status in the academic world; conversely, the ideas of high status people are often taken too seriously.[116]

A significant point here is that even if professors were not, as they now are, constrained by having to make decisions on the basis of indices, etc, they are now increasingly likely both to have done too much line-toeing during their formative years, and to want to retain their position, its emolument, and the chance of public recognition, by continuing to conform to whatever 'standards' administrators impose. Modern science, writes Peter Lawrence,

> particularly biomedicine, is being damaged by attempts to measure the quantity and quality of research … The measures seemed, at first rather harmless, but, like cuckoos in a nest, they have grown into monsters that threaten science itself. Already, they have produced an 'audit society'[117] in which scientists aim, and indeed are forced, to put meeting the measures above trying to understand nature and disease … trying to meet the measures involves changing research strategy: risks should not be taken as this can mean long periods trying out new things, good for the originality of research but bad if a grant has to be renewed.[118]

This development is also a good example of how an attempt to enforce 'objectivity', in order to increase fairness and diversity, a left hemisphere

misapprehension, leads to a skewed situation in which diversity is minimised and true fairness – that the excellent should flourish – is travestied, with the result that neither academe as a whole, nor the creative individual, is better off. Mediocrity results, and science, and therefore all of us, are the poorer for it.

Even those who toe the line sufficiently to remain in a team that is successful in this game of snakes and ladders will find that the need to maximise publications causes juniors to be treated more like technicians than encouraged to become the scientists of the future. Yet this is the most important time for them to be untrammelled. Original work in a field like physics was often in the past achieved by those least worn down by the pressures of conformity and most open to fresh thinking: the young. Newton was 23 when he developed his theory of gravity. Einstein was 25 when he discovered the theory of relativity; Pauli was 25 when he announced his exclusion principle; Heisenberg was 26 when he presented his uncertainty principle; Dirac was 26 when he discovered his relativistic equation; Bohr was 28 when he developed his atomic theory; De Broglie was 28 when he made his breakthrough in wave mechanics; and even Schwinger and Feynman found the renormalisation solution before the age of 30, despite the interruption of World War II.[119] This is not because young people are cleverer, and it cannot be that they know more: it is surely that their minds are more open than those of their seniors.

Research shows that there is a surge in original publication in an area once a leading figure dies, and that real advances are obstructed by a prestigious establishment with no reason to be prised away from the view it has always held.[120] ‘A new scientific truth’, said Max Planck, the originator of quantum theory, ‘does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it.’[121]

The celebrated neurologist and brain researcher Norman Geschwind saw a larger picture that disturbed him. ‘There is a widely held supposition that one’s scientific peers are honest, well informed, not swayed by prejudices, and *open to imaginative adventures into the unknown*’. He calls this supposition ‘a utopian faith in scientific advance’, one that is contradicted by ‘many occurrences which demonstrate that although science has replaced religion in the minds of many educated people, the unquestioning belief in the virtues of scientists may be as misinformed as

the older faith that the clergy were always the true repository of spiritual values.' He refers to 'the many instances of deliberate falsification of data', and mentions (writing in 1984) that 'within the last several years' researchers at the medical schools of Harvard, Yale, Cornell, and Boston University had been dismissed as a result of inventing or plagiarising data.'[122]

What I would emphasise here is not that this less than sweet-smelling hierarchy is merely unpleasant, self-serving and corrupt – most hierarchies are – but how much it is *not* imaginatively open. And Geschwind notices a discrepancy that I also find troubling. 'There is a vehement reaction', he writes, 'against what are construed to be anti- or pseudo-scientific activities … yet instances of scientific fakery activity are typically regarded as random aberrations which lead to unfavourable publicity.' This despite the fact that 'examples of scientific chicanery have been so common that one can hardly neglect them'.[123]

What makes Geschwind's account so pertinent here is that his observations are set against the backdrop of a setback in neurology occasioned by the almost total suppression, for about 60 years, of vitally important information about the effect of disconnecting the two brain hemispheres – because it didn't happen to fit the prevailing theory. It is often thought that we started to learn about hemisphere disconnexion only with the first split-brain operations in the 1960s. However, there are brilliant, detailed and vivid accounts of the effects of stroke affecting the corpus callosum going back to Hugo Karl Liepmann in 1900,[124] and Kurt Goldstein in 1908,[125] the latter being reported and discussed in *Brain*, Britain's most prestigious neurology journal of the period, in 1914 by Kinnier Wilson.[126] 'The remarkable fact is, writes Geschwind,

> that despite these superb descriptions of the clinical picture of callosal disconnection by master observers, and the confirmation of the location of the damage at post-mortem examination, almost every bit of this fundamental knowledge disappeared from the neurological literature … Even more striking than the neglect of this original knowledge concerning the functions of the corpus callosum and its disorders was the appearance in the literature of incorrect

> descriptions or bold statements that nothing was known about the callosum and its functions.'

To Geschwind's amusement, Walter Dandy, a pioneering neurosurgeon at Johns Hopkins, 'went so far as to state that, on the basis of his own experience, he could dismiss all the fantastic claims which had been made for the functions of the great cerebral commissure.'[127]

Science has two opposing thrusts, although they are often imagined to be aligned. It cannot avoid operating under a paradigm, because, without such a paradigm, its findings could not cohere. This is not a criticism but an inevitability. Not inevitable, however, though highly likely for a range of reasons, is that in practice this leads to science being resistant to imaginative insights. For almost all scientists, almost all of the time, the business of science is the solving of problems which are framed and interpreted solely within the prevailing paradigm. This is what Thomas Kuhn refers to as 'normal science'. It leads to further establishment of findings within the paradigm, but it militates against those great insights that change the direction of scientific history, despite this being widely believed to be precisely what science is about. 'Few people who are not actually practitioners of a mature science', writes Kuhn in his landmark work, *The Structure of Scientific Revolutions*,

> realise how much mop-up work of this sort a paradigm leaves to be done or quite how fascinating such work can prove in the execution. And these points need to be understood. Mopping-up operations are what engage most scientists throughout their careers. They constitute what I am here calling normal science. Closely examined, whether historically or in the contemporary laboratory, that enterprise seems an attempt to force nature into the preformed and relatively inflexible box that the paradigm supplies. No part of the aim of normal science is to call forth new sorts of phenomena; indeed those that will not fit the box are often not seen at all. Nor do scientists normally aim to invent new theories, and they are often intolerant of those invented by others. Instead, normal-scientific research is directed to the articulation of those phenomena and theories that the paradigm already supplies.[128]

This can become a self-referential, self-validating procedure, which is all the more devastating because true science is neither of those things.

The attempt to save the paradigm is a perfectly reasonable one, but only if it is balanced by an equal willingness to be aware of its limitations in the face of new evidence. Too little adherence to the paradigm and the wheels of science spin without purchase; too great adherence and they are stuck. In either case no progress is made. It is much more comfortable not to raise new ideas, because they will be met with opposition or ridicule, and most people are petrified of stepping out of line, not least because their career prospects depend on toeing it. A recent article entitled 'A call for an open, informed study of all aspects of consciousness', signed by 100 scientists, many of them holding chairs at prestigious universities, made the point that research into consciousness is hampered by blind adherence to an unproven dogma that consciousness must arise only from material causes.[129] Our minds are so constructed that we actually don't even *see* the discrepancies that our theory involves until the deviations are so gross we have no alternative.[130]

The certainty that what one was taught to believe must be right afflicts even the best scientists. It meant that Tycho Brahe could never accept Copernicus's discovery of the circulation of the earth round the sun, and that Justus von Liebig, the founder of organic chemistry, could not accept the germ theory of disease put forward by Louis Pasteur and Robert Koch. In the words of Bernard Barber, 'because of their substantive conceptions and theories, scientists sometimes miss discoveries that are literally right before their eyes.'[131]

Stepping out of line is a very serious business that takes moral courage: whether right or wrong, you will be vilified by some and may lose your livelihood. In case you think that might be an overstatement, I can tell you that many scientists say in private that they believe in purpose in nature – with no necessary implication of a designer God – but cannot say so in public for fear of losing their job. Purpose in nature is not the same as Intelligent Design, but Intelligent Design is of course anathema to mainstream science.

Take the case of the distinguished palaeontologist Dr Günter Bechly. Until 2016 he was Curator for Amber and Fossil Insects in the Department of Palaeontology at the State Museum of Natural History in Stuttgart, a highly prestigious post. According to his website not only has he published

over 160 peer-reviewed scientific papers, but he has described, or co-described, 172 new species, and numerous new genera and higher taxa, including three new orders of insect; no less than 11 taxa have been actually named after him. So hardly an outsider to scientific research. He put on one of the largest, if not the largest of, celebrations in Germany of Darwin's work in the bicentenary year of Darwin's birth, 2009: the exhibition, which attracted around 100,000 visitors, and which was designed to refute Intelligent Design theory, was awarded a coveted prize. However, he made the mistake, during the Darwin celebrations, of thinking that he really ought to read the pro-design books that he had put up to be dismissed. When he did, he found to his surprise that they had been misrepresented. They were much more sophisticated than he had been led to believe. He then had a crisis of conscience. Having been a lifelong atheist, and a follower of Richard Dawkins,[132] in 2015 he was foolish enough – or brave enough – to express open support for Intelligent Design: 'I did not change my views in *spite* of being a scientist but *because* of it, based on a careful and critical evaluation of empirical data and rational arguments, following the evidence wherever it leads', Bechly says.[133] He was immediately forced to leave his post; and English-language Wikipedia, until then, understandably, considering him a considerable scientist meriting a Wikipedia page, removed his entry. He has become effectively a non-person.

Let me be clear: I am not in a position to judge whether Bechly is right. I do not espouse Intelligent Design as I understand it (though I suspect that there is a broad range of views gathered under that rubric), for reasons that will become more obvious to readers of Part III of this book: but I also do not dismiss those who hold to it, since I simply do not know enough to be dogmatic. My point is that, in a properly functioning scientific establishment, the expression of such views should at least be entertained, if not welcomed, and certainly not silenced. If the argument has been already conclusively decided against teleology, it should not prove difficult to counter such views, and in doing so to enlighten those who really want to know the truth. But it has not. Such beliefs are widespread among scientists. Over 1,000 scientists, including those holding academic posts at or holding doctoral degrees from universities including the likes of Oxford, Cambridge, Harvard, Yale, Stanford, Princeton, Cornell and MIT, have risked jeopardising their careers and livelihoods by signing a statement that 'we are skeptical of claims for the ability of random mutation and natural

selection to account for the complexity of life. Careful examination of the evidence for Darwinian theory should be encouraged.' According to Philip Skell, a member of the United States National Academy of Sciences, and a former Evan Pugh Professor (an award for exceptional achievement) at Pennsylvania State University, 'scientific journals now document many scientific problems and criticisms of evolutionary theory and students need to know about these as well … Many of the scientific criticisms of which I speak are well known by scientists in various disciplines, including the disciplines of chemistry and biochemistry, in which I have done my work.'[134] The irony is that Darwin, in his modesty, would have been all in favour of taking such views seriously. The neo-Darwinists, it would seem, are less enthusiastic about doing science.

Then there is the discrepancy in status that turns established senior figures against their perceived inferiors. Though, in the best case, their very status might free them to think more imaginatively, more established figures, of higher status, have had more reinforcement of their preconceptions, and have more to lose by embracing new ideas. Geschwind remarked that 'it has become increasingly clear that scientists, even when honest, may engage in destructive competition and backbiting, often at the expense of vulnerable and junior people.'[135] The great botanist Karl von Nägeli patronised and dismissed the humble monk Gregor Mendel, whose experiments laid the foundations of modern genetics. And there is a prejudice against outsiders, who have the advantage of not starting with the same preconceptions. Helmholtz's crucially important discoveries in physics were dismissed because he was a medical doctor and philosopher by training; equally Pasteur's and Magendie's medical discoveries were dismissed because they were not physicians.

There is a tendency for many scientists to take an uncritically contemptuous, and at times, frankly, self-righteous attitude, to whatever might challenge the mainstream of conventional thinking. This is not only unattractive, but unscientific. We are rightly scandalised when the clergy put preservation of the comfortable edifice of the Church ahead of abiding by Christian principles in practice. Why are we tolerant of scientists who, *mutatis mutandis,* do the same thing? My claim is certainly not that there is something wrong with science, but that the contemporary science establishment is *not scientific enough*. That would require keeping an open mind and taking seriously, as does physics, non-mechanistic models.

Seriously enough to deal with them fairly. What we have here amounts to a groundless prejudice. As a result we are both missing great potential discoveries and stultifying the human mind. ‘Science means, first of all, a certain dispassionate method’, wrote William James:

> To suppose that it means a certain set of results that one should pin one’s faith upon and hug forever is sadly to mistake its genius, and degrades the scientific body to the status of a sect … Although in its essence science only stands for a method and for no fixed belief, yet as habitually taken, both by its votaries and outsiders, it is identified with a certain fixed belief, – the belief that the hidden order of nature is mechanical exclusively, and that non-mechanical categories are irrational ways of conceiving and explaining even such things as human life.[136]

The left hemisphere mindset likes conformity, seeks power, and has difficulty understanding the non-mechanical. I suspect it is operant here. It also tends, as we know only too well, to denial.

CONCLUSION

Science is a project that, when carried out in a spirit of humility, is exciting, and potentially beautiful and good, even if not necessarily always in possession of the truth. It can offer no answers that are not framed by a context – because truths are always limited by context. Earlier I quoted Whitehead to the effect that the question to be asked of scientific claims is under what circumstances they are true and under what circumstances they are false. This question often remains unasked. The left hemisphere tendency, unlike that of the right, is to take things out of context: yet it is awareness of context that gives us necessary awareness of the fallibility of a dogma. In philosophy there is a position known as 'pessimistic meta-induction', which views the history of science as the history of perennially mistaken ideas. While this does seem a very one-sided way of looking at things, it reminds us that today's fact is tomorrow's artefact.

The theories of Einstein could be put to the test, though they cannot be proved, and may need to be modified in the light of further information. Neither Darwin nor Freud produced hypotheses that can be 'disproved' by any conceivable experiment. It is a myth that science depends on such a stipulation. Even single findings, never mind whole theories, may prove very hard to falsify. Falsification is a complex business, characterised by incremental judgments, not by unambiguous precision. It is a matter of testing new ideas out against the rest of our experience of the world, in Darwin's case the natural world, or, in Freud's case, the human inner world – a matter of whether they open our eyes to something, so that after that we can hardly *ignore* the truth it constantly unconceals. That is the only possible test of great truths. As Richard Feynman said during his Nobel Prize acceptance speech in 1965: 'A very great deal more truth can become known than can be proven.' And, I might add, a very great deal more falsehood can become known than can be disproved.

Willard Quine and Pierre Duhem pointed out that things are not propitious for those who demand proof, since not only can a finding never be proved, as is widely accepted, but it cannot be finally *disproved*, either. This is because each finding is embedded in a host of assumptions, and it may be one of those assumptions that is at fault, not the finding. We simply

cannot avoid the exercise, however hard we try, of (informed) personal judgment. That doesn't, of course, entail that every judgment will be equally valid; just that the issue isn't subject to proof.

Interestingly the word 'proof', which now means a way of showing that something is the case beyond doubt, used to mean a trial run, as in a proof of a printed article, or putting something to the proof, tasting it, trying it out (cf French *éprouver*). It was a trial, in the sense of trying something out (for that word, too, is slippery) rather than a trial in the sense of a legal process leading to a judgment of fact. When one is 'trying' something nowadays, is one opening oneself to the experience, without which one will never know? Or 'trying' it in the sense of a court of law, whereby it will be finally found, in the abstract, to be right or wrong? The word 'experience' comes from the Latin *experientia*, from *experiri*, meaning to 'try out'. And that comes from the same Proto-Indo-European root *per-* which underlies our word 'peril' and the German word for danger, *Gefahr*. Experience is an inherently uncertain business that carries risk – a risk without which one can learn nothing. Such is our world, and such are the terms of our existence. And such was Blake's perception, when, referring to his own birth, he wrote: 'My mother groaned, my father wept, / Into the *dangerous* world I leapt.'[137]

The right hemisphere view of proof derives its value from the context, and so can never be absolute, regnant for all regions of space and time, and never single or immune from evolution. The idea of truth as independent of us, immutable and certain, is a relatively recent invention. In this chapter I have argued that we need to regain the strengths of the right hemisphere's 'antifragile' idea of truth and proof, and lose the weaknesses of the brittle, 'fragile' left hemisphere idea of each.[138]

Some people think that science must be a principally left hemisphere business. I'd caution that, like absolutely everything else, it has its left hemisphere and its right hemisphere aspects. And, like everything else, science profits from balance and harmony between them. Some kinds of scientific thought, especially the drive to see the overall shape, to draw together disparate findings, to make connexions, to achieve imaginative insight, to evolve, or to modify a hypothesis, to observe things as near as possible as they are (empiricism), and to see whole systems that can't be reduced to linear connexions, are likely to be more right hemisphere-dependent; the drive to make fine distinctions, to investigate localised areas or functions, to preserve the theoretical paradigm at all costs, to achieve

certainty, to see the world in terms of things that are cause and effect to other things, in predictable, linear fashion – all this is more likely to express the contribution of the left hemisphere. Both are essential: though here as always, it is the right hemisphere's role that needs to predominate, taking under its aegis the contribution of the left hemisphere. There needs to be a balance between opening up the flow of thought to possibility and closing it down towards an always provisional certainty. Certainty is always a matter of degree; about that I am as certain as it is humanly possible to be.

As the left hemisphere mode of construing the world predominates, however, things become unbalanced. Science is reconceived as a fundamentalist movement: prone to self-righteousness, closed to unfamiliar ideas, defensive, complacent, open to corruption and risking a lifeless failure of imagination. If you are like me, you will admire science for what it can do at its imaginative, mind-expanding and exciting best, but draw the line at what it never could – namely provide us with dependable, or ultimate, truths.

Seeing that I rely heavily on science, am I not vulnerable to my own arguments? To an extent, yes, of course. But only, I believe, to a limited extent.

There are two ways in which I might be. One is 'essential', and concerns the truth available to science; the other is 'accidental', and is about the validity of the particular evidence on which I rely.

As far as the first is concerned, I don't claim any more than science can legitimately claim – but that is a very great deal. I caused some confusion at the end of *The Master and his Emissary* by suggesting that, while I thought it unlikely I would be wholly right about hemisphere differences, I thought it unlikely I was wholly wrong; and that even in the improbable event that there was *nothing* in my hypothesis about the two hemispheres, and it turned out to be 'just' a metaphor, I would be content, since 'I have a high regard for metaphor. It is how we come to understand the world.' Some literal-minded individuals have interpreted this as meaning that I don't believe in the scientific validity of my own hypothesis. It will hardly surprise you to learn that I do. I wouldn't have spent a large chunk of my life on the scientific data and evaluating my hypothesis against it if I didn't. It's just that I also understand that metaphor is not opposed to truth, but the basis of all meaning, including – and even particularly, as philosophers George Lakoff and Mark Johnson claim – in science and philosophy.

As far as the second issue goes, the dependability of the science research on which I rely, no-one can avoid this nagging question. Yet science would be brought to a standstill by too great an insistence on dependability. The best security comes from drawing on as large, as broad-ranging, and as representative a base of evidence as one can. Wherever possible – and clearly that can't always be the case – one should try to ensure that assumptions are based on studies of different types, employing more than one method of approach (thus minimising the chances that the findings are all vulnerable to the distortions inherent in one methodology); on studies coming from more than one era (thus minimising the chances that the findings are influenced by fashion); in the case of a neuroscience hypothesis, not solely on the results of scanning studies (which are more prone to distortion and problems of interpretation than any other methodology); and, in the case of a human neuroscience hypothesis, on findings that are consonant, if at all possible, with those in animals, where relevant. This is a counsel of perfection, but I have tried as far as possible to follow these principles.[139] And I have been very lucky: I have had what is these days, alas, the luxury of not being forced to crystallise my thinking prematurely, and of being able to gather evidence on a large scale over long periods of solitary time.

I also think it more likely that one is on the right track if one's findings precipitate a coherent and integrated *Gestalt*. On this last point, it seems to me one of the strengths of the hemisphere hypothesis that it makes sense not in a piecemeal way, but as a whole synthetic project, proposing coherent experiential worlds, not just a randomly assorted set of findings. The test will be how well it answers to, and helps make sense of, the further findings we make over time and our lived experience. A working hypothesis, in other words. And, as von Neumann suggests, we can't know more in the way of scientific truth than that our hypothesis works. The hemisphere hypothesis is inevitably provisional, and with luck my provisional thoughts may be useful to others.

Nonetheless, what I am engaged in, here and in the next few chapters, may seem paradoxical. I am, as you know, not as troubled by that as others may be: it may be a sign that I am on the right path. But it is odd that it falls to someone whose argument depends on reason and scientific evidence to be the one to point out the limitations in both. However, my aim is to make both of these paths to certain kinds of truth the stronger, by clearing them of

false conceptions which only leave them open to misunderstanding, and to some extent, therefore, to the erosion of the respect which is their proper due. And to set them in a proper relationship, and harmony, with other possible paths to truth.

An attempt to restore balance is a thankless task. My reward for this may be that I will be seen by some as attacking science or reason; and be seen as offering comfort to those with whom I deeply disagree in their disregard and disrespect for the values that science and reason at their best uphold. By others I will be seen as a reductionist for placing as much emphasis as I do on the value of science and reason in helping us understand our all too human predicament. But those who insist on seeing what I say in a perverse light I cannot help: they won't want their prejudices to be disturbed.

Let me never be adduced in evidence against science. Science is, or should be, a source of wonder that opens out our understanding of the world and gives us one of the touchstones on the path towards truth. Just because science cannot answer all our questions does not mean that it is not the very best way to answer some of them, and a helpful contributor to answering many more. And that there is corrupt practice in science does not make it different from any other human enterprise. Anyone that is misguided enough to reject science must have a very limited imagination, as well as being blind to many beautiful truths, and will make many errors. But the same is true of anyone who accepts only science. For it can also become a tool that banishes wonder, stunts imagination and narrows down understanding, before closing the mind altogether. That is, however, what bad science does: it is not intrinsic to science. To see the limits of science empowers it; to see no limits to it strikes at the very heart of the enterprise.

I believe some of the political difficulties we are now experiencing in the Western world come from a lack of balance, in which wilful blindness to the problems in one's own position eventually causes an ignorant and extreme reaction, when those who are at some level all too aware of what is being ignored and denied can finally contain themselves no longer. Those liberal intellectuals who had their doubts about the Western liberal intellectual consensus of the last few decades were stigmatised for not having unlimited enthusiasm. Those who criticised the consensus liberal position for its excessive one-sidedness, before it was too late, were seen as enemies: they were in fact friends. 'Plato is my friend, but a greater friend

is Truth’, as Aristotle is said to have remarked; falsely, as it happens – but such is life.[140]

REASON & TRUTH

REASON'S CLAIMS ON TRUTH

> Reason is the special embodiment in us of the disciplined counter-agency which saves the world.
>
> —*Alfred North Whitehead*[1]

> The pride with which some artists announce that they cannot think logically reflects an attitude complementary to, and as dangerous as, the view that one needs only to be able to think logically.
>
> —*Jan Zwicky*[2]

> It is equally excessive to shut reason out and to let nothing else in.
>
> —*Blaise Pascal*[3]

IN THIS CHAPTER, AND THE NEXT, I EXAMINE WHAT THE HEMISPHERES CAN tell us about the use of reason as a guide to ultimate truth.

Heidegger said: 'We may venture the step back out of philosophy into the thinking of Being as soon as we have grown familiar with the provenance of thinking.'[4] What, then, is the 'provenance' of thinking? To question the provenance of something is to ask where it comes from, and whether we should take its claims at face value – as in the 'provenance' of a drawing attributed to Leonardo.

So what is reason?

Reason, wrote Whitehead, is ‘the discipline of shrewdness’. And he went on: ‘Reason which is speculative questions the methods, refusing to let them rest.’[5] It is, in other words, a critical discipline, more than a creative faculty, questioning our ways of thinking and keeping us from complacency, its first target being our ‘methods’ – which include itself. Arguably it is the widespread philosophical failure of science to question its methods that has led to the problem of scientism.

And what are reason’s methods?

Reason suggests a linear way of thinking, seeking chains of causation, which makes sense only in a limited environment. Its mode of operation is local, one bit at a time.

Reason suggests a global, holistic understanding, which makes sense only in the round. It is a seamless apprehension of the world.

Yes, you read that correctly. Reason means different things – has in particular two distinct meanings. In our world, one is becoming predatory, the other disappearing like a hunted animal.

The first is what a calculating machine, otherwise known as a computer, can do. At least it can be made to look as if it does by human beings who put in the rules for linear procedures, give it material to work on and interpret the results. In its increasingly pervasive interactions with us, the machine inevitably imposes on us what a clever urban geek put into it last year, as though this were the most intelligent way of conducting human life. It doesn’t know that in humans this is a very strange way of behaving, because there is no tempering of rule-following with reason – of the second kind. That can be offered only by a living, fully feeling, embodied being, since it draws on *value*, and on the vast, complex store of human experience, reflecting an understanding of how particular cases always differ by virtue of context.

In this way the first mode of reason replicates in us something like a way of looking at the world normally found in mental illness. A kind of (itself irrational) rationalising and a neglect of reasonableness are, as we have seen, striking characteristics of both schizophrenia and autism, which tend toward an unbalanced, rigid, disembodied, procedural type of mentation, lacking in normal emotional intelligence.

The second is what gives integration to our world. It sees the big picture and sees that the details are inevitably subordinate to that bigger picture.

Whitehead saw that what had gone wrong in the Dark Ages was the loss of this integrating faculty:

> It is not merely that in the earlier times the men knew less. They were intrinsically less able in moving about among general ideas. They failed to discriminate between minor peculiarities of details and the major notions. The power of going for the penetrating idea, even if it has not yet been worked into any methodology, is what constitutes the progressive force of Reason. The great Greeks had this knack to an uncanny degree. The men of the thirteenth century had it. The men of the tenth century lacked it …[6]

And, I would claim, we largely lack it now once more.

English has, for better or worse, become the *lingua franca* of the modern world. The distinction I am making between two kinds of reason is disguised in English by its using the same word for two very different phenomena. In other languages, it is not necessarily so. In German there is a distinction between *Verstand* and *Vernunft*, in Latin between *ratio* and *intellectus*, in Greek between *dianoia* and *nous*: in the first of each case, what one might call, in the absence of anything better, *rationality*, a *linear* process; in the second, *reason*, an understanding in the *round*. I suggest that these two versions reflect the typical mode of operation, and exemplify the characteristics of, the left and right hemispheres, respectively. The first is rigid, aims for certainty, tends to ‘either/or’ thinking, is abstract and generalised, ignores context and aims to free itself from all that is embodied, in order to gain what it conceives to be eternal truths. The second is deeper and richer, more flexible and tentative, more modest, aware of the impossibility of certainty, open to polyvalent meaning, respecting context and embodiment, and holding that while rational processing is important, it needs to be combined with other ways of intelligently understanding the world.

The philosopher Ernest Gellner referred to

> the ‘mechanistic’ insistence on impersonal, structural explanations … It was Kant’s merit to see that this compulsion is in us, not in

> things. It was Weber's to see that it is historically a *specific kind of mind*, not human mind as such, which is subject to this compulsion.[7]

Much philosophical reasoning is of the first kind – for two thousand years in the West, between Plato and Kant, it was more or less exclusively so. Elsewhere in the world, and at other times in the West, this kind of thinking, the kind associated more with the left hemisphere than the right, has been considered of only limited use, and a potential source of misunderstanding when given too much credence. According to this point of view, not to temper it with other modes of understanding would itself be contrary to reason. The problem is, however, that once one is inside the rationalist bubble, one can no longer see any need to break out of it, let alone any way of doing so. As Stanley Fish put it, 'does reason [ie, rationality] know what it is missing?'[8]

Rationality is exclusive: reason is inclusive, balancing rationality with intuition, emotion and imagination. Emotion is not, as some Enlightenment philosophers thought, necessarily an impediment to reason, but an essential component of it. If you need a demonstration, the patient 'Elliot' reported by Antonio Damasio (referred to in Chapter 7) will serve. In his case, as a result of a tumour, 'a large component of the right frontal cortices was not functionally viable.'[9] No longer able to intuit the value or emotional meaning of life situations, he was reduced to trying to compute rationally, as from first principles, in every case, and his life became insupportable. Not only did he take for ever to decide what to think or to do, but he reached, for an intelligent man, some very foolish conclusions.

And it is one of the messages of this book that imagination is not an impediment, but, on the contrary, a necessity for true knowledge of the world, for true understanding, and for that neglected goal of human life, wisdom.

Thus there is such a thing as reasoned truth, just as there is such a thing as scientific truth; but both are inseparable from the humanity that gives rise to them, both are provisional and uncertain. As with science, the vice is that of trying to avoid (what we call) the subjective by asserting (what we call) the objective. This presupposes that there is an 'us and them' about the world: something 'in here', trying to copy as well as it can something 'out there', and usually not doing it well. The one that is thought (on unclear

grounds) to do it best is said to be objective, and that in turn is taken to be the truth.

But it is the left hemisphere's process of apprehending the world that gives rise to the very idea of the 'subjective' and 'objective' – a false dichotomy. As I suggested in Part I, there is, rather, as disclosed by the mode of the right hemisphere, a 'betweenness' to reality; a world that comes into being for us, which, to paraphrase Wordsworth, we half perceive and half create. That doesn't mean that half is objective and half subjective, or half real and half a fantasy. It means that the coming into being of the world is, wholly and simply, an encounter, to which inevitably both parties contribute, and in which both parties are real: a something that is given *in our very experience of it*. That something is not an image, not a shadow, not a *representation* of something else. In as far as it falls short, it's because this something is only ever *partially* given – because inevitably partially *hidden*. It is like the Japanese Zen garden, Ryōan-ji, in which, from any one viewpoint, there is always at least one of the 15 stones that cannot be seen. Note that this does not imply there is something we *never* see; just that there does not exist a viewpoint from which everything can be seen at once.

To clarify, I am not saying that all I can know is a simulacrum, the relationship of which to a reality that I can never know I also can never know. I am saying that what I know is real enough, but it is only what I am able to see from where I am: a tiny portion of the whole. This differentiates a particular state (one that applies to each one of us, but somewhat differently) from the supposed deficiencies of a general state (one that applies to us all similarly). Not partially real, but really partial – or, better, wholly real and wholly partial. Not 'as is a landscape to a blind man's eye', but as is the living presence of the landscape of the Wye valley to William Wordsworth on 13 July 1798. And what that also hints at is the awesome property of great art: that when he wrote those lines he was able momentarily to transcend those individual limitations, and thereby pass on to us, his readers, the gift of seeing, for a while, what he saw.

What we see is real enough. It is not like the relationship between a child's drawing of his mother and the mother he loves, which the drawing represents; it's like the relationship between what the child knows of love, and what, if she has lived life to the full, the mother knows of love. As Whitehead puts it: 'We must reject the distinction between nature as it

really is and experiences of it which are purely psychological. Our experiences of the apparent world are nature itself.'[10]

It is true that we all have different experiences, but they share very much common ground. There is another 'betweenness', which links us to one another in intersubjectivity. Thus each individual consciousness is not fused with, but neither is it wholly separate from, that of others; nor is the world wholly separate from each consciousness. It is because of this that we are enabled to reach a balanced, rich understanding of the world, not an idiosyncratically meagre one. And for this reason it is vital that philosophy takes place in the *second person.*[11] This is how I believe and hope I am addressing myself to the reader. Mind you, it was why Plato thought philosophy could not be written down at all. It was always a reciprocity of minds. 'Dealing with subjective phenomena is not the same as dealing with purely private experiences, as is often assumed', write Varela and Shear. 'The subjective is intrinsically open to intersubjective validation (second person interactivity)'.[12] The attempt to speak in the third person only has a surprising amount in common with the attempt to speak in the first person only. Equally there is no betweenness; there is a suspicion of grandiosity about either.

'Bias for impartiality is as much a bias as is partisan prejudice, though it is a radically different quality of bias', wrote John Dewey, and continued:

> one can only see from a certain standpoint, but this fact does not make all standpoints of equal value. A standpoint which is nowhere in particular and from which things are not seen at a special angle is an absurdity. But one may have affection for [incline towards] a standpoint which gives a rich and ordered landscape rather than for one from which things are seen confusedly and meagrely.[13]

Dewey is not maintaining here that one just sticks to whatever point of view one happens to have. This is no charter for every partisan; on the contrary. To find the 'richest' view, the one that seems truest to the world as a whole, in the sense that it resonates with our experience in the richest way, the imaginative exercise of inhabiting a number of points of view is required. Seeing things from as many points of view as possible, so that we

don’t see them ‘meagrely’, is not mere subjectivity. Nor is it falsely claimed objectivity: in different ways it is the opposite of each.

No ‘-ism’ that is already *parti pris* can offer a ‘rich and ordered landscape’, because the mind that gives rise to it is closed, disregards the whole tapestry of reality in favour of just one strand, and inevitably needs to disparage those points of view it doesn’t share. The rich view, by contrast, will draw from a number of standpoints and achieve a balanced synthesis.

The physicist Leo Szilard once announced to his friend Hans Bethe that he was thinking of keeping a diary:

> ‘I don’t intend to publish. I am merely going to record the facts for the information of God.’
>
> ‘Don’t you think God knows the facts? ’ Bethe asked.
>
> ‘Yes’, said Szilard. ‘He knows the facts, but He does not know this version of the facts.’[14]

REASON BEYOND REASONING

Reasoning in the sense of rationality is a consistency tool, and nothing more. Its job is to tell us that if we hold *a* and *b*, and if we also believe that logical contradiction necessarily implies falsehood, then we must hold *c* as a consequence. It is an *intermediate* processor, albeit a very valuable one. It cannot ground itself, at the 'bottom' end, or give meaning to its outcome at the 'top' end. At the bottom end it must rely on axioms assumed on the basis that they are intuitively true (the word 'axiom' comes from the Greek word *axia*, meaning 'value' – in other words, reason is founded on what are in essence value judgments). Reason, like both science and, in a different way, morality, can bring a verdict into doubt only if it is grounded on something which is exempted from the doubting process. As Wittgenstein put it: 'the questions that we raise and our doubts depend on the fact that some propositions are exempt from doubt, are as it were like hinges on which those turn … If I want the door to turn, the hinges must stay put.'[15] Nor can it by itself give meaning to its results, at the 'top' end, but must rely on an intuitive grasp of a whole world in which alone they can be fully interpreted and understood.

Again, this is like the processing that a computer carries out. The computer neither understands the data that are put into it by a human consciousness at the start, nor understands the output, which equally requires a human consciousness, when the process is complete; but carries out an important task in the middle of this process. Even the rules by which logic operates, such as the 'law of non-contradiction' (that contradictory statements cannot both be true in the same sense at the same time) and 'the law of the excluded middle' (that for any proposition, either it, or its negation, must be true), have to be taken on the recommendation of intuition – and such intuition may be only partially reliable. These are choices, not laws: outside of courts there are no laws, only regularities. And these so-called laws of Aristotle were not intended as a description of how humans actually *do* think, but to suggest how a totally rational entity *might* think.

Pursuing logic will not in itself achieve understanding, which comes from living a thoughtful life. What the right hemisphere knows must be

already at least in part understood intuitively by another's mind for it to be *awakened* there. It cannot be *compelled* on that mind by a train of logic. This was a point pungently made by Samuel Johnson, replying to a 'pertinacious gentleman' who was unfortunate enough to say, 'I don't understand you, Sir'; to which Johnson replied, 'Sir, I have found you an argument; but I am not obliged to find you an understanding'.[16]

Even Plato, the founder of the Western dialectical tradition, thought argumentation was far from everything, as I mentioned in the Introduction. In his *Seventh Epistle*, he explained why he could not write a treatise on the nature of philosophy:

> For [philosophy] does not admit of exposition like other branches of knowledge; but after much converse about the matter itself and a life lived together, suddenly a light, as it were, is kindled in one soul by a flame that leaps to it from another, and thereafter sustains itself.[17]

This sounds more like insight, robustly associated with the right hemisphere: the sudden dawning of a quasi-spiritual truth, in which reason, imagination and intuition together play their part in interpreting experience.

It is true that in the *Republic*, a dialogue some aspects of which are so problematic that it has been argued that it must have been intended ironically, Plato has Socrates tell us that 'we must follow the argument wherever, like a wind, it may lead us'.[18] And in a similar spirit, in the *Sophist*, Plato has Theætetus say: 'I have to follow where the argument leads'.[19] Though he might have wanted us to explore, for the sake of the argument, where it led, Plato would hardly have wanted us blindly to follow logic, since logic is only an 'unpacking' of what is hidden in our premisses. If our conclusions are absurd, we do well to go back and re-examine our premisses; just as, on any journey, if one finds oneself going astray, the intelligent course of action is not to persist along a path that is going nowhere, but to retrace one's steps.

> Particularly when one initially has at least some reason for believing as one does, an awareness of one's own cognitive limitations might legitimately give rise to some measure of scepticism about arguments that attempt to undermine those beliefs.[20]

So writes Princeton philosopher Thomas Kelly. This is one reason why one might want to qualify the idea of following an argument wherever it leads. Plato, it should be remembered, believed that philosophy was not just the following of procedures, but required moral qualities, including humility and a capacity for love. *Given these qualities*, reason may lead you closer to the truth; otherwise it may mislead.

But how is one to judge *when* one is going nowhere? Just because results are unexpected does not make them invalid: our cognitive faculties are one way of prising us away from cherished, but mistaken, beliefs. Just when we think we are lost, we may be about to stumble on hidden treasure. There is no single way to determine the matter. It can't be reasoned towards, because reason is exactly what we are trying to evaluate, and it can only carry on unpacking what it is given; intuition, though far from fool-proof, is probably a better guide, since it is based, at least, on all one's experience, not a single logical point, and intuition intuits the partial nature of its own understanding – a similar appreciation of its own shortcomings is harder for reason to come by.

The linear path is seductive to the left hemisphere's mindset in its directness and simplicity. But what seems like a virtue – that it does not change direction – reveals itself to be a vice. It has deep rhetorical power over Western minds, making it easier to believe not only that the direct approach is always the most rational, which it is not, and that reciprocal, contextual and feedback effects can be ignored, which they cannot, but that if something is good, twice as much of it will be twice as good, which is rarely the case, and that apparent opposites cannot coincide, which they can.

The linear path is responsible for the myth of progress. Philosophy progresses, if at all, by a process of circling one's 'object', revisiting it from different angles, often over many lifetimes. In the history of philosophy no more than the history of music should one imagine that worse only gives way to better over time. The important issues have been argued about for millennia without any firm conclusions being reached. That does not make the process pointless, of course, any more than the inevitably provisional and partial process of science renders science pointless: the journey, not the arrival, matters. It is one of Carse's infinite games. But this does suggest that we will not be getting anything from it which we can carry away, saying, 'this, then, is the truth'.

Rationality starts and finishes in intuition, which supports it like a pair of massive bookends. I agree with Jan Zwicky that ‘the ability to think analytically is as inalienably human as the capacities for love and grief … It makes no more sense to attempt to eliminate it from human thought than it does to eliminate emotion, or desire.’[21] But the value of reasoning itself is an intuition drawn from experience.

A note on my use of the term intuition here. Throughout I take intuition *not* to be an immediate perception of some unquestionable, timeless truths, as in the analytic tradition it has sometimes been taken to mean, but rather a matter of judgment based on the whole of experience, not just that little part of which we are conscious – deep, but not by any means infallible. Indeed, like all knowledge from whatever source, it is something always subject to correction or further refinement. A *Gestalt* is never absolute and final: its value is that it replaces one that accounts for less or takes less into account. ‘Philosophy advances’, writes Arran Gare, ‘as less perfect forms of philosophy are discarded and their valuable contents assimilated to more perfect forms. A philosophical system should be judged according to its coherence and comprehensiveness, and its capacity to surpass by including more limited philosophical stances.’[22]

Moreover, rationality is dependent on intuition in a further way: we cannot justify rationality by reasoning, except by pointing to the fact that it often works, in the sense of delivering useful knowledge. Its worth, exactly like that of science, or of any philosophical approach, lies in that simple fact – that it ‘works’, in this sense – *where it does*. But how will we know where it *doesn’t* work, if we always assume, as in scientism, and ratiocentrism, that *where* it doesn’t, this can never count as evidence of the limits of the method, only of the limits of reality?

If reason sometimes gets between us and useful knowledge, why and when it does so cannot be simply reasoned towards, but again entails an appeal to the fruits of experience. So our commitment to reason is an intuitive one: our experience is that it is helpful to a certain degree in certain circumstances. Ignoring that nuance turns the matter unhelpfully black and white, to the impoverishment of our capacity to understand the world. As Whitehead put it, ‘the art of the speculative Reason consists quite as much in the transcendence of schemes as in their utilisation’.[23] We need to know when and how to use them to good effect, and yet know when to go beyond them. Reason should be our servant, never our master. Or as that

very reasonable man David Hume put it, ‘reason is, and ought only to be the slave of the passions, and can never pretend to any other office than to serve and obey them.’[24]

RATIOCENTRISM

As we saw in Chapter 8, the great advances of science and even mathematics are not typically made by reasoning, which is often filled in after the event, when the necessary accounting, the 'paperwork', must be seen to be done. Indeed such reasoning has been called 'the endless paperwork of the mind'.[25]

What philosophy absolutely depends on, and without which none of its enterprises is worth the paper it is scribbled on, is a *vision*. You can be as clever as you like at finding technical objections to the vision of another, but unless you have the courage to stand by one of your own, you are not a philosopher – just a logic-chopper. And a vision never results from following procedures. Philosophy, writes Waismann,

> is not a matter of 'clarifying thoughts' nor of 'the correct use of language' nor of any other of these damned things … At the heart of any philosophy worth the name is *vision*, and it is from there it springs and takes its visible shape … Though to an outsider [the philosopher] appears to advance all sorts of arguments, this is not the decisive point. What is decisive is that he has seen things from a new angle of vision. Compared to that everything else is secondary. Arguments come only afterwards to lend support to what he has seen ...The substance of my remarks is that the conception of a whole philosophical view … is never a matter of logical steps. A *Weltanschauung* like any of these or even a new approach like that of Wittgenstein is never 'arrived at', in particular it is not deduced, and once found it can neither be proved nor refuted by strictly logical reasoning …[26]

Philosophy is not, then, purely a matter of some abstract, procedural rationality. 'Although professional philosophers nowadays are often highly skilled in matters of argument', writes philosopher Bryan Magee, 'it is in the nature of things that not many of them can be expected to have original insights':

> The outcome is hundreds upon hundreds of books which are well argued but have little or nothing to say that has not been said before. And because the quality of the argumentation is the only distinguished thing about them, and also the thing their readers as well as their writers are best at, it becomes the object of interest, and hence the criterion by which they and their authors are judged. In consequence, many professional philosophers and their students slide unthinkingly into proceeding as if philosophy is *about* arguments and they lose sight of the fact that it is really about insights. So when a philosopher comes along who really does have something new to contribute, he tends to be judged more by the quality of his arguments than by the quality of his insights – and if the former is unremarkable the latter may go unappreciated.[27]

Waismann again cannot be bettered:

> What is essential in philosophy is the breaking through to a *deeper insight* – which is something positive – not merely dissipation of fog and the exposure of spurious problems. Insight cannot be lodged in a theorem and it can therefore not be demonstrated … It is dangerous in philosophy to hunt for premisses instead of just going over the ground, standing back and saying: look.'[28]

Philosophical reasoning since Plato is believed to take its value from restraining the emotions so as to apprehend truth by abstract logical argument. Nietzsche thought he saw in Socrates a 'hypertrophy of the logical faculty'.[29] John Cottingham, himself a distinguished philosopher trained in the analytic tradition (and editor of the classic edition of Descartes's works), writes that

> much Western philosophy has suffered from a ratiocentric bias – the notion that calm and detached rational analysis provides the unique key to understanding ourselves and our activities. At its worst, ratiocentrism involves a fantasy of command and control, as if by sufficiently careful use of reason we could gain an exhaustive understanding of the human condition.[30]

The phrase ‘command and control’ suggests the coercive fantasy of rationality, that conclusions can be compelled on another, and is strikingly in keeping with the suggestion that it is the tool of the left hemisphere, whose raison d’être is control. However, ‘no philosophic argument ends with a QED’, wrote Waismann. ‘However forceful, it never forces. There is no bullying in philosophy, neither with the stick of logic nor with the stick of language.’[31]

Indeed, it has been argued by cognitive scientists Hugo Mercier and Dan Sperber not only that rationalising does not lead to better decisions, of which there is ample evidence, but that the capacity for reasoning arose in the first place not to help us arrive at truth: its purpose was to win arguments – whether right or wrong.[32] The idea is not as novel as it seems: Burke observed that

> almost the only pleasure that men have in judging [using their reason] better than others, consists in a sort of conscious pride and superiority, which arises from thinking rightly … a pleasure which does not immediately result from the object which is under contemplation.’[33]

If it is truth we are after, why do we choose the evidence that confirms our bias? Why does experiment show that providing people with reasons to change their minds often makes their position more entrenched?[34] Thomas Hobbes wrote in the seventeenth century that ‘arguments seldom work on men of wit and learning when they have once engaged themselves in a contrary opinion.’[35] Reason on its own is powerless. And, note, that is *not* simply because we are irrational (though at times we certainly may be). It is because, rather, we need to respond with the whole person, in the context of history and experience.

Argument depends on language of some kind. There is a peculiar bias towards language and naming in Western culture. East Asians solve problems significantly better when not obliged to express themselves in words, as often do Westerners, as we will see in Chapter 17; but for East Asians language scarcely appears to be involved in the process at all.[36] Speech is much less prized than silence in Japanese culture; silence is considered more conducive to thought. According to psychologists Timothy

Takemoto and Thomas Brinthaupt, ‘Japanese culture, it would seem, is best described by the absence of words, including those to describe it’.[37] Visual thought is predominant among the Japanese and is preferred to verbal thought.[38] The Japanese language lacks a method for composing abstract nouns. *Xiǎng*, one of the basic words for ‘think’ in Chinese, is written with a glyph composed of the elements tree + eye + heart. The Chinese word that translates our word ‘concept’ means a simple symbolic impression from experience. The absence of theorising in Japanese and Chinese does not mean an absence of philosophy: philosophy is, or should be, the love of wisdom, to feel its call, not just the analysis of verbal propositions.[39]

I believe the combination of scientism and ratiocentrism is making our vision narrower than it should be. I commented that, inside the bubble (which I would identify with the left hemisphere’s reality) we no longer see the limitations of our viewpoint – precisely because of its limitations. But nothing can prevent us from noticing that things are not working out the way we hoped. Whitehead again:

> The main evidence that a methodology is worn out comes when progress within it no longer deals with main issues. There is a final epoch of endless wrangling over minor questions. Each methodology has its own life history.[40]

A philosopher colleague alerted me to a good snapshot of analytic philosophy obsessively engaged in endless wrangling over minor questions.

In 1940, of all years, when Western civilisation was facing one of its most terrifying moral and existential crises, notes taken at Harvard on discussions over the year by Carnap, Tarski and Quine – respectively the leading Austrian, Polish and American analytic philosophers of their age – show that much of their discussion was devoted to working out what arithmetic *would have been* like had there been only a finite number of objects.

I am not saying that there is no place in academe for such speculation, far from it. But the complete failure by many leading analytic philosophers to engage even tangentially with the most pressing problems of a civilisation in crisis is strikingly reminiscent of fiddling while Rome burns. One might object that such was their training and expertise that we could not expect them to change. But that inescapably says something about the nature of twentieth-century analytic philosophy: its narrowness and its degree of abstraction from life. I am reminded of a remark by philosopher Jan Zwicky:

> Thinking analytically is like going on a diet. Its aim is a healthy austerity of thought, a certain trimness of mind. But when it's carried too far, we're left only with a skeleton. Carried too far too often, we lose the sense that something is amiss when the patient exhibits no life. We come to take pride in our cases of polished bone.[41]

What has happened to philosophy in our time? It has suffered the general fate of modern academic life, narrowness and sterility. Freeman Dyson puts it with customary clarity:

> For most of the twenty-five centuries since written history began, philosophers were important … They spoke not only to scholars but also to rulers. They had a deep influence in the practical worlds of politics and morality as well as in the intellectual worlds of science and scholarship … Through all the vicissitudes of history, from classical Greece and China until the end of the nineteenth century, philosophers were giants playing a dominant role in the kingdom of the mind … Compared with the giants of the past, [contemporary philosophers] are a sorry bunch of dwarfs …[42]

Philosophy has become, like science, narrowly specialised:

> the debates have become so much the property of specialists who have devoted prodigious energy to devising the most intricate arguments and counter-arguments to support their views, that it is unlikely that anyone who did not have a professional or career motivation for putting in the requisite effort would willingly wade through the resulting conceptual treacle.[43]

Once again these are the words of Cartesian scholar John Cottingham, not a man, one would have thought, to be daunted by conceptual treacle where strictly necessary. (It may not be a purely modern phenomenon though: I am reminded of the words of Friedrich Schlegel, that 'there's a certain sort of person for whom the exaltation of tedium is the first impulse to philosophy'.)[44] And Cottingham continues, in words that are reminiscent of the connexion between writing obscurely and getting published which we noted in the context of science (it's 'more difficult for reviewers to fault it'):

> We learn our trade by writing doctoral dissertations, and few dissertations have been failed for being too technical or laborious, whereas a bold and transparently stated claim to which a counter-example can be found may lead to a thesis being referred back. Or again, if a journal submission manages to work through current technical debates in a manner so impressively complex that the referee cannot easily spot any flaws, it may get the benefit of the doubt. In the fierce jungle of competition, donning heavy armour against possible attack, however exhausting, sweaty, and hampering of movement, may be the safest survival strategy.[45]

Great philosophers of the past, by contrast, he points out, took broad views:

> If we look at Plato, or Aquinas, or Descartes, or Spinoza, or Hume, or Kant, what is striking is the *wide reach* of their thought – the extent to which it spans a great many of what we now think of as

> distinct specialities or sub-specialities of philosophy. Plato, for example, has a philosophical world view which has implications for ethics and politics, for science and mathematics, for metaphysics and aesthetics; and the stamp of his philosophical vision can be clearly seen in his writings in all these areas … In fact all the canonical figures just mentioned had a grand synoptic vision of the nature of the world, of the place of humankind within it, of the extent and limits of human knowledge, and of the best way for human beings to live.[46]

In other words they addressed Plotinus's question, 'who are we?', as Schrödinger recommended that scientists should. The vision of the left hemisphere is of narrow scope; and its process of understanding is by taking ever smaller parts. But understanding always works in both directions, upwards and downwards at the same time, so that the higher levels must be presumed to illuminate the lower as much as the lower illuminate the higher.

'One can only become a philosopher, not be one', wrote Friedrich Schlegel. 'As soon as one thinks one is a philosopher, one stops becoming one.' [47] A philosopher is never in possession of the truth, but endlessly searching for it. In the middle of the twentieth century, the philosopher William Earle wrote an essay called 'Notes on the Death of Culture'.[48] In it he wrote trenchantly about the rise of what he called the Technical Philosopher, a figure who is engaged in 'professionalising' wisdom. Or rather, this new kind of philosopher steers clear of wisdom altogether, probably convinced that there isn't any. For this figure, the most shameful thing is to be thought 'edifying', followed closely by being thought 'muddleheaded':

> all traditional philosophy was muddleheaded, had no idea of what it was doing, and did even that badly … exactly what might be expected of a philosopher who intended to be edifying.

Instead this new philosopher is a philosophical worker, or 'researcher':

> He would be delighted to teach his classes in a white laboratory coat … His inquiries, investigations, and research will be embodied in a ‘monograph’, a short paper with the ‘problem’ clearly stated at the beginning, and at the end a summary of the ‘results’. The monograph must also refer to the other ‘literature’ on the subject. The Technical Philosopher thus is short-winded; he has an instinctive distaste for the sprawling works of the nineteenth century, when philosophers sometimes sought a larger view of things.

Technical Philosophy is ‘simply one sort of work for which one is paid. It should have no resonance beyond those hours’. Ideally, it takes place not in ordinary language: ‘he has always had a fear of natural or ordinary language. Ordinary language is so obscure; words come dripping out of a sea of feelings and related meanings, and are logically unmanageable.’ Ideally, it should be expressed in some form of artificial symbolism, ‘which takes years of training to read with any ease’. The Technical Philosopher ‘has always envied the mathematician, with his proofs and symbols.’ By adopting such means

> everything should be clear, and to some extent it is; but unfortunately the language is so impoverished that nothing of any importance can be said in it, and so artificial in form that error is perhaps more frequent in it than in our mother tongue.

And so the philosopher turns his glare on the ‘muddleheaded’ use of language by someone else. As Earle points out, this depends on the assumption that the language was not clear in its first usage, and must be made clear by the analysis. However, if it is not clear at first, how does the philosopher know he has ‘clarified’ it? And if it was already clear, why bother? As it has been pointed out, there is a problem with analysis: if the analysis can be substituted for whatever it analyses, it is tautologous; but if it cannot, it is false.[49]

This assumption is combined with another ‘fervent assumption’,

> that the philosopher himself is entitled only to analyse; that is, his work consists of tearing apart intellectually phrases others have put together. He analyses syntheses but he makes no synthesis himself … To ask a Technical Philosopher for his vision of the world is to throw him into the worst of embarrassments. It is hopelessly to misunderstand what philosophy now is. The philosopher's answer will not try to supply that vision, or even recognise its absence; rather it will analyse the meaning of your question in order to show that it really has no meaning at all. It is left for others to supply the vision …[50]

And Earle concludes:

> Now this was not always so. For the longest stretch of its history, philosophy was, embarrassing as it is to Technical Philosophy, concerned precisely with large visions and the edifying. That is, it was concerned with the human situation and what was to be done about it … The new philosopher need know in his professional capacity *absolutely nothing* except how *words* are used … In any event, pure knowledge has nothing to do here; it seeks absolute purity, absolute independence, and absolute irrelevance to anything anyone might conceivably be interested in. Thus has a noble discipline committed suicide.

The separation of epistemology from ethics, which arguably began with Descartes, and the prioritising of epistemology over ethics, says the philosopher David Levin, contributed to the 'acceptability of a mode of perception the character of which is grasping, possessive, and dominating. The earlier mode, more responsive, more receptive, more predisposed to be moved by ethical factors, consequently withdrew to a reduced role in our cultural life.'[51] In this way the analytic frame of mind has led, as it has in science, to a fragmentation of vision, including the vision of a society. Philosophy, as Whitehead saw, is the 'very foundation of thought and of life. The sort of ideas we attend to, and the sort of ideas which we push into the negligible background, govern our hopes, our fears, our control of behaviour. As we think, we live. This is why the assemblage of philosophic

ideas is more than a specialist study. It moulds our type of civilization'.[52] The importance of philosophy, if it is to mean anything, must lie far beyond the seminar room.

This vision – or lack of it – is what the left hemisphere's procedures lead us to. As a result, as Ernst Cassirer put it, we have amassed a huge, and ever increasing body of facts, but

> unless we succeed in finding a clue of Ariadne to lead us out of this labyrinth, we can have no real insight into the general character of human culture; we shall remain lost in a mass of disconnected and disintegrated data which seem to lack all conceptual unity.[53]

The ever-growing number of fragmented, specialist disciplines which deal with the nature of humanity, do more to obfuscate than reveal. As a result, as Scheler thought, 'one can say that in no historical era has the human being become so much of a problem to himself as in ours.'[54] An explosion of knowledge leads us only to what Bohm called 'endarkenment'.[55]

Like spiritual exploration, philosophical exploration shows the fly the way out of the bottle. This is a form of enlightenment and is referred to (with deliberate paradoxical intent) as 'beginner's mind' in the Zen tradition: the freshness of insight before intellectualising dimmed it. At the end of his career, Husserl admitted that 'the first result of reflection is to bring us back into the presence of the world as we lived it before our reflection began (*Lebenswelt*)'.[56]

Reality is rich and complex, and I have suggested that part of it is always hidden from us. This is not just my take: it was, in different ways what Bacon meant when he said that 'the subtlety of Nature is greater many times over than the subtlety of the senses and understanding', what Heraclitus meant by saying that 'Nature loves to hide', what Einstein meant by 'Nature hides her secrets', and what Heidegger meant by 'the clearing in which Being stands is itself at the same time concealment'.[57] To quote Cottingham again:

> the way each of us makes sense of who we are and our relation to the world is a fearsomely complex process of which our

> intellectualising is only the thinnest of surfaces. At the very least this suggests the need for a certain humility about the philosophical project of ‘making sense of ourselves and our activities’. We need to recognise the limitations of intellectual analysis, and the way in which insight is achieved not just by the controlling intellect, fussily classifying and cataloguing the pieces of the jigsaw, but by a process of *attunement*, whereby we allow different levels of understanding and awareness to coalesce, until a picture of the whole begins to emerge.[58]

Analysis makes explicit what we are aware of in the first instance through intuition. At its best, it achieves a ‘fit’, whereby our intuitions get to be nudged and in turn our reason allows itself to be modified, somewhat like the process of attunement envisaged by Cottingham. Ultimately the result is that we trade off some of our intuitions against others.

An admirable process leading to an admirable achievement – but it carries risks. In making things explicit, one enters a labyrinth of ever-receding definitions, each one supposedly to be refined at the next turn in the labyrinth, a process which in reality is never to be completed. Consciousness, for example, let us say with Descartes, is a ‘thinking thing’, *res cogitans*. Well, I’m glad we got that clear. But what is thinking? And what is a thing? Unless the answers already include the possibility of human consciousness as we understand it, they fail. To understand these elements, ‘thinking’ and ‘thing’, they need once more to ascend, as well as to descend, the ladder of explanation. Something at a lower level of analysis does not account for, but merely re-describes, the phenomenon in which we are interested, often less helpfully. We understand human meaning by seeing what it constitutes, not just that of which it is constituted.

And this is not so much because humans are different from inanimate systems – indeed they are, but that is not the key point at issue. It is that the scientific process of breaking things down *never* offered an understanding of what something actually *is*, even if inanimate. It was only an understanding of its mechanism, and a partial one at that – a very different matter. Defining, and ever refining the definition, will never answer human questions. It is not uncommon, writes Cottingham,

> for a philosopher to say he has produced a ‘theory’ of pleasure, or a ‘theory’ of action, when all that is being offered is an extended definitional and conceptual discussion. It is very easy to be caught up in the intricacies of analysis, and to mistake the introduction of more and more technical terms for a substantive explanatory advance … What is needed is not philosophical analysis but philosophical *synthesis* – not chopping things into parts, but linking them together.[59]

In most areas of philosophy we need both: but analysis must be in the service of synthesis, the left hemisphere in service of the right. On this topic, there is a subtle observation by the astrophysicist and mathematician Sir Arthur Eddington. If we do not analyse at all, we do not separate distinctly enough. But if we carry analysis too far, ‘the parts become so simple that they are indistinguishable, their indistinguishability confuses them in our observational knowledge and, in a sense, undoes the separation which the analysis has effected.’ [60] To take a practical and familiar example: analysing a piece of music into phrases may give information; persisting in analysis eventually yields but single notes, that individually have no meaning and therefore yield no information whatsoever. The structure of matter illustrates the same problem: there are only a small number of elementary particles (we are told), and analysis yields progressively less information as they are approached. In other words, at an intermediate level we can usefully distinguish one material aggregation from another; at a deeper level of analysis we are left with a bunch of quantum phenomena. The uniqueness of what we had seen was in the *Gestalt* which we have just destroyed. We need to know about parts only because it can help us see how the parts *relate*. Take away the relations and we are left with nothing. Similarly, the point of a narrow and detailed specialisation is to provide knowledge that can be re-integrated into an understanding of the whole. On its own it is virtually useless.

Employing analysis, which works from the outside of its object, without listening to intuition, which inhabits the matter at hand from the inside, is like looking for the power of a poem in the translation, where it cannot be found, and then when one cannot find it, denying it was there in the original.

Even if viewed merely as an agent of consensus, unbalanced rationality does not compare favourably with a less purely rationalistic, more spiritually aware exploration of the world. Compare the great traditions of the East, in which reasoning has not been the single privileged path to truth, and where there is yet remarkable consensus over space and time, with Western cultures in which it has, and where there isn’t.

EXPLICIT AND IMPLICIT REASON

There are, then, two widely held and equally mistaken beliefs about reason. On the one hand, it is believed by many that, if properly followed, reason should compel all rational people to the same conclusions, and that these conclusions have 'objective' truth – the fallacy of ratiocentrism (a cousin to scientism). This was given concrete expression by Leibniz, in his projected 'calculus ratiocinator', a computer that would transform – indeed extinguish – philosophical discourse. 'When differences arise', he wrote,

> there will be no more disputation between two philosophers than between two accountants. For it will be enough for them to take up their pens and sit down at the abacus, and say to one another (calling in a friend if they want): let's calculate.[61]

On the other hand, it is believed by some that, because this very point of view is so blatantly absurd, reason is somehow discredited, and we can act as though we owed nothing to it – the reciprocal fallacy, that of postmodernism.

But it is only the extreme claims made for rationality that are discredited. There is no way we can have discourse without some reliance on rationality, never mind without reason, which is the basis of a shared culture and a civilisation. One could claim that only poetry or the paradoxical pronouncements of mystics attain what can be called truth, but that too is unbalanced: it would clearly be a very brave – many would say, foolish – person who claimed that rational discourse led us nowhere; although it would also be foolish to deny that such discourse needs to know its own limitations, and that poetry, metaphor, myth, narrative and paradox play an important role in taking us beyond its limits. I hear as often the words of Pascal the mathematician: 'It is equally excessive to shut reason out and to let nothing else in'.[62]

In trying to come to a better understanding of the proper use of reason, it may help to distinguish what one might call 'explicit reason' from 'implicit reason'. I have emphasised that the left hemisphere seems able to deal only with what is relatively explicit, and that it is the right hemisphere

that enables us to understand implicit meaning of all kinds; but I may seem to have been making a point that is more pertinent to the arts than to science or philosophy. All the same, as I have pointed out, the paths used by scientists, mathematicians and philosophers to reach conclusions are often implicit, and are only subsequently and incidentally coupled to an explicit justification. And I suggest that explicit reasoning brings with it hazards. As Heraclitus noted, ‘an unapparent harmony is more powerful than an apparent one’.[63]

Surely it is always right that nothing should be taken for granted? Not always so. Some things can only be experienced or understood when they are not put to analysis. This is not because analysis defeats them, but because they defeat analysis. The effect of the direct glare is to banish the penumbra of myriad delicate threads that make it what it is and connect whatever it is to what nourishes it and gives it life, like the roots of a plant or the vessels that feed the heart and which it feeds. Snatch the plant from the soil, snatch the heart from the body, and they not only die, but they can no longer be understood for what they are. The effect is to substitute something that can be analysed for something that cannot: to change the nature of what is examined.

One of the best explorations of the distinction between explicit and implicit reason was made by John Henry Newman. In a sermon delivered at Oxford University on the 29 June 1840, he offers a number of insights; in particular that implicit reason – which is a living, embodied human skill – encompasses many elements, unlike explicit reason, which is a useful, but single mechanical procedure. He describes the mind in action, as it ‘ranges to and fro, and spreads out, and advances forward’,

> not unlike a clamberer on a steep cliff, who, by quick eye, prompt hand, and firm foot, ascends how he knows not himself; by personal endowments and by practice, rather than by rule, leaving no track behind him, and unable to teach another.[64]

And he makes a similar point about how we become convinced of the rightness of a position:

> conviction for the most part follows, not upon any one great and decisive proof or token of the point in debate, but upon a number of very minute circumstances together, which the mind is quite unable to count up and methodize in an argumentative form …[65]

He also makes a point that should be familiar in relation to the hemispheres. Reasoning is not the same as the retrospective account we give of it – an analysis which may leave important elements out:

> Here, then, are two processes, distinct from each other, – the original process of reasoning, and next, the process of investigating our reasonings … In other words, all men have a reason, but not all men can give a reason … The exercise of analysis is not necessary to the integrity of the process analysed. The process of reasoning is complete in itself and independent. The analysis is but an account of it; it does not make the conclusion correct; it does not make the inference rational. It does not cause a given individual to reason better.[66]

The right hemisphere is more involved with the living process as it happens, the left with the post-mortem dissection that occurs *once it has stopped*. The representation of reason given by retrospective analysis is bound to be only a partial account of the true reasoning process, and Newman compares the relationship to that between a portrait and the living individual it portrays:

> How minute is the defect in imitation which hinders the likeness of a portrait from being successful! How easy is it to recognize who is intended by it, without allowing that really he is represented! Is it not hopeless, then, to expect that the most diligent and anxious investigation can end in more than in giving some very rude description of the living mind, and its feelings, thoughts, and reasonings … frequently we do not recognize our sensations and ideas, when put into words ever so carefully. The representation seems out of shape and strange, and startles us, even though we know not how to find fault with it.[67]

The reasons we formally adduce in moral inquiries, ‘are rather specimens and symbols of the real grounds, than those grounds themselves … hints towards, and samples of, the true reasoning’;[68] and too great a focus on analysing the process of reason, Newman points out, has some unhelpful side-effects of which we are not always sufficiently aware, particularly in the area of morality and religion. This is because of

> its weakening the springs of action by inquiring into them; its stimulating to controversy and strife; its substituting, in matters of duty, positive rules which need explanation for an instinctive feeling which commands the mind; its leading the mind to mistake system for truth, and to suppose that an hypothesis is real because it is consistent … [69]

However, all such objections, he wisely concludes, important though they are, should lead us not to distrust, and certainly not to abandon, explicit rational processes, merely to use them with appropriate caution. It is hard to find such a balanced account of reason in the debates of today.

The lack of a rational understanding of the limits to reason may prove fatal. The coherence of a civilisation depends on accepting the reality and value of principles which we do not, and perhaps never can, fully understand. In all societies hitherto this has been achieved by the influence of knowledge embodied in traditions, sometimes religious, that asked for acceptance by an appeal to imagination, not to reason alone. ‘The most dangerous stage in the growth of civilization’, wrote Friedrich Hayek,

> may well be that in which man has come to regard all these beliefs as superstitions and refuses to accept or to submit to anything which he does not rationally understand. The rationalist whose reason is not sufficient to teach him those limitations of the powers of conscious reason, and who despises all the institutions and customs which have not been consciously designed, would thus become the destroyer of the civilization built upon them. This may well prove a hurdle which man will repeatedly reach, only to be thrown back into barbarism ...[70]

Reason does in fact demonstrate its own limits, its incompleteness. However, this is so much a trade secret that the answer to Stanley Fish's question, 'Does reason know what it is missing?' is: 'very rarely, it would seem'. As he puts it,

> What secular reason is missing is self-awareness. It is 'unenlightened about itself' in the sense that it has within itself no mechanism for questioning the products and conclusions of its formal, procedural entailments and experiments.[71]

But there exist minds that are 'enlightened' in this respect. Pascal, one of the greatest philosopher-mathematicians that ever lived, nonetheless said that 'the ultimate achievement of reason is to recognize that there is an infinity of things which surpass it. It is indeed feeble if it can't get as far as understanding that.'[72] Kant demonstrated the limitations of reason in what are called his four 'antinomies' (or paradoxes): in each case reasoning about a fundamental aspect of reality leads equally, he claimed, to a conclusion *and* to its opposite. In the last century Kurt Gödel demonstrated definitively that every formal system is incomplete, in that each leads to conclusions that can be shown to be theorems of the system, but cannot be proven within the system. Mathematician and philosopher Greg Chaitin claims that 'an infinite number of true mathematical theorems exist that cannot be proved from any finite system of axioms'.[73] It is not rational to assume, without evidence, that rationality can disclose everything about the world, just because it can lead us to the disclosure of many important elements.

Equally, just because rationality can't solve many problems is not a reason to give up on it. In 1936 Alan Turing addressed the so-called 'halting problem' – whether, from the description of any computer program and an input, it is possible to determine if it will eventually come to a conclusion, or simply run for ever – by showing that a general algorithm for solving all halting problems does not exist. Of this, Chaitin writes:

> No algorithm, no mathematical theory, can ever tell us which programs will halt and which will not … This conclusion does not mean that proofs are no good, and I am certainly not against reason.

> Just because some things are irreducible does not mean we should give up using reasoning.

However, of mathematics after Gödel, he concedes:

> It turns out that an *infinite number* of mathematical facts are irreducible, which means no theory explains why they are true. These facts are not just computationally irreducible, they are logically irreducible. The only way to 'prove' such facts is to assume them directly as new axioms without using reasoning at all … Given any finite set of axioms, we have an infinite number of truths that are unprovable in that system.

'Irreducible principles – axioms – have always been a part of mathematics', he continues. It's just that there are 'a lot more of them out there than people suspected'.[74]

Of course one does not need to rely on abstruse mathematics to see the limitations of reason. Anyone who understands poetry, drama, ritual, narrative, music, painting, architecture, or the sheer beauty and majesty of the natural world – or for that matter has ever fallen in love – can see that ultimate meaning will *always* lie beyond what reason can conceive or everyday language express.

How do we best employ reason, then, in the search for truth? To insist on reason alone is deeply irrational, not to say the sign of a mental illness, and I have touched on some of the many reasons above. 'There is nothing so conformable to reason', wrote Pascal, speaking of the moment at which reason appreciates its own limitations, 'as this disavowal of reason'.[75] But to abandon reason altogether is also deeply irrational. 'Reason seems able to overthrow the deification of everything but itself,' writes Stanley Cavell. And yet

> to imagine that what is therefore required of us is a new rage of irrationality would be about as intelligent as to imagine that because heaven rejects the prideful man what it craves is a monkey. For the point of forgoing knowledge is, of course, to know.[76]

So we must use our discernment as to how much, of what sort, in what way, and to what purpose. ‘Where’s the certainty in that?’ you may say. ‘Isn’t it a matter of discernment which judgments we prefer?’ I can only say that if you are still hoping for something certain and above human judgment, please don’t let me disturb your sleep.

REASON'S PROGENY

> Improvement makes strait roads; but the crooked roads without Improvement are roads of Genius.
>
> —*William Blake*[1]

> Ambiguity is of the essence of human existence, and everything we live or think has always several meanings.
>
> —*Maurice Merleau-Ponty*[2]

AT THE BEGINNING OF THE PREVIOUS CHAPTER I GAVE TWO CONTRADICTORY definitions of reason, one very much the product of the left hemisphere's take on the world; the other, of the right's. I argued that we need both; that the right hemisphere's broader view of the world can accommodate both but that the left hemisphere is prone to regard its version of reason, rationality, as sufficient and, as a result, produces a narrow, ratiocentric account of the world that is deeply misleading. In this chapter I want to look in more detail at reason's progeny: the pairs of twins reason begets to help us approach truth. Again, one of each pair of twins claims paternity by the left hemisphere; the other, by the right. And once again we shall be led astray if we attend only to the dominant left twin rather than see that truth is more fully apprehended if both are enlisted, but with the left twin ultimately in the service of the right.

ABSTRACTION VS EMBODIMENT

‘The history of computers is often told as a history of objects’, writes Chris Dixon. ‘In fact, it is better understood as a history of ideas, mainly ideas that emerged from mathematical logic, an obscure and cult-like discipline that first developed in the nineteenth century.’[3] Earlier I made the analogy between the capabilities of apparently intelligent logic and those of the apparently unintelligent computer. If you think that is far-fetched, recall that one of the landmarks of philosophy in the last hundred-odd years was Frege’s development of his *Begriffsschrift* (or ‘concept notation’), a formal language of meaningless symbols manipulated by precise rules, exactly as a computer operates. For the first time in philosophy, truth is specified by content-free, manipulable structures *separately* from any meaning-giving context, in a fascinating rupture of the link that, in the real world, indissolubly binds form and meaning.

Music is as near an example of pure form as one might find: it does not refer outside itself. And yet its meaning is profound. Meaning arises richly and inevitably out of any *embodied* form: but it must be embodied. Only in algebra, which is disembodied, can form and meaning be separated. Frege’s ‘concept notation’ is a kind of algebra which respects logical structures, but is indifferent to meaning. This, then, is the ultimate triumph of decontextualisation and abstraction.[4]

However, that is what one might have thought of as the downside of a machine – not the upside of a person. According to two distinguished computer scientists who won the Turing Award for services to artificial intelligence, the computer necessitated a form of logic ‘purged’ of meaning – developed by the work of Frege, Whitehead and Russell –

> often referred to as the ‘symbol game’ … played with meaningless tokens according to certain purely syntactic rules. All meaning had been purged … Thus progress [in AI] was first made by walking away from all that seemed relevant to meaning and human symbols.[5]

The left hemisphere tends to abstraction in a number of ways. One is its dependency on linguistic thought. ‘As soon as I have expressed something in a word’, wrote Erich Fromm,

> an alienation takes place, and the full experience has already been substituted for by the word. The full experience actually exists only up to the moment when it is expressed in language. This general process of cerebration is more widespread and intense in modern culture than it probably was at any time before in history … words more and more take the place of experience. Yet the person concerned is unaware of this. He thinks he sees something; he thinks he feels something; yet there is no experience except memory and thought. When he thinks *he* grasps reality it is only his brain-self that grasps it, while he, the whole man, his eyes, his hands, his heart, his belly, grasp nothing – in fact, *he* is not participating in the experience which he believes is *his*.[6]

The ‘brain-self’ versus the ‘whole man’ – for which one can read the left hemisphere vs the right.

As we have seen, the left hemisphere has a greater affinity for categorisation and the general than for the unique and individual, and it deals with what has been relatively disembodied and removed from context. Once again, it is clear that all these preferences involve distancing from nature and the experienced world, in which everything is unique and individual, and dwells in embodied form within a context. In this very fact, the right hemisphere is more veridical, since real and existing things are never equal. To quote Nietzsche:

> Every word instantly becomes a concept precisely insofar as it is not supposed to serve as a reminder of the unique and entirely individual original experience to which it owes its origin; but rather, a word becomes a concept insofar as it simultaneously has to fit countless more or less similar cases – which means, purely and simply, cases which are never equal and thus altogether unequal. Every concept arises from the equation of unequal things. Just as it is certain that one leaf is never totally the same as another, so it is

> certain that the concept “leaf” is formed by arbitrarily discarding these individual differences and by forgetting the distinguishing aspects.[7]

This doesn’t mean there is something intrinsically *wrong* with the left hemisphere’s thought processes – unless they get mistaken for reality. A map may be very helpful in orientating you in the world, and helps you to understand aspects of it better; it can help you see further, but only when what it tells you has been returned to the world in front of your eyes. If you start to believe the map is the world, you are lost.

A map gives one power to manipulate, to understand the *form*, while at the same time, and not coincidentally, distancing one from the substantial world which gives it content. General terms, according to Charles Fried,

> are attempts to sweep a large set of particulars under a single conceptual rug; but it is an attempt doomed to failure. General terms have no objective correlates; they are merely compendia of particulars collected together for our convenience in terms of similarities we note for our purposes. To say that general terms have no objective reality is to say *first* that general terms do not of themselves identify the particulars subsumed under them, and *second* that therefore the process of subsumption is a value-laden process, one which refers to human goals and purposes.[8]

Conceptualising anything is a way of asking ‘what it can do for us’, says Bergson.[9] One of the drives behind cartography was the subduing of subject peoples, or at least the acquisition of their potential mineral or material wealth. Britain’s Ordnance Survey, one of the world’s largest purveyors of detailed maps, takes its name from its original military purpose, the mapping of Scotland in the aftermath of the Jacobite rebellion of 1745, in order to make sure that any future rebellion could be more easily quelled.

In *The Scientific Outlook*, Bertrand Russell wrote:

> Scientific thought [by which he meant not imaginative scientific work, but rational, linear thinking] is … essentially power-thought –

> the sort of thought, that is to say, whose purpose, conscious or unconscious, is to give power to its possessor. Now power is a causal concept, and *to obtain power over any given material one need only understand the causal laws* to which it is subject. This is an essentially abstract matter, and the more irrelevant details we can omit from our purview, the more powerful our thoughts will become.[10]

He then goes on to point out that the farmer who tills the field and grows the corn makes less money from his produce than the railway companies that transport it, from whom it is more remote and for whom it is relatively abstract; and that the dealer on the stock exchange, for whom it is entirely abstract, and who is as remote as one can get from it, stands to make much more than either of them. Thereby he correctly exposes one of the most unattractive aspects of capitalism; it remains, however, a curious way to recommend a style of thought.

This was a matter that particularly concerned William James. '*The intellectual life of man*', he wrote '*consists almost wholly in his substituting a conceptual order for the perceptual order in which his experience originally comes*.' [11] In similar vein, Kierkegaard had commented drily:

> What the philosophers say about reality is often as disappointing as a sign you see in a shop window: Pressing Done Here. If you brought your clothes to be pressed, you would be fooled; for the sign is only for sale. [12]

James's philosophy could be seen as one lifelong battle on behalf of experience against the fallacies of abstraction and representation: not offering the sign for sale, but actually doing the pressing. Where Plato had elevated ideas, which he supposed to be real and eternal, and disparaged the world of experience, which he claimed to be a poor copy of perfect ideas, James aimed to redress the balance. Naturally, like all philosophers, he works a lot at the abstract level – how could he not? But it is always in the service of a fuller understanding of the phenomenal world, not, as so often happens, a *substitution for it*. He is not (nor am I) against conceptualisation. Concepts, he writes,

> are precious in themselves … apart from their original use, and confer new dignity upon our life …so long as their original function does not get swallowed up in the admiration and lost. That function is of course to enlarge mentally our momentary experiences by *adding* to them the consequences conceived; but unfortunately, that function is not only too often forgotten by philosophers in their reasonings, but is often converted into its exact opposite, and made a means of diminishing the original experience by *denying* (implicitly or explicitly) all its features save the one specially abstracted to conceive it by.[13]

The abstractions that we create through language seem to be real and are taken by the unwary for things. Although, general, single in nature and withdrawn from the experiential world, they are always derived from particular, instantiated, complexes, not vice versa. The abstracting tendency does, as James is very ready to admit, have its uses in many cases and places; but it can be remarkably inefficient as a way of approaching or dealing with experience, and it certainly needs to be kept in check.[14] For as Heisenberg warned: 'The concepts initially formed by abstraction from particular situations or experiential complexes acquire a life of their own'.[15] Which of us could deny this in the world of today? 'It is not always remarked', wrote the philosopher Max Müller,

> that we men have almost entirely left the sphere of purely intuitional knowledge, and that the world in which we live and move and have our being is a world of concepts; a world which we have created ourselves, and which, without us, without the spectators in the theatre, would vanish into nothing.[16]

Long before this, Berkeley had criticised the 'false principles … amongst all which there is none, methinks, hath a more wide influence over the thoughts of speculative men, than this of *abstract general ideas* …'[17] Hume called this insight of Berkeley's 'one of the greatest and most valuable discoveries that has been made of late years in the republic of letters.'[18] There is a clear connexion between the will to power of the left

hemisphere, and a tendency to try to make reality conform to our theory; wisdom lies in conforming one's theory as far as possible to experience.

Pronouncements emanating from management culture are the worst. The bureaucratic mind prefers nouns to verbs, abstract nouns to concrete nouns, and, in verbs, the passive to the active voice. 'Seat-belts must be worn', just as 'the beaker was placed …' To some extent each of these preferences is aligned with the proclivities of the left hemisphere. While much of language is of course processed in the left hemisphere, there is a tendency for concrete nouns to be processed more bilaterally than abstract ones, which are predominantly (though not exclusively) processed in the left.[19] Left temporal brain-damaged patients perform significantly better with concrete than abstract words, for which the left superior and middle temporal gyri and insula appear to be crucial.[20] And disrupting the left temporal lobe using TMS causes impairment in processing words with abstract referents, while disrupting the equivalent right temporal area interferes with processing words with concrete referents.[21] Equally, passive constructions in languages as syntactically divergent as English and Japanese cause additional recruitment of left hemisphere regions, particularly the left inferior frontal gyrus and posterior perisylvian regions.[22] Only one study found that the right inferior frontal gyrus was also involved, which the report's authors attributed to the need for 'effortful syntactical reanalysis':[23] the right hemisphere is recruited in direct proportion to the difficulty of meaning construal.[24]

Whitehead emphasised that there was 'a right adjustment' to be observed – a proper measure and manner – in the deployment of abstraction. And he made the wise observation that abstraction, like everything else, can be valuable *up to a point*, but that too much emphasis on it starts to be more of a handicap than an asset:

> the higher animals are distinguished from mere life, by their abstractions, and by their use of them. Mankind is distinguished from animal life by its emphasis on abstractions. The degeneracy of mankind is distinguished from its uprise by the dominance of chill abstractions, divorced from aesthetic content.[25]

The word ‘aesthetic’ here is used in its strict sense, referring to sense perception and feeling, not just to an appreciation of beauty – though he was very far from denying the value of beauty. Whitehead, like Schelling, believed – as do I – that reality is neither undiscoverable, nor discoverable by the intellect alone, but by the whole embodied being, senses, feeling, intellect and imagination.

‘The first thing the intellect does with an object’, writes James – and for ‘intellect’ we may substitute here ‘left hemisphere’ – ‘is to class it along with something else.’ It is Procrustean: it simply chops off all that makes one individual different from another. It was this that Nietzsche meant by his saying that ‘every concept arises from the equation of [what are in reality] unequal things’. [26] And James continues:

> But any object that is infinitely important to us and awakens our devotion feels to us also as if it must be *sui generis* and unique. Probably a crab would be filled with a sense of personal outrage if it could hear us class it without ado or apology as a crustacean, and thus dispose of it. ‘I am no such thing’, it would say; ‘I am MYSELF, MYSELF alone’. The next thing the intellect does is to lay bare the causes in which the thing originates. Spinoza says: ‘I will analyse the actions and appetites of men as if it were a question of lines, of planes, and of solids.’[27]

One of James’s greatest contributions to philosophy was to see this as one of the principal causes of derailment in our thinking. He called it ‘vicious abstractionism’. What he meant by this was that we replace, without even being aware of it, something concrete and particular with something abstract and general, on the basis that it has a feature that entitles it to belong in a certain category. At that point, instead of the process of categorisation *adding* to the ‘originally rich phenomenon’, by associating it with other ideas, it *strips* what it has categorised:

> Abstraction, functioning in this way, becomes a means of arrest far more than a means of advance in thought. It mutilates things; it creates difficulties and finds impossibilities; and more than half the trouble that metaphysicians and logicians give themselves over the

> paradoxes and dialectic puzzles of the universe may, I am convinced, be traced to this relatively simple source. *The viciously privative employment of abstract characters and class names* is, I am persuaded, one of the great original sins of the rationalistic mind.[28]

James was, of course, not alone in seeing this. His philosophical colleague Dewey thought that neglect of context was ‘the greatest single disaster which philosophic thinking can incur’.[29] He was surely right. To quote Aristotle, ‘law is universal but about some things it is not possible to make a universal statement which shall be correct’.[30] The more philosophy abstracts and generalises, the more it distances itself from a world in which all that is is unique. All our perceptions and thoughts are parts of a living, embodied organism, uniquely embedded in a place and a moment in time. In an arresting phrase, Bergson points out that ‘our concepts have been formed on the model of solids’.[31] Given that concepts are inevitably immaterial, this may seem paradoxical. What he means is that when concepts stand in for whatever it is that exists in the world of experience, and therefore within time, they immobilise and sunder the natural flow of the entity in question: they *freeze*, so to speak, elements that are in their very essence *dynamic*, and they separate into parts the essentially inseparable. Conceptualisation is a form of congelation, freezing in time.

It may be fairly argued that it is hard to do philosophy in any other way (though both the so-called ‘Pragmatists’ and the ‘phenomenologists’ made significant attempts), but in that case we should be appropriately modest about what philosophy can achieve. ‘All philosophers suffer from the same defect’, wrote Nietzsche,

> in that they start with present-day man and think that they can arrive at their goal by analysing him. Instinctively they let ‘man’ hover before them as an *æterna veritas* [timeless truth], something unchanging in all turmoil, a secure measure of things … A lack of historical sense is the congenital defect of all philosophers … but everything has evolved; there are no *eternal facts*, nor are there any absolute truths. Thus *historical philosophising* is necessary henceforth, and the virtue of modesty as well.[32]

As usual with Nietzsche, this is an extreme statement of a much-needed contrarian point of view. While, as I am arguing, there are indeed no ‘eternal facts’ or ‘absolute truths’, there are certainly enduring realities, ones that are recurrent, too, in many different cultures, and ones on which we may yet hope to agree if we are reasonable people. ‘There is no merit’, wrote the philosopher and social anthropologist Ernest Gellner,

> in the contemporary exaggeration of the valid point that experience is never pure; indeed it is not, but there are very marked and narrow limits to the extent to which it can be corrupted, and hence the reverence for experience makes an enormous and salutary difference. [33]

One ground for believing that we might agree in our experience is the fact that we share our embodied nature – which even analytic minds, however much they may dream of being brains in vats, cannot escape. As Lakoff & Johnson make clear, metaphor is not an embellishment of thought, but its very ground.[34] The form (metaphor) is not *added* to the thought, but is itself the stuff of thought, and takes us back to bodily experience; which is probably yet another reason why the right hemisphere is better at appreciating metaphor than the left. It understands that language is embodied.

And literally so. Language as a whole evolved out of the motion (and emotion) of the body, as I argued in *The Master and his Emissary*. Reason, too, as Lakoff and Johnson point out, originates in the body:

> Reason is evolutionary, in that abstract reason builds on and makes use of forms of perceptual and motor inference present in ‘lower’ animals … Reason is thus not an essence that separates us from other animals; rather, it places us on a continuum with them … Reason is not completely conscious, but mostly unconscious. Reason is not purely literal, but largely metaphorical and imaginative. Reason is not dispassionate, but emotionally engaged … Since reason is shaped by the body, it is not radically free, because the possible human conceptual systems and the possible forms of reason are limited. In addition, once we have learned a

> conceptual system, it is neurally instantiated in our brains and we are not free to think just anything.[35]

Here the word reason is being used in its broad sense; rationality, in the narrow sense, then arises out of reason, dangerously aspiring to leave its embodied nature behind.

Abstraction simplifies. For years, at least until behavioural economics came on the scene, classical economists simply assumed that we, the actors in the economy, all behaved ‘rationally’, by which they meant according to their own abstract theory. That’s to say we ‘rationally’ and single-mindedly pursue ‘utility maximisation’ (getting the most we can for ourselves) to the exclusion of any other consideration. In a more recent twist on the idea (rational expectations theory), they even assume that our beliefs about what will happen in the future are themselves determined by our ‘rational’ adherence to what their theory says will happen. It’s as if we are robots programmed to behave according to their theories. We have all seen where such theories got us. The point is that we are vastly more complex than any machine – or the mechanical model that can be erected in our place. We do not perform as the model of *homo economicus* says we should in maximising our benefit; and at least one reason is that there is more to life than maximising our benefit. We often willingly and knowingly prefer other ends, such as being kind, charitable, or creative – or having children. You can, of course, ‘factor’ these in, as rational choices that make us happy, but as you do so the definition of the word ‘rational’ slips out of control and becomes complex beyond calculation. Consider: adversity is also a part of fulfilment. Serendipity, including serendipitous mistakes, leads us where no-one foresaw. Turns of events can’t be predicted, and neither can the responses of others. Our objectives change, and are, in any case, ambiguous. Nor is there anything irrational in having incompatible desires.

Note the assumption that the failing is in humanity if we don’t fit the model, not that there is a failing in the model if it doesn’t fit humanity: the map is, it would seem, more real than the terrain.

All abstractions are only our own simplifications of something that came to us originally in the flesh and blood as perceiving, sensate, intuiting beings, enmeshed in an unfathomable network of human society and its history. ‘Abstraction’, according to John Kay, ‘is the process of turning complex problems we cannot completely describe into simpler ones that we

think we can solve. But gauging which simplification is appropriate requires judgment and experience. Our simplifications are idiosyncratic and subjective.'[36] And in testing certain features of human decision-making, the circumstances have to be altered and simplified to yield artificially clear objectives, divorced from any context. In doing so the model-makers 'are substituting a problem their methods can solve for the problem we actually face'.[37]

Rationalistic deductions apply only within the bounds of an abstract model, not in real-world situations, and thus need to be balanced by an intuitive grasp of the whole. 'The belief that models are not just useful tools but are capable of yielding comprehensive and universal descriptions of the world blinded proponents to realities that had been staring them in the face', wrote Kay of leading Western economists prior to the crash of 2008:

> That blindness made a big contribution to our present crisis, and conditions our confused responses to it. Economists – in government agencies as well as universities – were obsessively playing *Grand Theft Auto* while the world around them was falling apart.'[38]

Cognition arises out of emotion, not the other way round. Abstraction literally means something that has been 'dragged away' from the context in which it lies, as if one were able to pull the bones out of a body. And abstraction is fine – for an intermediate process. But, to be of any use, what is abstracted must live once more: it has to be returned, as if the sinews, flesh and blood were given back to the bones. As William James says:

> whatever elements an act of cognition may imply besides, it at least implies the existence of a *feeling* … Beautiful is the flight of conceptual reason through the upper air of truth. No wonder philosophers are dazzled by it still, and no wonder they look with some disdain at the low earth of feeling from which the goddess launched herself aloft. But woe to her if she return not home to its acquaintance … every crazy wind will take her, and like a fire-balloon at night, she will go out among the stars. [39]

Let me take an example. In 1984, the moral philosopher Derek Parfit set out his so-called Repugnant Conclusion. He formulated it thus:

> For any possible population of at least ten billion people, all with a very high quality of life, there must be some much larger imaginable population whose existence, if other things are equal, would be better even though its members have lives that are barely worth living.[40]

(By 'better', Parfit means that the 'total amount of happiness' would be more.) According to the Stanford *Encyclopedia of Philosophy*, 'as the name indicates, Parfit finds the Repugnant Conclusion unacceptable and many philosophers agree. However, it has been surprisingly difficult to find a theory that avoids the Repugnant Conclusion without implying other equally counterintuitive conclusions.' If that is true, it suggests to me that this could well be a case where the conclusion sits in judgment on the methods used to reach it, not the methods on the conclusion. If your line of thinking leads to a conclusion that flies in the face of any kind of wisdom, it is surely worth considering that there is a flaw in the thinking.

My thoughts about this are those of an outsider, therefore inevitably naïve. However, I'd like to think that practitioners in any field might be tolerant enough to welcome an occasional view from outside. I don't pretend, here or elsewhere, to have 'answers' to philosophical riddles. I can only offer a perspective, one which might provide a new way of looking at them, rooted in knowledge of the brain. And here, as often in modern academic philosophical debate, it seems to me that hemisphere balance has been lost somewhere along the line.

In the first place, there is no sacrifice of happiness involved for somebody who doesn't exist and never will do, and therefore no need to 'remedy' this by bringing 'them' into being. Happiness is an *experience*, one that can only exist for an actual human being, and, for the non-existent human being, happiness cannot arise. The potential for 'that person' to have existed (or not) only means something once that person actually exists (that is, once I exist there is a meaning to the thought that I might never have existed, but until then not). 'That person', that 'I', has no referent and is unknowable, because he or she is not sitting *in potentia* in an ideal space somewhere until summoned up into daylight by the forces of life, but would

be a genuinely new, in important senses unforeseeable, entity that it makes sense to talk about only once existent.

And, by the way, such is the freshness of creation, we also can't know in advance what sort of quality of life this person might have: given the very same circumstances he or she might be content or miserable, a matter of personal disposition. Happiness is not as dependent on circumstance as utilitarian and consequentialist philosophy tends to assume. We are not the interchangeable counters of this calculus: we are not only born different, but then go on to forge, to an extent, the different persons that we become.

In the second place, you can't sum 'happinesses' in order to see how much 'Happiness' with a capital H there is in the world. Happiness is not some thing you can have: brief acquaintance with life as it is lived outside the seminar room would suggest that this 'thing' doesn't exist. (It's that trick the Greeks played on us, again, by inventing abstract nouns.) Being happy is rather something you must enter into. All that exists is the mode of being of those who exist, and for them happiness is more of an adverb than a noun. There is only the quality of happiness in the way a unique individual has a life. There isn't a tank of Happiness where the ballcock rises as more and more people feed their pipes into it. And if you really can't get by without summing something, then the sum of billions upon billions ('some much larger imaginable population') of people's wretchednesses ('lives that are barely worth living') is not something that any sane person could possibly think desirable.

These thoughts work for me – which is possibly all one can hope for – no doubt not for Kant's *Denker von Gewerbe*.[41] It seems to me, in sum, that it is not so much the conclusion that is 'repugnant', but the mental processes that lead to it.

Serious moral thought can never be about the right calculus – how much one should give, or how many people one should save – but about a whole change of relationship to the world. A rationally achieved 'equilibrium' position in one's relationship to the world is a bureaucratic notion, that could be enforced by an administration, without necessarily having any intention, or power, to engage the moral sense at all. Cottingham again:

> Abstract, decontextualised, psychologically jejune, detached from the drama of the human journey (the journey from complacency, through suffering, toward moral and psychological growth), the

> ‘equilibrium’ it promises seems all too abstract and intellectualised a notion to provide a proper way of addressing the deep ethical challenges of the human condition.[42]

His assessment is in line with that of Dewey:

> Thinking takes place in a scale of degrees of distance from the urgencies of an immediate situation in which something has to be done. The greater the degree of remoteness, the greater the danger that a temporary and legitimate failure of express reference to context will be converted into a virtual denial of its place and import. Thinking is always thinking, but philosophical thinking is, upon the whole, at the extreme end of the scale of distance from the active urgency of concrete situations. It is because of this fact that neglect of context is the besetting fallacy of philosophical thought.[43]

In the first edition of Quine’s *Philosophy of Logic*, the first page contains the remark: ‘I would say that a sentence is logically true if all sentences with its grammatical structure are true.’[44] Sixteen years later, in the second edition, that sentence had been removed. But what is intriguing is that such a sentence could ever have been written by a respected philosopher. It means that the left hemisphere’s rule-following is allowed to have the status of truth (a certain kind of truth, at least). This is exactly what the left hemisphere believes: that it *is* cold in tropical Ecuador, because that’s what the logical structure – though starting from a false premise – dictates. But what kind of truth is that, and why would we be right to pursue it?

PRECISION VS ACCURACY

Earlier I made a distinction between precision, which literally means cutting something off too soon, and accuracy, the literal meaning of which is to exhibit due care towards the subject of concern. Rationality, the left hemisphere's version of reason, demands we be precise, otherwise (so it believes) meaning will escape. Thus philosophy has taken to mimicking science.[45] Yet meaning is not increased – more often diminished – by the process, and all that is achieved is a lack of flexibility. There is a kind and a degree of reaching after precision, clarity and rigour which is misplaced, because its subject becomes more and more tenuous as this process continues. It ends in a kind of increasingly unrewarding pedantry, reminiscent of an anorexic's attempt to split a pea rather than swallow it. The attempt is to *over*-clarify an area that intrinsically does not permit it. 'It is the mark of an educated man', wrote Aristotle, 'to look for precision in each class of things just so far as the nature of the subject admits'.[46]

Human affairs are a case in point. Knowledge of something that is by its nature not precise will *itself* have to be imprecise, if it is to be accurate. Aristotle again: 'For when the thing is indefinite the rule also is indefinite … the decree is adapted to the facts.'[47] In the same vein, Whitehead writes:

> There is a conventional view of experience, never admitted when explicitly challenged, but persistently lurking in the tacit presuppositions. This view conceives conscious experience as a clear-cut knowledge of clear-cut items with clear-cut connections with each other. This is the conception of a trim, tidy, finite experience uniformly illuminated. No notion could be further from the truth.[48]

Contrary to some fashionable philosophers, and not just those of the 'Continental' tradition, I agree with Ortega y Gasset that 'in philosophy, clarity is courtesy'. We do have a duty, to ourselves and to our interlocutors, to be as clear as our subject of enquiry permits – *but not a whit more*. When we trespass further, we blunder: we substitute something petty for something great. According to Edmund Burke, 'it is the nature of all

greatness not to be exact'.[49] His point is that precision is narrow in its focus: it deracinates and simplifies to achieve its effect. It cannot accommodate what lies beyond precision. 'A clear idea', he concluded, 'is therefore another name for a little idea.'[50]

No-one expressed the proper relationship between precise thinking and missing the point better than Pascal. He contrasts what he calls *les esprits fins* ('subtle spirits') with 'geometers': what makes 'geometers' incapable of subtlety, he says, is that

> they do not see what is there in front of them, and, being used to the crude, cut and dried principles of geometry, and to never reasoning until they are certain of their principles, they're lost when it comes to the subtleties, where you can't lay your hands on the principles in this way. Such principles are scarcely to be seen at all; they are sensed rather than seen; it is well-nigh impossible to get anyone to understand them if they do not sense them for themselves. They are so fine and so numerous that you must have a very delicate and very acute sense to perceive them, and without for the most part being able to demonstrate them in sequence, as one would in geometry, because such principles are not to be had, and because there would be no end to such an undertaking. You've got to see it just like that, at one glance, and (at least to a degree) without going through any reasoning process. So it is rare that the geometers achieve subtlety and that subtle minds are geometric, because the geometers want to treat matters of intuition like geometric proofs, and make fools of themselves, wanting to start with definitions and then move on to principles, which is not the way to deal with this kind of reasoning. Not that the mind does not do so, but it does it implicitly, naturally, and without artifice; for it is beyond man's wit to say how, and even to intuit it belongs only to a few.[51]

The lust for precision comes from a need for certainty. However, knowledge not only does not imply certainty, but is actually incompatible with certainty. Certainty resides only in our concepts, not in the reality to which we apply them. There is an intrinsic tension for the philosopher between the rational pursuit of certainty and the rational desire for

knowledge. As Hegel pointed out, ‘immediacy’ (the quality of being understandable without the need for any other concept or idea) is not compatible with determinacy, and hence certainty is purchased at the expense of content: in Scruton’s phrase, paraphrasing Hegel, ‘the more certain our knowledge the less we know’.[52] In a similar vein, Claude Lévi-Strauss wrote that:

> the work of the painter, the poet or the musician, the myths and symbols of the savage, ought to be seen by us, if not as a superior form of knowledge, at least as the most fundamental, and the only kind really common to us all – knowledge of which scientific thought is merely the sharpened point: more penetrating because it has been honed on the stone of fact, but *at the price of a loss of substance* …[53]

The left hemisphere’s experience is precise but diminished and fragmentary, taken out of the flow of experiential life; in fact, tending towards stasis.

The harm done by precision is that it limits what we find in reality. The right hemisphere is conventionally said to have ‘coarse’ semantic coding (I am always amused by that – such a revealingly loaded word), whereas there is nothing coarse about the left hemisphere, with its ‘fine’ (another loaded word, when you think about it) semantic coding. What this means is that the left hemisphere narrows down to a highly localised network and hence to a local, usual and familiar set of associations. This is not always bad – it renders us important service in the day-to-day world. But it is a hopeless way to embark on an understanding of the complexities of reality. The right hemisphere activation is at the same time more provisional, less prepotent, than that of the left hemisphere, and more diffuse, engaging a much broader semantic field, including elements only distantly related.[54] The point to understand here is this: the *less* sharply each word’s meaning is specified, the *more* likely it is to connect to other words and concepts. Needless to say, this makes the right hemisphere invaluable in enabling us to understand a range of implications,[55] to see the overall ‘point’,[56] to understand all that is non-literal in language,[57] and to gain insight into an interrelated whole.

Words constantly shift in meaning, and it is only the ‘wiggle-room’ in language that enables it to keep true to what it purports to describe. ‘Just as a good swimmer must be able to swim up-stream, so the philosopher should master the unspeakably difficult art of thinking up-speech, against the current of clichés’, wrote the philosopher Friedrich Waismann, a pupil of Wittgenstein:

> Language is an instrument that must, as occasion requires, be bent to one’s purpose. To stick to language as it is can only lead to a sort of Philistinism which insists on the observance of the *cliché* and will end up with a hara-kiri of living thought … Correctness is a useful, but a negative virtue.[58]

As Bryan Magee points out, the demand that one define one’s terms in advance is not only limiting to thought, but actually illogical:

> the clinging notion that if we are to have a worthwhile discussion we need first to define our terms is demonstrably self-contradictory. Every time we define a term we have to introduce at least one new term into the definition, otherwise the definition is circular. But then we are under an obligation to define our new term. And so we are launched into an infinite regress. Attempts to clarify all our terms must, and can only, result in discussions of words and meanings to which it is logically impossible there should ever be a conclusion. So discussion, if it is to take place at all, has no alternative but to make use of undefined terms.[59]

The hunger for certainty leads to a quest for precision where precision is actually harmful. When dealing with complex conscious beings rather than machines, there can even be a sort of slovenliness about certainty. To quote a not uncritical obituary of Sir Leslie Stephen, the founding editor of the *Dictionary of National Biography*,

> To love certainty overmuch is often to be content with too easy solutions, and definiteness may be achieved only at the price of inadequacy … For, after all, neither literature nor life is quite sane

> and orderly, and the whole truth, perhaps the most vital part of the truth, is not to be looked for in a clear and well-regulated survey. A thing may be perfect only because it is incomplete …[60]

This, too, is a point made by Waismann:

> There is nothing like clear thinking to protect one from making discoveries. It is all very well to talk of clarity, but when it becomes an obsession it is liable to nip the living thought in the bud. This, I am afraid, is one of the deplorable results of logical positivism, not foreseen by its founders, but only too striking in some of its followers. Look at these people, gripped by a clarity neurosis, haunted by fear, tongue-tied, asking themselves continually, 'Oh dear, now does this make perfectly good sense?'… some of the greatest discoveries have even emerged from a sort of primordial fog. (Something to be said for the fog. For my part, I've always suspected that clarity is the last refuge of those who have nothing to say.)[61]

Waismann, it should be remembered, was a member of the notoriously 'rigorous' Vienna Circle, himself one of the key theorists in logical positivism, a mathematician and a physicist, and Reader in the Philosophy of Science at Oxford.

There is an important role for ambiguity (polysemy) in all understanding, something which metaphor, symbol, humour, tone of voice, and all the implicit modes of expression of the arts best understood by the right hemisphere, imply. This is not ambiguity in the sense of just not having taken proper trouble to pin down the meaning: but in the sense of having, indeed, taken proper trouble *not* to pin down the meaning too closely, so as to let it live – the proper rigour of ambiguity.[62] Bringing an unwarranted simplicity to the matter strips away layers of depth, rather than enhancing insight.

Everything is in truth a matter of degree, and everything changes with context – all of which the 'take' of the right hemisphere accommodates better than the left. And the characteristic approach of the right hemisphere is better designed to respect uniqueness. Our ability to produce and

understand generalities was developed and directed to cope with practical requirements; it relates to our tendency to classify our surroundings in a manner that will ensure useful action. All actually existing entities, being unique, can conform only partially to the categories to which our minds consign them; and everything is what it is only within the context in which it finds itself. But the left hemisphere privileges categories in order to make general predictions; thus matters of degree, context and uniqueness are sheared away when the left hemisphere's rationality takes over from the right hemisphere's reason. The process is reminiscent of an attempt to preserve a dragonfly by squashing it into a matchbox.

The dangers of removing things from context apply not just to the more particular case of rendering explicit and precise something whose whole *existence* depends on being implicit and unstated – such as remarks that are humorous or ironic, words that are metaphorical or poetic – but to our simplest categorisations. The most everyday words require to be seen in context, and to understand them clearly they cannot be abstracted from that context.

Take something measurable, like the size of a cereal carton. We may be able to say that it is large, without having to measure it. Our decision is contextual. But, if we agree it is large, could it also be small? Apparently so. In the US there are four sizes of cereal packets: 'jumbo', which means very large; 'economy', which means large; 'family', which means medium; and finally 'large', which means small. (In other words it may be compared with either an absolute or a relative standard.)

The left hemisphere has more of an affinity for what is general than what is unique, and hence is keen to develop rules for putting things in categories where they can be managed. It does so based on the presence or absence of a single feature. But classifying is not stable when based on a single feature, precisely because it ignores context. Thus, a chihuahua is a dog, and, unsurprisingly, a skinny chihuahua is a skinny dog, and a yellow chihuahua is a yellow dog. But a tall chihuahua is not a tall dog. More interesting is the so-called 'pet fish problem'. A guppy is neither a typical pet (think dog), nor a typical fish (think salmon). But a guppy *is* a typical pet fish: here two contexts are required to overlap in order to make the statement true.[63]

We need to categorise in order to make sense of experience. This makes experience neat and orderly – easy to deal with. Surely precision about our

categories can only help here? Since neither hemisphere can begin wholly afresh with every encounter, categorisation is not just a left hemisphere business. But it takes place differently in the two hemispheres, in keeping with their proclivities to focus on a detail or on the whole picture. This is why in the left hemisphere it tends to be carried out according to the presence or absence of a certain feature. For example, employees of a company are those on its payroll. That is nice and precise. But are the owner of the company, who acts as managing director, and the company lawyers, who are all on the payroll, employees? The distinguishing feature of birds is that they fly around; but the kiwi, that doesn't, is nonetheless a bird.

In the right hemisphere, categorisation tends to be carried out according to the degree to which the object, taken as a whole resembles an exemplar – employing what Wittgenstein called a 'family resemblance'. There is no one feature the possession of which decides the case; the secret is pattern recognition. Here it might be easier (though not always) to see that there is something else that goes to making someone an employee, and that the MD and the company lawyers don't have it; or there is something else that goes to making a bird that a kiwi does have. This hemisphere difference, providing two modes of categorisation, one precise and according to detail, the other more global and according to exemplars, must have considerable survival value, as it is also present in other species – including kiwis and guppies.[64]

Sometimes the left hemisphere's precise, 'either/or', criterion is more helpful. For example, there are precise criteria for being a grandmother, namely that you are a woman whose child has become a parent. Here the exemplar of a grandmother – a wise, elderly, white-haired, woman – gets some grandmothers, certainly, but takes in some old women who never had children, and fails to identify the young fitness fanatic with long blonde hair, who has a grandchild. On the other hand, possession of a steeple, while it catches many churches, fails to catch those churches which don't have a steeple, and falsely identifies those buildings, such as a huge and bizarrely unattractive office block in West Oxford, and a parking structure at Baylor University, Texas, that do. There is no single feature to identify a church that will be as helpful as the family resemblance approach. We need both.

In terms of the law, it is usually helpful to apply left hemisphere categorisation at some points – 'for this matter to qualify as an *X*, it must

have a *y*' – but it will also be necessary to look at past cases, effectively employing the 'exemplar' approach of the right hemisphere, and be able to say, this case is more like case *A*, than case *B*, overall. The right hemisphere is more flexible, and so is this process.

It seems to me that one of the most distinctive human characteristics is that of flexibility. 'Single-mindedness is all very well in cows or baboons', wrote Aldous Huxley: 'in an animal claiming to belong to the same species as Shakespeare it is simply disgraceful'.[65] Shakespeare was, according to Coleridge, 'myriad-minded': his genius was manifest in the unpredictable freshness of his creations, who often refuse to respect the stereotype the plot demands of them.[66]

To those who like regularity (literally, 'the following of rules'), another trait prominent in autism, such flexibility and originality can seem no more than inconsistency. Richard Duppa, a lawyer and draughtsman, observed drily: 'While philosophers were seeking to find a character for man to distinguish him from other animals, inconsistency ought not to have been forgotten.'[67] Whether he approved or not, I don't know: he had a good sense of humour. However you look at it, consistency has its unacknowledged dark side: 'Too much consistency is seeing situations as similar when they are, in fact, different', as John Kay puts it, and as I have tried to suggest.[68] Or, to quote Aldous Huxley again:

> Too much consistency is as bad for the mind as it is for the body. Consistency is contrary to nature, contrary to life. The only completely consistent people are the dead.[69]

The need for consistency and certainty drives out ambiguity. Philosophy literally means the love of wisdom; and wisdom, as the pronouncements of the Delphian oracle demonstrated, is never void of ambiguity. One of the most justly famous works of literary criticism is entitled *Seven Types of Ambiguity*: different types of ambiguity account for much of the richness and depth of literature. As its author William Empson put it, in the work of art you have something like a stew, in which the pieces of meat you recognise play a part, but 'the juice in which they are sustained must be regarded with a peculiar respect because they are all in there too, somehow, and one does not know how they are combined or held in suspension.'[70]

Here we are close to what Keats, in a well-known passage in one of his letters, called ‘negative capability’:

> at once it struck me what quality went to form a Man of Achievement, especially in Literature, and which Shakespeare possessed so enormously – I mean Negative Capability, that is, when a man is capable of being in uncertainties, mysteries, doubts, without any irritable reaching after fact and reason.[71]

It is because of the complexity of truth that we need to reach down into the realm of the unconscious, not just into that tiny part of our embodied being of which we are fully conscious, and where all is clear. The painter and sculptor Braque said that ‘in art there is only one thing that matters: what cannot be explained.’[72] It is the duty of art not to let things collapse into an illusory simplicity, but to permit them to be present as far as possible in all their complex and sometimes contradictory nature, something that can be achieved only by allowing much to remain implicit.

Clarity is a wonderful, indeed beautiful, thing, where it can be achieved without loss of truth. We cannot let ourselves off the hook of striving for it. But we need also to know the proper place to stop. Its application is limited, and on a larger scale its virtue becomes a vice; then it is no longer the agent of truth, but – somewhat paradoxically – its obfuscator. It gives us the bogus sense that we have covered the ground, whereas we have only started scratching it. As Rabindranath Tagore put it, ‘the small wisdom is like water in a glass: clear, transparent, pure. The great wisdom is like the water in the sea: dark, mysterious, impenetrable.’

It would be a mistake to think that it is just in a somewhat mystical sounding realm that precision causes problems: it can cause them in any philosophical judgment. Here I think of Whitehead once more:

> The sharp-cut scientific classifications are essential for scientific method, but they are dangerous for philosophy. Such classification hides the truth that the different modes of natural existence shade off into each other.[73]

And even at the level of everyday life, precision can be far from helpful. Since our language has relatively few colour words, there will be many shades that might be classified as ‘blue’ by some people, as ‘green’ by others, and as ‘grey’ by still others, without anyone being wrong. But that’s not because there is no right or wrong: try calling it ‘orange’. Language is neglectful of the unique. We saw that 40 million colours are discriminable by the human eye: if we had 40 million words for colours that would not be an improvement. Language relies on approximation: a language with a word for every distinguishable aspect of the world would not be a language at all. It would be like the map that is the same size as the world it maps.[74] Language always shrinks reality: the one exception to this is poetry, which absolutely depends on ambiguity to escape. Language is a gross approximation – and that’s why it works. Yet there exist people who believe that only once a thing is stated in *language* can it be precise. (Well, I grant you, a map has a precision that life lacks. It’s just that that precision has little to do with reality.)

The philosopher Bryan Magee writes that ‘*whenever* I see, all that language can do is to indicate with the utmost generality and in the broadest and crudest of terms what it is that I see’:

> Even something as simple and everyday as the sight of a towel dropped on to the bathroom floor is inaccessible to language – and inaccessible to it from many points of view at the same time: no words to describe the shape it has fallen into, no words to describe the degrees of shading in its colours, no words to describe the differentials of shadow in its folds, no words to describe its spatial relationships to all the other objects in the bathroom. I see all these things at once with great precision and definiteness, with clarity and certainty, and in all their complexity. I possess them all wholly and securely in direct experience, and yet I would be totally unable, as would anyone else, to put that experience into words. It is emphatically not the case, then, that ‘the world is the world as we describe it’, or that I ‘experience it through linguistic categories that help to shape the experiences themselves’, or that my ‘main way of dividing things up is in language’ or that my ‘concept of reality is a matter of our linguistic categories’.[75]

We *can* find ways of using language and figures to be more precise, but we risk conveying less by doing so. For example, being told that a certain colour is ‘bluey-green’, though vague, is much more informative than telling me that it has an RAL number of 5018 or a wavelength of 492nm. Similarly, telling me that a certain Thai engineer earns 25,250 baht per month is more precise, but much less helpful, than saying he or she is well-off by Thai standards, though still poor by those of the USA.

Precision may impair the content of an utterance in a number of ways. Thus I may say to a friend who is coming to dinner, ‘do please bring your toothbrush’ – meaning he is welcome to stay over. But if I am more precise, I enter a mire. ‘Please bring your toothbrush and some toothpaste.’ Worse – much worse: he may now think I am suggesting that he needs to be prompted to freshen his breath. A broad vague term, doing a lot of work, has suddenly collapsed into too narrow a specificity. I am now obliged to carry on with this process. ‘Please bring your toothbrush, toothpaste and some pyjamas’ avoids the imputation of bad breath to some extent, but is now in danger of being a comment on my prudishness, or his nudishness, and is getting so specific that it may seem odd that I am not requiring the addition of a hairbrush (perhaps I am implying that he can borrow mine?) or a razor.

In order to be effective, laws have to balance precision with vagueness. It might seem that the more precise the law, the better it is for those who have to obey and to enforce it. But clearly this is not always – indeed not often – the case. Let’s take a very simple case. Where there is a sign stating ‘no ball games in the park’, a person practising archery there ought not to expect to go ahead with impunity simply because the projectile in this case is not a ball. Equally, someone playing a handheld plastic pinball game would not expect to be apprehended for playing this particular ‘ball game’ in the park. But to specify all proscribed projectiles, along with exceptions to the list, would be unbearably tedious, would require the environment to be even more polluted with signs, and much bigger signs at that, than it already is, and would convey much less information, because few people would have the patience to read them: the funeral of common sense.[76] The proliferation of prosperous lawyers *pari passu* with the proliferation of laws suggests that there must always be a large element of interpretation in any system, however detailed its provision.

And its very specificity would be a strong argument that anything not specifically mentioned was permissible, even if potentially lethal. The more you pursue this path, the more you are open to the burden of completeness. There will always be such items, even if only because they were invented, or the term came into parlance, after the notice was last revised (and the notices would have to be endlessly revised). And how stupid do you have to assume your reader to be? Exhaustiveness is exhausting, and exhausts the human in us. What do you assume he cannot work out for himself? The concept of an appeal to reasonableness still, just, lingers on in the courthouse, so that we expect the law to be interpreted flexibly, with a sense of proportion and, dare I say it, a proper sense of the absurd, not imposed by administering a machine-like algorithm. Soon we may not be so lucky. As Louis de Bonald saw in the first few years following the French Revolution : ‘A people that has been deprived of its customs through a desire for written laws has imposed on itself the harsh necessity of writing down everything, even its customs.’[77]

Occasionally, it seems to me, we need to abide by the letter of the law, particularly where a reasonable person could have so interpreted it, and particularly where to do so gives the benefit of the doubt to a defendant; but mostly we hope that the spirit of the law may prevail over the letter.

There are borderline cases. Personal judgments are inevitable in the law, as they are in medicine, in both of which the whole experience and personality of the decider may influence judgments of what is reasonable, effective or humane. That judges differ, provided it is within an unspecifiable, though recognisable, circumscribed span, is not a matter for regret, but for acceptance, perhaps even celebration; and indeed a variety of approaches is truer to the range of views on such matters held in a society than just one, inflexible, view ever could be.

A failure to see this leads to accusations of unfairness when sentences for similar offences differ. There are calls for standardisation. But the alternative is to have inflexible sameness in every case, resulting in (justified) accusations that ‘the law is an ass’, because common sense was unable to discriminate differences in the apparently similar cases. Equally, where a health authority may choose its priorities by reference to the needs of its particular population, this leads to accusations of a ‘postcode lottery’, because services available in one area are not in another; but where it no

longer has such freedom to choose, the accusation is that central planning of healthcare ignores local needs and local preferences.

Additionally, what was considered reasonable – or offensive – 50 years ago, might not be so considered today. This is not grounds for considering that judgment cannot work, but that we clearly cannot work without judgment. These are *necessarily* vague areas. Even some that look superficially precise, and where our language is precise, may be rendered 'open-textured', in Waismann's phrase, by the onward march of technology. Thus, 'mother' is a classically precise term; but now that a baby may be derived from the ovum of one woman, delivered from the womb of a second woman and brought up by a third, the term has become 'porous' to a degree that renders precision impossible, at least without some such ugly qualifier as 'genetic' mother, 'birth' mother or 'care' mother.

By being more precise we increase the risk of spurious inaccuracy – being perhaps trivially wrong. 'A bunch of kids' is more accurate than 'seven' if there were in fact eight. Dryden died in 1700: if I say he died at the beginning of the eighteenth century, I am right even if I am thinking of 1704, whereas if I say he died in 1701, I am less mistaken, but plain wrong. Vagueness can be importantly protective. If I tell you that a fungus you have picked is an *amanita*, you will probably not want to eat it, and will live; if, being more precise, I tell you it is *amanita cæsarea*, a prized delicacy, and it is in fact *amanita phalloides*, otherwise known as deathcap, you may not.

Sometimes it is in the nature of our *knowledge of the object* that we cannot be precise, as with the 9,000,000 year-old dinosaur; and sometimes in the nature of *the object of our knowledge*, since in real life things tend to spread, blur and ramify: rivers and streams, woods and forests, hills and dales, families and communities are all like this.

We have seen already how bogus precision creeps into the 'mismeasure' of all things human, not always because, as Gould thought, they simply can't be measured (though many can't), but because norms cannot have clear cut-off points. The problem is not that we cannot measure obesity, for example; we can, at least with a non-negligible degree of accuracy. But behind our measurements lies an inevitably arbitrary, but sharp, boundary: obese or not. Therein lies the problem, or at least one of them.

CALCULATION VS JUDGMENT

Our admiration for calculation deserves scrutiny. But first let me say something about precise calculation and brain lateralisation.

There is considerable overlap between areas involved in calculation and those involved in language.[78] This is because doing arithmetic involves elements that are obviously linguistic. Being able to recite and articulate number names and 'times tables' involved in multiplication draws on language areas of the left hemisphere.[79] However, there are just as obviously non-linguistic elements, including the visual representation of number forms and relationships, which draw on both hemispheres.

Exact calculation shows a more left-lateralised pattern of activity than approximate calculation.[80] Approximate calculation sounds like something obviously inferior, but by 'approximate' calculation is meant, for example, being able to see which of two proposed answers to a problem, neither of which is precisely correct, is *closer* to being correct. This does not involve carrying out a sequence of verbalising processes according to rules, but having a 'feel' of what the right answer is likely to be. Even just identifying which of two numbers is the larger has been found to exhibit a right hemisphere lateralisation, as opposed to the strong left hemisphere lateralisation involved in multiplication.[81] It is not perhaps surprising that understanding false versus genuine facial expressions of emotion, whether the task is deliberate or automatic, depends on the right orbitofrontal cortex and temporoparietal region.[82] But so does number processing. In a task involving appreciating the relative value of a number

> the same parietal functional asymmetry seems to underlie both automatic and intentional numerical processing with only the right, but not left, intraparietal sulcus being causally relevant for successful performance during both tasks.[83]

There is I believe, a suggestive comparison here with hemispheric contributions to language. Most aspects of syntax, certainly syntax that is in any way complex, are far better carried out by the left hemisphere;

however, understanding ultimately what an utterance *means* is highly dependent on the right hemisphere's so-called 'pragmatics'.[84]

The quantification of human variables is almost bound to entail measuring a proxy that is quite different from what it purports to be measuring, and coming up with a figure that implies a degree of precision neither the subject, nor the means of measurement, can sustain. This is not an amusing technicality: it happens every day and plagues our lives.

In an era in which measurement and monitoring apply across the board they can have a baleful effect on creativity. In September 2016, the Arts Council of England forged ahead with plans to impose a standardised system for measuring artistic quality on its 'National Portfolio Organisations'. Arts organisations themselves were understandably sceptical of a standardised approach to measuring quality in the area of creativity, not to mention the administrative burden associated with it. Despite resistance the Arts Council chugged on regardless, claiming to have developed a 'meaningful measure' of artistic quality that yielded consistent results, and providing a digital 'platform', ominously called Culture Counts, to manage the process and handle the data. You can tell how much the administrators of the Arts Council understand about art from their beautifully crafted statement that 'the trial has given us confidence that there is sufficient support within the sector to examine the quality of work in an exciting, contemporary way, enabling us to now support a wider roll out of the quality metrics'. Shelley could not have put it better; indeed he would have been rendered temporarily aphasic. One 'arts professional', whatever that is, possibly speaking for many, is reported as expressing concerns about 'reducing artistic quality to a statistic'.[85] Also to something that has to be delivered in measurable amounts within a time schedule. If that's what 'the public requires' when it comes to the spending of public money, the public needs to be educated. Wherever money comes from to support the arts, the only way that makes sense – as with research in academe – is to choose good people by judgment rather than by formula, and let them get on with it, not hover over them, brandishing a metric, and breathing down their necks.

One of my favourite lines is 'OK, the data's lousy, but it's all we've got': according to a booklet bearing this title, it is 'an actual quote, and the speaker, a full professor of economics at a reputable US university, is reasonably well known'.[86] As the booklet's author, Gerald Gill, points out,

‘it may seem obvious, but in view of what has just been said it is perhaps worth stating the obvious: *wrong data are worse than no data*’. And he quotes the biologist and historian Robert Chambers’ critique of ‘survey slavery’:

> Exhausted researchers … stare at print-outs and tables. Under pressure for ‘findings’, they take figures as facts. They have neither time nor inclination to reflect that these are aggregates of what has emerged from fallible programming of fallible punching of fallible coding of responses which are what investigators wrote down as their interpretation of their instructions as to how they were to write down what they believed respondents said to them, which was only what respondents were prepared to say to them in reply to the investigators’ rendering of their understanding of a question and the respondent’s understanding of the way they asked it; always assuming that an interview took place at all and that the answers were not more congenially compiled under a tree or in a teashop or bar, without the tiresome complication of a respondent.[87]

In mathematics – at least in calculation, which is just one part of mathematics – precision may seem to be essential. For some purposes, naturally, it is: our society’s exchange mechanisms depend on precise calculation, as does engineering, and as do many elements of science. But it is quite a jump from such a utilitarian justification of calculation to the wider belief that any conclusion reached by the exercise of reason can be truly rational only through the deployment of calculation. Yet that, it seems, is a view increasingly held, explicitly or otherwise, in the contemporary world. And it involves (indeed it requires) the transposition of what the right hemisphere identifies as ‘quality’ into what the left hemisphere can manipulate as ‘quantity’ – that’s to say, the conversion of something imprecise into something precise – a number – the necessary precondition for calculation to proceed. Much harm ensues.

From the point of view of the hemisphere hypothesis, numbers are interesting in their own right. We have, alas, become used to trying to represent quality by quantity, but not to seeing that quantities, too, have quality. By this I mean three things.

First, numbers themselves have qualities – certainly the lowest numbers, from 1 to 10 do, and to a mathematician many more, such as, in particular, 37 or 1729. They differ not just in amount, but in the characteristics of the number. Each of the first numbers, 1–9, has a different role and appears in different places for different purposes throughout nature – odd numbers, like asymmetry, being particularly associated with generating newness – and has different qualities within music.[88] According to Jung,

> There is something peculiar, one might even say mysterious, about numbers. They have never been entirely robbed of their numinous aura … Unlike concepts, they are based not on any psychic conditions, but on the quality of being themselves, on a "so-ness" that cannot be expressed by an intellectual concept. Under these conditions they might easily be endowed with qualities that have still to be discovered. I must confess that I incline to the view that numbers were as much found as invented, and that in consequence they possess a relative autonomy analogous to that of the archetypes.[89]

Like everything else, numbers can be approached in the typical mode of the left hemisphere, or of the right. In left hemisphere mode, they are thought of as absolute entities, abstract, of equal quality, and adynamic (the word 'statistics' is derived from the same root as 'static'). In right hemisphere mode, they may be seen as dynamic relations: music and beauty arise out of the relational nature of numbers, their proportions and structures. In music this is inherent in melody, harmony and rhythm. Something as simple as changing from 4/4 time to 3/4 time changes the *quality* of the experience entirely, and of course harmony and melody are utterly changed in their meaning by altering the relationship between the notes – in which the music exists, and in which alone it exists – even by small (though not by infinitesimally small) amounts, such as a semitone or a quartertone.

In the visual world certain proportions, such as the Golden Ratio (φ) which is found repeatedly in nature, are experienced as intrinsically beautiful.[90] Thus the number has human meaning. The golden ratio is arrived at mathematically by taking any number you like, dividing 1 by it,

adding 1, and repeating the process an infinite number of times. Whatever number you start with, you converge on a number that is approximately 1.618, universally appreciated as aesthetically satisfying in its relation to the number one. I say ‘approximately’ because, like other important ratios we find everywhere in nature, such as π, *e*, and √2, it can only be approximated, never finally reached. It is said to be ‘irrational’: that is, its inherent reality can, in the nature of things, be specified only imprecisely.

Thinking again of numbers as having individual properties, the golden ratio has a relation with the number 5, since φ is repeated throughout the structure of a pentagon and a pentagram, but that relationship is concealed.

The idea that numbers are relational, rather than absolute, is also embodied in colours: colours have frequencies, and those whose frequencies do not ‘harmonise’ are said to ‘clash’. For Pythagoras, there was a natural harmony in the universe founded on numerical relationships, and it was expressed as the music of the spheres, a belief that the numerical proportions – the relationships – of planetary movements expressed a music inaudible to our ears, a belief that was held up to at least the time of Johannes Kepler, who wrote a treatise on the subject, *Harmonices mundi*. Shakespeare’s Lorenzo in the *Merchant of Venice* puts it thus:

> There’s not the smallest orb which thou behold’st
> But in his motion like an angel sings,
> Still quiring to the young-eyed cherubins;
> Such harmony is in immortal souls;
> But whilst this muddy vesture of decay
> Doth grossly close it in, we cannot hear it.

I mentioned Jedediah Buxton in Chapter 9. He was an extreme case of the apprehension of quantity dominating the apprehension of quality, and of meaning, to the point of the latter’s total obliteration. But it is only an extreme case of a much more common phenomenon in contemporary culture: the attempt to convert as much as possible of what we value qualitatively into a quantity that can be subject to an exercise in calculation and ignore, Buxton-like, anything that cannot be converted. Very often these are all the most important things.

This is the second sense in which quantification introduces qualities of its own. I have seen a 300-page report on the impact of a certain projected

development on a region of outstanding natural beauty that catalogued possible impacts on the local economy, employment, the return on investors' capital, the likely productivity of the scheme, its potential for 'recreational activities' and so on, and only on the last page acknowledged that there were 'possible impacts' on the profound beauty, peace and majesty (naturally the terms are not theirs, but mine) of the landscape, but that these were impossible to assess and had therefore not been included in the calculations. Even more striking is a report from the World Bank on the World Health Organization's onchocerciasis control programme, which saved hundreds of thousands of poor people in Africa from going blind. A cost-benefit analysis was 'inconclusive' because the people were so poor that saving their eyesight had little economic impact. 'There are humanitarian benefits associated with reducing the blindness and suffering caused by onchocerciasis', they conceded, but 'these benefits are inherently unmeasurable, and we will not account for them here.'[91]

Our desire to calculate leads us to invent weights and measures to 'evaluate' issues before us. But numbers can never *evaluate* anything at all, precisely because they don't deal with values. Even if you 'evaluate' something as 'profitable', the value is nowhere to be found in your measurement, which has no capacity to deal with value (although, subtly, it imports a pernicious value, that of the person who believes everything can be measured). The value is what is in the background here: your desire to make a lot of money. When we measure the worth of a person, a poem, a quartet, a painting or a landscape – or a social policy – it is not that *they* are judged by our measures, but that the appropriateness of our measures is weighed in the balance by *them*, and most often found wanting.

And then there is the third point, that quantity in and of itself changes quality. For example, we casually say 'you can't have too much of a good thing'. Yet more of a good thing – say, liberty, transparency, equality, pudding size, hang-gliding, insulation, economic growth, safety, hygiene – does not inevitably make things better: it often makes things worse. Even things we think of as bad – say, punishment, secrecy, kale salads, shame, hunger, discomfort, constraint, taxation, grief – don't get better if diminished beyond a certain point. *Quantity always changes quality*. This is so obvious that I am sorry to have to state it, but the fact remains that in public debate, the very large majority of the time, some things are just assumed to be better, the more we get, and others to be simply bad, however

much we have, and to be extirpated root and branch. If you asked people to consider whether this was realistic they would probably say ‘no’, but would then go back to behaving as if it were true. ‘Complete inability to control the response to pain is damaging’, writes John Kay, ‘but so is too much control.’[92] For *everything* there is an optimal amount, and it is rarely if ever zero or infinity. Even what appears evil may cause some good, and what seems good cause some harm. If it is true that every devil has his angel, it is also true that every angel has his devil (see Plate 24).

Furthermore, some things cannot be expanded indefinitely without radically changing their nature. To take an obvious example, access to wild and beautiful places: once they are mass tourist destinations they are no longer wild and beautiful, so the process of expansion destroys the reason for their being desirable. No doubt controversially, I would argue that this can happen with university education: the attempt to expand it beyond a certain level begins to erode the valuable things for which it was desirable in the first place. Of course it remains an open question, for each of these issues, *at what point* we start to go down the other side of the curve, something on which reasonable people may differ, but it is a question that is insufficiently publicly discussed. It is simply assumed that there is a straight line. I shall come back to our predilection for linearity.

Ultimately, many human qualities are just not quantifiable in any but the vaguest conceivable way, yet we know exactly when, and to a large degree how greatly, we experience them: for example, beauty, anger, hunger. Asking to quantify them would be like someone hearing Othello’s great howl of rage and despair, ‘O Spartan dog, more fell than anguish, hunger or the sea!’, and responding: ‘Yes, OK – but how much more fell?’

I will have more to say about morality in due course, but since we are here talking about the drive to quantification, I wish simply to note that it surely says much about us as a society that serious moral philosophers now believe there is a calculus of morality, whereby we can tot up the costs and benefits, and come up with an answer. This is the fulfilment of Leibniz’s dream of his famous abacus, and declaration *calculemus* (‘let us calculate’). Thus we have the infamous ‘trolley’ thought experiments: would you be doing the morally superior thing if you pushed a fat man off a bridge in such a way that in landing he switched the points, and changed the course of a runaway truck, so that it would kill only one adult and two children instead of five adults?

No doubt it would be said to be in the service of our friend, objectivity. Yet one of the reasons we are captivated by great plays such as *Richard III* – to return to the Jedediah Buxton example – and novels, narratives and myths, is that they allow us to stand back: to step away from the immediacy of experience, through what I call 'necessary distance', and see the complexities under which all human life labours. Such distance does not alienate, but, on the contrary, enables us to see ourselves with heightened awareness, and to empathise with those who stand *for* us – and for more than us. Great dramatic performances play out, in archetypal form, the intricacies of all human relationships and human motives, the conflicting demands of many-faceted love, of friendships, family and kin, of valued work, vocation, and the urge to create, the striving to preserve dignity and pride, and the lure of beauty towards things that are perhaps exciting, dangerous, deeply fulfilling and unendurable at once – not to mention loyalties to religious conviction, to a society's cohesion, to the need to avoid pain, and the call to confront evil, to belong to a society and to be a unique individual, to heal, to save and to give meaning to life. In short, they inculcate the practice of judgment. That something like this can be reduced to calculation is an extraordinary idea, to say the least. Here is Roger Scruton:

> When Anna Karenina asks herself whether it is right to leave Karenin and to set up house with Vronsky, she is asking herself which of two courses of action would be better. But although she is making a comparative judgment, it is not one that can be resolved by a calculation. She is torn between her obligations to her husband and her child, and her love for Vronsky. Her dilemma is not detachable from its peculiar circumstances – her husband's vindictiveness and coldness of heart, her son's sweet devotion, Vronsky's *Leichtsinn* and Anna's knowledge of his faults. Dilemmas of this kind exist because we are bound to each other by obligations and attachments, and one way of being a bad person is to think they can be resolved by moral arithmetic. Suppose Anna were to reason that it is better to satisfy two healthy young people and frustrate one old one, than to satisfy one old person and frustrate two young ones, by a factor of 2.5 to 1, ergo I am leaving. What would we think, then, of her moral seriousness?[93]

The very act of calculation here betrays a lack of awareness of what the whole experience of morality involves. In real life, *of course*, people do not make moral judgments like this, and only a very odd mind – perhaps brilliant at calculation, but otherwise incapable of understanding the richness of the normal human being's world – would think that they ought. If humans ever did, it would be the most grievous folly, one which would spell the reduction of human beings to the status of machines. Calculation works only if you strip humanity to the bone: and then it is no longer human.

More commonly what happens is that we delude ourselves when we retrospect on how we reach moral decisions, much as we are deluded when we retrospect on our motives for many actions, by the fact that when we do so consciously we engage the serial, analytic processing of the left hemisphere. The left hemisphere is a great 'confabulator', as we saw; when it doesn't know, which is much of the time, it doesn't say so: it makes something up to fill the gap. Not being aware of how the decisions were reached, it asserts confidently that we got there by the serial analytic processes it would have used if it had to set out explicitly to tackle the problem. Some professional philosophers then appear to believe this to be the case.

We do not 'work out' moral principles on the basis of utility, as the left hemisphere imagines. Except in artificially contrived situations, such as academic debate, moral decisions are not the product of deliberative calculation, but of unconscious and intuitive judgments, derived from experience and deeply bound up with our emotional sensitivity to others. But they are no less rational for that.

It is a point Waismann makes when rescuing the concept of reason from those who would restrict the term to the left hemisphere's narrower concept of rationality, the exercise of precision, calculation and deduction. 'When the judge reaches a decision', writes Waismann, 'this may be, and in fact often is, a rational result',

> yet not one obtained by deduction; it does not simply follow from such-and-such: what is required is insight, judgment. Now, in arriving at a verdict, you are like a judge in this that you are not carrying out a number of formal logical steps: you have to use discernment, eg to descry the pivotal point. Considerations such as

these make us see what is already apparent in the use of ‘rational’, that this term has a wider range of application than what can be established deductively. To say that an argument can be rational and yet not deductive is not a sort of contradiction as it would inevitably be in the opposite case, namely, of saying that a deductive argument need not be rational. This alters the whole picture. The point to be emphasised is that *a philosopher may see an important truth and yet be unable to demonstrate it by formal proof. But the fact that his arguments are not logical does nothing to detract from their rationality*.[94]

LINEARITY VS THE *GESTALT*

Calculation is just a specific case of a broader aspect of the left hemisphere's mode of reasoning, namely its attachment to linearity, building up its reasoned re-presentations of reality step by step. Waismann's point is that such a logical mode of reason isn't the only form. There is the other twin, equally rational, where 'a philosopher may see an important truth and yet be unable to demonstrate it by formal proof'. That's to say, the philosopher sees the 'important truth' as a *Gestalt*, the whole as a single totality rather than working his way to it as the end discovery of a linear, causal sequence.

An argument is not a single decontextualised event that must compel a conclusion in anyone, ever, at all. It is just one more piece of evidence to sit with, and be weighed with, many others. If it does not fit with the tendency of everything else one knows, from thinking and from the business of life, it may be wise to doubt it. Equally, there may be many truths to which one cannot climb by one thread, but only by a rope woven of many strands. There is profound wisdom in CS Peirce's remark that

> philosophy ought … to trust rather to the multitude and variety of its arguments than to the conclusiveness of any one. Its reasoning should not form a chain which is no stronger than its weakest link, but a cable whose fibres may be ever so slender, provided they are sufficiently numerous and intimately connected.[95]

Moral evaluation in particular involves, or should involve, moving on from what the left hemisphere sees as a simple causal sequence, step by step, to what the right hemisphere sees as a whole narrative: how the person arrived at those particular circumstances, what was going on in his or her mind at the time, what sort of a person would think or act in that way, whether we would like to live in a world where such people form the majority – in other words, the whole human picture, not the mechanistic part picture: Anna Karenina as a troubled spirit, not a sum to be solved.

In Part I we saw that narrative is not adequately understood by the left hemisphere; and that in schizophrenia, logic has to stand in for narrative as

the factor that attempts to link complex human events, with deleterious consequences. Linear causation is the kind of sequence that the left hemisphere *does* understand. But such reasoning can lead us astray, as one particularly elegant piece of experimental evidence neatly demonstrates. Subjects were presented with two scenarios: in one a woman put poison in a friend's coffee, believing it to be sugar, and her friend died; in the other she put sugar in her friend's coffee, believing it to be poison, and the friend lived. In the normal situation subjects naturally judged the second scenario morally worse, as most of us would, because the woman was intent on murder, not the victim of a mistake. However, with the right temporoparietal junction experimentally suppressed using TMS, subjects, relying on their left hemisphere, judged the woman in the first scenario to have acted more immorally, because the friend died.[96] Here the consequentialist approach, which the left hemisphere adopts, is really to do with an excessive willingness to judge a scenario by the externally observed chain of causation. Causing death is bad: whose action was causally responsible for a death? Then that's the guilty one.

Because the left hemisphere is the hemisphere that believes it *causes* things to happen – it is the manipulator – it privileges the relationship of causation, in which one action causes another. In fact it is claimed by Nikki Marinsek and colleagues that only the left hemisphere infers causation.[97] Whether that is so or not, the important point is that the right hemisphere is reluctant to assume causation, since the whole person requires the right hemisphere's input for us to judge whether what is taken by the left hemisphere to be causative is *capable of being so construed*. This is a matter of understanding a complex picture as a whole, not just latching on to a single thread. On its own the left hemisphere is over-eager to infer causation, and will infer a causative relationship even where clearly none exists.[98] The right hemisphere, particularly right temporoparietal regions, is more important for discriminating causation from non-causation.[99] Whether the proposed causal link is purely physical, as in one ball striking another, or social, as in the fatal coffee cup, the key activations associated with the evaluation are in the right middle/inferior frontal gyrus, right inferior parietal lobule, the right supplementary motor area, and bilateral insulae; for social causal judgments, the right temporo-parietal junction is of critical importance (as the fatal cup experiment demonstrated), as it is involved in judging animacy and intentionality.[100] The right hemisphere's appreciation

of the *Gestalt* is more reasonable, more likely to lead to the truth; the left hemisphere's linear approach is more likely to be mistaken.

And this brings me to another paradox concerning linearity and its limitations. For a rational being it seems obvious that you need to be clear about your goal, and then find the most direct way of pursuing it. To be unclear about your goals, to waste time by not pursuing them by the most direct means possible, is clearly illogical.

Unless, that is, the process doesn't work.

> 'I think I'll go and meet her', said Alice, for, though the flowers were interesting enough, she felt that it would be far grander to have a talk with a real Queen. 'You can't possibly do that', said the Rose: 'I should advise you to walk the other way.' This sounded nonsense to Alice, so she said nothing, but set off at once towards the Red Queen. To her surprise, she lost sight of her in a moment, and found herself walking in at the front-door again.

To a child this is amusing and nonsensical. However, to an adult – as is invariably the case with Lewis Carroll's paradoxical manner – it reveals a deep truth about the world.

Your ultimate goal might be happiness; and there are worse goals to have. The trouble is that, with all due respect to the US constitution, happiness can't be pursued. People who pursue happiness find that it constantly eludes their grasp, like the bunch of grapes before the outstretched hand of Tantalus. Just as the harder we pursue sleep the more it evades us. Some truths are less self-evident than others (all the true ones, by the way).

There are rational goals that the rational person ought to pursue, which nonetheless can only be achieved by not pursuing them: along with sleep and happiness, these include things as diverse as wisdom, sexual performance, sympathy and being natural. The direct approach destroys its object. Similarly there are things that can be conveyed only indirectly. To recapture the depth of what is said, or in order to say anything truly new, we are always engaged in going beyond everyday language, which means being alert to what is being said *implicitly*. It is because there is so much that cannot be conveyed in any other way, because explicitness changes its nature, that we value – or should value – poetry, humour and embodied

metaphor (otherwise known as ritual) of whatever kind. They all have the same quality that, once they are made explicit or 'explained', they completely lose their power and their meaning. Moreover, the difficulty with defining goals and logical methods of achieving them is not *just* that they often can't be achieved by the direct approach, but that only factors that are not only articulable, but, moreover, have already been articulated, are taken into consideration, leaving out all that is implicit and comes only from engagement with the world and experience of life.

Interestingly, much as the happiest people don't seek happiness, the wealthiest people are not those who most ruthlessly pursue wealth.[101] John Kay cites a number of cases of global giants, household names such as ICI, Boeing, Merck, Pfizer and Citigroup, which were once highly profitable organisations while they focussed on delivering a good product, but which nosedived as soon as the bean-counters took over, and told people to focus on the bottom line – making money. Greed doesn't pay (although abjuring greed because it pays better to do so is to thwart oneself, since it is the attitude of mind, not a certain action or set of actions, that is both in itself to be desired and goes to create prosperity). Success in business comes, bizarrely enough, as a by-product of running a good business.

Kay might have referred to the case of Kazuo Inamori, a Buddhist priest who took over as chief executive of Japan Airlines in the second half of 2010 at the age of 77, having no experience in the industry. The next year, he returned the company to profit and led it out of bankruptcy. In 2012 he relisted it on the Tokyo stock exchange.[102] His philosophy? Looking after his workers and making sure they enjoy what they do: 'if you want eggs, take care of the hen. If you bully or kill the hen, it's not going to work.' In case you think Japan Airlines was a one-off, Inamori started two companies of his own, the combined market value of which was $82 billion by 2015.

The problems for the rational mind begin with defining goals. Aims are complex and not infrequently incommensurable – even incompatible, if we are entirely honest. As Kay points out, goals need, in any case, to be flexible, responding to changing circumstances; and these in turn vary depending on *how*, and *why*, we pursue such goals. Since the world is, to all intents and purposes, infinitely complex in its structure, we could not predict it, even if there were no 'black swan' events, as Nobel Prize-winning economists have found out, with limited capacity to rescue face from egg.

Some uncertainties are irresoluble, and we do well to recognise our limitations, since it makes for better decision-making. We need to be responsive to each step of the process. If you watch an animal – even an animalcule, such as an amoeba – exploring its environment, you will see it make forays, withdraw and adapt, try again in another direction, withdraw, and then find a direction it is prepared to pursue. Trial and error. Good decision-makers are eclectic and not wedded to 'consistency'. But when things turn out, for whatever reasons, the way we thought they might, we tend to overestimate *our* role in their doing so. We overestimate our ability to predict and to control. That way disaster often ensues.

An algorithm as a replacement for an embodied skill is one case of an insufficiently flexible path, a concatenation of steps that aims to achieve a reliable goal. At its best, and if the poor performers at whom they are targeted were likely to follow them, they would avoid some poor outcomes. But they would ensure others. They are generalisations, and every case needs to be evaluated on its merits. Even if they were sufficiently reliable to cover most cases, they would eventuate in mediocrity. Dreyfus and Dreyfus outlined the difference between embodied skill and an algorithm, the skill being something that is so much part of an expert through experience that the skilled practitioner is barely aware of his or her own knowledge.[103] They distinguish five levels of skilfulness, beginning with the novice and working up to the person with judgment informed by a lifetime's experience. The detail of these levels is not important, but their conclusion is. In the first three levels of skill acquisition, algorithms are overall more helpful than not: in the highest two they actually impede excellence. You shouldn't break the rules until the rules have become second nature – but then you *must* sometimes break the rules if you are to be successful and excel at what you do. Skilled pilots, surgeons, or commanders can often offer little insight, after having skilfully handled a crisis, into how they thought, or why they did what they did. Most often they say, 'I just did what I had to'. Once questioned, they offer *post hoc* rationalisations, if anything at all.

As Kay puts it,

> solving equations of motion is a means of understanding how well-judged shots find the goal, but it is not a means of making it happen … People spend inordinate amounts of time asking experts like

> Beckham what is the secret of their success. They don't come away much the wiser.[104]

In politics, coming up with a list of clearly defined ends and then looking for the technical means of realising them most efficiently ignores the complexity, the many-strandedness, the non-absolute nature, of all ideals, of all knowledge, of all experience. The best of what we glean from experience is not technical in nature; and the kinds of knowledge it affords can be articulated only with great difficulty and subtlety, and are the first kinds to be ignored in articulation. They are acquired, honoured and transmitted only through our participation in a community extending over time in which we are immersed, and from which we take our very identity as individuals, our distinctness, even our capacity for intelligent opposition to received wisdom – what is called a tradition.

Beyond all such considerations, many rational and desirable goals are simply incompatible with the state of mind required to pursue them: they must come, if they come at all, as the by-products of a life well lived. Among these are humility, courage, love, admiration, faith and understanding. As the philosopher Jon Elster points out, in his brilliant book *Sour Grapes* (subtitled *Studies in the Subversion of Rationality*), trying to bring about such states directly is a moral fallacy. The corresponding intellectual fallacy is the attribution of such states, when they occur, to intentional action.

It's not just that linear thinking may be unproductive, even self-defeating, when applied to the setting and pursuit of goals. It's that, more generally, linear thinking may not get us past first base: instant apprehension of a *Gestalt* is our only chance to understand certain things. 'Some things are such that if you do not understand them immediately, you never will', wrote Mme de Sévigné.[105] This insight, too, is something you must already have – if not, I cannot help you. An understanding can never be given to another; it has to be awoken within them, and so must be there, in latent form already. Reasoning about it, evaluating it, and then deciding to acquire it will lead you nowhere. This thought lies behind many insights of the Oriental wisdom tradition. Thus, in the *Chuang Tzu* it is written: 'if you have not already got it in you, you cannot receive it'.[106] And in Zen Buddhism,

> the belief that there is a doctrine to be known appears to be a sign that one has not yet understood anything (the misunderstanding, however, may be indispensable for ultimate understanding).[107]

Zen masters do, after all, take on pupils. The point that one has to operate in a paradoxical way – pretending there is something to know, in order that others may discover in themselves that there is nothing to *know*, and thus gain true knowledge – is an example of how one has to think on many levels, not just one. There are different kinds of knowledge involved here, as there are different kinds of innocence. There is an innocence of the inexperienced, that of the child, and there is an innocence that lies on the other side of experience – one that is rarely achieved, that of the sage. Similarly, the knowing that there is nothing to know cannot be simply achieved at this moment, by a cognitive act, while you read the sentence. You must labour to know, meanwhile hoping that unknowing may come to you. It is as far from ignorance as can be.

I spoke of Carse's finite games that are played for the sake of winning, and his infinite games that are played for the sake of the game. Yet here, too, there are levels. The infinite game must involve, at one level, and to a certain degree, a desire to win, otherwise the game will not be satisfying *even if played for its own sake*. A game of tennis in which neither party (or only one) has the slightest intent to compete, at some level, will not be a game that satisfies at the higher level, at which competition is, quite genuinely, not the point.

I mention this to draw attention to the idea that what often looks paradoxical does so because the different levels of understanding have been flattened out. Just because at one level we don't want to win doesn't rule out that, on another level, we do – at least to some extent. Thinking of them as on the same level, makes us want to do a sum: 'how much you want to win' plus 'how much you don't', so that the oppositional element will be cancelled out (as +3 and -4 can be summed to a single quantity, with a single sign: -1, as though one just didn't care much at all). But it doesn't take into account that sometimes one wants or admires two entirely contradictory things passionately without being certifiably mad. Both must be retained *at the same time* – on different levels. Not just in different compartments on the same level, but on different levels: the point is important.

Although paradox can fruitfully be thought of as the two ends of a dipole, another way of expressing the coming together of opposites is not in terms of a straight line, but of a curve, prolonging each end until one comes 'full circle'. However, it may be not so much a case of coming full circle as 'full spiral', so to speak. *Not* that when you go far enough in one direction you arrive precisely where you started from, but that you arrive at a position superimposed on that from which you started, at the next turn of the spiral. This is why Eliot says, truly, that over a lifetime one keeps arriving at a fresh understanding of what seems to be the same imponderables, the same words, the same set of circumstances, images or ideas: 'And the end of all our exploring / Will be to arrive where we started / And know the place for the first time.'[108] According to the literal interpretation of the left hemisphere, to arrive back where you started is to have gone nowhere. But in seeing something we thought we knew afresh, it becomes both familiar and strange: we not only recognise it, but re-cognise it.

'Where would the difference be between great art and pure fancy?', wrote Bergson. 'If we reflect deeply upon what we feel as we look at a Turner or a Corot, we shall find that, if we accept them and admire them, it is because we had already perceived something of what they show us. But we had perceived without seeing.'[109] It seems to me that good philosophy is of this kind: that the mind is wakened to something it feels it always knew but never saw. This is what Plato called an un-forgetting: *anamnesis*.

We appear to ascend a spiral, like a staircase from which we can look down on our former vantage point. Very few writers have written more interestingly, and none more eloquently, of the coming together of opposites than William Blake. Even the titles of some of his most famous books of poems – the *Songs of Innocence and Experience*, *The Marriage of Heaven and Hell* – speak of this insight into the dipolar nature of reality. Jacob's Ladder, the staircase that leads from earth to heaven, is an image of spiritual progress. All the depictions of Jacob's Ladder I have ever seen show a straight staircase leading into the heavens – except Blake's, which moves very beautifully in a spiral. As we ascend we see how we thought we had the truth when we didn't, lower on the staircase, and how the staircase winds upwards as far as we can see (see Plate 14).

Many situations that we have been trained to think of two-dimensionally as a linear sequence are more like a sphere, or a three-dimensional net: not linear and flat, but round and having depth. The four

fundamental forces in physics all work like this, as 3-D fields, or flows, not as 2-D lines or chains. Human societies are like spheres, too – as in any complex system, there are many re-entrant loops. The idea of a sequence of causative steps breaks down, since nothing alters another thing without itself being altered; and, as I suggest, there are no wholly separate 'things' in any case.

But I have not yet tackled the real problem with linearity, which is the difference between a causal chain and a flow. This is what the historian of mathematics Morris Kline called the 'difficulty that preoccupied all the Greeks, namely, the relation of the discrete to the continuous'.[110] It is relevant here, as everywhere, but I need to postpone examination of this crucial distinction to the next chapter. There is ground to prepare.

We often imagine that science, philosophy and understanding of all kinds progresses by adding new bricks to the path that the seeker after understanding must tread. But it is not so. Instead, a new picture comes into focus, as things 'fall into place': a new *Gestalt* is revealed, which 'answers' better to the whole of one's experience, accommodating a richer array of meanings, than the one it replaced. The spiral accommodates simultaneously a direction and a circular motion, at each point along its trajectory offering a new vision in the round, not just the blinkered vision of the forward running line, locked to its already conceived target. In the end, it is a matter not just of cognition, but of re-cognition. The 're-' here functions not to indicate just sameness but also change, as it does in re-design, re-align: it is, as Jan Zwicky points out, a *Gestalt* shift.[111]

The remarks of the great German mathematician and physicist Hermann Weyl are interesting in this regard. Weyl contrasted algebraic (linear) thinking with topological (figural) thinking, suggesting that we need to be able to draw on both, but that, of the two, algebraic thinking is relatively blind. He wrote:

> We are not very pleased when we are forced to accept a mathematical truth by virtue of a complicated chain of formal conclusions and computations [left hemisphere fashion], which we traverse blindly, link by link, feeling our way by touch. We want first an overview of the aim and of the road; we want to understand the *idea* of the proof, the deeper context [right hemisphere fashion] …[112]

We need both – that is the point. It's just that, as Weyl makes clear, though they are both valuable, one sees more deeply than the other.

According to his obituary by Freeman Dyson, Weyl 'alone could stand comparison with the last great universal mathematicians of the nineteenth century, Hilbert and Poincaré. So long as he was alive, he embodied a living contact between the main lines of advance in pure mathematics and in theoretical physics. Now he is dead the contact is broken'.[113] Weyl had the simultaneous breadth and depth of vision that enabled him to tie together an insight into *different types* of mathematical and scientific thought with truth and beauty. 'My work', Weyl said, 'always tried to unite the true with the beautiful; but when I had to choose one or the other, I usually chose the beautiful.'[114] Although initially some of his work in physics was rejected, on the basis that it seemed to conflict with the experimental results then available, the subsequent formulation of quantum mechanics led to an acceptance of the important truth of Weyl's work. Thus, as in the case of Schrödinger, before the full scientific facts were known, the sheer beauty of Weyl's work anticipated its truth.

But it is the differentiation between what are clearly left hemisphere and right hemisphere strategies, and their relation with beauty, that is so striking: 'A modern mathematical proof is not very different from a modern machine, or a modern test setup: the simple fundamental principles are hidden and almost invisible under a mass of technical details.'[115] His observation clearly applies to a change in the scientific literature with which I am most familiar, that of neuropsychology, over the last 30 years or so. Papers which were lucid and beautiful, and full of humanity (particularly if one goes back as far as the early to mid-twentieth century French and German literature) have yielded to something like a machine process, with the philosophical and human element 'almost invisible under a mass of technical details'. Be that as it may, Weyl is here contrasting the unattractive, mechanical amassing of details, the 'blind' following of serial processes, with the more pleasing insight into the whole, the context and the overall path to be traversed. Similarly,

> the system of real numbers is like a Janus head with two oppositely directed faces. In one respect it is the domain of the operations + and x and their inverses [left hemisphere]; in another it is a continuous manifold [right hemisphere], and the two are

> continuously related [right hemisphere's synthetic take on both]. One is the algebraic and the other is the topological face of numbers … neither one of the two ways of understanding, the topological or the algebraic, can be acknowledged to have unconditional advantage over the other … In topology we begin with the notion of continuous connection … Algebra views [its] operations as the beginning of all mathematical thinking, and *admits continuity*, or some algebraic *surrogate* of continuity, *at the last step* of specialization. The two methods follow opposite directions. Little wonder that they don't get on well together. What is most easily accessible to one is often most deeply hidden to the other. Such classical theories as that of algebraic functions can be made to fit both viewpoints. But viewed from these two viewpoints they present completely different sights.[116]

Note that in conveying these two ways of understanding mathematics, Weyl contrasts one that is 'continuous' or 'topological', suggestive of the right hemisphere, with one that is made up of serial 'operations' (procedures) carried out on 'algebraic' signs (abstract discrete entities), suggestive of the left hemisphere. Both are, however, related 'continuously', that is by the process of the right hemisphere, though neither has unconditional advantage. Algebra 'views' its operations as grounding the process, but has to admit the continuous at some point, which it postpones until 'the last step'. They see different things and 'don't get on well together'. However:

> whenever applicable, the topological method appears, thus far, to be more effective than the algebraic one. Abstract algebra has not yet produced successes comparable to the successes of the topological method … I do not want to conceal from you the growing feeling among mathematicians that the fruitfulness of the abstracting method is close to exhaustion. It is a fact that beautiful general concepts do not drop out of the sky. The truth is that, to begin with, there are definite concrete problems, with all their undivided complexity, and these must be conquered by individuals relying on brute force. Only then come the axiomatizers and conclude that instead of straining to break in the door and bloodying one's hands

> one should have first constructed a magic key of such and such shape and then the door would have opened quietly, as if by itself. But they can construct the key only because the successful breakthrough enables them to study the lock *front and back*, from the outside and from the inside.[117]

Once the intuition gets you in the door, you can figure out how to unlock it. Once a leap of intuition gets you to your conclusion, you can reconstruct a path that you might have taken – but did not in fact take – to get there. This has something to say to the nature of reason, namely that it needs to transcend its intrinsic limitations in order to be able to operate rationally.

Jacques Hadamard similarly commented that 'any mathematical argument, however complicated, must appear to me as a unique thing. I do not feel that I have understood it as long as I do not succeed in grasping it in one global idea'.[118] And he also emphasised the suddenness of insight, which he repeatedly likened to a strike of lightning.[119] Yet at the same time, he draws attention to the fact that insight does not, as Weyl puts it, 'drop out of the sky': there is a period of preparation, during which an exertion is made, a period which is often long and exhausting. It is in the state of fatigue after this exertion, when the mind relaxes, that the illumination comes. In fact he comments that it is 'as though it were necessary for the conscious self to be weakened in order that unconscious ideas may break through.'[120] In our own day this view of mathematical thought as requiring the transcendence of computational methods that could be made explicit is in keeping with the view of Roger Penrose, as set forth in his *Shadows of the Mind*: mathematical invention cannot be modelled as computation.[121]

Unsurprisingly, there is a parallel distinction to be made among philosophers as there is among mathematicians. As Jan Zwicky suggests:

> Philosophers fall into roughly two classes: those who trust their perceptions more than they trust language, and those who trust language more than they trust their perceptions. Berkeley and Herakleitos fall into the first class, Locke and Parmenides into the second. And, although we don't take sufficient notice of this, to each class there *also* corresponds a distinct notion of abstract thought:

> members of the first class tend to think of it as a grasp of structural features [seeing the patterns] … while members of the second tend to think of it as the logico-linguistic manipulation of non-structurally-conceived placeholders [algebra].[122]

There is, as discussed previously, a peculiar bias towards language and naming in Western culture.[123]

In the 1960s, the architect and philosopher Christopher Alexander asked women students at a top American college, Radcliffe, to arrange short strips of paper consisting of random segments of black and white, in any way they chose. What interested him was that there were effectively two strategies for doing so. One might be described as sequential-digital, the other as figural-holistic. He saw that the first was 'less interesting, and … functionally less likely to be important in the behavior of real systems'. The second was 'deeper and more interesting', since it was more pertinent to the study of real physical systems such as emerging galaxies or developing embryos. He wanted to see what these young women, highly intelligent, but highly educated, made of it all. He found that 80% chose the sequential-digital approach, only 20% the figurative-holistic.[124] This is a tendency that is more marked in Westerners than non-Westerners, and in part reflects the *Einstellung* effect discussed in Chapter 4. (He assumed that the results would be the same for women as for men; as I showed in the same chapter, men tend to think more holistically, women more sequentially, so this result has to be interpreted in that light.)

We have seen that scientists and mathematicians, just like artists, make discoveries by having moments of insight into analogous forms, guided by intuition, hardly ever, if at all, by following a sequential process. On this the historical record is very clear. Insights may come on the back of much routine slog, but the moment of insight itself never comes this way. To take just two famous examples: Einstein thought in musical shapes; Bohr's notebooks contain no words or formulae, just pictures. So why is it that our education is largely geared to learning how to carry out rote procedures in a sequential, linear fashion?

We can kill creativity by instituting regular 'procedures' and closely monitoring the process – all of which the left hemisphere does best. This succeeds in over-controlling the 'product', and ensuring mediocrity (though without, of course, avoiding mistakes). It rules out anything not explicit,

and already foreseen in the schema. And it discourages analogical thinking: seeing the patterns that come to us through intuition. It’s not new procedures we need: it’s new shapes, new *Gestalten* – new wholes.

THE IMPERSONAL VS THE PERSONAL

We are inclined to be too easily persuaded by the rhetoric of academic philosophy into thinking that there is something impersonal, pure and eternal about the sort of reasoning in which it engages. Much as the beaker *was placed* in the fume cupboard, apparently without the intervention of anything so fallible as a human hand, we imagine that such reasoning carries no taint of flesh about it. We overlook the nature of the philosopher, and thus of the very particular nature of philosophical discourse, to which it is indissolubly linked. It is easy to forget that philosophical discourse is only one way of understanding the world, and inevitably a personal one. Personal elements come in different forms, but are inescapable, since what Thomas Nagel calls the 'view from nowhere' is impossible, and the very attempt does little more than speak of the personality making it. We cannot abstract philosophy from the happenstance of the physical being that dreamed it up.

To engage in philosophy is, I believe, as much a response to an instinct as to engage in science. Philosophers might be unlikely to agree. Or would they?

The idealist philosopher FH Bradley wrote that 'metaphysics is the finding of bad reasons for what we believe upon instinct, but to find these reasons is no less an instinct.'[125] That reasons often come late in the process, and are retro-fitted, is a point emphasised by the philosopher Francis Cornford:

> Almost all philosophical arguments are invented … to recommend, or defend from attack, conclusions which the philosopher was from the outset bent upon believing … To mistake [philosophical reasonings] for the causes which lead to a belief in the conclusion, is generally to fall into a naïve error.[126]

Economist John Kay has some incisive thoughts on this matter, in relation to what Benjamin Franklin called 'moral or prudential algebra', a process in which one sets out pros and cons, attaches numerical weights to

each consideration, and arrives at a balanced, and therefore, impartial moral judgment. Here is Kay's account:

> Franklin knew very well that this is not how real people, including himself, behaved. Franklin was an occasional vegetarian, having balanced the moral, nutritional and practical arguments. But confronted with the delicious smell of freshly grilled fish, he observed that the fish themselves disregarded his precepts by eating other fish and so deserved to be eaten. 'How convenient it is', he said, 'to be a reasonable creature, since it enables one to make or find a reason for whatever one has a mind to do.'[127]

Franklin, who had a well-developed sense of humour, was surely speaking tongue in cheek, but the point is nicely made – and very real.

Temperament counts for much in what we find in the world. Fichte wrote that the

> sort of philosophy one chooses depends … on what sort of man one is; for a philosophical system is not a dead piece of furniture that we accept or reject as we wish; it is rather a thing animated by the soul of the person who holds it.[128]

There is a difference between the view of philosophy as an edifice and as a dwelling. (Incidentally, the original meaning of the Greek word *ethos*, from which the word 'ethics' derives, is 'dwelling place'.)[129] In the one view it is something *constructed*, piecemeal, as it were from the outside; in the other it is something coming about through being lived, as it were from the inside. 'Place yourself', writes William James,

> at the centre of a man's philosophic vision and you understand at once all the different things it makes him write or say. But keep outside, use your post-mortem method, try to build the philosophy up out of the single phrases, taking first one and then another and seeking to make them fit, and of course you fail. You crawl over the thing like a myopic ant over a building, tumbling into every

> microscopic crack or fissure, finding nothing but inconsistencies, and never suspecting that a centre exists.'[130]

Note 'post-mortem'. Philosophy is not, then, purely a matter of impersonal reason, but living: bound up in the temperament, character and history of the person who expounds it. As Dewey pointed out, 'every particular case of thinking is what it is because of some attitude, some bias' and, as for the philosopher, 'when he becomes a thinker he does not leave his characteristic affection [inclination] behind.'[131] Moreover Wittgenstein, too, thought that ultimately differences of temperament lay behind many philosophical disputes;[132] and William James wrote frankly that 'the history of philosophy is to a great extent that of a certain clash of human temperaments.'[133]

So, when we set out to investigate the world objectively, are we at the end of the day only reporting on ourselves? 'However far man may extend himself with his knowledge, however objective he may appear to himself', wrote Nietzsche, 'ultimately he reaps nothing but his own biography.'[134] Elsewhere he expanded the idea:

> It has gradually become clear to me what every great philosophy has hitherto been: a confession on the part of its author and a kind of involuntary and unconscious memoir … I accordingly do not believe a 'drive to knowledge' to be the father of philosophy, but that another drive has, here as elsewhere, only employed knowledge (and false knowledge!) as a tool. [135]

This is intriguing, because of my belief that the raison d'être of the left hemisphere, which is to manipulate the world, underlies the coercive drive implicit in logical argument: as Nietzsche puts it, another 'drive', a will to power, acts under cover of an apparently impeccable, because *impersonal*, aim in order to achieve its own ends. It is not just that philosophy can never free itself from personality: a person's philosophy may be doing *psychological work for that personality*, which might explain why philosophies are so passionately defended. Nietzsche continues:

> even apart from the value of such claims as ‘there is a categorical imperative in us’, one can still always ask: what does such a claim tell us about the man who makes it?

Rather more trenchantly, Iris Murdoch wrote: ‘It is always a significant question to ask about any philosopher: what is he afraid of?’[136] In many cases it would seem to be uncertainty, vulnerability, laying oneself open to truth from experience – and to hell with the theory.

Though I confess to a lifelong addiction to it, there is a sense in which philosophy is in itself an unhealthy activity: the disease, perhaps, as Karl Kraus said of psychoanalysis, for which it purports to be the cure. Jung wrote:

> For all its critical analysis philosophy has not yet managed to root out its psychopaths … Philosophy still has to learn that it is made by human beings and depends to an alarming degree on their psychic constitution. In the critical philosophy of the future there will be a chapter on ‘The Psychopathology of Philosophy’ … Often what is thought is less important than who thinks it. But this is assiduously overlooked. Neurosis addles the brain of every philosopher because he is at odds with himself. His philosophy is then nothing but a systematised struggle with his own uncertainty.[137]

Indeed – well, sometimes. And the point here is, not just that philosophy is reflective of any old psychopathology that just happens on an individual basis to be present, but that a certain kind of unusual mind is preferentially and systematically attracted to philosophy of the analytic kind. This is a mind somewhere down the schizo-autistic spectrum, as many examples of now famous philosophers in the analytic tradition attest. For a philosopher such as Collingwood, imagination and empathy, the appreciation of context, both personal and historical, as well as the ability to feel your way into another’s mind (all skills that are highly right hemisphere-dependent), play a crucial role in understanding, ‘unlike philosophers in the Ryle mould’.[138]

‘Philosophers in the Ryle mould’ are more likely to take things out of context, think in disembodied schemata, and adopt irrationally rationalistic approaches. They tend towards utilitarianism in ethics, an approach that is

also characteristic of people with frontal lobe damage, especially in the right hemisphere, the clinical picture of which resembles some types of autism.[139] Which is not, of course, to say that all utilitarian philosophers are autistic – or that psychopathology makes the perceptions of its sufferers invalid: it may actually make some things easier to see, while hiding or distorting others. But it does invite the question why we should attach particular importance to a way of looking at the world which is typical of a spectrum of conditions which normally lead to their holders receiving treatment for a distressing illness.

According to Louis Sass's observations of schizophrenia, madness may be 'the endpoint of the trajectory consciousness follows when it separates from the body and the passions, and from the social and practical world, and turns in upon itself' – the more the world is purely cognitive, the closer madness and philosophy come together.[140] And as Sass has demonstrated, one can see from both Wittgenstein's notebooks and from Schreber's self-account that in both a position of alienation makes for a sense of unreality.[141] Hannah Arendt suggested that philosophy, as she knew it, was something unnatural and 'out-of-order', something *contrary* to the health of the human condition.[142]

Detachment is certainly necessary in some contexts, but it does not always and alone lead to better insights than engagement. Indeed, it may be safer to recognise the degree to which our minds, bodies, emotions and the environment are indissolubly linked than to pretend that they are not. And not just because these elements are some form of 'bias': the failure to take them into account may also lead to bias – distorted perceptions and a limited understanding of what one is dealing with. The closest humans get to being cut off from feelings, the body and the self is achieved not by great scientists, but by subjects with schizophrenia.[143]

Nietzsche amusingly comments, alluding to his idea of philosophy as an involuntary autobiography, that, in the case of Kant, it was not even 'an involuntary biography of a soul but … the biography of a *head*.'[144] Roger Scruton points out that the great modern philosophers have tended to 'avoid the experience of desire as scrupulously as they have tended to avoid its analysis'.[145] He quotes Kant's description of marriage as an agreement between two people as to the 'reciprocal use of each other's sexual organs'. He might also have quoted Spinoza on love: 'titillation accompanied by the

idea of an external cause'.[146] But Freud's attitude to sexual desire is almost as expressive of a sort of fastidious alienation, its aim, according to him, being the 'union of the genitals in the act known as copulation, which leads to a release of the sexual tension and a temporary extinction of the sexual instinct – a satisfaction analogous to the sating of hunger.'[147] He described the task of psychoanalysis as drying up the messy emotions of the patient. 'Where Id was, there shall Ego be', he declared somewhat portentously. 'It is reclamation work, like the draining of the Zuyder Zee'.[148] Perhaps Freud's biographer Ernest Jones could be referring to his own mentor, among others, when he suggested that philosophers are people who have been 'impelled to deal with various personal problems in their unconscious by making serious efforts to think consciously; they have intellectualized the emotional conflicts.'[149] The recommendation in Freud's technical papers for analysts to be emotionless, according to Ferenczi and Rank, had led to 'an unnatural elimination of all human factors' and to 'a theorizing of experience'.[150]

Approaching the relationship between philosophy and autism from the other direction, it is not just that there may be something autistic about certain philosophical styles, but there is a certain philosophical style to the pronouncements of subjects with autism. Tony Attwood, an acknowledged expert on the autistic spectrum, writes that there is a 'quasi-philosophical quality' to the autobiographies of adults with Asperger's syndrome.[151] What he is referring to is generally accepted to be an over-rationalistic, hyper-reflexive self-awareness, and a disengagement from emotion and embodied existence, which is very much in accord with my experience of looking after subjects on the autistic spectrum. Moreover, there is an abstract, quasi-philosophical mode of talking that is common in some kinds of schizophrenia, at first impressive, but ultimately recalcitrant to understanding; it is sometimes actually referred to as 'pseudo-philosophical thought disorder'.[152] Both autistic and schizophrenic individuals have an antipathy to what is embodied, uncertain and unknown (or unknowable), preferring what is abstract, certain and known, all of which is characteristic of the left hemisphere.

There is something like a sickness of the soul in requiring proof (in the left hemisphere sense) of absolute certainty. Thus Merleau-Ponty wrote:

> If I like, I can always be strict and put in doubt the reality of the other's feelings towards me; this is because such feelings are never *absolutely* proved … the normal, non-pathological attitude consists in having confidence above and beyond what can be proved … by means of the generosity of the *praxis*, by means of an action that proves itself in being carried out.[153]

The word 'generosity' there is not idle. There can be at times a hint of something mean and suspicious about calculation and the need for proof – a failure of trust. Life is an intrinsically exuberant, superabundant business, and to respond to it in a calculating spirit is an offence against nature. 'O reason not the need', cried Lear, when his daughters tried to calculate what he could get by without: could Lear's outrage still be understood in this era of accountancy?

Here I might make an aside on the philosophical personality. If I am right, as I argued in Chapter 9, that schizo-autistic features suggest a tendency to left hemisphere modes of apprehension of the world, and depressive features suggest the opposite, one would expect highly analytic philosophers to have character features suggesting they are on the schizo-autistic spectrum. Descartes had many hallmarks of the schizoid personality;[154] Spinoza and Kant were probably on the autistic spectrum, and so, clearly, was Bentham; in modern times there is a case that Bertrand Russell, AJ Ayer, and Derek Parfit also were, to name a few.[155] Similarly, one might expect philosophers who were opposed to the analytic tradition to be more prone to depression; it is arguable that Pascal, Hegel, Kierkegaard, Emerson, CS Peirce, William James and John Dewey were.[156] Wittgenstein is an intriguing case here, because the early Wittgenstein of the *Tractatus* was highly analytical, though his very purpose was to show the limits of linear analytical reasoning: he thought that logic and propositionalising left all matters of value untouched. Appropriately, then, it is well known that he had many features of a schizoid personality[157] and of Asperger's syndrome;[158] but, particularly latterly, he also suffered from bouts of depression.[159]

Let me be quite clear: people are massively complicated, and except perhaps in extreme cases, you can't put people in boxes marked 'left' and 'right'. Since the right hemisphere is always aware of the need for the left,

and the left not aware of the need for the right, it is always going to be more clear-cut, more obviously unbalanced, when the tendency is to adopt left hemisphere modes of thinking. That is why I have structured my comments on philosophers as a *relatively* clear relation between the left hemisphere and those of the analytic tradition – versus the rest. The 'opponents' I have mentioned were also perfectly capable of analysis. They would have subscribed to Pascal's 'two excesses: to admit only reason or to rule it out'. It's just that analytic types usually see only one of these two excesses.

Since, clearly, retrospective diagnoses are prone to error, autistic spectrum conditions not infrequently overlap with depression, and there must undoubtedly be counter-examples, why bring it up at all? Because there might just be *something* in it. For example, in an unpublished study, which I carried out as a Medical Registrar in the 1980s, of the degree subjects undertaken by approximately 200 university students who then went on to be admitted to the Bethlem Royal & Maudsley Hospital in London during a psychotic episode, I found that a subsequent diagnosis of schizophrenia was most strongly associated with having chosen to study engineering, followed closely by philosophy ($p > 0.001$). The abstract, impersonal, sequentialist approach of philosophy distinguishes it from all other humanities subjects (eg, literature, history), which require more understanding of humanity in the round, and which were the commonest degree choices amongst those who were subsequently diagnosed with an affective psychosis (psychotic depression or bipolar disorder).

My purpose here is neither to romanticise psychopathology nor to give a reductive account of philosophy, but to illustrate the inevitable connexions between individual psychology and philosophy, so often commented on by philosophers themselves. We cannot divorce the philosophy from the philosopher. I am sure that saying this will be resisted by many, and resented by some – but, though you can ignore it, it is hard to deny its truth. The options are to remain in denial (left hemisphere-preferred strategy) or to use the knowledge to avoid pitfalls (right hemisphere-preferred strategy).

Most appositely of all, the philosopher Paul Feyerabend wrote:

> Schizophrenics very often hold beliefs which are as rigid, all-pervasive, and unconnected with reality, as are the best dogmatic philosophies. However, such beliefs come to them naturally, whereas a 'critical' philosopher may sometimes spend his whole life

in attempting to find arguments which create a similar state of mind.[160]

It is a fascinating reflection. Two of the greatest phenomenologists of schizophrenia, Eugène Minkowski and Wolfgang Blankenburg, suggested that schizophrenics attempt to compensate for a loss of intuition, of that vital, pre-reflective grasp of reality, by a sort of pseudo-philosophising, or 'hyper-reflection' on experience – essentially a disease of over-awareness, in which things that should run smoothly at the preconscious level are yanked into the focus of awareness, where life comes to a juddering halt.[161]

Schizophrenics are in fact *more*, not less, logical than normal subjects, and deficient in common sense.[162] The theme has been explored by a number of contemporary psychologists and psychiatrists, such as Louis Sass and Giovanni Stanghellini.[163] It could explain a lot about contemporary academic philosophy, such as brains in vats, and various types of Cartesian scepticism, not to mention the denial of consistent human persons, or – most bizarre of all – the denial by intelligent human beings of conscious experience itself.

Since philosophy is related to individual psychology, the influence might run either way. Am I right to assume that, in my study of 200 psychotic subjects who broke down while studying at university, psychopathology influenced the choice of philosophy as a subject of study, rather than that philosophy as a subject of study actually precipitated episodes of psychosis? Probably, as usual, the answer is that both might operate to some degree: the process is not linear but circular. I had a patient, a philosopher, who suffered from obsessive-compulsive disorder: he reported that he was quite well as long as he was studying phenomenological philosophers, with their acceptance of uncertainty, but not when he was studying analytical philosophers, with their intolerance of it. Then it was that he developed OCD (obsessive-compulsive disorder) symptoms.

There may be something damaging to the whole character of a person in spending a life in abstract reasoning, whether in philosophy or science. I think of a famous, and touching, passage in Darwin's *Autobiography*:

> I have said that in one respect my mind has changed during the last twenty or thirty years. Up to the age of thirty, or beyond it, poetry of many kinds, such as the works of Milton, Gray, Byron, Wordsworth, Coleridge, and Shelley, gave me great pleasure, and even as a schoolboy I took intense delight in Shakespeare, especially in the historical plays. I have also said that formerly pictures gave me considerable, and music very great delight. But now for many years I cannot endure to read a line of poetry: I have tried lately to read Shakespeare, and found it so intolerably dull that it nauseated me. I have also almost lost my taste for pictures or music … My mind seems to have become a kind of machine for grinding general laws out of large collections of facts … and if I had to live my life again, I would have made a rule to read some poetry and listen to some music at least once every week; for perhaps the parts of my brain now atrophied would thus have been kept active through use. The loss of these tastes is a loss of happiness, and may possibly be injurious to the intellect, and more probably to the moral character, by enfeebling the emotional part of our nature.[164]

As they say, be careful what you wish for. Some 20 years earlier, in a letter to Huxley, Darwin had written: ‘alas’ – and how I respect that ‘alas’ – ‘a scientific man ought to have no wishes, no affections, – a mere heart of stone.’[165]

Before we move on, let me not duck the question of how much my own thinking is shaped by the sort of person I am.

Inevitably my personality is, as I have argued, bound to underwrite my thinking. Although I count myself very fortunate and get a lot of fun out of life, I have had several episodes of depression over my lifetime, mercifully well contained, but devastating while they lasted. And I have always had a passion for nature and for art. I suspect my overall temperament makes me sympathetic to the right hemisphere’s outlook, in as much as these things have any validity.

I think it is also true that my personality has guided my preoccupations. As a young man I was lamentably perfectionistic: it may lie behind my desire to decry the barrenness of perfection. (The book I wrote in my 20s called *Against Criticism* was at one stage going to be called *The Importance of Imperfection*. When the proofs came, I rang my editor with a fifth round

of corrections, which included a comma in the wrong font. She accepted the correction, but suggested that it might be a good idea if I now took a holiday.) But, at least, it made me want to argue *against* the value of perfection, not to propagate it. Many of the things I argue for I have – like many philosophers, as we have seen – felt obscurely all my life to be important. Whether that counts against them or for them I cannot say. On that point, it might be worth recounting a story of Niels Bohr:

> Bohr never referred to his philosophy as his own. He used to speak of it as a general lesson to be drawn from quantum mechanics. Yet when, shortly after the development of quantum mechanics, he told his old friend Edgar Rubin, the psychologist, of this general lesson, Rubin replied, 'Yes, it's very interesting, but you must admit that you said just the same thing twenty years ago' … Bohr has said that as far back as he could remember he liked to dream of great interrelationships. His philosophical attitude seems to have been shaped early with very little influence from outside, and he spent much time developing it. Shortly before his death Bohr spoke of his youthful philosophical work. When asked what place this work then had in his existence, he replied, 'It was, in a way, my life!'[166]

Someone once asked me, acutely, after I quoted the line of Iris Murdoch, 'so what are *you* afraid of?' I don't remember my answer. At this stage, with death not far off, I don't fear anything much that I am aware of, not even death, as long as it doesn't come too soon for me to finish this book. In the past I was afraid of stepping out of line too much and making a fool of myself. Now that I know how foolish we all are, I am happy to be just another human being.

With respect to the major themes of this chapter, in writing this book I have found it necessary to move back and forth between the distance that makes possible the detection of patterns, on the one hand, and the immediacy of experimental data and experience with patients, on the other, out of which the patterns emerge. To the extent that I have succeeded, it represents an example of fruitful hemispheric co-operation: aiming not to construct a linear structure of hard-edged categories, but to bring into focus a new *Gestalt.* In doing this I have aimed to combine precision about findings, with tolerance of necessarily imprecise structures in the process of

bringing the whole into focus, so as to be faithful to the findings; since precision at too early a stage of resolving the *Gestalt*, throws the whole structure out. In changing a wheel on a car, one does not fully tighten any one bolt until all are roughly in alignment. Science is not like building a wall, where the first steps must be fixed in advance of the rest: it is about bringing our ideas and the world into alignment, a reverberative, not a linear process. Whitehead puts it well:

> The true method of discovery is like the flight of an aeroplane. It starts from the ground of particular observation; it makes a flight in the thin air of imaginative generalization; and it again lands for renewed observation rendered acute by rational interpretation.[167]

And so for many iterations. In doing this I have wrestled hard to press abstraction, precision and linearity and all the other rational progeny of the left hemisphere in the service of their opposites. That is suitably paradoxical at one level; quite logical at another.

LOGOS VS MYTHOS

Where do all these twins leave us when considering the nature of Reason's assistance in our attempts to approach truth? I would suggest that our culture has tended to fall for the persuasive power of those twins that claim paternity by the left hemisphere, leading us to expect truth, or at least our attempts to express it, to be clear, precise, impersonal, probably abstract and unreasonably certain. In sum, we expect our truths to be something which we casually designate 'literally true'; anything that isn't 'literally true', we tell ourselves, isn't true at all. The opposite members of each pair of twins not only warn that these are false claims, but point, however tentatively, to the truths which such a view has concealed from our sight. But most of all the cautionary twins warn us about literalism, reminding us that all expressions of truth are rooted in metaphor and that literal truth is a chimera.

The subject of literalism is close to my heart – as it was to my father's, though in a different sense. My father was a decent, devoted, down-to-earth family doctor, who had no interest in novels, little in poetry, and none in classical music, especially none – perish the thought – in ballet or opera. It was the school holidays, and I was watching a televised relay of Mozart's *Don Giovanni* from Glyndebourne, when my father came into the room. The opera had barely begun, and it was that dramatic moment when the Don has just fatally wounded the dignified Commendatore, the veteran soldier and father of the Don's catch of the moment, Donn'Anna, by a blow to the heart in a duel over his daughter's honour. The Commendatore lies dying, the violins are delivering throbbing arpeggios, and the old man, lying propped on one arm, sings in an urgent cadence: '*Ah, soccorso*!' – 'Help me!' There ensues the following conversation:

My father: 'What's this?'
Me: (tentatively) 'It's – Mozart … an opera called *Don Giovanni*.'
My father: 'Well, that's ridiculous.'
Me: 'What's ridiculous?'
My father: (dismissively) 'Well he's just sustained a pneumothorax. *No-one* can sing when they've sustained a *pneumothorax*.'

This judgment delivered, my father left the room to return to his latest book on archaeology, a sort of passion of his, since there were an abundance of facts, and mercifully few artefacts, to be dug up.

Although I suspect my readers will want to distance themselves from this standpoint, I suspect also that some covertly share a modified version of it. For it has to do with the nature of truth. Science is what delivers truth, they will say – as indeed my father did. The arts deliver pretty, diverting, consoling – at times, they might concede, beautiful, engaging, and even disturbing – myths. Of which Mozart's *Don Giovanni* is one. But myths are, of course, false, aren't they? Nice enough to pass the time of day with, but nothing to do with truth.

Perhaps the best rant along these lines comes from William Cobbett, the late eighteenth- and early nineteenth-century farmer and political reformer, who wrote of *Paradise Lost*:

> … the whole of Milton's poem, is such barbarous trash, so outrageously offensive to reason and to common sense, that one is naturally led to wonder, how it can have been tolerated by a people amongst whom astronomy, navigation, and chemistry are understood.[168]

People who don't understand that myths are not to be taken literally, but nonetheless exist to express truths that everyday language is too limited, too narrow, too precise to convey, are like people who would dismiss Shakespeare's *King Lear* on the grounds that, according to the chronicles of Geoffrey of Monmouth, the historical Leir (as he was known prior to Shakespeare), fled to France, and with the help of Cordelia and her husband, overthrew his other daughters and sons-in-law, and was restored to the throne. Thus tactlessly ruining the tragedy. Or object that since Geoffrey's history, too, was of uncertain provenance, we know nothing reliable of the historical King Lear at all – if indeed he ever actually existed. Ergo, Shakespeare got it wrong.

The word 'myth', which derives from an ancient Greek word *mythos* (or *muthos*), was unknown in English, according to the *OED*, till just before the middle of the nineteenth century, when it was adopted by philologists and classical scholars to denote ancient stories – as opposed to ancient history. 'Story', by the way, is just an aphetic version of 'history', that is to say a

word form in which part has, over time, been lost. But as story and history separated, the status of a story became more ambiguous: there developed a slightly unfavourable assumption that it might not be true, whereas there is a presumption that history refers to something on which one can, more or less, rely. In modern English we even say ‘to tell stories’, meaning to *lie*. A similar fate has overtaken ‘fable’ (like ‘fate’ itself, from Latin *fari*, to speak: originally, ‘something that was spoken’, a narrative). Nowadays if narratives are considered fables, it is in the sense of untruths. And a legend was something proper ‘to be read’ (from the gerundive, *legendus*, of Latin *legere*, to read). According to the *OED*, it was only in the seventeenth century that ‘legend’ took on the meaning of something untrue.

There is a similar history to ‘metaphor’ (from Greek, *meta-*, across, + *pherein*, to carry), that which carries you over from an idea to an embodied experience. It is the root of all meaning: I cannot escape using the word ‘root’ here as a metaphor.[169] Yet by the seventeenth century, in the dawn of the new age of Enlightenment, Locke could write:

> … all the artificial and figurative application of words eloquence hath invented, are for nothing else but to insinuate wrong ideas, move the passions, and thereby mislead the judgment; and so indeed are perfect cheats …[170]

And so it has been with ‘myth’. Alasdair MacIntyre points out the novelty, again arising at the Enlightenment, of the idea of ‘facts’ as reflecting a reality independent of our judgment:

> Facts, like telescopes and wigs for gentlemen, were a seventeenth-century invention. In the sixteenth century and earlier ‘fact’ in English was usually a rendering of the Latin ‘factum’, a deed, an action, and sometimes in Scholastic Latin an event or an occasion … It is of course and always was harmless, philosophically and otherwise, to use the word ‘fact’ of what a judgment states. What is and was not harmless, but highly misleading, was to conceive a realm of facts *independent of judgment or of any other form of linguistic expression*.[171]

It’s not as if, until this use of ‘fact’ came along, no-one knew the difference between things that happened and things that hadn’t. According to NT Wright, it is only with the new emphasis on certainty with the Enlightenment, ‘with the suspiciously bright light of an incipient scientism’, that facts suddenly come into prominence:

> Everything else is suspect; give us facts. Science says, ‘Well, we’ll try’; scientism says, ‘Here you are – and you must take our philosophy as well.’[172]

A fact is presumed to be true independent of context. But no human knowledge is ever independent of context, even if only that it is human, and derived from experience. No world view can transcend such limitations – limitations that are by no means fatal to serviceable truths, but are fatal to the hubristic enterprise of accounting for the world fully in some impersonal way by what we call facts.

As Douglas Hofstadter points out, logic is neat and clean, but, if it is to lead to understanding, those very qualities get in the way:

> Why should not logicians, more than anyone, realize the places where hard-edged, clean logic will necessarily run into trouble in dealing with this chaotic and messy universe? One of Marvin Minsky’s favourite claims is ‘Logic doesn’t apply to the real world.’ There is a sense in which this is true. This is one of the difficulties that artificial intelligence workers are facing. They are coming to realise that no intelligence can be based on reasoning alone; or rather that isolated reasoning is impossible, because reasoning depends on a prior setting-up of a system of concepts, percepts, classes, categories – call them what you will – in terms of which all situations are understood. It is there that biases and selection enter the picture. [173]

Or as Einstein put it succinctly: ‘As far as the propositions of mathematics refer to reality, they are not certain; as far as they are certain, they do not refer to reality.’[174]

One path to knowledge is logic, which we now think of as something literal and explicit. The Greeks, though, who, after all, invented what one might call the Western logical tradition, hardly invented logic. 'Logic', as Bruno Snell pointed out,

> has been in existence ever since men have talked and thought; the reason why it did not, at first, find expression in speech was not that logic did not exist but that it was *implicit and understood*. As soon, however, as it is discovered, and intrudes into consciousness, human thinking undergoes a radical change …[175]

In other words, the Greeks did not invent logic; it's just that what before had been the ground of our thinking was suddenly foregrounded. A spotlight was thrown on it, and this, as Snell says, changed everything. This difference between something remaining as the ground, and coming to be foregrounded, is an important theme of this book, since it refers to the different mode of operation of the two hemispheres. The left hemisphere's attention latches onto the salient feature, what lies in the focus of attention, and effectively isolates it. The right hemisphere's attention is to the whole scene, especially to the context or background in which the salient feature finds itself placed.

Whitehead sets this in the context of normal psychology:

> It is a profoundly erroneous truism, repeated by all copy-books and by eminent people when they are making speeches, that we should cultivate the habit of thinking of what we are doing. The precise opposite is the case. Civilization advances by extending the number of important operations which we can perform without thinking about them. Operations of thought are like cavalry charges in a battle – they are strictly limited in number, they require fresh horses, and must only be made at decisive moments.[176]

It could be said that the trouble with Western philosophy began with Plato's foregrounding of *logos*. In the Greek world, as in most pre-modern cultures, there had always existed more than one way of acquiring an understanding of the world. The Greeks, let it not be forgotten, also gave

birth to many of the most enduring myths by which we understand our relationship to the world, such as those of Œdipus, of Prometheus, of the gods of the *Iliad* and of the *Odyssey*. There was, and is, no conflict here. Indeed they distinguished two types of truth, *mythos* and *logos*; each was considered essential in its own proper field, and the two were not to be confused. So Karen Armstrong writes:

> *Logos* ('reason') was the pragmatic mode of thought that enabled people to function effectively in the world. It had, therefore, to correspond accurately to external reality. People have always needed *logos* to make an efficient weapon, organize their societies, or plan an expedition. *Logos* was forward-looking, continually on the lookout for new ways of controlling the environment … *Logos* was essential to the survival of our species.

But *logos* had its limitations. Good at manipulating the world and making us powerful, it did not contribute to any broader understanding of the meaning of our lives – for that people turned to *mythos*. Armstrong continues:

> Myths may have told stories about the gods, but they were really focused on the more elusive, puzzling, and tragic aspects of the human predicament that lay outside the remit of *logos* … When a myth described heroes threading their way through labyrinths, descending into the underworld, or fighting monsters, these were not understood as primarily factual stories. They were designed to help people negotiate the obscure regions of the psyche, which are difficult to access but which profoundly influence our thought and behaviour … When Freud and Jung began to chart their scientific search for the soul, they instinctively turned to these ancient myths. A myth was never intended as an accurate account of a historical event; it was *something that had in some sense happened once but that also happens all the time*.[177]

In other words, myths were archetypal, not incidental, truths, reflecting eternal patterns that we could recognise, but which could not, without

diminishment, be translated into the everyday terms of *logos*. And, as Armstrong goes on to emphasise, myths were not primarily propositional, but grounded in action. The truth of a myth was not verified by data, but in the playing out of one's life:

> The only way to assess the value and truth of any myth was to act upon it. The myth of the hero, for example, which takes the same form in nearly all cultural traditions … showed us how to live more richly and intensely, how to cope with our mortality, and how creatively to endure the suffering that flesh is heir to. But if we failed to apply it to our situation, a myth would remain abstract and incredible.

However, things were slightly more complex than this suggests, since *logos* and *mythos* went through a number of transformations.[178] At one stage, indeed, according to the historian of ideas Bruce Lincoln, it was *logos* that was thought of as unreliable, feminine and seductive:

> the most ancient texts consistently use the term *logos* to mark a speech of women, the weak, the young, and the shrewd, a speech that tends to be soft, delightful, charming, and alluring, but one that can also deceive and mislead. [179]

'Words, words, words …' This would certainly fit with Mercier and Sperber's view that logic was invented in order to win arguments, not to take us closer to the truth.

Mythoi by contrast were the ideals of men of action, weighty, performative, supportive of the truth: *alēthea mythēsasthai* ('to speak the truth') occurs as a formula five times in Homer, Hesiod and the *Homeric Hymns* (all prior to the end of the seventh century BC) . *Mythoi* can at times be corrupt, but when they are, the effect is shocking and implies shame, such as if a lawyer were to lie; whereas the corruption of *logos*, at this stage, was taken for granted: 'the lying *logos* is deceptive, disingenuous and slyly delivered, hard to detect, the more to be guarded against'.[180]

It's worth noting that *mythos* is inclusive of *logos*, whereas *logos* is exclusive of *mythos*. *Mythos* 'denotes the whole package, the *logos* plus the

speaker and the context; when *mythos* is in play, something is at stake'.[181] It is thus dependent to an extent on trust in the authority of the speaker: as soon as people routinely question the authority of heroic figures, it loses power. Thus it is that with Plato one sees a reversal of the fortunes of *mythoi*. He cites them generally unfavourably in respect of their truth in numerous places, though he concedes there is 'some truth' in them.[182] In reality, he is himself the inventor of several of the best-known myths of ancient philosophy: the myths of Atlantis, of Er's journey into the afterlife, of the ring of Gyges, of the chariot of Phæthon, not to mention the myth of the Cave.[183] Plato was complex. However, his legacy has been one-sided; and from this point onwards, truth is no longer thought of as that which comes from the experience of living, but as what can be argued towards without reference to context. Such a view is a necessary counterpoise, and can be productive: but as always, there needs to be a balance.

It will be obvious to the reader that *mythos*, in its trans-linguistic, implicit, richly connotative, performative way, rooted as much in the body and emotion as it is in cognition, is more amenable to the right hemisphere's take on the world; whereas *logos*, at least in Plato's sense – Heraclitus, for example, had used *logos* to mean a deep understanding *beyond language*, never to mean rationality or rhetoric – is more amenable to the explicit, linguistic, propositional stance of the left hemisphere. We now live in a world where *mythos* has been largely routed, and confined to the fiction shelves. Yet we need to bear in mind that there is more truth about the human predicament in *King Lear* than in any number of textbooks of genetics, irrespective of whether there was ever a King Lear at all.

This distinction between *logos*, the literal and the essentially decontextualised, on the one hand, and *mythos*, the metaphorical and essentially contextual, on the other, is not only grounded in, but maintained by, the difference between the two hemispheres. Most knowledge is not, after all, propositional in nature: it's just that when we look where the spotlight is, that's what we find. We have seen that all the aspects of language that are peculiarly important to poetry – not just metaphor, but implied meaning of every kind – humour, irony, connexions between ideas not normally approximated, the connotative power of symbols, the 'music' of language (the movement of the verse, its ictus, metre and rhyme) – are all preferentially mediated by the right hemisphere. By common consent

over generations, it is poetry which enshrines our profoundest insights into reality. ‘Language halts behind intuition’, wrote Whitehead:

> The difficulty of philosophy is the expression of what is self-evident. Our understanding outruns the ordinary usage of words. Philosophy is akin to poetry. Philosophy is the endeavour to find a conventional phraseology for the vivid suggestiveness of the poet.[184]

Other philosophers such as Wittgenstein (‘philosophy should be written only as one writes *poetry*’),[185] Heidegger (‘all philosophical thinking, and precisely the most rigorous and most prosaic, is in itself poetic, and yet is never poetic art’),[186] and Whitehead (‘philosophy is akin to poetry’)[187] came to believe that philosophical discourse needed ultimately to have the quality of poetry, as Schopenhauer believed it needed to have the quality of music.

Music is the non-literal form of communication *par excellence*, reliant entirely on metaphorical meaning experienced in the physical frame of the hearer. Music and song are of fundamental importance in human relationships and societies, in bonding at work, in recreation and in worship. There is no known society in which music does not play a pivotal part and in which it is not also thought of as a medium through which one may contact the divine.[188] Birds use song to attract mates, but it is only humans that can synchronise the rhythm, or blend the pitch, of their utterances with that of their fellows. Human music is not, like birdsong, thought to be largely individualistic in intention and competitive in nature (birdsong, like other instrumental utterances, is grounded in the left hemisphere, not, like human music, in the right; *perception* of birdsong by birds, however, is grounded in the right hemisphere).[189] Everything about human music suggests that its nature is sharing, non-competitive.[190] It is the means of group bonding: for good or ill; the communal ‘we’ is also emotionally bound up with song and performance. In all known societies there are acts of communal, synchronous speech and song, in chants and prayers, which recruit right hemisphere regions associated with empathy, and are independent of those implied specifically in the generation and interpretation of language and music: it also seems that in such activities we

do not experience what is said or sung as coming from ourselves, but as being communal utterances.[191] There is a continuity in form and function with early poetry in preliterate societies, which was usually accompanied by music, was socially performative, and helped establish and expand common mythologies and narratives, confirming meaning in the deep structures of life, and consolidating the common purpose of the group: *mythos* at work.

Propositional discourse is limited in its ability to approach ultimate reality. Its very terms take us back, as left hemisphere discourse always does, to the familiar. In Nietzsche's phrase, 'language makes the uncommon common'. Philosophical language *requires* a metaphoric and flexible character and thus, according to Whitehead, 'philosophy in its advance must involve obscurity of expression, and novel phrases'.[192] He claims that the history of ideas should be studied with a 'constant remembrance of the struggle of novel thought with the obtuseness of language'.[193] He later adds that one of the two main problems of philosophy is the 'uncritical trust in the adequacy of language'.[194] Although language is indeed the tool required for philosophy,[195] it is nevertheless a limited servant that should never become the master.[196]

However, the rich ambiguity of meaning understood by the right hemisphere is seen by the left hemisphere only as a failing, a lack of precision: it sees there only obfuscation, or at worst, lies. The left hemisphere may add – and it adds enormously much – but what is added must be returned to the world that is grounded by the right hemisphere, or we misconceive the nature of reality. John Quijada, a *Star Trek* fan who studied symbolic logic (the predicate calculus) at university, and whose 'philosophical inclinations are toward an objective/realist philosophy', has invented a language, Ithkuil, which he describes on his website as 'an idealized language whose aim is the highest possible degree of logic, efficiency, detail, and accuracy in cognitive expression via spoken human language, while minimizing the ambiguity, vagueness, illogic, redundancy, polysemy (multiple meanings) and overall arbitrariness that is seemingly ubiquitous in natural human language.' No-one speaks Ithkuil, you will not be surprised to learn. Even its creator takes

> up to ten minutes to translate a simple sentence … much longer if new word-roots/stems are required, as the creation of roots takes

> careful thinking and planning … Long complex sentences can take up to half an hour. It then takes another five to fifteen minutes to look up the rules for writing the sentence in the script depending on the length of the sentence.[197]

An artificial language is like an artificial flower – it has no roots: it can teach us nothing. As Heidegger put it, it is not so much that we speak language, but that language, the storehouse of generations of experience, speaks in us. Without the historical perspective of a lived language, we enter a hall of mirrors where our thoughts are simply reflected back to us, without all that penumbra of meaning, tiresome and inexplicable as it may seem to some, that is 'seemingly ubiquitous in natural human language'. An artificial language is like Hans Christian Andersen's clockwork nightingale – perfect in its way, unlike the living bird, but meaningless. We tire of the man-*made*, but not of that which shows human influence, such as a beautiful landscape lived in for generations, the result of civilisation working in harmony with what Pope called the 'genius' – the spirit – of the place. A language is like such a landscape, and the languages of different countries, like their terrain, offer different views of the world. Again, we need both to contribute; whereas it is the tendency of the left hemisphere point of view, unlike the right, to want the field to itself.

Myths also have this quality, like language itself, that they do not just derive from one mind alone but from a shared consciousness that stretches over time and place, and are not even consciously – *cannot* be consciously – conceived. The great anthropologist Claude Lévi-Strauss mystified some of his more literal-minded Anglophone colleagues by saying: « *Les mythes se pensent dans les hommes, et à leur insu … d'une certaine manière, les mythes se pensent* entre eux. » [198] In other words, it is not that we think up, or think in, myths, but that myths 'think themselves' in us all, without our being aware of it, and even in some sense think themselves into being on their own. As Lichtenberg warned, 'the metaphor is far cleverer than its author, and so it is with many things. Everything has its depths.'[199]

We know that the mind is not a *tabula rasa*, a blank slate on which experience inscribes itself from scratch, but comes, as it were, prepared for the encounter it is to have with the forms of the world, including, but by no means limited to, the forms of language. To take a very simple example, the structure of the visual cortex comes fitted and prepared for interpreting the

principal physical shapes and their elements that it will encounter in the world. But that is only a very simple example. What is true of language may be true of the forms of myths, which are remarkably consistent and persistent in space and time: something like Jung's collective unconscious may be acting by means of epigenetics, or by means we may as yet be able only to surmise. The mathematician and logician CS Peirce wrote that 'it is somehow more than a mere figure of speech to say that nature fecundates the mind of man with ideas which, when those ideas grow up, will resemble their father,' – or, as I would prefer to say, mother, – 'Nature.'[200]

Nowadays our unthinking reaction is to reject any belief or experience whose origins are not known to us: unless we are fully conscious of everything about it and have it under control, it is treated as suspect. But one of the most important aspects of many experiences – such as the experience of love, of art of every kind, of the magnificence and beauty of the natural world, of ancient myths and narratives, of the solemnity of a religious ritual or of an ancient tradition – is that they require us to relinquish control. They speak of something much bigger than us, that cannot entirely be articulated; something ancient and enduring, which speaks, if it can be said to speak at all, *through* us, not just *out* of us. It is an eternal drama in which we each play a humble, but by no means insignificant part – no longer merely in the desolate limelight of our own story, signifying nothing, and reduced to strutting and fretting our hour upon the stage, only to be heard no more. The beauty and power of art and of myth is that they enable us, just for a while, to contact aspects of reality that we recognise well, but cannot capture in words. It is precisely their multi-layered, sometimes paradoxical meaning, well beyond articulation, that gives them value, and makes them resonate with us at so many different levels and in so many different ways.

The more important something is, the more we have to struggle in the attempt to reduce it to language. We would be lost without words, but sometimes it is wisdom to be lost *for* words. Words are always a representation in terms of something else. The work of art exists precisely to get beyond representation, to *presence*, even if that presence is itself composed of words, as it is in poetry. If this were not so, a lot of effort could have been spared, as it could all have been better stated in prose. The work of art does not hide, represent, or body forth something *else*, that must therefore be decoded: it is precisely what it is. And yet neither is it opaque,

as though we were stopped at its frontiers. It is *semi*-transparent, translucent: we see it all right, and yet see *through* it to something beyond.

'By the way', said Goethe, 'the Germans are an odd lot':

> They come and ask what idea I was trying to embody in my *Faust*, as if I knew that myself and could articulate it! … I am rather of the opinion that with poetic productions the more unparalleled, and the harder for reason to grasp, the better.[201]

Many languages have distinct words for knowing, dependent on the sense in which one can be said to know. In Latin *sapere* is distinguished from *cognoscere*, in French *savoir* from *connaître*, in German *wissen* from *kennen*. In each case the first indicates propositional knowledge, 'knowing *that*' such and such is the case, which requires no experience; while the second indicates knowledge *of* someone, some place, or other unique aspect of the world, directly from experience. Ultimately, in fact, all knowledge derives from experience, for which there are no propositions – thus *sapere* bows to *cognoscere*, *savoir* to *connaître*, *wissen* to *kennen*, propositional knowledge to knowledge by encounter. When we say we know something, what we mean is that we see that it is like something else that we reckon we already know better, from a previous encounter. And those 'somethings else', followed far enough, return us in every case to embodied experience.

What we are talking about here is a type of essentially *metaphorical* understanding, of which myth, poetry, drama and ritual are all manifestations. In true metaphor the intention must remain implicit; spelling it out causes its richness and emotional impact to collapse, much as explaining a joke makes it fall flat, or paraphrasing a poem reduces it to a series of banalities. It returns us from the 'presencing' of the world in language (right hemisphere) to its 're-presentation' in language (left hemisphere). We do not use metaphor to decorate, and therefore obscure, something best conveyed literally (although that would be how the left hemisphere sees it), but to bring to life a deeper and broader set of meanings than could be conveyed by literal language. 'It would be more illuminating', writes Max Black, '…to say that the metaphor creates the similarity than to say that it formulates some similarity antecedently existing.'[202]

All understanding whatsoever is, at bottom, metaphorical. It is not that there is, as *per* Locke, a bed of literal truth, on which metaphorical truth, like a colourful counterpane, is overlaid. It is the other way round. Metaphor is where, as Wittgenstein put it, one's spade reaches bedrock and is turned. Literal truth is something just further removed from experience, taken into the realm of the 'literal', ie, that of letters. Everything has to be expressed in terms of something else, and, as I say, those something elses in language eventually come back to bodily experience. There is nothing more fundamental in relation to which we can understand *that*.

Even words like 'immaterial', 'insubstantial', 'abstract' and 'virtual' refer ultimately to embodied experience. Immaterial comes from the Latin *materia*, meaning 'wood', and even further back, from *mater*, 'mother', in the sense of an origin: the immaterial is that which has no mother. 'Insubstantial' comes from Latin, *sub-*, under, + *sistere*, to 'stand firm': thus something that has nothing standing under it. 'Abstract', as mentioned earlier, is from Latin *abs-*, away, + *trahere*, to 'drag': something that has been dragged away from its 'context' (itself from Latin *con-*, together, + *texere*, to 'weave', ie, 'that which has been woven together'). 'Virtual' comes by a roundabout route from Latin *virtus*, the 'strength of a man' (*vir*). And 'literal' itself? It comes, via Latin *littera*, from a Sanskrit root *li*, indicating something 'daubed' or 'smeared': that's what letters are, after all.

As Lakoff and Johnson point out,

> metaphor is centrally a matter of thought, not just words. Metaphorical language is a reflection of metaphorical thought … Eliminating metaphor would eliminate philosophy. Without a very large range of conceptual metaphors, philosophy could not get off the ground. The metaphoric character of philosophy is not unique to philosophic thought. It is true of all abstract human thought, especially science. Conceptual metaphor is what makes most abstract thought possible.[203]

I will come on to the question of whether ultimate reality can be expressed in words at all. By their own accounts, physicists (like mathematicians) tend to think in visual images: to try to appreciate or understand mathematics without visualising it, as physicist Tristan Needham suggests, is like trying to understand music from the score in a

culture where it is forbidden to play or hear it.[204] But whenever physicists do express themselves in language, the language is highly metaphorical. One could say the same of spiritual insight: words betray it.

According to Bryan Magee,

> direct experience which is never adequately communicable in words is the only knowledge we ever fully have. *That* is our one and only true, unadulterated, direct and immediate form of knowledge of the world, wholly possessed, uniquely ours. People who are rich in that are rich in lived life. But the very putting of it into words translates it into something of the second order, something derived, watered down, abstracted, generalised, publicly shareable. People who live most of their outer or inner lives in terms that are expressible in language – for example, people who live at the level of concepts, or in a world of ideas – are living a life in which everything is simplified and reduced, emptied of what makes it lived, purged of what makes it unique and theirs.[205]

However, the connotative aspects of language, all that language implies rather than states explicitly, help us get back in touch with the world as the right hemisphere experiences it. ‘The metaphor is perhaps one of man’s most fruitful potentialities’, wrote Ortega y Gasset: ‘its efficacy verges on magic, and it seems a tool for creation which God forgot inside one of His creatures when He made him.’ Metaphor embodies thought and places it, where it belongs, in a living context. In this, it bridges the gap between language and the world, a gap entailed on us by the very nature of language. As philosopher Jan Zwicky puts it, ‘metaphorical language depends on non-metaphorical language the way the art of healing depends on the presence of injury and disease.’[206]

This is why poetry (which arose historically *before* prose) is so vital to an understanding of the world. Its new conjunctions, its metaphors, its tone, its musical aspects, are all – like music, for most of us – appreciated by the right hemisphere. But in day-to-day speech it is also the right hemisphere that ultimately makes sense of language, and understands an utterance as a whole, in context, with all its non-literal, implicit meaning.[207]

‘Some words and sentences’, according to the famous literary critic IA Richards,

> do seem to mean what they mean absolutely and unconditionally. This is because the conditions governing their meanings are so constant that we can disregard them … In weighing out a pound of tea we can forget about the mass of the earth. And with words which have constant conditions the common sense view that they have fixed proper meanings, which should be learned and observed, is justified. But these words are fewer than we suppose. Most words, as they pass from context to context, change their meanings; and in many different ways. It is their duty and their service to us to do so …[208]

He called the belief that a word has an ideally single meaning of its own, which dictates the purpose for which it should be uttered, the Proper Meaning Superstition. Unfortunately, when we forget that the stability we think we see depends wholly on the context always remaining constant – as, according to Richards, we commonly do – what is a reasonable practical shorthand assumption becomes a superstition that blocks our understanding. When we think about the world – or time, space or God – and try to make sense of it, we are, precisely, not in those everyday contexts: that’s where the idea of fixed meanings leads to false reasoning.

Recognising this is not a call to abandon rigour, but to embrace it fully. Without a language one can rely on, there is no way of establishing common truths. But a language that is not sensitive to context is dangerously unreliable. You can read a clock precisely, but you can rely on what it says only if the hands are moving in synchrony with the world. A stopped clock is always dependably the same, but almost always dependably wrong. Using language as accurately and clearly as one can (but not a whit more) is to be a custodian of truth in an age where language often seems to be floating free of its moorings in the real world.

Good metaphors are like good jokes: they rely on making unusual connexions. As Zwicky says, ‘Surprise is common to good metaphors and good jokes … Seeing [a weak metaphor] requires no leap of imagination.’[209] A metaphor fails if it is too familiar. Its energy dissipates

immediately and it dies. We no longer see the gap that is overcome. The two parties are either so remote that no ‘electrical connexion’ can take place, or so close that none is required: in either case, no *leap* of imagination takes place.

Mythos, relying on implicitness, can be responsive and responsible: inextricably bound up with its reception in the mind of the one who hears or sees, it is itself changed by that reception. Relying on explicitness, *logos* is unidirectional: it drives a line of argument, it declares ‘how things are’, and by so doing aims to fix them. Each has its uses. But note that in metaphor nothing can remain unchanged by the interaction, which is bi-directional, reverberative. When we call a man a wolf, we don’t just make the man more wolf-like, but the wolf more human. All knowledge, as Bateson once said, is knowledge of difference – except that it is knowledge of difference within sameness, and sameness within difference: it is only when we see both the sameness and the difference that we can say we know something. Each implies the other. And a metaphor, ultimately the only way to come by knowledge, is an *equal* drawing together of two things in which neither can escape being changed by the encounter.

I may seem to be making too much of this, but the point is important. We think that connexions are causative and temporal, running one way. *Logos* suggests as much. As if to make the point, Lakoff and Johnson, in their book *Philosophy in the Flesh*, in which they establish beyond doubt the grounding role of metaphor in understanding, nonetheless write: ‘Does the metaphor fit a pre-existing qualitative experience, or does the qualitative experience come from conceptualising what we have done via that metaphor?’[210] Surely, neither. This is the old temporal causation problem: in reality it’s not a linear relationship, but a betweenness. There is a never-ending reverberative loop set up between the experience and the metaphor, in which neither can be said to have precedence. It is not one of steps, or progress by parts, but one of the co-creation of a new whole.

Coleridge refers to two ways of arriving at truths: sequential, stepwise understanding, in which, as it were, one focusses on one’s feet, contrasted with the cultivation of a love for the subject which enables an imaginative seizure of the whole as one steps toward it. Describing how his father introduced him to astronomy as a child, Coleridge writes that he heard him speak of astounding matters far beyond everyday experience without the

least ‘incredulity’, because he was already familiar with tales of the imagination:

> my mind was habituated to the Vast – & I never regarded my senses in any way as the criteria of my belief … I know no other way of giving the mind a love of ‘the Great’, & ‘the Whole’. – Those who have been led to the same truths step by step thro’ the constant testimony of their senses, seem to me to want a sense which I possess – They contemplate nothing but *parts* – and all *parts* are necessarily little – and the Universe to them is but a mass of *little things*.[211]

Is it possible to combine ‘knowledge about’ (*savoir*/*wissen*, the stepwise understanding of the parts) with ‘knowledge of’ (*connaître*/*kennen*, the awe-inspiring encounter)?

The intellect is ‘incurably abstract’, as CS Lewis says, while experience is intrinsically concrete. How can we have both kinds of knowledge at once – knowledge about, and knowledge of?

> You cannot *study* Pleasure in the moment of the nuptial embrace, nor repentance while repenting, nor analyse the nature of humour while roaring with laughter. But when else can you really know these things? ‘If only my toothache would stop, I could write another chapter about Pain.’ But once it stops, what do I know about pain?[212]

Lewis carries on to suggest that in fact this is the whole purpose of myths. In them we see otherwise abstract truths more clearly, at the very same moment that the experiential reality is brought home to us. The implicit nature of myth, which must never be made explicit, permits it to embody something that, once it is looked at directly, turns into a wraith: it collapses into an abstraction.

The understanding yielded by *mythos* is not an optional extra, a dispensable add-on, an embellishment; but foundational, non-negotiable. It is something intrinsic to our ability to situate ourselves in the world, and to live a fully human life. We become sick without it: ‘mere purposive

rationality', wrote Gregory Bateson, 'unaided by such phenomena as art, religion, dream and the like, is necessarily pathogenic and destructive of life.'[213] Again I hear Darwin's poignant complaint that his mind had become a machine for grinding out facts; and that 'the loss of these tastes is a loss of happiness, and may possibly be injurious to the intellect, and more probably to the moral character, by enfeebling the emotional part of our nature.'

In truth, we are never without a *mythos* of a kind. In the absence of the celebration of the timeless *mythoi* given us through art and religion, we do not avoid espousing myths of our own making, much impoverished though they must inevitably be: nowadays they are those of the Mindless Machine and of the Selfish Gene.

Louis Sass points out that Wittgenstein saw greater wisdom in mythic than in scientific accounts of the world, which 'give us the illusion of explaining a world that we would do better to wonder at'.[214] And he compares Wittgenstein and Freud:

> Though [Wittgenstein] is in many respects the deeper sceptic of the two, his is a curious scepticism, profoundly dubious about doubt itself and peculiarly sympathetic to belief. Wittgenstein, who had been trained as an engineer, wrote that he himself found scientific questions interesting, but never really gripping. Hypotheses, cause and effect relationships, even the sorts of insight psychoanalysis could offer: in his view, none of these could address the truly significant issues or existential dilemmas of our lives … Wittgenstein believed, in fact, that the causal and scientific understanding so prominent in our age often had the insidious effect of *concealing* important questions – by giving a false sense of inevitability and turning us away from the richness and multiplicity of the world. 'People who are constantly asking "why"', he wrote, 'are like tourists who stand in front of a building reading Baedeker and are so busy reading the history of its construction, etc., that they are prevented from *seeing* the building.'[215]

(So *that* was what people did to shield themselves from reality before the invention of the iPhone.)

Knowledge *about* displaces knowledge *of* the world. What we see comes to be our representation of reality, in which there are *things* that we have to learn how to connect, not relationships out of which what we subsequently call 'things' emerge. Evelyn Underhill saw how labels become more real than the reality they try to represent, and how such a world is inevitably not just re-presented, but *mis*-represented:

> Because mystery is horrible to us, we have agreed for the most part to live in a world of labels; to make of them the current coin of experience, and ignore their merely symbolic character, the infinite gradation of values which they misrepresent. We simply do not attempt to unite with reality. But now and then that symbolic character is suddenly brought home to us. Some great emotion, some devastating visitation of beauty, love, or pain, lifts us to another level of consciousness…

And then it is that we see beyond the 'neat collection of discrete objects and experiences' which we have got used to calling the world.[216]

Among the beneficial effects of art and religion at their best are to keep us from wandering aimlessly in this deserted landscape. Jürgen Habermas, formerly unaccommodating of religion, has come to believe that religion must play a large and indispensable part in society:

> Among the modern societies, only those that are able to introduce into the secular domain the essential contents of their religious traditions which point beyond the merely human realm will also be able to rescue the substance of the human.[217]

Clearly Habermas is speaking not of the propositional element in religion, but of the *mythos*. Propositions, however intricately devised, are the work of *logos*, and merely get in the way of the process of religion, which is, or should be, about how to find meaning and fulfilment in life, and to help us understand our relationships with one another, with the world at large, and with the divine, however we conceive it.

One important difference between *mythos* and *logos* is that, according to *logos*, knowing how or why something happens appears to exhaust its

nature; whereas according to *mythos*, the nature of something is precisely what cannot even be approached by *logos*. In talking about art, neuroscience seems satisfied with describing mechanisms of perception and offering reductionist accounts of human preference. But it's not just a matter of *preferring* something, like mint toothpaste or a type of handbag. It's not even a matter of accounting for beauty or pleasing emotions, since art cannot be reduced simply to either of these. Philosopher of neuroscience Alva Noë writes in relation to work on the mechanisms of perception:

> Some of us might wonder whether the relevant question is how we *perceive* works of art, anyway. What we ought to be asking is: *Why do we value some works as art? Why do they move us? Why does art matter?* … Far from its being the case that we can apply neuroscience as an intellectual ready-made to understand art, it may be that art, by disclosing the ways in which human experience in general is something we enact together, in exchange, may provide new resources for shaping a more plausible, more empirically rigorous, account of our human nature.[218]

In other words *mythos* is required to help us situate *logos*, not the other way round; since, about *mythos*, *logos* has plentifully little to say. 'Myth is the isthmus which connects the peninsular world of thought with that vast continent we really belong to', writes Lewis.[219] 'It is not, like truth, abstract: nor is it, like direct experience, bound to the particular.' And he continues, refining its relationship with truth: 'What flows into you from the myth is not truth but reality (truth is always *about* something, but reality is that *about which* truth is), and, therefore, every myth becomes the father of innumerable truths on the abstract level.'[220]

The ancient myth of Orpheus and Eurydice has a deep meaning that is relevant to one thread that winds its way through this entire book. Let me remind you of the story in outline. Orpheus was a demigod, his mother being one of the Muses and his father a Thracian prince. His mother gave him the gift of music, and he grew to be such an incomparable musician that all things, both animate and inanimate, were drawn to his lyre. He could move animals and trees, but also rocks and stones, and even alter the course of rivers, by the power of his music alone. He loved a nymph called

Eurydice: and they married. But shortly after the wedding, while she was walking in the fields with her bridesmaids, she was bitten by a viper, and died. Heartbroken, Orpheus resolved to go down into the underworld to rescue her; there he was summoned to the presence of the gods. After pleading his case, he sang, and the gods were so moved that they relented, and acquiesced to his request to take his bride back, though on one condition: that he must not look directly at her while he was leading her out to the upper world again. So he stepped ahead of her on the ascent, and she followed; but at the last minute, when they were almost at the mouth of the cave that led out of the underworld, he could contain himself no longer. He turned and looked at his bride. With cries of joy he ran to embrace her, but she vanished before his eyes, and was drawn back to the underworld, never to be seen by him again.

This is not only, in my view, probably the greatest of the Greek myths, as an account of love, its mysteries and its losses, but is itself an account of *the nature of myth*, as CS Lewis pointed out:

> In the enjoyment of a great myth we come nearest to experiencing as a concrete what can otherwise be understood only as an abstraction. At this moment, for example, I am trying to understand something very abstract indeed – the fading, vanishing of tasted reality as we try to grasp it with the discursive reason … But if I remind you, instead, of Orpheus and Eurydice, how he was suffered to lead her by the hand but, when he turned round to look at her, she disappeared, what was merely a principle becomes imaginable. You may reply that you never till this moment attached that 'meaning' to that myth. Of course not. You are not looking for an abstract 'meaning' at all. If that was what you were doing, the myth would be for you no true myth but a mere allegory. You were not knowing, but tasting; but what you were tasting turns out to be a universal principle. The moment we state this principle, we are admittedly back in the world of abstraction. It is only while receiving the myth *as a story* that you experience the principle concretely. [221]

It makes us feel, as nothing else could do, the dangers of explicitness, and therefore the value of obliqueness: of myth, intuition, poetry, music, and all the other arts, true philosophy, true spiritual understanding, and

every imaginative act whose aim is to offer a glimpse of the elusive nature of reality, not to mention the power of all that body of tacit knowledge without which we begin to lose life. It is the natural counterpoint to the myth of Prometheus, which similarly warns of equally problematic tendencies of the left hemisphere's disposition towards the world: striving to know far more than the human mind can understand, and to control far more than it should, if it is wise, attempt to control. And, once again, if you don't see why, I cannot help you, because if I attempted to grasp its 'meaning' any more firmly and drag it into the light, it would vanish and die.

CONCLUSION

The idea of reason has at least two main meanings: a rigid, abstract, linear mode, prizing precision and certainty, and owed to the left hemisphere; and an embodied ability to hold in suspension knowledge of various kinds justly, and to evaluate them in the context of lived experience, where reason is not in any sense at war with feeling or imagination. This mode is more dependent on the right hemisphere: and is, like the right hemisphere's understanding of science, in my view more fruitful than the alternative that is often served up in its place. And it is vanishing and dying.

LOGICAL PARADOX: A FURTHER STUDY IN LEFT HEMISPHERE CAPTURE

The evil and thus keenest danger is thinking itself.
It must think against itself, which it can only seldom do.

—Martin Heidegger[1]

THERE IS A PARADOX ENTAILED IN PARADOX. WHAT WE CALL PARADOX IS seen by the purely analytic mind as a sign of an error somewhere – an error which it may be hard to identify, but which nonetheless exists, and must be flushed out and exposed, no doubt by further analysis. Meanwhile, to the imaginative mind it may be a sign of quite the opposite: that we are at last approaching, in one of two possible senses, a deeper level, not of error, but of truth.

The first sense is this: that in the deep (though, clearly, not the superficial) structure of reality opposite truths do actually coincide, and we must therefore accept both. Such a view can be found in, for instance, the writings of Heraclitus and Empedocles, and in the philosophical literature of China and India for millennia; and it was given memorable expression in our own time by the 'father' of modern physics, Niels Bohr: 'it is the hallmark of any deep truth that its negation is also a deep truth.'[2] I will come to this important topic in the first chapter of Part III, in which I consider the coincidence of opposites. Note that such a realisation does not leave us logically adrift, so that we have to accept that any statement and its opposite must be true. Bohr makes an important distinction: everyday truths

do not give rise to paradox, deep truths do. ‘One of the favourite maxims of my father’, wrote his son Hans Henrik Bohr,

> was the distinction between the two sorts of truths, profound truths recognized by the fact that the opposite is also a profound truth, in contrast to trivialities where opposites are obviously absurd.[3]

Either I had milk in my coffee this morning or I didn’t, but a particle may also be a wave. So far, so good. But what is the second sense? This concerns the structure of the mind and brain: the distinct versions of the world made possible by either hemisphere. As the reader is aware, these have complementary, but contradictory, properties. If, as the philosopher Nicholas Rescher puts it, a paradox is ‘a set of mutually inconsistent propositions, each of which seems true’,[4] that may be because of differences between the ways in which the right and left hemisphere experience the world. I believe, in fact, that many, if not all, logical paradoxes can be seen as arising from the left hemisphere’s attempt to analyse something that is better grasped as a whole by the right hemisphere. Which is why, unlike insight into the coincidence of opposites, such paradoxes leave us, not illuminated, but puzzled. We *know* that Achilles can overtake the tortoise, yet the more we think about it the more impossible it seems. Much philosophy concerns itself with such paradox. ‘One must not think ill of the paradox’, wrote Kierkegaard with a hint of his characteristic mischief, ‘… the thinker without a paradox is like the lover without passion: a mediocre fellow’.[5]

It is this form of paradox I wish to look at in this chapter: the product of the left hemisphere’s attempt to grasp analytically what the right hemisphere intuitively understands. By such an approach, I hope to generate a new perspective, and perhaps cast some light. And often, as I hope to show, we find evidence of more than one aspect of hemisphere differences operating at once in the same paradox, fitting together coherently, and thus strengthening the argument for the relevance of a hemispheric approach.

In what follows I am not offering ‘solutions’ to the paradoxes I discuss. I am merely pointing out how a hemispheric viewpoint helps to show why they arise. It is worth noting that, according to philosopher Margaret

Cuonzo, as far as the deeper paradoxes go, at least, ‘not much in the way of progress has occurred’.[6] So *any* light might, I hope, be welcome light.

UNEQUAL TRUTHS

Though I suggest that paradox arises from two conflicting views, each of which has a claim on truth, I will argue that that does not entail the simple conclusion that they have equal claims. If you are uncomfortable with unequal truths, thus with degrees of truth – 'surely, either it is true or it isn't?' – you will be particularly susceptible to being baffled by paradoxes, since one of the many elements that give rise to paradox is, precisely, that there are degrees of truth: not all truths are created equal. This has consequences for apparent contradiction, since a statement and its denial can often be true in different degrees and different contexts. Such thinking is dependent on the right hemisphere: black and white thinking, as you remember, is a predilection of the left hemisphere. Let us have a look at some of the paradoxes that involve such an element, and see what other hemispheric elements they contain along with it.

A number of paradoxes depend for their status as paradoxes primarily on an inappropriate lust for precision. I have mentioned the Quine-Duhem Paradox.

- *Quine-Duhem Paradox*. No hypothesis can be tested in isolation from an indefinite set of auxiliary hypotheses; in order to show that a hypothesis is mistaken, it is necessary to isolate that hypothesis from its set of auxiliary hypotheses; therefore, no hypothesis can be shown to be mistaken.

But conviction comes by degrees. The perception that an apparently mistaken hypothesis might in fact be correct, if we were only prepared to question one of the many auxiliary hypotheses that surround and support it, is hugely important, and is constantly overlooked. But that doesn't mean that we cannot often be reasonably sure whether a hypothesis is mistaken.

One answer to uncertain situations is to adopt what is known as a Bayesian approach, after an eighteenth-century mathematician and probability theorist, Thomas Bayes. In essence, this involves a sophisticated mathematical estimate of the change in probability added by the new evidence, obtained by contrasting 'prior probability' (before taking into

account the new evidence) with ‘posterior probability’ (after taking the evidence into account). Although there is precision to the formula, there is an inevitable lack of precision to the estimate of prior probability, which is based on one person’s idea of the strength of a belief that varies from person to person, and within the same person from moment to moment. Purported accuracy is only as valuable as the accuracy of its antecedents.

Related to the Quine–Duhem Paradox is the Sceptical Paradox.

- *The Sceptical Paradox*. I can know for sure that I am in London only if I can know that I’m not dreaming; I cannot know that I’m not dreaming; therefore, I cannot know for sure that I am in London.

An answer to this is to interpret what counts as knowledge in context, an approach known, indeed, as ‘contextualism’. It entails acceptance of the fact that if you set the bar high enough, we can never be said to know anything. Knowledge is a matter of degree: our standards for ‘knowing’ anything change with context. Demonstrating an everyday matter such as that I am now in London does not demand tiresomely high standards of evidential confirmation. However, proving that I am not dreaming may require such a high standard of evidential confirmation that it cannot be achieved, and we will never know whether, in the words of the title of Calderón de la Barca’s famous play, *Life Is a Dream*.

You will recall William James’s words: ‘more than half the trouble that metaphysicians and logicians give themselves over the paradoxes and dialectic puzzles of the universe’ are due to abstraction from context.

Sensitivity to matters of *degree*, and to *context*, are both areas in which the left hemisphere is handicapped by comparison with the right. The Hedonic Treadmill refers to the fact that we adapt quickly to whatever circumstances we find ourselves in, and that pleasure comes from a *relative* difference of position between ourselves and others, or between ourselves now and ourselves in the immediate past, so that we can end up rich, but always, nonetheless, miserably searching for something further. It shows that pleasure is not attached to the possession of things that supposedly have absolute value (LH), but derives from the context of the web of life, according to which ‘things’ change their value constantly (RH). It is worth remembering that time is a context, and that the left hemisphere appears not

to understand time: this results in the neglect of one of the most important contexts we have. Let's take a look.

An interesting paradox concerns the Unexpected Examination (or, in another version, the Unexpected Hanging).

- *The Unexpected Examination*. A teacher announces to his class at the beginning of the week that at some point in the week he will submit them to an unexpected examination. Apparently this can never occur. This is because clearly it cannot take place on Friday, because by then, not having happened yet, it would be expected. But it can't take place on Thursday either, since this is now the last possible day, and so the same reasoning applies. Nor Wednesday for the same reason, and so on. Therefore it cannot happen at all.

The word 'unexpected' has two meanings here. One is 'unexpected at the moment it happens'; the other is unexpected at the time the announcement is made. The first type of unexpectedness changes in degree, and does so with context, as the week goes on, day by day: on Monday it is one in five, on Tuesday it is one in four, and so on. In other words it changes with time. According to this meaning, what is unexpected only becomes, in a sense, certain, once Thursday is past, and by then the term unexpected has done its work – and the *least* expected day, according to the left hemisphere, turns out to be the very day of the exam:

> That day will have been unexpected all along. When it comes around it will, of course, no longer be an unexpected day, for what is now present is no longer unexpected. But the last day *cannot be dislocated from the other days at the time the announcement is made*, except by a kind of theoretical anticipation of actual history, and thus by moving away from the announcement of a possibility to that state of affairs where possibilities are specified and distinguished *one after the other*.[7]

The point being made here by the philosopher Paul Weiss is that the situation cannot be picked apart serially: it needs to be understood as a whole at a moment in time, the moment at which the announcement is

made. From this perspective the date is from the outset uncertain, and to be prepared means, however you look at it, being prepared every single day: whatever the left hemisphere tells you, you will be caught on the hop if you work out cleverly that there can't be an unexpected examination – and it then happens on Wednesday.

Another way to think of the paradox here is that it involves the degree to which imprecision is tolerated. If the teacher were to say 'there may or may not be an examination', the effect would be the same, but the paradox would not arise. The imprecision here has the effect of allowing the meaning of the word 'unexpected' to change with time, in other words with context, and therefore to be more accurate, if less precise. The left hemisphere finds it hard to accommodate such flexibility. A desire for an interpretation that is unambiguously correct at all temporal points lies behind much of the paradox literature, and once again illuminates the handicaps of a certain highly decontextualised, over-precise way of looking at the world. Such paradoxes are fun, but the fun derives from the awareness of how badly (what we can now see as) left hemisphere thinking leads us astray.

We have noticed that the days are picked off *serially*. Then we might notice that this has to be done starting at the end of the time period and working *backwards*. In other words we view the week a slice at a time; and we view it retrospectively, not prospectively as it is lived. For the time being, let us just note these elements – serial analysis and retrospection; their significance will be revealed as the argument unfolds.

Many paradoxes involve the breaking down of a flow into parts or slices. Of these, perhaps the most celebrated cases are the paradoxes of Zeno of Elea, a Greek philosopher of the fifth century BC. He is well known for paradoxes relating to time and space, often inviting the conclusion that motion is impossible. Zeno's paradoxes have tantalised ever since they were first formulated, and have been considered by some philosophers to be simply beyond solution.

- *The Dichotomy (or Division*). Suppose you wish to leave the room. Before reaching the door you must get halfway there, and before that, a quarter of the way there, and before that, an eighth of the way, and a sixteenth … and so ad infinitum. An infinite number of

> steps cannot be accomplished in a finite time, so no motion is possible, and you are rooted to the spot.

One answer is that a convergent series of infinitely many parts may be contained within a finite number of any size you like. The infinite series 1 + ½ + ¼ + ⅛ … does not sum to infinity, but to 2. The serial analysis of any given step you take is compatible with there being a finite number of steps between you and the door. The problem comes from thinking of infinity as the last in a series of escalating (or diminishing) numbers. But there is no last, and infinity is not part of a series.

The Dichotomy involves a number of elements, but among them there is a *retrospection*: one begins, conceptually, at one's destination and works backwards. This demands that the completed act must be posited at the outset, so that one can talk about its half, quarter and so on. It can be broken down retrospectively into pieces: it can be *analysed*. But it cannot be built up prospectively – that is to say, *created* – from pieces or slices of space or time. It can potentially be analysed *ad infinitum*, but it cannot be created *ad infinitum*. That in turn relates to the issue of wholes and parts: a given whole can be broken down, after the fact, into as many 'parts' as you like, but it cannot be put together from parts, not even as many as you like. That is because the parts, like slices of time or space, are a mental device only: they belong to a left hemisphere *representation,* or fiction. A finite distance is achieved in a finite number of steps: 'the illusion that it is infinite is due to mathematicians who confuse their mathematical *representations* with *what is represented*.'[8] Or as I would put it for clarity's sake, who confuse the representation with the presence, the left hemisphere's take with that of the right.

This difference in time between the hemispheres – retrospection on something completed (in the left), as opposed to being present moving forward in an always-evolving process (in the right) – is of crucial importance, since what is at stake here is nothing other than the nature of time itself. Analysis is a (1) *fragmentation* into (2) *static* instants of a (3) *'re'*-presentation, by definition 'after' the fact and (4) *in an abstract realm*; it has all the hallmarks of the left hemisphere about it. By contrast our intuitive understanding takes as an (1) indivisible *whole* (2) the nature of *motion* as it is (3) *present* within (4) *embodied experience*, and has all the hallmarks of the right hemisphere about it.

Consider another space-time problem of a simple kind in which the emphasis is on space, rather than on time: that of how to construct a line. Extension is an irreducible element in our experience of both space and time. Once a line already exists, you can *retrospectively* locate a point in it; but you cannot make a line, *prospectively*, out of points, even an infinite number, since a point by definition has no extension. If you think of a point as a pencil dot, you are cheating, because the dot already possesses extension – it is, in effect, a short line – and you have just smuggled in the very thing you were trying to account for. Similarly a span of time cannot be broken down into instants, because the instant has no thickness. As soon as you allow it the least thickness, it is already a span of time, and you have just imported the element you were trying to account for by putting together instants. An infinity of points or instants will not get you to extension, because the nature of extension, or depth, requires a leap (as the left hemisphere would see it), to something of an irreducibly different nature.

This reminds me of a saying of Kierkegaard, which is invariably misquoted, truncated, and taken out of context, and therefore becomes a banality, to the effect that life is lived forwards but can be understood only backwards: in other words, we see what we were stumbling towards only with hindsight. But this is completely to misunderstand his point, which emerges if one looks at what he actually said in context:

> It is perfectly true, as philosophers say, that life must be understood backwards. But they forget the other proposition, that it must be lived forwards. And if one thinks over that proposition it becomes more and more evident that life can never really be understood in time simply because at no particular moment can I find the necessary resting-place from which to understand it – backwards.[9]

He is talking about the rather less obvious point that philosophy *stops time* and *represents* it, retrospectively; whereas when we are living, we experience the world as it happens, in the flow of time. Thus it cannot be ‘understood’ in the sense used by analytic philosophers outside of time.[10]

I earlier referred to a closely related, and more famous, paradox of Zeno’s.

- *Achilles and the Tortoise*. The tortoise challenges the famously swift-footed Achilles to a race, and Achilles graciously gives the tortoise a good head start. But Achilles can never catch up with, never mind overtake, the tortoise, since first he must get to the place from which the tortoise started, but by then the tortoise will have moved on; so then he must reach the tortoise's new position, but by then the tortoise has moved on; and so *ad infinitum* …

The problem here is effectively the same as in the Dichotomy: slicing a flow, seeing a whole as the sum of the parts, retrospecting on what in reality is over in a few seconds and a few strides, and thereby reducing it to segments – a *representation* from which the actual flow of time and movement, what Bergson called *durée*, has been removed, and cannot be recaptured. It is easy to kill something with a knife, but with the knife you cannot make it live again.

Time is represented, retrospectively, along a line, whether that is straight or curved; and it is along that line that time is measured, by taking the difference between two points. Every moment the clock points – at a point: a digital clock equally specifies a series of static points by naming them, however rapidly they succeed one another. But time is not made up of duration-less moments, any more than the line that represents it is made up of points. A point has *no* extension, whether in space or time: that is the whole point about a point.

Note that all the 'building blocks' of the experiential world – space, time, depth, and, I would add, consciousness – are clearly different in kind from anything else, are irreducible, and therefore require a leap: they cannot be approached incrementally. Motion, being reciprocally emergent with space and time, also requires a leap, and can't be crept up on gradually from stasis. There is in fact an ancient paradox, known as the Antinomy of Change, which was discussed by Plato and Aristotle. It both touches explicitly the paradox of how motion arises, and, at a second level, implicitly illuminates the need for what I call a leap in arriving at other irreducibles.

- *The Antinomy of Change*. Imagine an object at rest that then begins to move. At the instant when the movement starts, is it at rest or in motion?

The point is that this paradox applies to change of every kind, and his inability to find a satisfactory answer predictably led Parmenides to deny the existence of change (the world's first great exponent of 'because that's what it says on this piece of paper'). Plato also saw change as a delusion. According to Bruno Snell, Greek science generally lacked a concept of motion: in their enquiries their objective was 'to trace only the constant, static relations … In the field of optics the Greeks did not pass beyond a geometry of light rays; and their scientific mechanics did not develop beyond statics.'[11] This is a profound insight that goes to the core of Platonism, and thence of Western philosophy, for centuries.

Aristotle thought that at the instant when movement starts, the object was neither at rest nor in motion – which is an odd response coming from the person who formulated the law of the excluded middle. It presumably indicates that he was stumped. An alternative response might be that no such instant exists, and that if it did, it would make change impossible. It seems to me that it is more reasonable to accept the existence of change and deny the existence of an instant, which is a theoretical invention, than to accept the existence of an instant and be forced to deny the existence of change, which is a matter of direct knowledge from experience.

'What Zeno shows', as philosopher George Melhuish puts it, 'is that *continuity cannot be composed of discrete elements* even if there is an infinity of them.'[12] It has to be inhabited whole; it cannot be composed from without. Flow is an irreducible, not an emergent, element in the universe.

A further paradox of Zeno's also concerns motion and is more outrageous still, but the same set of considerations apply.

- *The Arrow*. When the arrow occupies a place just its own size, it is at rest. At every moment during its flight, the arrow occupies a place just its own size. Thus at every moment of its flight, the arrow is at rest, and it never moves.

As Bergson writes:

> A passage is a movement and a halt is an immobility. The halt interrupts the movement: the passage is one with the movement

> itself. When I see the moving body pass any point, I conceive, no doubt that it *might* stop there; and even when it does not stop there, I incline to consider its passage as an arrest, though infinitely short … but it is only my imagination which stops there … as every point of space necessarily appears to me fixed, I find it extremely difficult not to attribute to the moving body itself the immobility of the point with which, for a moment, I make it coincide; it seems to me, then, when I reconstitute the total movement, that the moving body has stayed an infinitely short time at every point of its trajectory. But we must not confound the data of the senses, which perceives the movement [RH], with the artifice of the mind [LH], which recomposes it … You substitute the path for the journey, and because the journey is subtended by the path you think that the two coincide. But how should a *progress* coincide with a *thing*, a movement with an immobility? [13]

There are a number of hemispheric elements in all three of these paradoxes. First, retrospection is required because we are dealing with a left hemisphere *post factum representation*. It is true that, in the case of the arrow, retrospection does not seem to apply, but only because it is hidden in what is still an exercise in *post hoc* representation of a flight: the path, not the journey. Second, slicing of motion or time produces *stasis*, a characteristic of the left hemisphere's represented world. Third, the left hemisphere believes it can put anything together from *parts*. By contrast, the right hemisphere is dealing with what is *present* and actually experienced; it inhabits *movement* in time and space each of which has depth; and it sees that the *whole* is not the same as the sum of the parts.

On Zeno's paradox of Achilles and the tortoise, Bergson points out that nobody seems to have thought of asking Achilles how he did it. If asked he would have said, 'I don't have to take an infinite number of steps – I am past the tortoise in three strides'. And if anyone were to think of asking me, I'd say I don't have to take an infinite number of steps to get out of the room, nor does the arrow in flight get to be stationary at any point: except retrospectively, in the left hemisphere of the reader.

Note that time and space are always considered together in Zeno's paradoxes. This might be because, as Einstein believed, they were inseparable; but it is more probably because we attempt to understand time

by representing it spatially. That, according to Bergson, is where we make the fundamental error.

Related to this is a paradox promulgated by the Cambridge metaphysician JME McTaggart in 1908.

- *McTaggart's Paradox*. There are two main ways of thinking of time, claimed McTaggart: 'past, present and future' versus 'earlier or later'. The first is time as we experience it, in which the now of presence is constantly changing, and turning what was the future into the past. In other words, my 70th birthday lies now in the future and will one day lie in the past. He called this the 'A-series'. The second is time viewed from such a standpoint that there is no change: what was earlier (or later) will always remain so, however much time moves on. Nothing that can happen now will ever alter the fact that my birth was, is, and always shall be, earlier than my death. He called this the 'B-series'.

He deduced from this that time cannot exist, because (i) in the B-series there is no change, which is essential to time; and (ii) the A-series is self-contradictory, since it can never be true that anything that is in the past can also be in the present and in the future. If you were to object that this is to ignore the difference time makes, McTaggart would respond that that is to invite in the very thing he is engaged in deconstructing and has already shown to be incoherent – unless there is a second A- & B-series to ground the first, in which case the same arguments apply to them, and so a third pair of series will be required … and so ad infinitum.

Once again the left hemisphere, in whose realm many philosophers seem to do most – or all – of their work, has represented time from a standpoint outside the flow and convinced itself that time does not exist. Just as Zeno demonstrated that, if you spatialise time, you are forever rooted to the spot, Achilles can never beat the tortoise, and an arrow can never fly, so McTaggart was stuck in 1908. Zeno was probably engaged in an amusing *reductio ad absurdum*; but McTaggart was in earnest.

Similar, but different, problems of division occur in a number of other paradoxes belonging to the class of the Sorites Paradox (Greek, *sorites*, a heap). Here, too, we find precision and stasis (LH) pitted against imprecision and evolution (RH).

- *The Sorites Paradox*. One grain of sand is not a heap. At no point does adding a grain of sand make the difference between being a heap and not being a heap. Yet after adding many grains there is a heap.

This has the same structure as a number of other paradoxes, for example that of Baldness (a bald man has no hair; adding a single hair at no point makes the difference between being bald and not being bald; yet after many hairs are added, he is no longer bald); and of Amphibius (a tadpole is filmed at 24 frames a second as it turns into a frog over three weeks; the first frame shows a tadpole, the last shows a frog; there must be a point in the series where a frame showing a tadpole is followed by a frame showing a frog, though only a fraction of a second separates them).

Again one sees a number of familiar hemispheric issues. First, words like ‘heap’ and ‘baldness’ are imprecise, and in this context, so is ‘frog’: they do not have sharp boundaries. To the left hemisphere this is just an example of not having thought clearly enough. Second, and related, there is no room conceded for partial assent (‘it’s getting to be something like what we could call, at a stretch, a heap’; or ‘thinning on top’, ‘balding’, ‘bald as a coot’): the left hemisphere prefers either/or answers. Third, the process of becoming a heap, or a frog, or ceasing to be bald, is turned into a series of sharply delineated individual, in themselves *static*, events – a series of *states*. Fourth, a heap cannot be recognised by enumerating its parts, but only as a whole. All four demonstrate left hemisphere predilections at work.

Fascinatingly, there exist philosophers who argue that, since the principle of bivalence is true (a proposition must be either true or false), there must be a single grain of sand which does make the difference – it’s just that we haven’t found it.[14] I wonder if they also hold that there must be two consecutive frames, microseconds apart, one of which shows a tadpole and the next a frog? Many paradoxes hinge on a (psychologically perfectly understandable, but in my view philosophically mistaken) hungering for certainty.

Strangely enough, some game theory paradoxes arise from breaking down a decision that must be taken globally into what are, locally, logical steps, but which nonetheless lead inexorably to an illogical conclusion. This is a perfect example of what happens when the constrained vision of the emissary replaces the global vision of the Master. A paradox known as the

Dollar Cost Auction involves a series of individually irrefutably logical steps leading inevitably, by logic, to an illogical conclusion. The problem here is local focus and seriality, two cardinal features of the left hemisphere approach.

- *The Dollar Cost Auction*. A dollar is put up for auction, and goes to whoever bids the highest, in increments of 5 cents, however low that bid may be. But, according to the rules of this auction, the under-bidder pays the full amount of his bid and gets nothing in return. What happens is that once embarked on, it is impossible to exit a bidding war in which both parties lose.

The smart strategy would be for one party to bid 5 cents, and the other not to bid at all – and then agree to divvy up the gains fairly. But if co-operation is not allowed, what happens is that each tries by every means to avoid being the under-bidder, so that even winning and making a small loss (by bidding, eg, $1.05) is eventually better than being the under-bidder, who would have spent a dollar or more for nothing at all. The logic here is symmetrical for either party, and so the game is bound to continue until everyone (except the auctioneer) is worse off than they were: in fact the bidding war will not cease until one party is bankrupt.

This has elements in common with the Prisoner's Dilemma, in which, once again, in the absence of co-operation, each party ends up worse off.[15] There might be a message here that co-operation leads to logically superior results at the global level, even if competition gives the appearance of doing so at the local level. We saw this in the case of biological evolution. And once again, the right hemisphere is better able to see both the *overview*, and the worth of *co-operation* compared with simple competition.

Notice also how infinity has a habit of cropping up in the left hemisphere's version of the world: in reaching the door of the room, in the few strides that Achilles takes in real life to overtake the tortoise, in the regress of 'times' implied by McTaggart. Infinity doesn't actually come into it in real life in any of these cases. It is often entailed by the attempt to reconstruct a flow from slices, and then turn the resulting chain into a continuum. One of Minkowski's schizophrenic patients commented

balefully of his attempt to count endless sequences: ‘that leads toward infinity’.[16]

This is true of Lewis Carroll’s paradox of entailment.[17]

- *Carroll’s Paradox of Entailment*. Let us make the assertion: (X and Y) entails Z. One person might accept that X and Y are the case, but not accept that their combination entails Z; another might accept that *if* X and Y were the case, that *would* entail Z, but hold nonetheless that X and Y are not in fact the case. So it seems there are two separate propositions being made here, and the overall assertion thus becomes: (X, Y and (if X and Y, then Z)) entails Z. As you can see, this is the start of an infinite regress …

There are two problems here.

The first is that a self-reference is involved. The assertion about what X and Y entail is on a different level from the assertion of X and Y themselves. So asserting the facts of the case – ‘it is raining’ and ‘rain makes you wet’ – is on one level; asserting that if these are the case they imply that ‘you are wet’ is not a statement of fact, but a matter of logic implicit in the syntax of the sentence. It is a meta-proposition, which should not be included in the very propositions to which it refers and on which it operates. I will come to paradoxes of self-reference shortly.

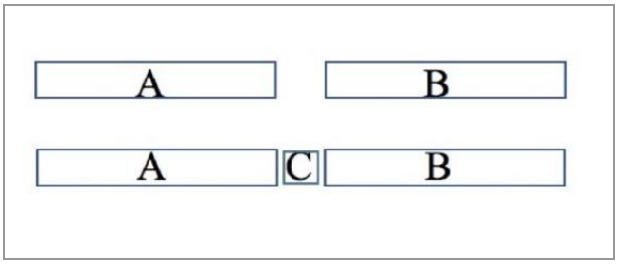
Carroll’s logical case shares an important structure with the Third Man Paradox, owed to Plato and discussed in its ‘Third Man’ form by Aristotle. Plato was honest enough to confess that it looked like an argument against the existence of Forms (themselves characteristic of left hemisphere thinking).

- *The Third Man Paradox*. According to Plato, Fred and Harry are alike, as ‘men’, because they each share the qualities of the Form of a Man, which must itself have all the qualities that Fred and Harry have. Thus, there are three elements that are alike: Fred, Harry and the Form of a Man. But how to explain their likeness? For this, there must be a further Form – call it the Superform of Man – which explains the alikeness of each of the three to each of the others. So now we have four items: Fred, Harry, the Form of

Man, and the Superform of Man … and you see where this is going.

This seems to me a consequence of creating an abstraction, and reifying it; thus 'thingifying' a mode of being, which is not a noun or a thing, and setting it on the same level as the supposed 'things' to which it itself refers.

So, first, there is a problem of self-reference. The second problem follows from believing the world to be made of wholly discrete elements, not overlapping patterns or flows. In trying to form connexions between discrete elements, the new connexions themselves need to be connected by a further overarching connexion, and so on, a point made in different forms by Bergson and James about the irreducibility of flows to chains. If A and B are wholly distinct, I have to yoke together A and B by means of a joining element C. The result is that where there was once just one pair of ends to join (the opposed ends of A and B), there are now two pairs, the opposed ends of A and C and the opposed ends of C and B:



As this process is repeated, in the attempt to unify the pieces of a chain, instead of the gaps being eliminated, they multiply without end. I hardly need to point out the hemispheric significance of this since it has been constantly emphasised in earlier chapters. This was formalised as a paradox by FH Bradley.

- *Bradley's Paradox of Relations.* If A and B are two terms that are connected, they are necessarily connected by some relation C. Equally for C to act as a connection, it must in at least some respect differ from each of A and B. Yet C can only relate A and B if there is some connection between A and C and between B and C;

> so there must be new relations D and E to explain these connections … and so ad infinitum.

It demonstrates beautifully that continuity can be disrupted, but cannot be created without some sort of leap. Continuity, like extension in space or time, cannot be put together, only taken apart.

Here I wish to quote James, because the passage is so much more revealing than anything else on this subject:

> Suppose … many distinct beings *a, b, c,* etc, to exist independently of each other: *can a in that case ever act on b*? What is it to act? Is it not to exert an influence? Does the influence detach itself from *a* and find *b*? If so, it is a third fact, and the problem is not how *a* acts, but how its 'influence' acts on *b*. By another influence perhaps? And how in the end does the chain of influences find *b* rather than *c* unless *b* is somehow prefigured in them already? And when they have found *b*, how do they make *b* respond, if *b* has nothing in common with them? Why don't they go right through *b*? The change in *b* is a *response*, due to *b*'s capacity for taking account of *a*'s influence, and that again seems to prove that *b*'s nature is somehow fitted to *a*'s nature in advance. *A* and *b*, in short, are not really as distinct as we at first supposed them, not separated by a void.[18]

The necessary preadaptation to *b* on the part of *a* – that what we take to be parts are already situated in a coherent whole – is an idea with which the reader will be familiar. For there to be a connexion between two entities there must be both a degree of difference *and* a degree of similarity.

These paradoxes should be distinguished from a quite different problem which arises through the business of representation, and then reifying our representations – both left hemisphere tendencies. We encountered it in the case of McTaggart's Paradox. He removes the force or movement from time, in representing it as a series extended in space (his series B); this means he needs to motivate the series (get it moving) by importing a second-order time (his series A), which might impart the essential quality of change, somewhere beyond or beneath it. And that then requires a third-

order time for the same reasons … and so on. Similarly, there is a Paradox of Place, which was promulgated by Zeno.

- *The Paradox of Place*. Everything that exists has its place; place exists; therefore place too must have a place, and that place have its place, and so ad infinitum.

Here what seems to be happening is that the left hemisphere, dealing with representations rather than experience, finds itself in a hall of mirrors, in which a representation is represented by a further representation, which is represented by a further representation, and so on. Hardly surprisingly this paradox is bound up with the left hemisphere's version of language, whereby words are taken for the *things* they represent: a tool of representation.

Take the example of a paradox promulgated by Quine.

- *The Morning Star Paradox*. Both the Morning Star and the Evening Star are the planet Venus. But one has properties that the other doesn't have (such as appearing in the morning or the evening). Are they the same or different?

For our purposes it draws attention to two hemispheric traps: believing that naming a thing in two different ways might make two different things, and a reluctance to see that the same entity can appear at different times in a different phenomenological guise without losing its identity. This reluctance has something in common with Capgras syndrome, which as we have seen, is caused by a right hemisphere deficit: my wife in the morning is different from my wife in the evening because time has elapsed and she looks subtly different. Things, according to the left hemisphere – which invented them – don't change, because, remember, to the left hemisphere change doesn't exist. So when something does appear in two different lights, it implies, to this way of thinking, two distinct things.

Another kind of paradox also seems to hinge on the left hemisphere's tendency to see a name as a thing. An example is Kripke's Pierre, named after Saul Kripke who first promulgated it.

- *Kripke's Pierre.* Pierre, a Frenchman who has never been to England, has heard that '*Londres est jolie*'; so it could be said that he believes London to be pretty. Later he finds himself in a district of a foreign city, whose language he learns from those around him, and finds it is not pretty. He gathers the city's name is London, but makes no connection with the *Londres* of which he heard so much. As a result, he seems to believe that London is both pretty and not pretty.

From one perspective, until he is told that *Londres* and London are the same place, he does not have contradictory beliefs. Once told, he is free to reconcile them in any way he wishes – by, for example, telling himself that his experience of one area of London was not typical of London as a whole, or that London has changed since he first heard about it, or that he has better taste than his parents and friends, or that it is a curate's egg, or in a host of other ways. I would suggest that from a hemispheric perspective, though they operate in different ways, this and the Morning Star Paradox suggest the left hemisphere's difficulty in adequately distinguishing language from experience.

Then there is:

- *The Paradox of Negation*. To state that, eg, 'unicorns don't exist' is to imply the existence of something called a unicorn at the same time as denying its existence.

Once again, while one interpretation of the grammar is that I am affirming and then denying the existence of something, anyone familiar with how we use language will surely know that not everything we think corresponds to reality, and so neither does our language. By naming something, I do not bring it into being. We have words for ideas and images that we may know do not exist – or which we believe exist, though they don't. Once again an exaggerated notion of language as *constituting* reality, the natural position of the left hemisphere, seems to be part of the problem. According to Parmenides, you can speak only about what is: what is not cannot be thought of and what cannot be thought of cannot be. All three statements are false, it seems to me. As with almost everything that

Parmenides says, one is brought up sharply against the falsity of the left hemisphere.

Parmenides' position casts light on why Greek mathematics was never able to use 'zero', a concept they lacked and which was later derived by the seventh-century Indian mathematician, Brahmagupta. He recognised the significance of zero as an entity in its own right, thereby expanding the possibilities of mathematical calculation. Zero, he saw, was the result of combining any number with its negative counterpart: not just an absence, then, but the positive presence of x with -x. By doing so he made possible the development of modern mathematics.

Here let us consider a paradox promulgated by GE Moore.

- *Moore's Paradox*. Take a statement of the form 'x [where x is any statement, eg, 'this table is almost entirely empty space'], but I do not believe x'. The paradox here is that such statements appear absurd but are not necessarily untrue or contradictory.

There are a number of ways in which such sentences are not necessarily untrue or contradictory. All are illuminated, in my view, by a hemispheric analysis.

First, to the right hemisphere, it is taken for granted that what we say can only ever approximate a part of what we think or feel: to the left, which does the speaking, there is a greater temptation to imagine that words are the whole reality. Second, to the right hemisphere statements of belief are less purely cognitive and may take into account different levels of thought, feeling and experience. Third, to the right hemisphere, which is more in touch with our unconscious selves, it is easy to see how the same person may embody different levels of belief at any one moment in time. Similarly, it is also (eg, Capgras phenomenon, again) harder for the left hemisphere to see that multiple facets of the same person may exist together, and/or may change over time, without that person's personhood being at stake. In the words of Walt Whitman: 'Do I contradict myself? / Very well then I contradict myself, / (I am large, I contain multitudes.)'[19] And fourth, there is the usual hemispheric difference in assent to *degrees* of truth – *partial* beliefs – ambivalence. Not to mention simply the left hemisphere's relative bafflement because of its poorer understanding of the complexities of human nature.

This relates to another paradox:

- *The Paradox of Self-deception*. How can one deceive oneself about something one knows to be false?

The correct response to that is: ‘very easily’, and I do not need to repeat the points made above. Denial – self-deception – is, as we have seen, a characteristic of the left hemisphere, so the supposed impossibility of self-deception may be in itself a form of left hemisphere denial – a denial of denial. But more than that, we are multiply stranded, and multiply layered, beings. The Paradox of Self-deception founders on believing that we are single and wholly conscious. To quote Montaigne: ‘within ourselves we are somehow double creatures, with the result that what we believe we do not believe, what we condemn we cannot rid ourselves of.’[20] So we may say: ‘I know I’m dying, but I can’t believe it’; ‘I am fearful of ghosts, but I don’t believe in them’; ‘I believe I’m fated, yet I know fate cannot be a reality’. My favourite is the remark reportedly made by Niels Bohr:

> A friend was visiting in the home of Nobel Prize winner Niels Bohr, the famous atom scientist. As they were talking, the friend kept glancing at a horseshoe hanging over the door. Finally, unable to contain his curiosity any longer, he demanded: ‘Niels, it can’t possibly be that you, a brilliant scientist, believe that foolish horseshoe superstition?!’ ‘Of course not’, replied the scientist. ‘But I understand it’s lucky whether you believe in it or not.’[21]

Also related is

- *The Paradox of the Preface*.[22] A writer may say, in the preface to his work, that ‘there will inevitably be errors’ in what he writes, but presumably believes that everything he writes is correct, otherwise he wouldn’t have written it.

Not for the first time, it is hard for a non-professional philosopher to believe that this counts as a paradox, but to the extent that it does, it must do so because of three criteria of interhemispheric difference: the *telescoping of time* by the left hemisphere, so that the present (the moment of the assertion) and future (when the envisaged mistakes will become apparent) are ‘flattened’; the conflating of a *general* truth with *particular* truths; and the loss of *gradation*, so that truths are now absolute.

It is evident that many paradoxes involve self-reference. We have seen several already. The most famous of these is the saying of Epimenides the Cretan, that ‘all Cretans are liars’: false if true, and true if false.

The most obvious response to such a paradox is that few statements apply inflexibly to every case at every moment in time. The right hemisphere doesn’t conflate the particular remark, which has a context, with an absolute, context-free proposition. In the real world, no-one reflecting that all Cretans are liars imagines an audience to understand that every single statement ever made by any Cretan was and is a lie. This is clearly an impossibility for a single functioning human being, let alone for a people that have been continuously civilised for nearly 5,000 years. Only someone who was autistic, or had some other form of right hemisphere deficit, could be expected to believe the remark in this absolute sense. On this I feel like Wittgenstein:

> … it is very queer in a way that this should have puzzled anyone – much more extraordinary than you might think: that this should be the thing to worry human beings. Because the thing works like this: if a man says ‘I am lying’ we say that it follows that he is not lying, from which it follows that he is lying and so on. Well, so what? You can go on like that until you are black in the face. Why not? It doesn’t matter.[23]

More interesting is to consider the *shape* engendered by the remark. If one sees this as a circle – if one flattens the plane of the argument – it makes no sense. But the meaning here is rich and has many levels. In three-dimensional, rather than two-dimensional, space, it is not *circular*, but has the structure of a *spiral*, in which the returning loop avoids re-entrance.

Let me be more explicit. One way of understanding the remark – which comes from a poem or song, and was probably humorous in intent – requires, as we have agreed, abandoning an inhuman, po-faced literalism, and understanding what goes on in another's mind (not a strength of the left hemisphere). After all, Epimenides was a man, not a computer. Epimenides, I suggest, knows that you know that this remark creates an absurdity, if he is to include himself as a liar. And so he seems to be exempting himself, making himself better than his fellow Cretans. In doing so he is also acknowledging that you know that that is what he is doing, and the very act of doing so risks exhibiting a lack of self-knowledge (boastful ignorance), which he is also mocking in himself. But by the act of mocking himself, he exhibits that he has self-knowledge at a still higher level. The humour comes from the 'I know you know I know' complexities involved (the phrase – more fully, 'I know *that* you know *that* I know *that* …' – implies embedded levels of meaning, a more explicit playing out of levels, not just elements on the same level). By means of this, he draws attention to the sort of claims one cannot make about oneself – such as 'I am wise' or 'I am humble' – without self-defeat. And in doing so he leaves open the possibility that he may be wise and humble, while laughing at it and himself, at the same time, and suggesting he is probably neither. Leaving it to you to redress the balance. There! All of that so economically implicit, and understood by the right hemisphere; while according to the left hemisphere the statement simply 'does not compute'.

You could think of the two approaches here like this: the literal one is two-dimensional and therefore issues in a circle, while the nuanced one is three-dimensional, the circle becoming a spiral. The left hemisphere world is hermetic, so one 'hits one's head on the ceiling', so to speak, and can go no higher. But, according to the right hemisphere, to which all frames of reference are open, there is always another level to which one can go to ask a question that *transcends the frame of reference*. This difference of spatial depth, even if the space is a cognitive one, differentiates the two hemispheres.

One way of seeing the Liar Paradox is that two cognitive-linguistic planes are involved. The state of affairs described by the sentence has to be on a different level from the sentence itself (in this it is like Carroll's Paradox of Entailment). At one level language is being used to refer to a state of affairs outside language; at the second level, another statement is being made, from a higher level, about the statement itself, as a piece of language. In the first situation language is commenting or referring elsewhere, as it usually does; in the second situation, language is referred to from inside itself. These distinct levels are flattened, as though a spiral was squashed to a circle.

Yet another way of seeing it is that two temporal planes are involved. Thinking temporally, the sentence refers to a time before the pronouncement is complete – up until this speech event takes place. Then there is a second temporal context. The paradox results when the two distinct times are conflated.

Take another paradox of self-reference.

- *The Paradox of Euathlus.* Protagoras taught his impoverished student Euathlus the law on the basis that Euathlus would repay his teacher as soon as he won his first case. Euathlus decided not to pursue a career in law, and so did not repay Protagoras. Tired of waiting for his money Protagoras sued him for it. He reasoned that if Euathlus lost his case before the court, he would have to pay; and if Euathlus won his case, he would be bound to pay according to the terms of their agreement. However, Euathlus reasoned with equal force that if the court found in his favour he would not have to pay, and if it didn't he would still not be obliged to repay Protagoras, since he would not yet have won a case.

Here again the problem is self-reference, but it could be seen to resolve if one is careful to distinguish two different temporal contexts. At the moment the court makes a decision, both men are bound to abide by it. Suppose that the court favours Euathlus: Protagoras has lost his money. But only for now: if he then sues Euathlus a second time, he is almost certain to win, since Euathlus has clearly already won his first suit.

There are a number of self-referential paradoxes, most of which resolve if one is clear that distinct levels of language are conflated. To make a

statement A about a situation, and to make a statement B about the language in which statement A was made, are two different kinds of thing. However, some paradoxes are deliberately set up in such a way that language must refer to itself. An example is Grelling's Paradox.

- *Grelling's Paradox*. Developed by the early twentieth-century German logician and philosopher, Kurt Grelling, it involves referring to words that describe themselves, such as *short*, and *polysyllabic*, as autological, by virtue of the fact that *short* is a short word and *polysyllabic* is a polysyllabic word. Those which don't, such as *long*, and *monosyllabic*, are called heterological. Is the word heterological heterological? If yes, it isn't; if no, it is.

From a hemispheric point of view, language becomes itself an aspect of reality in the left hemisphere: 'what it says on this piece of paper' becomes as real as (indeed, more real than) the world of experience. The left hemisphere lives in what I have characterised as a hall of mirrors, in which it doesn't so much know the world by direct experience as know its own knowledge of its own knowledge of its own knowledge … so that its thought becomes untethered from reality and highly self-referential.

Much of Magritte's work plays with levels of reference and the relationship between presence and representation. In *La Belle Captive*, the frame on the easel contains something that looks like a representation of the seascape in front of the viewer, so placed as to overlap with it exactly (see Plate 15). Is it, or is the frame merely empty, the seascape continuously present? The fact that the living fire surreally breaking from the tuba on the beach creates a glow on the area within the frame suggests a third possibility: that it is a blank piece of glass – something we need to see *through*. And in a painting such as his 1949 version of *Le Domaine d'Arnheim* (he repeatedly approached this visual conundrum from different metaphysical angles), the glass in the window is not blank but holds an exact painted representation of the scene beyond the window, revealed in the shards that have fallen on the floor.

The most famous modern paradox of self-reference is Russell's barber.

- *Russell's Paradox of the Barber.* In a certain village there is a barber whose rule it is to shave all those, and only those, who do not shave themselves. According to this rule, if the barber shaves himself, he must not shave himself; but if he does not shave himself, he must.

Notice that this works only if there are rules, that is to say *inflexible* rules. This is the left hemisphere mindset, and that is fine. What is worrying is that it is the world in which, guided by machine thinking, we are all increasingly expected to live.

Self-reference is sometimes endlessly generative and sometimes leads to a dead end. This is a case that is impossible: the barber cannot exist (if he is to abide rigidly by the rule). In this it is like the statement 'this statement is false': the statement cannot meaningfully be made. Garbage in garbage out. Yet the paradox has important implications to do with completeness. While it is fatal to the aspiration for a complete, closed system, it is not to an open one. In other words, the paradox demonstrates that following the consistent procedures of logic will always fall short of completeness, and any enclosed, self-referring system the left hemisphere comes up with, if taken strictly on its *own* terms, self-explodes: there is always a member of the system that cannot be accommodated by the system. There is always a way out of the hall of mirrors.

Let us turn to some paradoxes involving specifically the relationship of wholeness and parts. The best known of these is the so-called Ship of Theseus Paradox.

- *The Ship of Theseus Paradox*. According to Plutarch, 'the ship wherein Theseus and the youth of Athens returned had thirty oars, and was preserved by the Athenians down even to the time of Demetrius Phalereus, for they took away the old planks as they decayed, putting in new and stronger timber in their place, insomuch that this ship became a standing example among the philosophers, for the logical question of things that grow; one side holding that the ship remained the same, and the other contending that it was not the same.'[24]

The ‘logical question of things that grow’ (*auxanomenos logos*), or Growing Paradox, refers to the argument that, since the cells (and for that matter, the constituents of cells) in all living things are constantly being lost and replaced, no organism is the same from year to year, or indeed even from moment to moment. Thought of as Novalis’s moulded rivers, or living streams, we could be seen either as the same, or not the same, like the Ship of Theseus: but in view of the way in which living things only remain the same through change (see Chapter 12), we would not normally deny continuity on this basis. In the case of the ship, to the right hemisphere, which sees the whole, the *Gestalt* has not changed, and the ship is still the Ship of Theseus; that a thing changes as it evolves is taken for granted. To the left hemisphere, which puts the ship together from its parts, it is not; when the parts change, it becomes something else. Those who find it difficult to see what the right hemisphere sees, such as people with schizophrenia and some kinds of autism, tend to doubt that they are the same person from moment to moment. This comes together with time-slicing, since both an inability to see that the whole is not the sum of the parts and the belief that flow can be sliced are aspects of the left hemisphere mindset.

Philosophers with such casts of mind run into the same problem. Descartes displays an essentially schizoid personality. He was an example of both extreme left hemisphere credulity (animals are merely machines and feel no pain, despite their cries when dissected) and left hemisphere scepticism (I have no continuity of existence; other people may be simply automata). ‘It does not follow from the fact that I existed a little while ago’, he wrote in his *Meditations on First Philosophy*,

> that I must exist now, unless there is some cause which as it were creates me afresh at this moment … it is quite clear to anyone who attentively considers the nature of time that the same power and action are needed to preserve anything at each individual moment of its duration as would be required to create that thing anew if it were not yet in existence …[25]

and he continues in the ‘Objections and Replies’:

> there is no relation of dependence between the present time and the immediately preceding time … the individual moments can be separated from those immediately preceding and succeeding them, which implies that the thing which endures may cease to be at any given moment.[26]

So he argued in the seventeenth century.[27] And Derek Parfit argued a still more extreme position, in relation to the non-continuity of the person, in recent years.[28] In contrast to which I would urge the words of Bergson: 'I believe that our whole physical existence is something just like this single sentence, continued since the first awakening of consciousness, interspersed with commas, but never broken by full stops.'[29]

A more intriguing version of the paradox can be entertained. Suppose someone kept all the rejected timbers as they were discarded piecemeal, and reconstructed them into a ship: which would now be the Ship of Theseus? If they each have a claim, are there now two Ships of Theseus, or just one, the issue of precisely *which* being undecided? Does the fact that in one case changes have been made only incrementally, without the *Gestalt* being lost at any point, make a difference? Suppose, then, that that ship is loaned to a museum, and is taken apart, and the pieces numbered and then reconstructed on arrival – is its claim for priority over the ship reconstructed from the old timber weakened? Why would the one that is reconstructed from new timber be *more* authentic than the one that is reconstructed from the original timber? And if the claim of the repaired ship is weakened by being taken apart, is there a moral argument against sending it on loan?

In such puzzles, where the whole is not living, but put together from parts, the left hemisphere and right hemisphere point of view seem equally to have something to be said for them. However, in the case of the ship reconstructed from the old parts, the situation is different: the one preserved in the harbour, in which new parts have been substituted, has *Gestalt* only: the one made from the salvaged parts has *Gestalt* plus parts, so that, on the face of it, it has more of a claim to be the original. But against that is the consideration of the difference between something that has gradually changed against something that had to be built up from scratch. We want to make a distinction there: for example, we would prefer the serially repaired

ship, even when it no longer contained any original pieces, to a replica made from scratch from new wood. Why? Presumably because we treat such a treasured object as having a history and fate shared with living things – caught up in the life of those whose narrative it shared; and to that extent we liken it to an organism. And in the case of organisms – those 'things' to which the Growing Paradox applies – it seems to me clear that the right hemisphere point of view is the more reasonable: I am still I (though changing, as every living being is), and the substitution of cells does nothing to invalidate the fact. It is the *Gestalt* that trumps all here, not the 'parts' out of which it is made. To reverse that in the case of living things is tantamount to rendering them inanimate.

Yet, as we now know, even non-living things, such as rocks, are pure *Gestalt*, since the constituent 'parts' are, at the atomic and subatomic level, in perpetual flux. *Everything* flows, and *at the same* time the flow keeps forming temporary *Gestalten* within the flow. There are distinguishable entities within a resonant whole. All this the right hemisphere is better equipped to understand. And here there is an intimation that the boundaries between the living and the inanimate are not as watertight as they are often assumed to be.

Let me conclude by touching on the two most problematic categories of paradox, those that involve time travel and/or future knowledge, and those that directly concern infinity.

Typical paradoxes of the first kind go like this.

- *Paradox of Prediction*. If you had certain knowledge of the future, you could take action in the present to alter events in such a way as to invalidate that knowledge.
- *Flint's Paradox*. If you had both certain knowledge of the future and could travel into it, you could take action in the future to alter events in such a way as to invalidate that knowledge.
- *Grandfather Paradox*. If you could travel back in time you could kill your own grandfather when he was a child, so that you could not exist to travel back in time – so your grandfather would live, and you could be born to travel back in time and kill your own grandfather when he was a child … and so ad infinitum.

These and similar paradoxes merely demonstrate the impossibility of certain future knowledge or time travel. I suggest that the problem arises because time, which is present to the right hemisphere, is re-presented as a sequence of events to the left hemisphere. Once it is laid out on paper, to know the future we need only look further along the line to the right, and to travel back in time we would need only to move our gaze to the left.

Thus spatialising time leads to paradoxes by encouraging retrospection, from some future imagined standpoint, on what can only be understood from the standpoint of the present (as in, for example, Zeno's paradoxes) or projection forwards to some future imagined standpoint of what can only be understood from the standpoint of the present.

An intriguing paradox involving prediction is Newcomb's Paradox.

- *Newcomb's Paradox*. Two boxes are on a table. Some (virtually) omniscient entity, Omega, has put $1,000 in one box (A) and either nothing or $1,000,000 in the second (B). It has done so on the basis that if it predicts you will choose just box B, the box contains $1,000,000; if it predicts you will take both, it has put nothing in it. It has an astonishingly good track record of being right. Rationally speaking, should you take both boxes or just box B – bearing in mind that by now nothing can alter what is in the boxes, so that on the face of it you cannot possibly lose by taking both?

Mathematicians and philosophers divide pretty evenly into 'one-boxers' and 'two-boxers'. That is perhaps because there is no way of evaluating a situation that cannot exist. Accepting the omniscient being is like accepting that the porcupine is a monkey: any conclusion drawn from such a premise is invalid. I suppose it could be argued that there might come a time when a computer was so good at assessing your personality that it knew whether you were almost certain to be a one-boxer or a two-boxer. In that case the 'paradox' would simply become a matter of assessing, on the basis of everything else you know about the world, the weight to attach to the improbable claim – the being's track record might be a scam, or wrongly reported, or the result of a lucky streak, all of which are frequent causes of error in life, whereas no claim of infallibility has ever yet been validated. The left hemisphere takes one box, since it believes 'what is written on this piece of paper'; the right hemisphere takes two, if on taking a look at the

claim, it figures the claim is unlikely to hold – ‘the porcupine is not a monkey’.

Incidentally, in the case where Omega is a very efficient computer that can tell with astonishing accuracy whether you are a one-boxer or a two-boxer, you could game the situation by recognising that you are a classic one-boxer and deciding on this occasion to take two. To get round that Omega would have to know not just your boxing tendencies, but your cheating ones as well.

However, I suspect that the reason that there are as many one-boxers as two-boxers is not so much that people divide neatly into one of two groups, but that they are of two minds – sometimes favouring one-boxing and sometimes two. That would apply to me, at any rate. That we are inconsistent seems to have been forgotten, as in Moore’s Paradox.

And so to problems of infinity. The mathematician JF Thomson described the following paradox:

- *Thomson’s Lamp*.[30] If a lamp could be switched on and off an infinite number of times, each act of switching taking half the length of time of the previous one – the first lasting a minute, the second half a minute, the third a quarter of a minute (‘Zeno fashion’) – at the end of the two minutes that it would take to complete the series, would the lamp be off or on?

It could not be off, because every act of switching off is followed by one of switching on: and it could not be on, because every act of switching on is followed by one of switching off. There is no solution to this, except to declare the task not just practically but intrinsically impossible. This is an answer that is more tolerable to the right hemisphere than the left, because it involves accepting that some things can never be decided, and that some things can never be accomplished. As Margaret Cuonzo says, speaking of Kant’s antinomies: ‘although both antinomies are the result of trying to go beyond the limits of our reason, it is nevertheless inevitable that reason’ – for which, here read the left hemisphere – ‘will attempt to overreach its limits.’[31]

There are limits to our reasoning when applied to the stuff of reality, and this includes, but is not confined to, dealing with infinity. There is an

incompleteness intrinsic to mathematics when applied to the real world, where there are only irregularly curved surfaces and planes, not ideal rectilinear ones. A curved line has fundamental properties distinct from a straight one. Just as there is no way you can get to extension in space or duration in time by the amassing of infinitesimal points or slices, there is no way you can get to a curve using straight lines: you can approximate it with evermore tangents but never actually achieve a curve. A polygon with as many sides as you like never actually becomes a circle, though it approaches it asymptotically. A mechanised doll may be as lifelike as you can make it, but it will never actually live. The process in each case, the process that *doesn't* work, involves putting things together. In every case what can only be called a 'leap' has to be made from one realm into another, to bring it to life.

It's not just calculus (which is a rectilinear method of assessing non-rectilinear spaces that has to quit at some point), it's true of any curve, including a circle or sphere, since *pi* is an irrational number, that is to say one that never resolves but goes on for ever. I am reminded again of Einstein's saying, 'as far as the laws of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality.'

A 'leap' becomes necessary, I believe, not because of some disjunction in reality, but because of an incompatibility between the 'truths' that our two hemispheres hold. Bergson himself puts his finger on it when he contrasts the roundness of intuition with the rectilinear nature of logic. He says of the logician: 'Having in fact left the curve of his thought, to follow straight along a tangent, he has become exterior to himself. He returns to himself when he gets back to intuition.'

The profound fifteenth-century philosopher, mathematician, theologian, scientist and general polymath Nicholas of Cusa (often referred to as Cusanus), thought that truth is not a thing like other things, or put together from other things: it is irreducible. We can't arrive at more than an approximation to it, using what he called the intellect (effectively the analytic left hemisphere), much as a straight-sided figure cannot ever quite achieve a circle.

Leibniz, who invented integral calculus to deal with the problem of areas under a curve by endless approximation, said that we cannot step across the gap from finite, measurable spaces to the whole infinite space – to get across would require a leap. 'How slippery', he warned, 'are our

thoughts on infinity'.[32] In order for asymptotes to meet, in order to move from the finite to the infinite, a leap is called for. And as he put it, 'we cannot leap over' by the unaided intellect.[33]

This corresponds to Galileo's explanation that the infinite cannot be reached by a successive progression of steps, but only 'at a stroke'.[34] Galileo's key perception was that the supposed endpoint of the sequence cannot be just *a special element of the sequence* itself, and similarly that an infinite number is not a special case of the finite numbers. David Hilbert was to say of infinity:

> Instead of the old principle *natura non facit saltus* [nature does not make jumps], we might even assert the opposite, viz, 'nature makes jumps'.[35]

This leap is makeable by imagination but not by analytic reason. Infinity cannot be reached by continually adding another number to the series, or prolonging length or time indefinitely. An idea that is difficult for many people to grasp is that a line prolonged to a length of billions of billions of light years is no nearer infinity at the end of the process than when it was a thousandth of a millimetre long. To understand infinity we have to make a leap: you can't get there by continuous movement from here.

I would suggest that the leap is from the incremental, computational (Newtonian), left hemisphere-compliant universe to an intuitive, non-incremental, non-computational (Planckian), right hemisphere-adapted universe. Discoveries in mathematics and physics often require a leap of the imagination, the so-called 'aha' moment of insight, which as we have seen is accompanied by activations in the right amygdala and right superior temporal sulcus.

Cantorian proofs can be constructed to show that two lines of any length – for example, an infinitely long line and one that was one millionth of an inch long – would both have the same number of points and that a line a millionth of an inch long has the same number of points as there are in the entire universe.[36] Nor is an infinity going to contain everything, just because it is infinite: the series of all whole numbers is clearly infinite, but so is the series of even numbers, which doesn't contain the (infinite)

number of odd numbers that are in the series of whole numbers. Yet the series are the same size (a one-to-one correspondence between the elements of each can be demonstrated).

What this suggests is that we must not imagine infinity to be a noun and a quantity (left hemisphere fashion), and therefore a finished entity, but a process of a certain kind and therefore adverbial (right hemisphere fashion). Oddly enough, this is *not* to treat infinity differently from other mathematical symbols: all such symbols can be regarded as shorthand for processes, just as they can be regarded as things. For example, ¾ – three quarters of, let us say, a cake – seems thing-like; but it refers explicitly to the *process* of dividing three by four. Irrational numbers (called irrational because they can never be finally resolved), such as π or √2, reveal the point starkly, because the alternative to the thing-like symbol, which is a useful shorthand for mental manipulations, is to carry on a process of division that can never terminate. The process is never-ending, but the thing is finished. We therefore need the symbol for practical purposes. As Hermann Weyl remarked: '*mathematics is the science of the infinite*, its goal the symbolic comprehension of the infinite with human, that is, finite means.'[37]

Quantum mechanics poses paradoxes of its own. Surprisingly, Quine accepted that the 'problem' with quantum mechanics might rather be a problem with conventional Western logic. 'Revision', he wrote

> even of the logical law of the excluded middle has been proposed as a means of simplifying quantum mechanics; and what difference is there in principle between such a shift and the shift whereby Kepler superseded Ptolemy, or Einstein Newton, or Darwin Aristotle?[38]

Take the Einstein-Podolsky-Rosen paradox. This asserts that it follows from the principles of quantum mechanics, which provide the most complete and most accurate account of the nature of physical reality, that two quantities may instantaneously (with no temporal delay) influence each other, and without there being any contact between them. Einstein was so appalled by this that he spent the rest of his life trying to show that quantum mechanics was incomplete – without success. Because, if it is true, the cosmos is not composed of entities that exist in their own right, influencing

one another, but of patterns that are reflected in reciprocal movements of what only come to look like entities when they are observed by us. Louis de Broglie, the founder of quantum wave mechanics, wrote:

> In physics, as in every other branch of knowledge, the problem of continuity and discontinuity has existed at all times: for in this science, as elsewhere, the human mind has always manifested two tendencies at once antagonistic and complementary. On the one hand, there is the tendency which tries to reduce the complexity of phenomena to the existence of simple elements indivisible, and capable of being counted; a tendency whose analysis of reality seeks to reduce it to a dust-cloud of individuals. On the other hand, there is a tendency based on our intuitive notion of time and space, which observes the universal interaction of things and regards every attempt to disengage definite individual entities from the flux of natural phenomena as artificial …[39]

De Broglie, like Bergson, could have had no knowledge of hemisphere difference, but seems to have intuited it perfectly from his knowledge of physics: how physical reality appears to the mind.

It is time to make the leap from reason to intuition.

INTUITION, IMAGINATION & TRUTH

INTUITION'S CLAIMS ON TRUTH

> The heart's unrest is not to be stilled by logic.
>
> —*Friedrich Waismann*[1]

> If you have intuitions at all, they come from a deeper level of your nature than the loquacious level which rationalism inhabits.
>
> —*William James*[2]

> There is in us something wiser than our head.
>
> —*Arthur Schopenhauer*[3]

IN THIS PART II OF THE BOOK WE ARE CONCERNED WITH THE PATHS BY which we may approach the truth. Contemporary culture favours science and (very much in theory) reason as the ultimately valid approaches, and is deeply sceptical about intuition and imagination – the former because it is regarded as primitive, quirky and unreliable, and the latter because it supposedly just 'makes things up'. I suggest that this is profoundly mistaken. In Chapter 19, I will explore how intuition, in the form of producing insights, acts with imagination to establish our sense of the world and of what we can truly say about it. But first, I want to look at the role of intuition in everyday life – in how we manage the business of living.

Such intuition has had a bit of a bad press lately. Academic psychologists and philosophers are inordinately fond of thinking up experimental situations in which we are deceived by what our ‘intuitions’ tell us. These are a sort of cognitive counterpart to intriguing optical illusions: in this figure, for example, we (think we) *know* square A and B can’t possibly be the same shade and colour – and yet, I promise you, they are.

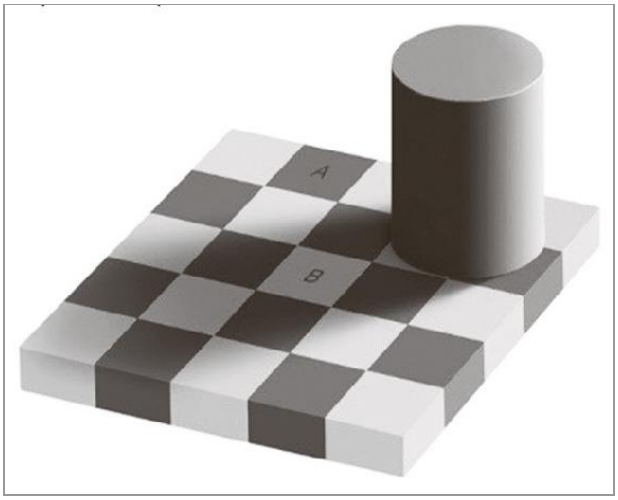


Fig. 34. Chequerboard illusion (created by EH Adelson)

Don’t believe me? Take a look at Plates 16 [a] and [b].

However, I never heard of anyone saying, after being shown a good optical illusion, ‘that does it: from now on I’m going to live my life with my eyes closed’ – whereas a lot of people seem to have come to the conclusion that intuitions are the sort of thing bright people should avoid having.

Our intuitive capabilities are often misrepresented: they are, as I shall show, less erroneous than one might assume.[4] For instance, impressions of other people are often surprisingly accurate even when formed on the basis of very brief exposures, through ‘very subtle, almost imperceptible, nonverbal cues … so subtle that they are neither encoded nor decoded at an intentional, conscious level of awareness.’[5] We are fairly accurate at identifying emotions from non-verbal behaviour that we have glimpsed for only about 300 milliseconds.[6] Often, as we will see, people make better judgments by intuition than they do by conscious deliberation.[7] Gut

feelings are surprisingly reliable;[8] and inferences drawn from gut feelings are not blind, but amenable to modification in the light of subsequent experience or reasoning.[9]

What is more, intuition is not just a sort of quick, but 'rough and ready', *faute de mieux* way of arriving at a decision that would be far better done explicitly over a longer period. It is not only faster but much more capable of dealing with more, and more complex, information. 'For all nontrivial problems', writes the jurist Christoph Engel,

> calculating the best response is cognitively way too taxing. This, however, is true only for the consciously controlled handling of information. The automatic system handles huge amounts of information in almost no time. Only the end result is propelled back to consciousness as an intuition. Consequently, in appropriate contexts, institutions should in principle see to it that decision-makers trust their intuitions.[10]

Which is not to say that there are not times when the admixture of conscious deliberation pays off – why else would we have developed the capacity to add it? Just that its relationship with intuition has often, and increasingly, been wrongly conceived and projected. And we have come to mistrust, indeed allowed ourselves to become anxious about, a capacity for understanding the world which we should be celebrating.

LET'S GO TO THE RACES

A couple of years ago, a French race horse trainer, Franck Mourier, got in touch with me after reading *The Master and his Emissary*. He was 47, and had a master's degree in physiology. From childhood he had had a passion for horses. As a young man at university he researched and established a complex mathematical model for selecting the best thoroughbreds based on the correlation of around a hundred parameters. He saw himself as very methodical and analytical. All his life he had been involved in buying, selling and training racehorses.

Now retired, he lived in England, and made a living by going to the races every day and acting as a tipster. His job was to watch the runners for a few minutes before a race, and estimate each horse's chances of winning. He then produced what is called a tissue (a sheet of paper showing the 'form' of the horses competing in a race). He had done more than 1,200 such tissues over the previous year and kept records and an analysis of all the data. 'Surprisingly', he commented, 'my percentage has been consistently better and more accurate than the market consensus.' But he and his colleagues soon began to notice 'some strange facts that should upset any rational mind'.

Two minutes before the race started, he would communicate the tissue to his partners, who then exploited any difference between his opinion and the market. When he rang to give his predictions, there would typically be a conversation such as this:

Franck (reading from the tissue): Love Dreams … 50% … But I don't believe he can win!
Team: Ok, but why did you put 50% chance to win, then?
Franck: I really don't know!
Team: What should we do then?
Franck: I don't know!
Team: The race begins in one minute, the market on Love Dreams is 20%. What do you want us to do?!
Franck: I don't know, change Love Dreams to 20% …

‘As you can imagine’, he told me, ‘Love Dreams then wins,’

> and the team are upset because they weren’t able to take advantage of my tissue. Such examples went on and on, until the day when the team said, ‘Don't call us anymore. Just text us your tissue and don’t comment on it!’ This produced better results, of course, but the fact that I have to keep my mouth shut really torments me.

He had also noticed that the more pressure he felt under to come up with a good tissue, the worse he would do:

> Previous life experience taught me that the more preparation you make, the more commitment you have and the more you focus on a goal, the more likely you are to achieve it. Strangely, after analysis of the 1,200 tissues, it appears that the opposite is true. And if I write one bad tissue (one in which I do worse than the market), I am three times more likely than chance to write another bad one in the following race … I can’t help it; again, the harder I try, the worse the results.

He found that he was getting a little better at dealing with it, but was still handicapped by emotions such as self-blame, fear of losing, and aversion to risk that got in the way of ‘simply trusting what I see’.

A year passed, and he wrote to say that he had made ‘significant progress’. He had come to realise that the problem was that he just could not believe his own success:

> How can I pretend to know that horse A is going to run a mile one-tenth of a second faster than horse B, just by looking at them for a couple of minutes before they run? It doesn’t make any sense to me, but somehow it consistently works! The margins between winners and losers are always terribly slim. So how is it that my predictions can be so accurate – consistently better than everyone else? It creates a terrible discomfort; I am still never truly secure and confident about a tissue I’ve just written.

On his suggestion, his wife Capucine (‘Capy’) also wrote to me to explain what she had observed. At first, in his new role as tipster, Franck had seemed rather odd, insecure and ill at ease. She could not understand why it was that, although he could see how good his predictions were, he refused to go ahead and process any tissues. In an effort to help understand, Franck had started reading various books, including *The Master and his Emissary*. A few days after starting reading it, he apparently told her: ‘Iain is talking about exactly what I am experiencing, in the way he describes the brain hemispheres’. He was amazed by the sense of having discovered ‘a new part of the brain he was not aware of using before, and as a scientist and left-brain user he did not want to accept it or believe it … and yet he was really moved by what he had learnt.’

Capy, also a horse trainer, with a background in law and economics, then also read the book and felt a similar realisation. As a result of this, at least as she and her husband put it to me, a number of things changed. ‘We needed to find ways to help Franck shut off the constant presence of “the left brain”. He started being more open, talking about his emotions (something new!); he became more sensitive to the things around him, and became more creative.’ As a result, Franck’s role in the family had changed, and, along with it, their relationship, in a whole range of ways – much (as they both confirmed) for the better.

He had been ‘tipping’ races between five and 10 times a day for more than two years, and now had a rich database of more than 3,000 tissues, which were analysed by the team so as to monitor his performance. He was proud to report that his success meant that he made considerably more than a comfortable living.

I asked him to describe what he actually did. He explained that a meeting consists in a succession of six to eight races with 30 minutes between each of them. Before each race, the horses are led into the paddock, and walk for a few minutes around it; five minutes before the race, the horses will gallop to the start. He, like the rest of the crowd, would observe them, with or without binoculars. He would then write a tissue, which would usually take about 20 seconds, in which he would accord each horse a percentage chance of winning, and then send a text to his team. ‘I do not fully understand why I am writing these percentages in front of each horse’, he told me, ‘and, surprisingly, the less I understand it the better it is. I never go to the races with too much previous knowledge and information.

When I have a tissue already in my head before I see the horses it usually results in disaster.'

Conscious that experts can rarely articulate how they are able to do what they do, I nonetheless asked if there was anything he was aware of looking out for. He replied:

> I am really at a loss to explain what I am seeing, and have generally no real clue how I come to a percentage. It is definitely a combination of a lot of factors – but if I had to name a few, they might be: Does the horse look happy or worried to be on the racetrack? What is the quality of the relationship between the horse and the person that leads him to the race? Does the horse appear healthy and fit? Are jockey and horse a good match? Does the horse trust his jockey and listen to him? Can the jockey understand the horse and communicate with him properly? But again these are just some impressions. It is not consistent and certainly not straightforward … Anyway, after the race we can immediately see the accuracy of my predictions. Then the process starts again in the next race.

It seemed to me that Franck could have a second career as a psychiatrist, were he in need of one, which he clearly wasn't. But how, I wondered, had he come to realise that these intangible feelings about relationships were more important than any measurable facts about the horse? He couldn't say.

By close scrutiny of his record, he and his wife had worked out that there were a number of factors that made a significant difference to his performance. For example, his 13 year-old son loved to come to the races with him, and Franck really enjoyed his company. He was supportive, very knowledgeable about horses, and understood what his father's job entailed. But a comparative analysis of the 100 tissues written when with his son and 100 from the same period when he was on his own showed that with his son he averaged £0 per tissue, while without him he averaged £1,000 pounds per tissue. 'This asymmetry could not be explained by chance alone', Franck remarked, 'so the team asked him kindly to stay at home'.

He needed also to dissociate himself from 'anything material or financial' during the mornings before the race, and to remain ignorant of the

amounts at stake, or it would ruin his form: ‘The best results are achieved when I see it as just a game with no pressure … as if I am going to the races just to enjoy the horses and write the percentages I feel.’

He also reported that he used to wake up very early most of his adult life and could get away with very little sleep. Now he and his wife had noticed that he needed a long sleep, ‘and I do even better if I have a little nap in the car, right before the races start’.[11] The significance of this will be touched on later.

This story, it seems to me, describes perfectly the plight of an intuitively gifted person in a society resolutely hostile to intuition. So bad have things become that we have difficulty accepting indisputable facts because our theory contradicts them. Unusually, this was a situation in which intuitions could be tested against incontrovertible and immediate evidence, time and time over – and yet so deep is the mistrust with which we have been indoctrinated, that Franck initially became miserable, withdrawn and immobilised by anxiety, rather than accept the reality of his gifts. Of course, the idea that my book made much of a difference I put down to the generosity of the account I was given; it may, though, have provided Franck with an insight into a scientific basis for accepting his own intuitive faculties.

‘While the American army was being menaced by hidden improvised explosive devices’, writes Peter Struck, in a recent scholarly examination of the history of divination in the ancient world,

> certain soldiers appeared to their comrades to have preternatural abilities to sense the presence of these bombs. The army, in a deeply pragmatic spirit, poured money into studies of such people, trying to see whether there was anything to the anecdotes. Cognitive scientists determined, in a finding not at all surprising to those familiar with the discipline, that some soldiers indeed had more accurate predispositions to sense trouble than others. When the soldiers were asked to describe how they knew something was out of order, they called it a hunch, or a gut feeling … It is, of course, more than just uncanny that two millennia ago the single arena in which the seer’s gifts were most consistently valued was also the battle field. According to the Greek military handbook by the 1st-century CE tactician Onasander, a general should be temperate, self-

> restrained, vigilant, and hardened to labour – and he should also be a skilled reader of entrails, so he can be personally involved in the readings his diviners are giving him …[12]

Perhaps there was an intuitive metaphorical connexion between experiencing gut feelings and inspecting entrails. But there is more to it than that.

Speaking of ‘gut feelings’ may, like our references to the heart in matters of deep emotion, be more literally correct than we have become accustomed to think. Both feelings of anger and a ‘broken heart’ can trigger a heart attack.[13] A meta-analysis shows that it is the right hemisphere that predominates in receiving and interpreting information from the heart.[14]

The gut and the psyche have close connexions. Anxiety, depression, and other disorders have characteristic expressions in gut behaviour – and the associations work both ways: diseases of the gut affect mind and mood. As well as containing 95% of the body’s serotonin, which also acts, as is well known, as a neurotransmitter in the brain, and is thought to be involved in affect regulation, the gut has some 200–600 million neurones, rather more than there are in the brain of a dog.[15] And most of the neural traffic is from the *gut to the brain*, not the other way round. You can take it that they are not all just there to control peristalsis: ‘The system is way too complicated to have evolved only to make sure things move out of your colon.’ [16]

Struck gives an account of the famous Pythia, the High Priestess of the Temple of Apollo at Delphi, to whom ‘people that had run up against the limits of their own knowledge brought their remaining questions’. He emphasises not just her female sex, which the Greeks associated with ‘body over mind’, but her ‘legendary illiteracy’; and that for them what was felt to be divine in nature was deeply rooted in the corporeal, in what we share with animals, bypassing the everyday realm of the explicit on the way.[17] When she spoke, her utterances were famously oblique, and came in the form of poetry. ‘When that realm which lay above us chose to speak’, he writes, ‘the messages mostly came in and through the one that lay below us. It does not simply stand to reason that the phenomenon would be organized this way.’

In most non-Western cultures, people describe a faculty or faculties, corresponding to intuition or a sixth sense, whereby they can discern

matters absolutely not present to consciousness. We should be careful to attend to this and not dismiss it as ‘superstition’.

INSTINCTS

Many of the patterns that organise and make sense of the dance of life in animals – and importantly in humans – come from somewhere, we have little or no idea where or how: instincts. Instincts are usually taken to mean deeply embedded drives that do not have to be learnt, are not pursued as conscious aims, and find their fulfilment directly in their expression. Examples might be the instinct to eat when hungry, and probably the choice of *what* to eat (eagles don't waste time on strawberries); to drink when thirsty; for a predator, to hunt; for prey, to look out for predators (hens that have been brought up from chicks in barns immediately show fear reactions when exposed to predators they have never before encountered); for a bird to fly (birds brought up without the opportunity to observe or be guided by adult birds nonetheless fly when released from confinement);[18] in migrant animals, to migrate; to make a home – a den or a nest of some kind; to seek a mate, to take part in ritual displays and to procreate; to protect one's mate, one's young and one's territory. There are others that are more highly evolved: to form relationships;[19] in apes and humans, and probably other taxa as well, to imitate members of one's own species (human infants will in some cases copy an adult's facial gesture as little as 45 minutes following birth);[20] to utter in order to communicate (in many species), to sing or call (in birds), arguably to develop language (in humans); both to compete with, and, in mammals at least, to empathise, and co-operate with, other creatures.

But there are many, many others. William James indeed held that humans, rather than having somehow 'cast off' their instinctual nature, having fewer instincts than animals, had many more: 'man possesses all the impulses that they have, and a great many more besides. In other words, there is no material antagonism between instinct and reason … no other mammal, not even the monkey, shows so large an array.' [21] If imitated patterns of behaviour become hardwired – and they do – and we are the imitative species, *par excellence* –and we are – this makes perfect sense. James's colleague CS Peirce, who thought that we were born not just with the basic biological inclinations, but 'certain tendencies to think truly about physics, on the one hand, and about psychics, on the other', wrote: 'if you

are going to think every poor chicken endowed with an innate tendency toward a positive truth, why should you think that to man alone this gift is denied?' [22]

As far as the chronology is concerned, instinctual drives are always 'on' in the background of our lives. At times they can be accentuated for obvious reasons, and at times they can be overridden, though James thought they could be overridden only by a contrary instinct, and that cognition in and of itself had no power to gainsay an instinct, having a role, rather, in leading one towards a position where a counter-instinct could be reinforced. Instincts can also wither, if the environment affords no opportunity for them to be established – or if systematically disattended to, as in our society today.

Here I should mention an interesting recent development. The idea of human instincts about physics and 'psychics' that Peirce alludes to, and that James suggests are so numerous, is a way of accounting for shared forms of thought and feeling, of apprehension of the world, of knowledge and understanding even, that appear to be in us without ever having to be learnt – something reminiscent of Jung's idea of the collective unconscious. We now have suggestive evidence of possible mechanisms of transmitting one generation's experience to the next. For example, it seems that trauma suffered by Holocaust survivors may have been passed on to their children.[23] A genetic study of 32 Jewish men and women who had been interned in a Nazi concentration camp, or witnessed or experienced torture, or who had had to hide during the Second World War, showed that they and their children exhibited epigenetic changes not found in children of Jewish families who were outside Europe during the War. The changes were in the region of a gene that is known to be involved in regulating stress; the children also had an increased likelihood of stress disorders.

This builds on research in animals, showing that induced fears in one generation may be inherited by the next. Mice were trained to fear the scent of cherry blossom by coupling it with a small electric shock, so that eventually the mice showed a fear reaction when exposed to the scent on its own. The offspring of these mice, despite never having encountered the smell of cherry blossom before, or having any reason to associate it with anything unpleasant, had the same fearful response to the smell on first exposure – and so did their own offspring. Epigenetic changes at the site of a gene responsible for detecting this scent were found.[24]

The implications of this are important, and incidentally form an example of how scientific intuition can eventually win out against dogma. It used to be doctrine that acquired characteristics could not be transferred to the next generation: Lamarck, who was intuitively right, was held to be plain wrong. With the discovery of the importance of epigenetics that has changed. Perhaps Lamarck was not so wrong after all. Many beliefs that were once intuitions only have been found to have a basis in science, and I have no doubt that many more will in the future, as the horizons of science inevitably expand.

One of the great questions in this continually evolving universe is how it is that we come to express, without being taught, patterns of behaviour, patterns of thought, that we share with our ancestors, and why do we not have to wade through all the options laboriously in order to rediscover them. Enculturation is an obvious response, and one that is surely correct up to a point; but it doesn't by a long way cover all the observable phenomena, including the inheritance of tastes, physical gestures, mannerisms, predilections, of people to whom we are physically related but whom we have never met – and even possibly by transplant of an organ, such as the heart, though that is still controversial at this stage. [25] As a grandparent I have seen physical mannerisms, facial expressions, and tastes unmistakeably expressed in my children and grandchildren that are identical to those in forebears they never knew.

Rupert Sheldrake's idea of morphic resonance seems to me a concept very well worth considering seriously, though in the current climate in science it is generally anathema.[26] According to Sheldrake, morphic resonance is

> a process whereby self-organising systems inherit a memory from previous similar systems. In its most general formulation, morphic resonance means that the so-called laws of nature are more like habits … Thus each individual inherits a collective memory from past members of the species, and also contributes to the collective memory, affecting other members of the species in the future.[27]

The question, of course, is: how? It is often objected that this would be to endorse the existence of forms that can be detected only by their

consequences. As David Bohm rightly stressed (*à propos* another matter, though he was certainly not dismissive of morphic resonance):

> There is no reason why an extra-physical general principle is necessarily to be avoided, since such principles could conceivably serve as useful working hypotheses. For the history of scientific research is full of examples in which it was very fruitful indeed to assume that certain objects or elements might be real, long before any procedures were known which would permit them to be observed directly.[28]

In fact, being at least open to the hypothesis is necessary in order even *to make the observations* that could validate the hypothesis.

Epigenetic changes may be a special case of such morphogenetic fields in operation (after all, like all fields known to physics, they would have to interact with material mechanisms in some way). Recently, the frequency of oscillation of electromagnetic fields has been found to make the difference between carcinogenic and cancer-inhibiting effects on organisms, and this is not a one-off finding, but consistent with a large and rapidly growing body of evidence – the mechanism is, however, uncertain.[29] Yet a tumour can be seen as, in some practical sense, an independent organism with its own primitive morphogenetic field;[30] an 'opportunistic, self-organizing, and adaptive complex dynamic biosystem.'[31] Whether it realises itself or not seems to depend on the resonances within a field.

Instincts are, indeed, much more remarkable than we often assume. How do complex patterns of behaviour become present to offspring that may not have known their parents – for example, the complex mating routines of hummingbirds and birds of paradise, or the octopus's building of a garden out of attractive shells? Not to mention a bird 'simply' flying, or building a nest of a certain kind in a certain way in a certain sort of place, or, in the case of a cuckoo, invariably *not* building a nest, but flying thousands of miles in order to commandeer some luckless other bird's nest? Or a spider weaving its web? How is it that repeated patterns of behaviour create changes that allow such complex four-dimensional behavioural patterns to be transmitted from generation to generation? Where exactly are these patterns instantiated?

Are archetypes something similar to this? Jung suggested that instincts and archetypes were related as, respectively, motor and sensory phenomena with common ancestry: ‘instincts are typical modes of action’, while ‘archetypes are typical modes of apprehension’.[32] An archetype is not like a stereotype. Unlike the stereotype, which is a *post factum* abstraction that is purely general in nature, the archetype exists *ante factum*, and is instantiated. It is the coming together of the absolutely unique with the absolutely universal – in fact this absolutely unique experience is felt as both absolutely unique and absolutely universal at the same time. Every time someone falls in love, the experience seems unique, as though it could never have happened before or ever happen again in the history of the world. And yet it is as ancient as humanity itself – or older – as the experiencer also acknowledges. It is both a typical human experience, and a completely unique one, of unmatchable power and significance. And so it is, to one extent or another, with all archetypes. In fact their constantly repeated nature is part of their power: according to Jung, ‘endless repetition has engraved these experiences into our psychic constitution.’[33] When we encounter them afresh, it is the experience, not of cognition, but of re-cognition, or anamnesis. The finding of the universal in and through the unique, rather than by turning away from it, is a theme I will recur to.

Jung was influenced by both anthropology and the study of the evolution of animal behaviour patterns. From these arose his idea of the archetype as a structuring principle, which he found reflected in the history of both philosophy and mythology.[34] We can observe motor instincts more easily than we can observe the reality of the archetype within consciousness. Since we know, however, that perception and sensory function are tied to motor function, each depending for its coherence on the other, it seems probable that archetypes will exist as the imaginative counterparts to instinct. Jung argues that instinct and archetype ‘determine one another’,[35] and he suggests that the archetypal may be experienced as an affective state through an image, metaphor or myth.[36]

Jung thought of archetypes as paths that our ancestors had traced, or rivers they had followed, and that every time an experience of this powerful nature was recovered it opened up an ancient riverbed:[37]

> Archetypes are like riverbeds which dry up when the water deserts them, but which it can find again at any time. An archetype is like an old watercourse along which the water of life has flowed for centuries, digging a deep channel for itself. The longer it has flowed in this channel the more likely it is that sooner or later the water will return to its old bed.[38]

We are transmitters, as D.H. Lawrence said. It may be that much of our thinking and behaviour is relayed to, and through, us: not originated by us at all.

Instincts are not the same as intuitions, since they seem to be general and inherited, though forms of behaviour and thinking we might not generally call instinctual may be inherited too, as the findings of evolutionary psychology suggest, and so the difference cannot be absolute. Intuitions may have taken a long time in evolving, both through individual experience *and* through that of a whole historical culture. As anthropologist Merlin Donald puts it,

> individual decisions are made in the brain. Human brains, however, are closely interconnected with, and embedded in, the distributed networks of culture from infancy … Humans are collective thinkers, who rarely solve problems without input from the distributed cognitive systems of culture.[39]

As far as the significance of the hemispheres goes, most of these drives are dependent on subcortical regions, some as deep as the brainstem, and certainly the limbic system. Such global drives cannot be ascribed to one hemisphere alone.

THE BALEFUL EFFECTS OF CONSCIOUSNESS

On the Isle of Man, off the west coast of Britain, there is an annual event called the TT races. This is a terrifying motorcycling event quite unlike normal circuit events, since it takes place on ordinary public highways, and has been described as the most dangerous sporting event in the world. By an act of the island's independent parliament, the Tynwald, the island's roads are closed to ordinary road users for two weeks. A medical consultant who looks after the well-being of the contestants wrote to me with some intriguing observations. He began by explaining the origin of his interest in the competitors:

> Why TT racers, not circuit racing? There are significant differences: circuits are smooth, little high speed, many corners, and a grid start. Riders are focused on each other and corners are tactically vital, so position and braking are key. The TT, by contrast, is a time trial, so no grid start, riders go off individually and race their own time, so to speak. A map of the course suggests many corners, but the fast ones say there are only three, the rest are fast sweeps. Fast is the key here, as sustained speeds are now up to 200mph, which is nowhere sustained on any British circuit. Finally it is a normal island road, which is not smooth, not swept, and with drain covers, patch repairs, etc. It is nearly 40 miles long and climbs from sea level over the mountain; the weather is different around the course and the mountain can be fairly gusty. The key is great *smooth riding* – there is no late braking or diving under; and good TT racers don't generally do well on circuits. It is a specialised and dangerous game: there are no run off areas, just stone walls, which it is normal to brush the leathers against at speed.

So clearly there is little room for error: what those who are successful can tell us will be of considerable interest. What do they report?

> An example: the speed past the grandstand is around 175mph, yet just past is a blind brow covering a fierce drop down Bray Hill,

which has a kink at the bottom. I suggested to a good racer that surely you have to be inch-perfect at the grandstand, as you do not have time to correct your line before the plunge down Bray Hill and the kink at the bottom. He replied that when you go past the grandstand you're thinking of the Quarterbridge. Now the Quarterbridge is a mile further down the track … It begs the question as to exactly what the present moment means to these chaps.

Conscious will is a handicap. The doctor described two riders battling

the whole way with very close times. They started together and stayed together for the whole race until the last lap when [X] missed a gear coming out of Ramsey, saw his fellow disappear in the distance, and with only the climb up the mountain to go knew he had lost. Happy to come second, he 'backed off', as he said, but to his amazement caught the lad up fairly soon, and overtook and won. It is possible that, by abandoning the determination to win following the missed gear, he removed a small bit that was interfering with his actual capability … A similar tale involves the truly great [Y] who, following a pitstop fumble, had lost too much time to win, so accepting second place as a given, backed off to run a risk-free last lap. He broke the lap record, a very difficult thing to do, requiring absolute perfection, and did not believe it when told, as he thought he was little more than touring home.

Further observations were:

- all anxiety goes when they start, almost like a switch; some say their body vanishes (ie, they are so in their body that they don't notice it as distinct from the self);
- they operate in a weird state where they say they are 'way ahead of the bike': pictures that show their eyes at difficult parts of the course would make you think they are quite unfocused, gazing at infinity;

- perception is quite markedly improved, which may be visual, but is also auditory and tactile, and ‘they are quite happy to include a sixth sense’; one rider describes entering a ‘horrendous fast descent to a tricky left hander and noticing a spectator stood back in a field light a cigarette, saw the puff of smoke blown by the wind, and smelt the tobacco inside his full face helmet’;
- they say they have all the time in the world, in fact time slow-down is almost universal, particularly in accidents, where they are able to think and act in slowed down time.

My correspondent had another fascinating observation. Racing engines get extremely hot and ‘operate very close to piston seizure’, so the temperature gauge is vital. One rider had fitted a new digital gauge: his performance deteriorated drastically and he only regained form after re-fitting the old analogue one. The digital gauge presented him with changing numbers, whereas the analogue presented a sweeping scale. Having to ‘read’ the digits, rather than see the position of the needle, interfered with his smooth racing. And the number would flicker and change, over a degree or two of no consequence, all the time: the sweep gauge supplied the trend without distraction. My correspondent wondered if some accidents were due to the left hemisphere taking hold.

The ideal state described is one in which attention must be far from the immediate point in space and time, instead inhabiting the whole feel or shape of the course as it unfolds; the passing of time and the presence of the body are not noticed – not because they have gone away, but precisely because they are so completely inhabited that they are no longer available for inspection, no longer ‘objects’ to which focussed attention could be drawn. They are no longer *in* the field, they *are* the field. All is *zuhanden*, nothing *vorhanden*. This enables ‘smooth-riding’: being in the flow. All anxiety, which narrows attention, all analytical thinking or interpretation, all distracting, obtrusive detail, must be banished. It is not unlike some aspects of both a trance-like meditative state and the mental state described by practitioners of Japanese martial arts.

Experiments with experienced handball players indicate that they make better decisions when they have less time.[40] Expert golfers (though *not* novices) do better when they have only three seconds to putt than when they can take all the time they want.[41] Analytical decision-making seems to

interrupt the intuitive processes that serve experts well. This is not confined to non-cognitive tasks. Instructing individuals to verbalise their reasoning disrupts otherwise effective processes that are outwith the realm of language, leads to over-focus on elements of the superficial structure of the problem at the expense of the depth, and can lead to poor decisions.[42] This is the phenomenon known as 'verbal overshadowing of insight'.[43]

As Peter Struck's comments on the Delphian Pythia suggest, it seems that we make our best judgments about risk outside the petrifying stare of consciousness. Unconscious influences lead us to the right answer, and in their absence conscious strategies do not suffice – indeed, they can impede. We often revise better decisions taken more intuitively and replace them with worse decisions after thinking them through more explicitly.[44] Experiments have indicated that conscious deliberation (explicitly verbalising and analysing reasons when making decisions) can have a disruptive effect.[45] As a corollary, being prevented from deliberating is not always detrimental to, and can improve, decision-making.[46]

In a famous and often repeated lab test called the Iowa Gambling Task, subjects are asked to turn over cards from four packs, two red and two blue. Depending on the card, they will either win or lose money, and their goal is to maximise winnings. Effectively the red cards are disastrous – you can win well, but you can also make heavy losses; and the best strategy is to stick to the blue cards which give you regular, modest winnings. Although it takes subjects usually about 80 cards to be able to articulate what is going on, they are able to verbalise a preference for the blue cards after about 50. However, in one study, the subjects were hitched up to a polygraph (a 'lie-detector'), that measured how sweaty their palms were. What this revealed, astonishingly, was that after only 10 cards, long before the subjects were conscious that there was a difference, the polygraph registered that they were more anxious when their hands hovered over the red cards: and that already at this point, though again the subjects were not aware of it, they had *actually started to change their behaviour* to accommodate the new information. Long before the conscious mind reached its conclusions the body had perceived what was happening and was already responding to it.[47] It should not surprise us to learn that lack of awareness of emotions negatively affects intuitive decision-making.[48]

When asked for their judgments about which decks rated good or bad, subjects often responded in a manner discrepant with the actual choices they made on the task. Unconsciously they were aware of what their articulate left hemisphere was not. It seems that, when information conflicts, we tend to favour implicit over explicit knowledge; until we are asked to reflect on the matter consciously, verbally – with the reverse outcome.[49]

Not everyone's 'gut feelings' are helpful, however, and for some individuals they lead to consistently wrong choices. Whether this is because such people are trying too hard, and the conscious effort is getting in the way, is not known. But one possibility may be that those more alert to their own autonomic responses, such as their heart beat, are those who make the best players. When subjects were tested for their ability to monitor their own heart beat prior to the gambling task, it turned out that those who were better able to do so – literally to listen to what their heart was telling them – were better at the game.[50]

This was interestingly reflected in a study carried out by Stuart Valins in the late 1970s. It had been previously reported that an increased heart rate was related to higher levels of accuracy in interpreting facial gestures,[51] and that heart rate was one cue that some participants were aware of using to gauge appropriate responses when asked to respond to visual stimuli.[52] A group of people were filmed while concentrating on a gambling task. When other subjects were asked to interpret, from the facial expressions on film, how much money someone had just won or lost, the subjects were separated into so-called 'intuitives' (those who responded almost immediately, but could not verbalise about their process) and 'intellectuals' (those who delayed responses until the latter half of each trial session, but *could* verbalise about their process). Each subject did the test four times, in two blocks of two. On one occasion in each block they were given reinforcement, in the form of monetary reward, if they got a right answer. On the other they were not. And then the order was varied, so that they did both conditions again, but in reverse order, in order to rule out an effect of precedence.

What the experimenters discovered was on the surface puzzling. Overall, there was no difference between the two groups in terms of efficiency. However, under reinforcement conditions, the level of accuracy for intellectuals was significantly higher than for intuitives: but under *non-*

reinforced conditions, intuitives performed significantly more accurately than intellectuals. In other words, for intuitives, the rate of accuracy actually declined significantly when they were given immediate reinforcement about correct responses.

The phenomenon of ‘choking’ refers to the well-attested fact that people often do worse on a task when the reward is higher – a familiar phenomenon in sport, but also in the workplace. Why would that be? One possibility in the Valins test is that the external reinforcement drew attention consciously to performance, made them self-conscious, and interfered with their sensitivity to the internal cues they were receiving from their body.[53] But there are others. A study of people playing a computer game in which they had to catch prey looked at the brain correlates. As expected those offered the higher rewards did worse. On the scans, there were changes in midbrain function (ie, at the level of the brainstem) between the two conditions, but the cortical areas which were more active in the low-reward than high-reward condition as the subjects approached their target were the right anterior cingulate and right medial prefrontal cortex. [54] If these were relatively ‘switched off’ by trying too hard for the higher rewards – remember the left hemisphere is acquisitive – that would explain why ‘intuitives’ were more handicapped than ‘intellectuals’ in the high-reward condition. Note that the conscious mind thinks it knows best, despite its lack of understanding.[55]

We are often – in fact, usually – unaware of the patterns that govern our insights.[56] They operate only at the unconscious level and are often quite complex. Arthur Reber, a pioneer in the field of implicit, or unconscious, learning, showed that people can learn complicated patterns without any awareness of doing so. Simply from memorising a list of letter strings (derived from a ‘grammar’ of which they are completely ignorant), subjects can judge subsequent test strings as ‘grammatical’, or not ‘grammatical’, even though they have no conscious sense of why, eg:

'Grammatical' strings	'Non-grammatical' strings
VXJJ	VXTJJ
XXVT	XVTWJ
VJTVXJ	VJTTVTV
VJTVTV	VJTXXVJ
XXXXVX	XXXVTJJ

Moreover, knowing beforehand that the letter strings to be memorised have come from an underlying grammar *decreases* the subjects' performance, presumably because it alerts the left hemisphere to look for rules it is not going to be able to articulate.[57] Several studies have shown that the ability to learn at an implicit level is impaired by asking subjects to look actively for complex patterns, an effect that has been called the 'benefit of not trying'.[58] As one team put it, 'learning predictive relations between events depends on *attention*, not on awareness'. That sounds rather like the way that many skills are learnt: by a habit of receptive *attending*, that is more important than awareness – and might actually be inhibited by awareness; though in the earlier stages explicit rules can help up to a point.[59] This ability to detect a pattern in the absence of verbal awareness is prima facie likely to be mediated by the right hemisphere, a hypothesis that is confirmed by superiority of the left hand over the right when asked to respond in such circumstances.[60]

It might seem obvious that you take things in better when you are focussed on them; and that you will make better decisions if you are thinking about the question that needs to be decided. But neither of these is necessarily the case: in fact often the opposite applies, as repeated psychological studies have suggested.

In one study subjects were asked to look at a series of abstract images. During half the task they were able to concentrate, but during the other half they were deliberately distracted. When they were later asked to identify images they had seen, they did better on the pictures they had viewed while distracted.[61] When, in another study, subjects were asked to detect the odd one out in a field of symbols, responses were more accurate when time was severely limited (to less than half a second).[62]

Furthermore, in a test of originality, subjects were asked to generate items in response to a cue. There were three conditions: in one, they had to respond immediately; in the second, after a few minutes' conscious thought; and in the third, after being distracted for a few minutes on another task. The most creative and original answers came from the group that had been distracted.[63]

Using a geometric and spatial insight problem, it was found that providing participants with breaks improved their performance as compared to participants who did not receive a break. However, the length of incubation between problems did not matter. Thus, participants' performance on insight problems improved just as much with a short break (four minutes) as it did with a long break (12 minutes), suggesting that disruption of conscious deliberation was enough to improve performance, irrespective of the *length* of disruption.[64]

In another study, this time of decision-making, subjects were asked to evaluate the best out of four models of car on the basis of 12 criteria.[65] One group were given time to ponder before coming to a decision; the other had to move on immediately to address another task after reading the information through, and then made a spontaneous decision later. The first, 'pondering', group chose the best car only a quarter of the time, whereas about 60% of the 'spontaneous' group made the right choice. Some other studies suggest that subjects make better decisions immediately after reading all the characteristics than after *either* a short period of conscious consideration *or* a short period of distraction, suggesting that it's more that their first thoughts are best than that there is a period of unconscious 'mulling'.[66] But overall it would seem that a (brief) period of 'mulling' does improve judgments.[67]

Interestingly, the advantage conferred by distraction seems only to work when the participants are induced into an appropriately holistic way of thinking (they are asked to form a global impression of each alternative) not when they are encouraged to adopt a 'featural' one (in which they are asked to compare individual attributes of the alternatives).[68] For example, participants who are simultaneously engaged in a distracting task are able to differentiate good from poor shares on the basis of 75–150 numerical return values that were presented at a fast speed – but *only* when the participants were asked which shares 'feel better', rather than, for example, to report

which of the shares had the highest average, which encourages focal attention.[69]

The ‘conscious’ and ‘unconscious’ are not wholly distinct realms. The whole discussion of ‘conscious’ and ‘unconscious’ processes is set up as though the two were different species of fish kept in separate tanks. As I have argued elsewhere, the boundaries of consciousness are fluid, and elements can come and go from conscious awareness from millisecond to millisecond, rather as objects ‘appear’ and ‘disappear’ when a spotlight moves around a stage. And the field of consciousness at any moment in time has no sharp edges, but a ‘fringe’ around it where it meets the unconscious. This area on the edge of awareness is far more fruitfully creative than the centre of the field of consciousness. The essential point is whether what we ‘see’ is paralysed by *focussed attention*, such as the left hemisphere applies, or freed up by *attention to the field as a whole*, as is the case in the right hemisphere. Arguing about consciousness versus unconsciousness misses the point. If we are able to bypass that dichotomy, there emerges a point on which both sides (proponents of conscious and unconscious ‘processing’) might be able to agree: closing down to narrow attention is what needs to be avoided, whether by depriving the serial-processing left hemisphere of time, or by distracting its Gorgon stare elsewhere.

While I am on this topic, I am often asked whether the unconscious mind can be identified with the right hemisphere. It is sometimes argued that the right hemisphere is less conscious than the left, and most neuropsychologists seem to assume that this is so: I understand what is meant.[70] To the extent that what we mean by unconscious is ‘outside the spotlight of attention’, the answer is a definite ‘yes’. But this doesn’t mean it has no awareness of the world, indeed quite the opposite. After a major left hemisphere stroke the subject has a greater awareness of the world than someone who has had an equivalent stroke in the right hemisphere – even, arguably, in some respects greater than normal.[71] Any unconsciousness here is limited to a lack of *self-conscious* awareness.

The key point to remember is that what is capable of being retained in the centre of our field of awareness is very limited indeed, and when we use only what we see there to construct our view of reality we go wrong. Not just because of how little we can see there, but because even the little that we *can* see is necessarily distorted by the type of fixing, isolating,

abstracting, distancing, devitalising attention brought to bear on it. To this extent we rely heavily on the right hemisphere and what it knows – all of which, from the left hemisphere point of view, is classed as 'unconscious', since it knows very little about it.

It is this very large field open to the unconscious, by comparison to the conscious, that Malcolm Gladwell's interesting account in his best-selling book *Blink* appears to me to miss. He supports the idea that intuitive expertise relies on reaching a conclusion on the basis of minimal information: but by identifying 'thin-slicing' – which he interprets as the sampling of very few elements in a picture – he gets hold of exactly the wrong point.[72] What is distinctive about the unconscious mind is not how little, but precisely how much, it takes into account, very quickly. This was the point made earlier by jurist Engel of the Max Planck Institute. By contrast with the conscious mind, which cannot hold all the information at once, and therefore tends to focus only on a handful of salient details – sometimes simply the last details it heard – the unconscious mind appears capable of dealing with complex patterns that can't easily be reduced. Gladwell's substitute for this holistic perception is what he calls a 'thin-slicing flurry'.[73] Of course, looked at from the perspective of the analytic left hemisphere, that's what it must seem to be. Yet what is actually being represented is a brief but *continuous process*, not a small *series of slices*.

Part of the power of the unconscious mind is its capacity to deal with numerous different elements *simultaneously* – and, even more importantly, to see their interconnexions one with another. This form of parallel processing is central to pattern recognition because it is able, without obtruding into conscious awareness, to take note of complex simultaneous events, and the emergent patterns of connexion: a seamless process.

There is a tendency to think that because it is quick, it must rely on a simplifying dirty trick. Not so. Equating unconscious intelligence with the ability to reduce situations to a simple underlying pattern is at best incomplete.[74] In some types of situation it may be possible to reduce matters to simple underlying signatures, but these are unusual – those in which one or two pieces of information have a disproportionate role in the outcome. The conscious mind can maintain in an active state and process only four to seven pieces of information at the same time. [75] It is at its limit when recalling a phone number it has just heard. However, the unconscious mind does not have the same limitations. The intuitive embodied parallel

processing approach is essential: rather than being just a source of bias, it integrates across a huge range of values and judgment factors.[76] And experiments on implicit learning reveal that, as the underlying pattern gets more complicated, the unconscious mind tends to have the advantage – which does not seem to fit with what Gladwell would have predicted.[77]

Gladwell makes good use of the intriguing case of the Getty *kouros*, but draws, it seems to me, the wrong conclusions. This concerns a purportedly archaic Greek sculpture of a naked young man (a *kouros*) that the Getty Museum acquired, believing on the basis of extensive documentation and a number of expert opinions that it was genuine. However, other experts, asked to examine it, found themselves extremely dubious, sometimes referring to incidental details (one refers to a detail of the fingernails), but generally appealing to a sense that it immediately – and it was in almost all cases an immediate reaction – looked wrong as a whole. One said that it felt too 'fresh'. Another said that he felt physically sick in its presence. Eventually, after piece upon piece of paperwork attesting its ancient provenance proved to be a forgery, the case for its authenticity started to look thin.

It is notable that the famous art historian and connoisseur Bernard Berenson described his talent for validation of masterpieces as a sixth sense. 'It is very largely a question of accumulated experience upon which your spirit sets unconsciously', he said:

> When I see a picture, in most cases, I recognize it at once as being or not being by the master it is ascribed to; the rest is merely a question of how to fish out the evidence that will make the conviction as plain to others as it is to me.

Berenson recalled that once, upon seeing a fake, he had felt an immediate discomfort in his stomach.[78] We are back to the guts. Here we have more than one expert talking about feeling physically sick or feeling an immediately unpleasant sensation in the stomach on seeing something that was intuitively wrong with a work of art.

In the Getty *kouros* case, from the perspective of the conscious mind, these judgments certainly appear to happen in a very thin 'slice' of time, so must depend on a thin 'slice' of information – right? Wrong:

> these conscious reflections reveal little about what was going on in the art historians' unconscious minds. The expert who found himself staring at the statue's fingernails and the expert who judged it too fresh likely blended below awareness a large amount of physical or stylistic information to conclude the statue was a forgery. The inarticulateness of the judgments of most of the experts, on the one hand, and the credence they gave these inarticulate judgments, on the other, argues even more clearly for the complexity of the underlying patterns behind their conclusions.[79]

There is a 'give and take' between the conscious and unconscious minds. We can consciously decide to hand over to the unconscious: thus it can carry on working while the conscious mind focusses on something else. We don't do this as often as we might. For a solution may only appear with time and unfocussed attention, allowing a broad survey of relevant material: 'mind wandering may … allow otherwise opposing networks to work in cooperation.'[80] Note the suggestion that the unconscious mind is not disturbed, as the conscious mind is, by the coming together of (apparent) opposites.

Equally the decision to take more conscious control may arise, but that decision itself *arises from the unconscious*.[81] All thought is ultimately intuitive in its provenance, in the sense that it is grounded in unconscious intelligence, which elects either to explore it consciously or not; much as our sight is macroscopic, and it is from that oversight of the world that we decide to take a close view of some detail through a magnifying glass – not the other way round. Most of what the unconscious mind knows, of course, never gets into the focus of awareness, but when it does so, it happens some while later: the unconscious shows signs of having solved a problem as much as eight seconds before the solution comes to consciousness.[82] It is also of interest that both the heart and the brain appear to be able to anticipate an error in performance by musicians.[83]

Clearly some decisions, detection tasks, and creative acts do require deliberation and cogitation, even focussed attention. It's just useful to be reminded of quite how much goes on *better* as long as it remains outside the spotlight of attention, since our immediate unexamined assumption, coming from the explicit articulate left hemisphere, is that we do everything better

when we are focussed on it and trying hard. In reality such occasions clearly do exist, but they are relatively rare. (I will consider a striking example later in this chapter.)

Before we leave this section, what about the time course here? The laying down of whatever it is we draw on when we speak of having gut feelings takes a while, and may go back a long way. But access to knowledge that is stored seems to take anywhere between milliseconds and several minutes, presumably depending on how much information needs to be retrieved from memory. We make judgments about a person's trustworthiness, competence, aggressiveness and likeability within the first tenth of a second, judgments which do not change significantly with added time.[84] This might go to show how accurate our first impressions are – or just how difficult it is to change them subsequently. But, either way, judgments on complex matters, that are hard to specify, are made almost instantaneously, and we generally feel no need to alter them.

EMBODIED COGNITION, PATTERN RECOGNITION AND THE EMERGENCE OF SKILL

Much of what we call intuition is the result of what John Kay calls ‘finely honed, well-developed skills’.[85] ‘Well-developed’ here means repeatedly exercised through practice, and it is on the grindstone of experience that our intuitions are honed. Even if they manifest as cognitive, they are embodied, in the sense that they are both informed by and inform the motion of our limbs, our breathing and pulse, the emotion of our heart and gut and mind, together with alert perception, and intelligent insight, all manifest in interaction with, rather than abstraction from, the world. Such intuitions are highly context-sensitive, responsible and responsive, not random or wilful; they are the fruit of disciplined attention to the world over time.

It is this kind of intuition, something that is grounded in praxis, not analysis, that is the decisive element in chess,[86] just as it is in calligraphy, or playing the cello.

Chess is often thought of as an analytic game, but it clearly is not: it is an expertise operating almost entirely at a non-conscious level. Deliberation does take place, but on a ready-made selection (typically not more than half a dozen) out of literally millions of possible future scenarios, and, contrary to what is often believed, does not necessarily look more than a few steps ahead. Professionals can play simultaneous games, sometimes against as many as 50 opponents, with only slightly less success than in games played under tournament conditions. In simultaneous play, the professional takes much less than a minute, often only a few seconds, for each move. There is no time for careful analysis, which, if systematic, would take thousands of hours. A chess expert is, rather, an expert at perception: it is skilled perception, not unaided memory, that enables the chess Grandmaster to memorise nearly perfectly a position that has been presented for a few seconds only, as detailed analysis of the eye movements of strong and weaker chess players, when confronted with a novel position, shows.[87]

The difference in perception is that the expert already sees, not a mass of details that have to be organised by rules to make sense, but patterns that have meaning within the game. That their skill is a matter of pattern recognition, not just a photographic memory, is demonstrated by the fact

that though such experts are much better than normal subjects at remembering a board in a chess game after glimpsing it for a few seconds, this superiority to a great extent (though not entirely) disappears, if the task is to remember a random arrangement of pieces that has no meaning within the rules of chess.[88] It is worth watching the memory performance of chess Grandmaster Patrick Wolff, available on YouTube.[89] What is clear is that he is relying heavily on right hemisphere brain functioning: he talks of seeing coherent patterns that fit together in chunks right across the board. 'You try to absorb everything quickly, but occasionally you overlook the details', he says – but he had already demonstrated that he does not overlook any single piece *if it is important*, that is, if its presence or absence would in any way change the overall meaning of what is seen. Such a piece could not, in any case, ever be an isolated 'detail': it would be already bound into what he calls the 'structure'. It is only the inessential that he forgets, with astonishing efficiency.

How good are we at knowing whether we have seen something before? The answer appears to be 'very'. 'A number of studies demonstrate that recognition memory is vast, easily etched on, and remarkably retentive despite short presentation times', according to psychologists Gerd Gigerenzer and Dan Goldstein.[90] An experiment in 1967 by Roger Shepard had shown that immediately following a single exposure of 612 picture stimuli, for about six seconds each, subjects could select the correct picture in two-alternative recognition tests with a 98% success rate. [91] Over the next few years, another psychologist, Lionel Standing, went further:

> Standing increased the number of pictures (photographs and 'striking' photographs selected for their vividness) to 1,000 and limited the time of presentation to five seconds. Two days later, he tested recognition memory with pairs of pictures in which one had been presented previously and one was novel. Participants were able to point to the previously presented picture 885 times of 1,000 with normal pictures and 940 times of 1,000 with 'striking' pictures. Standing then outdid himself by a factor of 10. In perhaps the most extensive recognition memory test ever performed, he presented 10,000 normal pictures for five seconds each. Two days later participants correctly identified them in 8,300 of 10,000 pairs. When

> more and more pictures were presented, the retention percentage declined slightly, but the absolute number of pictures recognized increased …

This is despite the effects of fatigue: Standing himself reported that ‘in the case of 10,000 items, the cumulative effects of five days’ viewing … are extremely gruelling and unpleasant’.[92]

In his experiments Standing compared pictures and words, and considered that ‘the superiority of the pictorial mode in recognition and free recall learning tasks is well established … recognition memory for pictures is almost limitless’. He was referring here to both accuracy and capacity. The average recognition time for words and images was less than a second when there were 10,000 objects. The unconscious memory can work on shapes, pictures and images, juggling many factors, in very short periods. Standing reckoned that, given a further second, the mind could search over 50,000 pictures in unconscious memory.

There are also things that can never be recalled because we weren’t aware of them at the time – yet we know them at some level. If ‘we’ don’t know that we know them, how can we be so sure? Well, we are much more than our conscious selves; it is variously estimated that around 99% of all that our brains take note of never needs to break into conscious experience. This, incidentally, partially explains the results of Libet’s well-known experiments (and the subsequent similar experiments of Soon and others)[93] – they are not a proof that in some spooky way our ‘brain’ makes decisions that ‘we’ don’t know about, still less that there is ‘no free will’. They merely require us to accept that we are more than our conscious minds, and that most of our decision-making goes on at a level below consciousness, something which, if it wasn’t already obvious, was made abundantly clear over a century ago by Sigmund Freud. Most of our knowing is ‘knowing without knowing why’, as psychologist Guy Claxton felicitously puts it.[94]

When asked to find a fourth word that linked another three (such as HOME, SEA, BED) people are better than chance at discriminating a triad for which such a word exists from one which has no such word, even when they are not able to name the fourth word.[95]

Sometimes this ‘knowing without knowing you know’ can manifest itself in some interesting ways. Fearful faces exposed for as little as 17-thousandths of a second, and then followed immediately with a neutral face

that ‘masks’ it, can nonetheless evoke a response in the amygdala, showing that an appropriate emotional reaction to the fearful face occurs, even though subjects are completely unaware that they have seen it.[96]

In a condition known as blindsight, the primary visual cortex (also known as the striate cortex, or V1) has been destroyed or damaged in such a way that subjects are blind, in the normal sense of the word. Yet if asked to guess the presence and location of an object, they perform better than they could by chance. They can even ‘guess’ the colour and shape of an object or its orientation, and react spontaneously when something moves; and can catch something thrown at them, put out their hand and grasp, eg, a walking-stick by the handle, and recognise whose face they are looking at – yet they nonetheless insist that they see nothing.

A patient called TN, who was cortically blind, exhibited what is called affective blindsight. He was able to react spontaneously to facial expressions, with an appropriate emotional response accompanied by activity in the right amygdala, even though he denied that he had seen anything – and indeed, in the conventional understanding of the word ‘see’, he had not.[97] He was also able to walk down a corridor negotiating a range of awkward obstacles that had been placed in his path, some low to the ground, some higher – a bin, a tray, a tripod – and avoided every one of them. He had to squeeze up against the wall to get past a bin: when asked why he did it he said he ‘just felt like’ walking that way.[98]

This phenomenon has been much debated by philosophers, who have used it both to support and to deny the existence of consciousness. But there is something very odd that is less often noted. Subjects with blindsight are both less surprised by their ability than we feel they ought to be, and at the same time, much less confident in their ability than we feel they ought to be – they carry on needing to be prompted to use it (as did Franck Mourier). Something like confabulation is evident. The conscious articulating mind, not knowing what is going on, prefers anything to accepting the truth of the matter – that we are getting along OK without its input. The situation is similar to that found in split-brain patients, when the right hemisphere is aware of something that the left hemisphere is not, and the left hemisphere, nothing abashed, constructs a story to make sense of what has just happened, without having a clue as to what actually did.

Aristotle distinguished three kinds of knowledge: *episteme*, *techne* and *phronesis*. They don’t have exact equivalents in English, but they can be

explained without too much difficulty. *Episteme* is abstract, context-independent, invariant and general. It is based on analytical reasoning. In our terms, it represents the left hemisphere in action. *Techne* is the skill of the craftsman: practical, embodied, flexible and dependent on context. *Phronesis* is a kind of pragmatic wisdom, which involves the appreciation of values, is more reflective, but is also flexible, tacit, intuitive and context-sensitive like *techne*, to which it is closer than it is to *episteme*. Both *phronesis* and *techne* show signs of being more right hemisphere-dependent. Aristotle also distinguished *nous* (intuition) and *sophia* (another kind of wisdom). These are each harder to put into modern English terms, but *nous* is something like the intellectual spirit that enables us to reason at all, while *sophia* (the root of our word 'philosophy', and usually translated as wisdom) interestingly covers a very wide range of experience, bringing together, more clearly than any other, what is conventionally seen as the 'lowest' level, embodied wisdom, with 'highest' level, inspired (or divine) wisdom. In ancient Greek thought, these were not sundered: Homer is, for example, able to speak of the *sophia* of a shipbuilder,[99] and Theocritus of the *sophia* of a tapestry-weaver.[100] At the same time, the word may also mean insight into the deepest nature of things by a poet or thinker. It is also often used interchangeably with *phronesis*, the wisdom of judgment that comes with experience.

Most importantly, Aristotle realised that different kinds of knowledge were appropriate to different contexts, so that the knowledge of an accountant was of a different kind to that of a physician, and each was different from that of a sculptor.

What sorts of knowledge are needed to develop expertise? And what role does intuition play? Those of you who have read Daniel Kahneman will likely have a somewhat jaundiced view of expertise. What Kahneman says should not be ignored: I will come to that in the next chapter. But meanwhile what *does* make an expert?

You need to start by consciously learning a very great deal, for years; but in the long run that will never make you an expert. There are far too many options to consider for you to cover them all in the time available – which is not to say that experts don't think or deliberate. They very definitely do. But it is important to know how much, and when, to do so. Too much self-awareness, or self-awareness at the wrong moment, will not

help; indeed it will positively get in the way of good judgment or good practice. Judging that, too, is part of expertise.[101]

In this, expertise is like a Japanese martial art,

> full of balancing acts that demand the application of rigorous technique and the surrendering of the self to its most intuitive state. In Kendo, rigour is acquired through strictly repetitive drills, and flexibility only becomes possible when the fencer is proficient enough to ban all thought of rigorous technique and respond intuitively.[102]

Something similar applies to being an experienced physician. As a medical student starting out on the wards, I had learnt a colossal number of pieces of information – several a minute, on average, it certainly seemed – over the previous three years. At times it had felt like trying to drink from a fire hose. Yet for all that, I was completely at sea when it came to putting what I had learnt into practice. As part of my training, I was encouraged to introduce myself to patients and take their history. I particularly remember that, as a medical student, after almost two hours of listening to one poor middle-aged lady, I had no clue what was wrong with her. She wore wrist splints and, having tried to kill herself, was brought in in a wheelchair to a general medical ward: she seemed to have complex problems in every system that I enquired about. I despaired. I had millions of facts at my disposal but not enough pattern recognition to do anything the least bit helpful with them. Another thing I had yet to learn was that just sitting and giving her undivided attention for a couple of hours was quite possibly, in her case, as therapeutic as anything I could offer. But knowing that also involved recasting what I saw according to experience that at that stage I didn’t have. I was desperate not to have missed a mechanism.

On the wards where I was trained, each general medical team would take it in turn to be the one to accept the medical emergencies that came in during a 24-hour period: this is known as being ‘on take’. At the ward round the morning after being on take, as a House Physician, the lowest form of medical life, I would watch the Registrar, a qualified doctor with a middle rank in the team, having probably about three or four years of postgraduate experience, and having like me been up all night, move from

bed to bed, presenting to the Consultant, without notes, a concise history, findings on examination, and the results of any investigations and procedures that had been carried out, for each of about 25 patients. And I wondered how on earth he could remember so many details:

> This gentleman is a 67 year-old retired miner, a lifelong smoker, with a family history of heart disease, a history of type II diabetes controlled by diet only, and hypertension currently poorly controlled by atenolol. He had recently experienced increasing fatigue and presented in Cas at 4 am, after his wife called an ambulance. She was worried, as he had become increasingly short of breath, was wheezing and showed signs of confusion. On arrival he was poorly perfused, with cold peripheries, BP was 130/95, he had a raised JVP, some wet rales, signs of cardiomegaly and an S3 gallop, a palpable liver edge at 2cm, and some pitting oedema. On direct questioning he admitted to a cough, but denied paroxysmal nocturnal dyspnoea. An ECG showed some Q waves, left axis deviation, but no ST elevation. His sodium came back at 124, potassium at 5.2 (we will repeat these later today), slightly elevated transaminases. We put him on nitrates, an ACE inhibitor, a furosemide drip and CPAP, and he is currently stable.

And then, after the Consultant had nodded and asked a few pertinent questions, and checked that an ‘echo was in the pipeline’, he’d walk on to the next bed and start all over again. How on earth did he do it? Was he a memory freak? To me it all seemed a bewildering mass of fairly unpredictable details.

But, like the chess player, he was using pattern recognition. There were half a dozen common possibilities here, and a number of less common ones. Enough details cohered to suggest what was most likely congestive cardiac failure; and once you have a template, you know what fits and what doesn’t – each becomes easy to remember for different reasons. All quite routine, really…

And then there were the astonishing feats of diagnostics involving rare and unusual conditions, which could be expected only from senior clinicians, those with the greatest experience. I have frequently had reason

to be genuinely in awe of the acumen of senior neurologists, general physicians and radiologists with whom I have worked.

Experts in any field need both to attend to the *Gestalt*, the picture as a whole, and, occasionally, to engage in (preferably limited) analysis. Why preferably limited? Because it has costs. It takes time, yes; but worse, it also changes its object, risks focus on areas that may be inessential, risks substituting something explicit and measurable for something much more important that is implicit and unmeasurable, and inevitably interferes with the functioning of expert skills, as we have seen in earlier sections of this chapter. As Whitehead said, such analytic forays 'require fresh horses', and must only be made at decisive moments.

Researchers into medical expertise have investigated the role of perception and memory in the decision-making ability of novice, as opposed to expert, physicians.[103] Physicians develop 'illness scripts' for diseases through experience.[104] They then verify the script against the information provided by the patient: as long as it matches the script, this is an unconscious process.[105] Experience, as in chess, changes what you see when you look, and how you relate it to what you remember having seen. Expert chess players' fixations are to one side of specific pieces and near the centre of the board, whereas novices more often fixated a single piece at a time. Novices were found to activate only left hemisphere areas, whereas the attention paid by experts recruited the right hemisphere over and above the left. [106]

Similarly, experienced radiologists were found to apply a 'global' analysis of mammography images in detecting breast cancer, their expertise reflected in a shift from detailed scanning of the image to a holistic, *Gestalt*-like perception.[107]

A general surgeon in the US wrote to me to say that he found that he needed a way to keep tabs on a large number of patients, for whom all the technical assessments and investigations were carried out by his 'residents' (junior doctors). Every day he would stroll through the ward, doing what appeared to be social rounds. In reality he was comparing each patient's face with how it had been the day before. 'To my surprise', he wrote, 'I knew which patients were getting into trouble two or three days before even the best residents had a clue.'

Jerome Groopman has written a book-length study of the way doctors think. He notes that they blend *Gestalt* appreciation with deliberate analysis

in more problematic cases, and that this requires time.[108] But he is worried about the computer-like procedures involved in clinical algorithms:

> Clinical algorithms can be useful for run-of-the-mill diagnosis and treatment … but they quickly fall apart when a doctor needs to think outside their boxes, when symptoms are vague, or multiple and confusing, or when test results are inexact. In such cases – the kinds of cases where we most need a discerning doctor – algorithms discourage physicians from thinking independently and creatively. Instead of expanding a doctor's thinking, they can constrain it … Statistics cannot substitute for the human being before you; statistics embody averages, not individuals.[109]

Reliance on clinical 'instruments' for decision-making is fashionable. It is considered culpable, for example, not to administer one to a psychiatric patient so as to assess risk of self-harm. However, as I and my colleagues had long suspected, and confirmed through experience, instruments for predicting suicide turn out to be effectively useless. According to recent research:[110]

> Risk scales following self-harm have limited clinical utility and may waste valuable resources. Most scales performed no better than clinician or patient ratings of risk. Some performed considerably worse.[111]

These rote procedures induce complacency, encourage nursing staff to take their eyes off the ball, and to mistrust their intuitions. My most valued 'suicide detection instrument' was the acumen of an untrained auxiliary nurse with 30 years' experience on the wards. Auxiliary nurses often spend more time talking with and quietly observing patients than their trained colleagues; her having an 'uneasy feeling' about a patient was a sign worth heeding. Such intuitions are only useful, however, when they emanate from someone with experience, not from a novice.

The asking of routine questions and ticking of boxes can also make the patient feel reduced to a formula on a piece of paper, rather than truly attended to as an individual. This also makes the clinician seem more like a

technician than a nurse or doctor, thus lowering the clinical potential for helping an individual desperately in need of empathic engagement. And it lowers the morale of both clinician and patient. *Ars est celare artem* – or, to quote Valentine and Gabbard, 'technique, in general, should be invisible. The therapist should be viewed by the patient as engaging in a natural conversational dialogue growing out of the patient's concerns; the therapist should not be perceived as applying a stilted, formal technique.'[112] In my training, I watched my mentors effortlessly elicit aberrant psychic phenomena in a few minutes that I had failed to elicit in a considerably longer interview. If I eventually had a skill as a psychiatrist, it was to make sure that I covered every aspect of a patient's life within an hour of what appeared to be a naturally unfolding conversation, so that patients would exclaim, 'I have never spoken about this – you now know more about me than my partner [or parents or children].' And to see the *Gestalt*.

There is much more to be said, but not here, about the obsession with algorithms, correct procedures and 'evidenced-based medicine', on the pitfalls of which Groopman is devastatingly clear.

Please note that, as ever, observing that we have become excessively reliant on a certain way of thinking or doing things, whatever it may be, does not imply there is no good in it at all, or that it should be wholly abandoned – only that it needs to be balanced with other elements, as just one strand in a coherent whole. Every sensible doctor will want to take into account the findings of clinical trials – though they have problems of reliability all of their own, as we have seen – but will also realise that such findings can only help shape, not substitute for, his or her own reflections on experience with various treatments.

Dreyfus and Dreyfus, like others, distinguish different phases through which the novice passes on the way to becoming a highly skilled expert. They delineate five, but for these purposes the detail does not matter as much as the clear overall shape. In brief, they show that in the first three phases, in different ways and to different degrees, having a procedure or algorithm to follow improves performance; but that in the last two phases such explicit modelling impairs decision-making and destroys the possibility of excellence. It enforces mediocrity. Intuition is what makes good judges, good physicians and good generals, as well as good teachers, pilots, poets, artists and leaders. Of course they need to have learnt and thought a lot – intuition is not in conflict with that, but indeed depends on it.

Nor is there anything that says that intuitions have to work fast: sometimes an intuition must guide us in a split second, but sometimes it unfolds over hours, weeks or months.

They summarise the expert's skill as 'pattern recognition, similarity recognition, common-sense understanding, skilled know-how, sense of salience and deliberative rationality.'[113]

It is not that experts are better at recall, or have a gift for analysis: we saw an example of that in expert chess players. It is those at an *intermediary* level that are best at explicit recall and reasoning, because, although they have more of an idea than the novice, they don't yet have the rich schemas of the expert.[114] Just as we saw that understanding was achieved by innovative mathematicians and scientists through visual imagery, experts' judgments are strongly shaped by visual concepts derived from previous experience.[115] This inevitably means that their explicit verbal accounts of how they proceed non-verbally and implicitly will not be accurate, and should not be taken as a model. The mathematicians and scientists we met in Part I were often at a loss to tell how they had arrived at their conclusions. In solving problems in geometry, experts do not pass though intermediate steps, but employ prototypical schemas.[116] In physics, experts match schemas to features of the problem: novices and advanced students, by contrast, work from the bottom up, not having the schemas.[117] Expert physicians, psychiatrists, nurses, judges, soldiers and businessmen may all reach decisions in ways that are not dissimilar.

There is a distinction to be made – and the Dreyfuses make it – between calculative rationality, which is what computers do, from the bottom up, and deliberative rationality, the last reflective stage for the true expert, in which reason may act on intuition.

> When time permits and much is at stake, detached deliberative rationality of the type described [leading to a deliberately taken new perspective] can enhance the performance of even the intuitive expert. We reiterate, however, that such deliberation tests and improves whole intuitions. No rules or principles are used to arrive at conclusions, and so it is not the sort of calculative rationality used by the beginner or competent performer as a surrogate for intuitive understanding.[118]

Translating this into terms of hemisphere-typical function, the work of the left hemisphere is valuable, but should, as always, be secondary to that carried out by the right hemisphere. And Dreyfus & Dreyfus might have added that only intuition tells us *when* to invoke the specifically analytic processes – there are no rules for that, either.

Both explicit and implicit knowledge contribute to adaptive decision-making.[119] Why ever would they not? Both meet in pattern recognition, the appreciation of the *form* of something, not just the pieces packed inside the form. This is where *logos* and *mythos* meet.

But unfortunately the logically fettered mind can never come to know what it is it doesn't know:

> To the extent that junior employees using expert systems come to see expertise as a function of large knowledge bases and masses of inferential rules, they will fail to progress beyond the competent level of their machines. With the leap beyond competence to proficiency and expertise thus inhibited, investors in expert systems may ultimately discover that their wells of true human expertise and wisdom have gone dry.[120]

There is a difference between knowing a poem by heart and knowing where to find it in a book. There is a difference between the embodied experience (and a lifetime's reflection on it), that distinguishes a capable judge or a capable physician, and the following of flow diagrams or application of rules that could be done by a clever teenager. Knowledge that is so far assimilated as to have become part of us changes us, and enables us to be competent practitioners. A doctor is not infallible, but neither is a machine: the more the doctor's knowledge is externalised – outsourced to the following of an algorithm or a computer – the more deskilled he or she becomes. And a deskilled doctor is no good to a patient: something more like an investment adviser, able to summon up figures on a screen, deliver the news of what is in your account, and sell you the package the machine advises.

Doctors have not been as closely studied as nurses. In the world of nursing, Patricia Benner notes that becoming an expert means shifting from

abstract principles to seeing intuitively the patient before you in relation to other real-life experiences, and noting similarities and differences.

She also emphasises three other features of expertise, each of which can be seen as a shift from left hemisphere to right hemisphere 'mode': a change from viewing separate pieces of information to perception of situations as a whole; a 'fluid, flexible' performance; and the 'passage from a detached observer to an involved performer, no longer outside the situation but now actively engaged in participation'.[121]

Benner recognised that nursing was poorly served by theories developed in the academy, and introduced the (nowadays) revolutionary idea that the practice itself could and should inform theory.[122] As a result her ideas are open to criticism from more conventional quarters for not being quantitative, and for using narratives.[123] Remember once again that the left hemisphere is more interested in quantification than qualification, and distrusts narrative – indeed has difficulty understanding and seeing the point of narrative at all. Equally, because her model relies on experience, which partly comes with age, rather than rules which any person (or machine) could follow, it has been argued by some that she represents a step back into tradition and authority in nursing.[124] Though the left hemisphere's theory may dictate that each person is effectively the same as and replaceable by any other member of the category, the right hemisphere is aware of individuals as individuals and that learning comes from living. The words 'tradition and authority' are here being used as boo words for what is merely common sense – namely that we learn best from those who have more accumulated experience, and have had more time to reflect on it, than we have. Not to recognise that fact is a sort of self-inflicted disability.

In fact such clinical skills are inevitably those of a real individual, here the skilled nurse, in relation to another real individual, the patient in question. It is as much about knowing the patient, as it is about knowing facts.[125] And, interestingly, experienced nurses recognise not just the importance of their own intuitions, but the importance of the patients' own intuitive feelings.[126]

A number of studies have established that intuition in nursing is real and indispensable.[127] Attending to past experience improves nurses' judgment.[128] It is not mystical or somehow 'unscientific'.[129] Many nurses in practice feel that they should not be using intuition in reaching decisions and find

that it is often denigrated by managers, their own colleagues and doctors.[130] However, a lack of intuition means that patients may receive inappropriate or incomplete care; and, despite formal discouragement, most nurses persist in putting their intuitive knowledge to use.[131] What is more, incorporation of intuition into judgment increases with expertise – which is as it should be, since the gut feelings of novices should not be equated with experienced intuition.[132]

What is involved appears to be a rapid process of perception, happening below the level of conscious awareness, and bringing to bear neither abstract cognition on its own, nor the promptings of feelings alone, but their fusion in an intelligent understanding of the situation as a whole. The process is fast and frugal, in Gigerenzer's phrase, and can work with only partial information.[133] The reader will recall from Part I that that, too, is a classic hemisphere difference: the right hemisphere is superior where information is only partial, or partially degraded – which is mostly the case in real life.[134]

CONCLUSION

Intuition appears to be something that, while inevitably fallible, is often more reliable, much quicker, and capable of taking into account many more factors, than explicit reasoning, including factors of which we may not even be consciously aware. It also underlies motor, cognitive and social skills, and is the ground of the excellence of the expert. The attempt to replace it with rules and procedures is a typical left hemisphere response to something it does not understand – a response that is, alas, powerfully destructive. We inhabit a world in which reason is needed more than ever before, yet in which reason is so narrowly conceived that it drives out true understanding. For that we would have had to learn respect for the power of intuition, not as opposed to reason, but as both grounding it, and the means for it to fulfil its potential in making judgments in life.

In *Also Sprach Zarathustra*, Nietzsche wrote: 'The body is a great sage, a *Many* with *One* purpose, a war *and* a peace, a flock *and* a shepherd … There is more sense in thy body than in thy best wisdom.'[135] He saw that what he calls the 'body' (namely, all that lies outside the conscious stare of the left hemisphere) understands a purpose that includes the free and the determined together, conflict and harmony together, multiplicity and unity as one; and understands that opposites coincide. Words that are worth bearing in mind throughout the rest of this book.

THE UNTIMELY DEMISE OF INTUITION

> My concern is with a movement or programme which is aimed at ultimately bringing the body entirely under control of the mind.
>
> —*Patrick Curry*[1]

IN OUR DISCUSSION OF SCIENCE AND REASON AS APPROACHES TO TRUTH, WE came time and again upon the implicit belief that truth could really be grasped only if the embodied human being, with its distastefully irrational feelings, prejudices and instincts could somehow be got out of the way. According to this belief, human beings are inherently fallible and it is this human element that is the source of error; only by expunging it can there be any hope of approaching truth. Of course human beings are indeed fallible, but this false belief that we must transcend the human in order to approach truth is both in itself irrational, and leads, as I suggested, to exaggerated claims for the truths of science and to a narrow sense of reason that equally misleads. It is, I'd suggest, this allergic attitude to the human and to inherent human fallibility that lies at the heart of the mistrust of intuition. For, as we have seen, intuition draws the products of its understanding straight from the body and places them instantly on the table, as it were, without the chance for the left hemisphere first to clean it all up, wash off the traces of the human innards and re-present it all as something purer, free from the stain of the human and so more 'objective'. Intuitions come from the 'guts', for heaven's sake: if one is going to look for truth from such a

source one may as well put one’s faith in the Pythia’s reading of the entrails of a chicken.

So it is not surprising that psychologists like thinking up what one might call ‘illusions of intuition’, cognitive equivalents of the chequerboard at the beginning of the previous chapter, to show how foolish we would be to trust in intuition. It’s an observation worth pondering that this may have little to do with how psychologists, philosophers and other theorists actually behave in real life. As philosophers Andrew McGee and Charles Foster put it:

> We [both authors are academics] spend a fair amount of our time with people who, for money, prestige and because they think it’s the right thing to do, try not to be intuitive. Universities are full of them. But here’s the thing: they are only non-intuitive at the office – and only very, very inconsistently there. As soon as they push open the Faculty door and leave for the real world of relationship and sick children, they’re immediately and unavoidably back in the atavistic world of the Upper Palaeolithic that they officially fear and repudiate.[2]

By definition, psychologists belong to a class of people who generally like taking things apart to see how they work, and therefore intuitively dislike the idea that results can be had without working explicitly through the logical steps. And of course they are right – up to a point. It would be as foolish to assume that intuitions will always lead to the right answers as to assume that pure rationality will.

Intuition is capable of fooling even those who might be regarded as supremely rational and therefore most immune to it. Take this, for example:

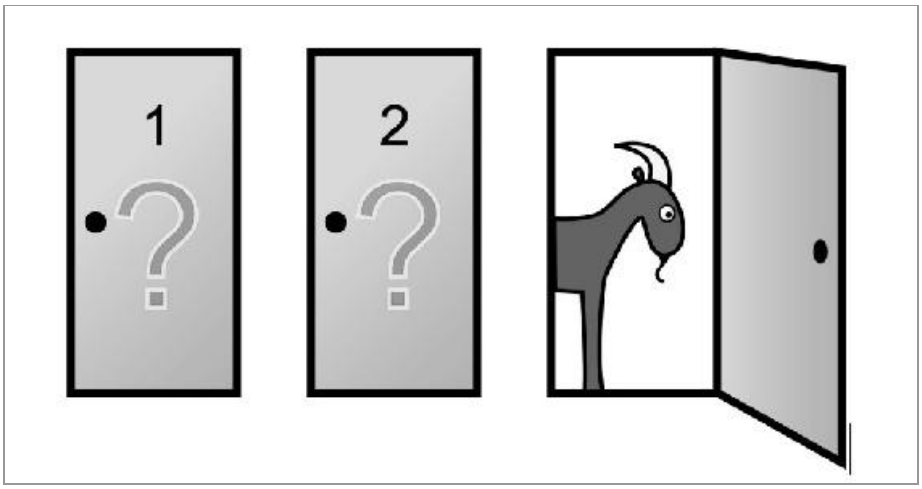


Fig. 35. The Monty Hall Dilemma

It is called the Monty Hall Dilemma, named after an American TV game show, a problem that defeats some of the world's greatest mathematicians, and is arguably better solved by pigeons than humans. So why do I say that conscious focussed reasoning works?

The problem is simple and can be briefly and completely stated. A contestant chooses one of three doors, knowing that behind one there is a smart new car, but behind each of the other two there is a mangy goat: there is no way of telling which. After the contestant selects a door – at this stage still unopened – the host (Monty Hall) reveals a goat behind one of the *other* two doors. The contestant is then given an opportunity to switch from his or her original choice to the other still unopened door. Most individuals decline – despite the fact that switching would double their chance of winning.

Double their chances? How could it possibly change them at all?

Here's the explanation:

> The probability that a participant will randomly select the door with the prize on the first guess is one in three, because there is one prize and three possible locations. If the initial selection is the winning door, then after the host reveals one goat, it follows that the second goat must be behind the remaining unselected door. Thus, on one-third of all trials, staying wins and switching loses. In contrast, the probability that a contestant will not choose the door with the prize

> on the first guess is two in three. If the contestant's chosen door conceals one goat, and the other goat has been revealed, then the remaining door must conceal the prize. Thus, two-thirds of the time, switching wins and staying loses.[3]

If you still find this difficult to comprehend (and I assure you it is correct), take some comfort from the fact that even prodigiously clever mathematicians find this hard to get. They seem to be fixated on the idea that the facts of the situation haven't changed. True. But our information about the situation *has*. And since a rational choice should be based on all the information, not just the information we started out with, it makes sense to change when you know something new that alters the odds. Paul Erdös, one of the greatest mathematicians of the last hundred years and a specialist in probability theory, thought it was impossible that switching made any difference, and got angry when a colleague tried to explain it to him – though some days later he conceded the point.[4]

The problem was submitted to Marilyn vos Savant for comment in a magazine column she ran for many years looking at mathematical problems:[5]

> She answered the question of 'to switch or not to switch' by saying, 'yes, you should switch', and gave her explanation. In a later column she published signed letters from 4 PhDs (some quite nasty and sardonic) which severely chastised her for misleading and corrupting the public. Later she gave an alternate explanation. In a still later column she published letters from another 5 PhDs, who all called her an idiot.[6]

In a simulated lab version, humans can be brought to a point where they get the idea that they are better to switch, but they still only actually switch about two-thirds of the time, because they indulge in what is called 'probability matching': they try (wrongly) to match their awareness that they will win only two-thirds of the time, by *doing the right thing only two-thirds of the time*, so that they score only a little above chance. The sad fact of the matter is that pigeons do better: they learn that they do better to switch every time, and thereby win 67% of the time. And the most likely

reason they do better is that they learn from experience, and don't let 'reasoning' get in the way: after 200 trials, humans largely failed to adopt the optimal strategy that the pigeons had quickly mastered.[7]

This has relevance to the hemisphere hypothesis. In an unconnected experiment with split-brain patients, the subjects were asked to guess which colour, red or green, was going to be displayed next, in a series where there were four times more green than red lights displayed. The right hemisphere saw – like the pigeon, though unlike the pigeon it saw it immediately – that the way to get the best score was to choose green every time, leading to a score of 80%; the left hemisphere chose green at random, but about four times more often than red ('probability matching'); which sounds smart, but is illogical, since you have no way of knowing what the next colour will be. As a result of being smart, the left hemisphere scored little better than chance. It had developed a 'rule', but the rule was wrong.[8]

What can one learn from this? First, that reasoning can of course be helpful, but only if you can be certain your reasoning is right – which apparently even mathematical geniuses can't. Failing that, reasoning will mislead you: and being attuned to what experience tells you (pigeon fashion), without letting the attempt to reason get in the way, is safer – though it may take a while longer. Thinking slow?

So of course it is true that intuitions can lead us astray. But does that mean that they are worthless or, at the very least, dangerously unreliable? The case for believing so seems to derive from suspicion of the apparent instantaneousness of intuitive knowledge. It comes unexamined. It arrives without having been put through the wringer of critical scrutiny. The truths it claims to offer have in some mysterious way been cooked up beforehand, 'pre-judged'. In short, intuition peddles prejudices not truth.

That is a charge we need to take seriously. I will argue, however, that this account fails to invalidate intuition because it is based on a number of illusions, quite apart from the fact that intuition is clearly a far richer phenomenon than any form of prejudice. These illusions include: that human beings can *ever* avoid prejudice, in the sense of forming judgments from experience of the past to help them deal with the future; that an analytic training in science, or education in modern Western academic practices reduces the likelihood of such prejudice; that prejudices are largely mistaken; that prejudice inevitably issues in bias; that bias is not normally subject to correction as soon as a judgment can be made on more

than the barest outline; and that even if we were able – which clearly we are not – systematically to substitute reason for intuition, we would be guaranteed against bias.

In the 1960s and ’70s academic psychology became dominated by an urge to demonstrate that human ways of thinking, dealing with aspects of experience in memory, and understanding the world through intuition, were radically flawed. This coincided with the espousal of the idea of the brain as a computer, a calculating machine, encoding, storing and retrieving data from memory banks; ‘by the standard of decontextualized and literal processing of information on a computer hard disk, the human mind was a poor performer’, says psychologist Brady Wagoner.[9] We were seen as lazy, inefficient, ‘cognitive misers’. As he points out, however, ‘this focus on identifying error and distortion obscured important, non-mechanical dimensions of mind and the study of accuracy as more than what a computer does with information.’ Part of the legacy has been a common conviction that compared with an ideal form of computing that would be carried out by a machine, we are prejudiced – and therefore almost bound to be wrong in making judgments.

PREJUDICE VS BIAS

I quoted earlier Douglas Hofstadter to the effect that ‘isolated reasoning is impossible, because reasoning depends on a prior setting-up of a system of concepts, percepts, classes, categories – call them what you will – in terms of which all situations are understood. It is there that biases and selection enter the picture.’ [10] Necessarily so – not just by an unfortunate accident. And the fantasy that machines could somehow produce unbiased outcomes that human beings, flawed as they are, can’t, is, to say the least, naïve. Partly, there is no such thing as avoiding a point of view, which is why it is important that the fact is recognised; and that it is recognised that the point of view is the result of reason combined with thoughtful experience, not just any old bias someone happens to have at the time. A machine that ‘learns’ has no thought or experience, but incorporates any imbalances or biases in the data from which it ‘learns’ as well as those that will be built into the ‘decision-making’ processes coded into it by human programmers – who are not necessarily any better at spotting either kind of bias than anyone else. Such systems learn the biases of their programmers and trainers. A dyslexic naturalist friend of mine asked Siri how to spell *tiercel* – the word for a male hawk, as she explained to Siri. Siri replied to the effect: ‘What’s all this about gender? It shouldn’t matter which gender it is.’

If we are foolish enough to imagine that machines avoid bias, the now concealed bias is all the more dangerous. We also know that interactive systems tend to gather information from and produce it for people who think in similar ways, insidiously compounding biases: this tendency, well known to be built into internet search mechanisms, and reinforced by the ‘blogosphere’, produces potentially toxic ‘bubbles’ or cocoons of bias, in which people feel justified by the fact that they only ever hear confirmatory points of view. We overestimate the sameness of out-groups compared with our in-group.[11] Since the right to express competing and contrasting points of view is the very core of democracy, and since hearing competing and contrasting points of view is the basis of education, and therefore, once again, of an informed democracy, and since without it creativity and all forms of innovation quickly wither away, this is of first-rank importance.

Taking a much broader view of the topic of pre-judgments (*Vorurteile*), in his magnum opus *Truth and Method*, the philosopher Hans-Georg Gadamer urged that prejudice-free knowledge is neither possible nor desirable. Gadamer argues that prejudices are not necessarily vicious, and that the Enlightenment had a 'prejudice against prejudice'.[12] Prejudices cannot be done away with: they are replaced only with other prejudices, sometimes better, sometimes worse, and we should bear in mind that the more historically unusual they are, the less we have to go on in assessing their accordance with reality. It is not our duty to be without prejudices, but to be aware of them – including the prejudice against prejudice – and examine them unremittingly, abandoning one prejudice in favour of another if we find the first does not accord with experience. It requires experience and good judgment to know when to retain, and when to reject, a prejudice. We cannot possibly make all – or perhaps any – of our own judgments from scratch: the idea that it would be feasible, never mind commendable, for us to reject completely the accumulated wisdom of humankind, and start again on the basis of our own limited knowledge and intellect, is a species of arrogant folly. On the contrary, writes Gadamer scholar Lauren Barthold,

> prejudices are the very source of our knowledge. To dream with Descartes of razing to the ground all beliefs that are not clear and distinct is a move of deception that would entail ridding oneself of the very language [since language embodies a tradition of thought] that allows one to formulate doubt in the first place … To affirm, as Gadamer does, that one can never escape from one's tradition, does not mean he is insisting we endorse all traditions writ large … accepting the fact that one can never entirely reflect oneself out of tradition does not mean that one cannot change and question one's tradition. His point is that in as much as tradition serves as the condition of one's knowledge, the background that instigates all inquiry, one can never start from a tradition-free place. A tradition is what gives one a question or interest to begin with.[13]

And a tradition is a body of beliefs which exists apart from and prior to any particular set of circumstances – prejudices, if you like; except (and this is Gadamer's point) to call them such is to invite unthinking dismissal,

given the intellectual tradition to which we now belong. Even those who revolt against tradition are doing so as part of a, now venerable, tradition – that of the seventeenth- to eighteenth-century Western Enlightenment. You cannot *not* belong to a tradition.

But – here's the point – a tradition is never static: if it were to become so, it would die. It is there not just to oppose change but to inform it and guide it. It is a living thing, a process of change in response to new circumstances. It is reverberative and responsive, not linear and fixed: forever in flow. Nonetheless, there is a difference between organic change and forced or abrupt change, as there is a difference between training a climbing plant and cutting it off, or uprooting it. A tradition changes by being born anew in each member of the community that shares in it. It is, above all, lived:

> To embrace a tradition is to make it one's own by altering it. A passive acknowledgment of a tradition does not allow one to live within it. One must apply the tradition as one's own.[14]

In this respect, it is obvious that we are each only what we are, only think what we think, only believe what we believe, and love what we love, against a background of shared meanings within a culture and a landscape from which, though individual, we stem, in which we are never wholly separate one from another, and in terms of which 'meaning' has meaning. The rightful rejection of the Cartesian fantasy of an isolated, decontextualised, rational mind, hopping around the universe accessing uncontaminated truths, is at the heart of the last hundred years of philosophy in Europe, and is what Heidegger, Scheler, Merleau-Ponty and others were striving to achieve and to communicate. Not to have affections, not to have affiliations and loyalties, not to have love, but only reason to act for us in understanding what we do and who we are, is literally a form of madness. Nonetheless, Jung's concept of the collective unconscious and its archetypes is another way of conceiving this broad implicit understanding on which we depend, one that takes up the individual tradition and, without eroding its identity, sets it in communion with other traditions. One of the striking things about research into implicit beliefs, whether one calls them intuitions or prejudices, is how constant they are across widely different cultures.

A prejudice literally means a pre-judgment. We inevitably make generalisations in order to guide action when we have little to go on, or little time to weigh up all the factors in a deliberative fashion, which is almost all the time. We couldn't survive if we did not, since having time to deliberate all the aspects of a situation is rare. Nor would we survive if the generalisations were not reasonably reliable, even though they are primarily of practical value, and cannot be other than highly fallible guides to the truth of particular instances. The knowledge that tigers are dangerous has survival value, and is not disproved by one friendly tiger, though it's not true in that particular case. The knowledge is drawn from general experience in advance of the situation, not from the particulars of the actual situation; which does not in itself make it unintelligent, imperceptive or factually wrong. In fact it would be foolish – indeed impossible – not to draw conclusions from experience to date. Thus pre-judgments are rational. I would argue that prejudice is usually a derogatory term for what we cannot help imbibing from experience, even if we wanted to, and indeed *must* imbibe if we are to live as fully functioning human beings.

However, prejudices can be based on ignorance, rather than experience; and even one based on experience is, obviously, ugly and harmful when it is incommensurate with that experience, or, very importantly, substitutes the category for the individual. Prejudice and bias are not the same thing. But, as I hope to show, you can be prejudiced without being biased – which is just as well, because otherwise unbiased judgments would be impossible, since we all have prejudices. In many cases, however, prejudice and bias concur. Some degree of bias in favour of what you believe, is inevitable – otherwise you wouldn't believe it, would you?

Such a bias has, as it turns out, nothing to do with intelligence, as you might expect. A large body of research suggests that, to quote one recent paper, 'high intelligence is no inoculation against my-side bias'.[15] In other words, intelligent people are every bit as likely to have biases as less intelligent people – and to deny their own prejudices. Nor does the quality of causal reasoning about an issue relate to intelligence, apparently.[16] Being a scientist doesn't help, either, by the way: there is ample evidence, some of which we have already looked at, that scientists are no less prone to bias than anyone else. Indeed, some evidence shows that people with more education are *more* likely to cling to ideological beliefs in the teeth of evidence.[17] They also express less racist views, but show more implicit

racially aversive responses (ones that cannot be controlled): they say one thing, but believe another.[18] And interestingly, an investigation into belief in pseudoscience found that it was associated with analytic, but not intuitive, thinking style:

> After controlling for demographic variables, level of science literacy and cognitive ability, both analytic and intuitive cognitive styles positively predicted paranormal belief. Belief in non-paranormal pseudoscience associated positively with analytic, but not intuitive style.[19]

On the topic of scientific bias, an aside: the astonishing apathy about climate change is not a matter of scientific ignorance, more about bias. Those members of the public with the highest degrees of science literacy and technical reasoning capacity were not the most concerned about the issue, but they were the ones with the most polarised views. 'This result', write the authors of the study that reached this conclusion,

> suggests that public divisions over climate change stem not from the public's incomprehension of science but from a distinctive conflict of interest: between the personal interest individuals have in forming beliefs in line with those held by others with whom they share close ties and the collective one they all share in making use of the best available science to promote common welfare.[20]

Groupthink so often rules, because membership of the 'in' group is more important than using one's critical faculties, and even *questioning* an established fashionable idea can lead to exclusion and vilification.

Groupthink is the danger. Groupthink will lead people to mistrust both their senses and their intuitions. In a now famous experiment, subjects were told that their vision was being tested, and asked to say which line, in an array of three, was closest in length to a target line.[21] The answer was obvious. However, stooges were set up to give the same, obviously erroneous, answer – after which the naïve test subject, in a third of trials, fell in with the majority, despite knowing it to be false (though, chillingly, some participants even started to believe the majority were right). This is

one reason why it is of the utmost importance that there be dissenting voices, since the presence of even one dissenting voice reduced conformity by 80%.[22]

In fact, being less dispassionate – more emotionally involved – with a topic leads to your being *more* willing to listen to evidence, rather than less. It matters to you more. It turns out that when people have low investment in an argument, neither strong nor weak arguments are persuasive. Their minds are made up, and no argument shifts them. But when they are highly involved with an issue, both strong and weak arguments have a significant effect, in the way that you might hope: weak arguments making people more entrenched, but strong arguments resulting in a shift of position.[23] So motivation encourages a more thorough evaluation of the evidence with a genuine commitment to find what seems truest. However, as might be expected, strong arguments are only persuasive if people are given some deliberation time before being forced to give a reaction.[24]

Evidence suggests that speaking your native language promotes contact with the emotional depths of experience and that speaking only in a second language promotes a dissociation from them:[25]

> Losing your native tongue unmoors you not only from your own early life but from the entire culture that shaped you. You lose access to the books, films, stories, and songs that articulate the values and norms that you've absorbed. You lose the embrace of an entire community or nation for whom your family's odd quirks are not quirks all. You lose your context.[26]

In an era when a simplified, to some extent denatured, version of English is becoming the lingua franca of all debate, this is troubling. And the disconnexion can be devastating. In those First Nations of British Columbia communities where fewer than half of the members could converse in their indigenous language, young people killed themselves six times more often than in communities where the majority spoke the native language.[27] It was remarked that they had lost cultural continuity, and risked losing 'the thread that tethers together their past, present, and future.'[28] As I write, such a fate has become a reality for indigenous people of every culture, including those of so-called 'developed nations'.

Julie Sedivy, a Czech-born Canadian, remarks of her father, who deplored his family's espousal of English:

> I watched as my father grew more and more frustrated at his powerlessness to pass on to his children the legacy he most longed to leave: a burning religious piety, the nurturing of family ties, pleasure in the music and traditions of his region, and an abiding respect for ancestors.

To have no particular predilections is impossible. The difference is not between those who have such predilections and those who don't, but between those who know they have them and those that are ignorant that they have. And these are the dangerous ones: those that think they lack prejudice.

They exemplify what is called the bias blind spot. Fairly obviously, believing you are less biased makes you more dangerous, because you are less open to advice or to alternative views. And it is widespread. In one study series, only one out of the 661 participants judged himself or herself more biased than the average person.[29] Moreover, according to the same series of studies, believing yourself to be unbiased is not related to intelligence (or to education, self-esteem, age, sex or race).[30] 'If anything, a larger bias blind spot was associated with higher cognitive ability', conclude Richard West and colleagues, leading researchers in this area.[31]

But prejudices do not *have* to issue in bias. Even an unbiased person will have accumulated past experience, and if, as seems likely, experience does not lead to a conclusion that there simply are no group differences to observe, a pre-judgment is inevitable, and to ignore it entirely is irrational. However, you can and must also take such a pre-judgment into account when making a judgment, so as not to be biased. Prejudices, like reasonings, are only accidentally, not intrinsically, mistaken. As Lee Jussim, Professor and Chair of the Psychology Faculty at Rutgers, points out, if members of motorcycle gangs have higher convictions for acts of violence than do ballet dancers, and men have higher rates than women, we would be simply irrational not to be more concerned by an encounter with male bikers than ballerinas on an ill-lit street at night.[32] We are made to feel that such generalised judgments based on knowledge or experience are based on

nothing solid. But they could just as well be called judgments as pre-judgments.

A common form of objection to any generalisation is to point to examples that contravene it. But on its own this argument has no force: a true generalisation of any kind is fairly obviously not to be dismissed on the grounds that it is not invariably so. Of course it is true that men are taller than women; and of course you can find women – many of them – who are taller than many men. And of course the second does not contradict the first. So it is with all generalisations.

It is itself a prejudice that members of all groups must have the same qualities: even if it were not disproved by experience, the assumption would be irrational. Prejudice against stereotypes, according to some psychologists, is itself an example of prejudice in the face of evidence to the contrary. Examples of silent false assumptions include, according to the sociologist and philosopher Gustav Ichheiser (incidentally a man who knew what malign prejudice could mean: as a Jew, he had had to flee Hitler's Germany): 'people are essentially alike'; 'to think that they are different is prejudice'; 'cultures make no difference to how people think and behave'; 'prejudices, rather than differences, are the main cause of intergroup tensions'; 'stereotypes concerning characteristics of cultural and racial groups must be false'; and 'the layman is prejudiced, but the social scientist is not'.[33] According to a substantial body of evidence, stereotypes are, in fact, surprisingly accurate (see below).

According to Jussim, whose book *Social Perception and Social Reality*, published by OUP in 2012, is the most substantial examination of the area I can find, we assume that, because it has historically produced palpable social wrongs, prejudice must be factually wrong. Looking for the empirical evidence underlying such assumptions revealed that 'there was nothing there, just a black hole … Stereotypes are almost never perfectly accurate, and they are sometimes highly inaccurate', he says. However,

> stereotype accuracy is one of the largest and most replicable findings in social psychology. Over the last 30 years or so, rigorous social science assessments of the accuracy of stereotypes have been steadily rolling in – and, usually (though not always), they show that people's beliefs about groups are pretty (not perfectly) accurate.

> Pointing this out has often evoked harsh yet scientifically vacuous responses …[34]

In statistics, there is a measure of the strength of a correlation known as the Pearson correlation coefficient (*r*): the closer *r* is to 1.0, the more reliable the correlation. To set things in context, an analysis of 25,000 studies, involving 8 million people, across the whole of social psychology research revealed that the most typical *r* value is 0.21.[35] By contrast, the correlations between stereotypes and criteria range from 0.4 to over 0.9, and average almost 0.8 for cultural stereotypes (the correlation of beliefs that are widely shared with criteria).[36]

Stereotypes of age,[37] sex,[38] and race[39] have all been repeatedly shown to be remarkably reliable, and transferable across cultures.[40] Corinna Löckenhoff [41] at Cornell has shown, in a paper with 50 authors, that a study of 3,323 individuals across 26 nations, when applied to males and females, demonstrated that the standard survey items captured sex stereotypes in personality over different generations and cultures that correspond to established sex differences: 'perceptions of actual sex differences may play a more important role than culturally based gender roles and socialization processes.'[42] Robert McCrae, another leading researcher in the field, writes that 'consensual stereotypes of personality traits of different age groups and sexes have proven to be remarkably accurate.'[43] Interestingly, it seems that stereotypes of male/female differences are accurate but understated (for the curious reader, the first author on each paper here is a woman), whereas stereotypes about political 'right/left' differences are accurate but overstated.[44] Perhaps only our stereotypes of how much other groups engage in stereotyping compared with our own are mistaken.[45]

There is a well-known argument that the reason for objective measures coinciding with prevailing beliefs is what might be called 'self-fulfilling prophecies': people conform to expectation. Jussim addresses this at length in the book referred to, and argues, I think convincingly, that this is not generally the case. More of a problem, it seems to me, is knowing how to be sure that the 'objective' correlate with which one is comparing is itself truly free from bias. This is a problem for those who wish to claim we are deceived in our prejudices as much as for those who wish to claim we are not. The danger is always of a circular process in which results favouring

one point of view are compared with results that also favour that point of view, and found to be astonishingly concordant. Of course, this problem is generally acknowledged in the design of experiments investigating the validity of prejudice, and often, but perhaps not always adequately, taken into account.

So prejudices are not necessarily wrong. What is wrong is to be biased in any individual case by your prejudice. And crucially and very fortunately – our capacity to avoid prejudicial bias when judging *individual cases* is nothing like as limited as is often suggested. In fact it is remarkably good.

It is not true that we don't compensate for prior beliefs in particular cases, and we may even overcompensate for them. According to a meta-analysis of this issue, carried out by the distinguished social psychologist Ziva Kunda and the philosopher Paul Thagard, when individuating information (information about the individual in question, regardless of stereotype) is clear and relevant, its effects are 'massive', with an *r* of .71 (making it one of the most robust effects in social science), and stereotype effects tend to be 'weak or non-existent'.[46] In general, therefore, based on an overview of more than 300 experimental studies and a smaller number of naturalistic studies, stereotypes are found to have only very modest influences on our perception of actual individual cases. Jussim and colleagues report:

> Considerable evidence has accumulated that people usually (though not always) apply their stereotypes in a largely rational manner, relying heavily on stereotypes in the absence of clear individuating information, but relying heavily on relevant individuating information when it is available …[47]

Putting it more technically, the effect of stereotypes is 'one of the smallest in social psychology': 0.1. The effect of individuating information is 'one of the largest': 0.7.[48] They conclude:

> To be sure, evidence of stereotype inaccuracy clearly exists. But it exists amidst a body of literature that also includes abundant evidence of stereotype accuracy. In 2014, when this chapter was written, it is only possible to maintain blunt declarations of

> stereotype inaccuracy by cherry-picking studies demonstrating inaccuracy, systematically ignoring studies that demonstrate accuracy, and employing double standards that permit the derogation of accuracy [of] studies that are at least as methodologically sound as inaccuracy studies. Thus, our final recommendation is that researchers simply stop declaring stereotypes, in general, to be inaccurate ...[49]

A report commissioned by Britain's Ministry of Justice from Cheryl Thomas, Professor of Law at University College London, and the author of *Diversity and Fairness in the Jury System*, is of relevance here.[50] She was invited to address concerns about racial prejudice in juries. In her 2010 report entitled *Are Juries Fair?*, also commissioned by the Ministry of Justice,[51] she found that all-white juries in Britain are not more likely to convict black defendants, or to acquit white defendants accused of racist assaults. In fact, it seems all juries, black or white, are more likely to convict white defendants, and notably, white juries in a racially mixed area were 'significantly more likely to convict the white defendant when he was accused of assaulting a black or minority ethnic victim compared to a white victim'. Thomas also refuted earlier findings – based on a much smaller case sample – about rape cases. She found juries' conviction rate in rape cases to be about 55%, higher than for attempted murder, manslaughter and GBH (grievous bodily harm, the most serious level of physical assault under British law). While accepting that the low proportion of rape allegations resulting in conviction remains a real concern, she suggests that this has little to do with juries' perceived unwillingness to convict.

I wouldn't want to make too much out of all this: there are a number of caveats to enter. Of course we can be blinded by prejudice. Nor does Jussim claim, obviously, that there are no wrong prejudices, nor that there are never adverse consequences to prejudice – just that our view that they are usually wrong is false. He does not claim there will not be individual studies that are discordant with his conclusion, since he is basing conclusions on meta-analytic overviews of the research. Nor does he have anything to say about why it is that differences between groups exist, a quite separate issue, or whether the indicators he is using reflect enduring differences, or just how things stand at a moment in time. But just because we have a prejudice against prejudice is not a good enough reason to ignore the evidence.

We also make judgments of fact very swiftly: are they reliable? Some people object to the natural human capacity to judge character from faces: perhaps inevitably someone has coined the term ‘face-ism’.[52] Such judgments will often be wrong, of course, so whenever one has more to go on one should not simply rely on judgments based on the face (just as one should always seek the widest range of information practically available in making any judgment). However, as has been repeatedly pointed out by scientific experiment, we are quite capable of judging character from the face, even if the effect is not very strong.[53] People prefer elements on which they can pass a conscious judgment, such as hair or clothing, but these elements impair the quality of their first ‘instantaneous and effortless’ judgments based on the face.[54] Such *Gestalt* judgment is significantly better than chance at exposures of around a tenth of a second (though not at 1/30th of a second).[55] It is based at least in part on experience; thus accuracy at the task increases 2.5 times between the ages of 13 and 18.[56] The effect operates equally well in a cross-cultural context.[57] Female subjects ‘may exhibit an evolutionary-based overestimation’ of ‘defectors’, ie, understandably be more cautious in judging someone trustworthy.[58]

We are highly accurate at judging age, sex and race with very brief exposures (around a tenth of a second).[59] But we are also much better than chance at judging more ambiguous categories, such as sexual orientation (even when subjects make an attempt to disguise it)[60] and political affiliation. A meta-analysis careful to allow for confounding effects found that ‘aggregating across tens of studies and hundreds of effects, people were found to be significantly more accurate than chance in categorizing members of perceptually ambiguous groups’. The total combined effect suggests that approximately 64.5% of targets would be correctly categorised, compared with the expected 50% by chance alone. This yields an *r* of .29, which, as the authors point out, is better than the average for social sciences results.[61]

The time course of action of a prejudice is clearly instantaneous, though it may take years to evolve.

As far as hemispheres go, stereotypes are aggregates of experience, and depending on how you look at them, could be associated more with either hemisphere. Their genesis requires pattern recognition and social sensitivity (more typical of the right hemisphere); their application may involve

conclusions that have been jumped to (more typical of the left hemisphere). The left hemisphere plays a more prominent role when targets are considered as examples of generic social categories (eg, men or women, black or white) rather than unique individuals.[62] People who have difficulty dealing with and being alive to social relations may fail to detect reliable patterns of difference and rely on abstract reasoning to conclude that there therefore are none. However, there is evidence that the right frontal area has a very important role in inhibiting *acting* on prejudice in any one case. The retrieval of conceptual knowledge typically involves the left inferior frontal gyrus; by contrast, dealing with the individual case, and deciding whether this case fits the general concept, depends on the right inferior frontal gyrus. Activity in the right inferior frontal gyrus is seen when subjects are judging whether sex-stereotyped traits apply or not to a series of male and female individuals (as compared with traits that were unrelated to sex stereotypes).[63]

The right inferior frontal gyrus has, in fact, a role in inhibiting prepotent responses across many domains.[64] Most findings indicate that activity in the left lateral prefrontal cortex is linked to the implementation of action, whereas activity in the right lateral prefrontal cortex is linked to inhibition of action.[65] 'This pattern of lateralised function – stereotype retrieval and implementation on the left and response inhibition on the right – suggests a useful distinction in the processes through which stereotypes are applied in behaviour', according to neuroscientist David Amodio.[66]

Overall, then, one thing is clear: the left hemisphere is more prone to bias than the right.

Finally, the idea that reason acts as the 'cleaner-upper' of the messy, gut-sourced prejudices produced by intuition is itself an illusion. In their seminal paper referred to earlier, entitled 'Why do humans reason?', cognitive scientists Hugo Mercier and Dan Sperber argue that while

> reasoning is generally seen as a means to improve knowledge and make better decisions … much evidence shows that reasoning often leads to epistemic distortions and poor decisions … reasoning pushes people not towards the best decisions but towards decisions that are easier to *justify*.[67]

Reasoning, they suggest, enables people to 'produce arguments to convince addressees who would not accept what they say on trust' – one consequence of which must be that in any society large enough that people no longer know one another well it becomes the default mode of discourse. Boxes have to be ticked, algorithms followed. Mercier and Sperber point to the fact that 'when we reason, we know that we are reasoning, whereas the very existence of intuitive inference was seen as controversial in philosophy before its discovery in cognitive science'; and that 'the very function of reasoning puts it on display in human communication'. In other words, it is rhetorically more appealing than any alternative – often, I would add, quite rightly, while accepting that if not tempered by intuition, it may lead to poor outcomes. Daniel Kahneman's highly enjoyable *Thinking, Fast and Slow* brought into the popular realm ingenious work that he and Amos Tversky had been carrying out and publishing for about 40 years, demonstrating errors in reasoning.[68] In a discussion of Kahneman's influential positing of system 1 (immediate) and system 2 (deliberative) thinking styles, Mercier and Sperber write:

> It is sometimes claimed … that the meliorative function of system 2 reasoning is achieved by correcting mistakes in system 1 intuitions. However, reasoning itself is a potential source of new mistakes. Moreover, there is considerable evidence that, when reasoning is applied to the conclusions of intuitive inference, it tends to rationalize them rather than to correct them.[69]

We need to regain some middle ground here. Contemporary discourse can be excessively dismissive of intuition and feeling *and* of reasonable argument – hyperrationalistic and overheated at the same time (both characteristic of the left hemisphere). We should never dismiss reason, but then we should never just dismiss intuition, either. We need them to work together, since reason guided by intuition is better than reason that disregards it; and intuition that is not dismissive of reason is better than intuition that is. We need as many ways of getting hold of reality as we can. This is well put by Jonas Salk the discoverer of the polio 'vaccine'. He suggests precisely the R→L→R progression whereby the hemispheres work well together:

> Reason alone will not serve. Intuition alone can be improved by reason, but reason alone without intuition can easily lead the wrong way. They both are necessary. The way I like to put it is that when I have an intuition about something, I send it over to the reason department. Then after I've checked it out in the reason department, I send it back to the intuition department to make sure that it's still all right.[70]

For Salk, while intuitions should always be passed before the eye of reason, it is intuition that should always be the final judge. Bergson explains why:

> … philosophers, in spite of their apparent divergencies, agree in distinguishing two profoundly different ways of knowing a thing. The first implies that we move round the object; the second that we enter into it. The first depends on the point of view at which we are placed and on the symbols by which we express ourselves. The second neither depends on a point of view nor relies on any symbol. The first kind of knowledge may be said to stop at the *relative*; the second, in those cases where it is possible, to attain the *absolute.*[71]

Intuition is not just another tool, like analysis: it inhabits, rather than inspects, the matter at hand:

> By intuition is meant the kind of *intellectual sympathy* by which one places oneself within an object in order to coincide with what is unique in it and consequently inexpressible. Analysis, on the contrary, is the operation which reduces the object to elements already known, that is, to elements common both to it and other objects. To analyse, therefore, is to express a thing as a function of something other than itself. All analysis is thus a translation, a development into symbols, a representation taken from successive points of view from which we note as many resemblances as possible between the new object which we are studying and others which we believe we know already.[72]

This distinction becomes of overwhelming importance when we try to approach inexpressible, because *sui generis*, experiences, such as those of time, space, consciousness and the sacred, as we will see in Part III.

FURTHER DECLINE IN THE FORTUNES OF INTUITION

None of the evidence of the importance of intuition has stopped its routine and often casual denigration. It seems that we have constantly to be told how unreliable our intuitions supposedly are – even when the evidence adduced to prove it often tends, on closer inspection, to do nothing of the sort. An important element is that adopting the apparently 'sceptical' posture puts the instant 'expert' in a one-up position compared with the poor old 'man on the Clapham omnibus', who appears naïve. Intuition is also a threat to a world-picture based on administration, adherence to ordained procedures, the power of technology, and a belief in the superiority of abstract mentation over embodied being. And to the reductionist, the power of intuition is also a threat that must be 'debunked'.

A typical case happens to come to my notice as I write. A piece of research has just shown that confidence in your intuitions is only weakly predictive of whether they are good or not: 'while confidence in one's intuitions vis-à-vis a particular task at hand may bear some relation to actual intuition performance, the predictive validity is likely low.'[73] Notice two things. First, and relatively trivially, the research doesn't show that if you think you are good at intuition you are *not*, just that if you don't think you are, you still may be – if you are confident, you are not necessarily any more correct than someone with lower confidence in their judgment. Second, and much more importantly, it has nothing to say about whether intuitions are themselves valid – only about whether the strength of one's belief that one's own intuitions are valid is valid. As it happens, intuitions themselves are more often valid than not, as one of the authors of the paper himself states: 'overall, actually, our intuitions are quite good.'[74] Yet how was this research reported on the web (by an author of 'several health-related books')? 'Think your intuition helps you make wiser decisions? Probably not, say researchers … A recent study from Great Britain suggests that relying on intuition may be yet another delusion we have about ourselves.'[75] The only deluded person here is the journalist.

Casual knocking of intuition matters more, however, when it appears to undermine faith in the way we make judgments, often with the implication that if only the human element could be removed, we'd all get along much

better. Earlier I described how, from my own experience, intuitive judgment plays a vital role in the practice of medicine, as it does in many other professions; and just how striking it can be. So in reading Kahneman's *Thinking, Fast and Slow*, I was struck by this passage, where he talks about medical expertise, and it gave me pause for thought:

> Experienced radiologists who evaluate chest X-rays as 'normal' or 'abnormal' contradict themselves 20% of the time when they see the same picture on several occasions. A study of 101 independent auditors who were asked to evaluate the reliability of internal corporate audits revealed a similar degree of inconsistency. A review of 41 separate studies of the reliability of judgments made by auditors, pathologists, psychologists, organizational managers, and other professionals suggests that this level of inconsistency is typical, even when a case is re-evaluated within a few minutes. Unreliable judgments cannot be valid predictors of anything.[76]

It wasn't the first time I had heard similar points of view expressed, but this struck me as remarkable for two reasons: it was unusually damning, and it didn't tally at all with my experience. Maybe I had been lucky to have had the honour to be trained exclusively by, and to work alongside, some particularly astute clinicians; but the idea that an experienced radiologist assessing a patient's chest X-ray would contradict himself or herself frequently, and sometimes after only a few minutes, was a bit of a surprise. So I decided to read for myself the source material on which this was based, which, of course, Kahneman scrupulously cites: he notes a paper in support of each of the first three sentences of this paragraph.

For the first sentence – 'Experienced radiologists who evaluate chest X-rays as "normal" or "abnormal" contradict themselves 20% of the time when they see the same picture on several occasions' – he cites a 1968 paper by Hoffman, Slovic and Rorer.[77]

I looked it up. To my bemusement, I discovered that the paper had nothing to say about chest X-rays, or even about chests. It was about gastroenterology, and concerned not the interpretation of a single image, or indeed of a 'picture' of any kind. Nor did it concern a decision of 'normal' versus 'abnormal', but the far harder issue of whether in the abstract a

constellation of six factors on radiological examination suggested malignancy or not – not a cut and dried matter, and a question of balancing intrinsically uncertain signs, that are certainly abnormal, but may or may not mean cancer, often depending on the context, which here the ‘experts’ didn’t have. The test was highly artificial: assessing six pieces of ‘yes’ or ‘no’ data on a sheet of paper, as though one made clinical judgments outside the context of a specific patient, rather like solving a quadratic equation. Moreover, the radiologists in question were nine, three of whom were not even fully qualified, never mind experts; and of the other six their degree of experience is not reported – in which case it cannot be presumed that *any* of these clinicians were actually experts, for one very good reason, which James Shanteau explains:

> In many studies, self-designation or scores on a short knowledge test are used to select ‘experts’. In other studies, job titles or academic credentials have been used. From the present view, such ‘experts’ in fact are more like novices … Because of the exalted position of experts within their profession, it can be difficult for researchers to study or even to communicate with them. Experts typically are busy and reluctant to talk – and their time is valuable. In comparison, novices generally are more available and willing to talk – and their time is relatively cheap. It is therefore easier to study novices, but such research won’t answer questions about experts.[78]

The one thing that was correct was that, in these rather different circumstances, the participants, whoever they may have been, were only 80% consistent. A machine of course would not have assessed two sets of criteria differently on two occasions. That, however, is not because a machine is superior, but because it is mindless and inflexible. A human being thinks, and therefore considers a range of possibilities where it may be artificial to suppose that just one of them is right. There may be good reasons to arrive at a range of conclusions, which human thinking better reflects.

I thought I might have better luck with the second paper Kahneman mentions. This is the one on which he bases the remark: ‘A study of 101 independent auditors who were asked to evaluate the reliability of internal corporate audits revealed a similar degree of inconsistency.’ I’m clearly no

expert on accounting, so, like Kahneman (I presume), I have to take what the author of the paper tells me – in this case, Paul R Brown, a distinguished professor of accounting, whose paper was published in 1983.[79]

This concerned 288 questions of judgment – rating 'satisfactory', 'adequate', etc. More than half of the 101 subjects had between three and seven years' experience: whether that makes them experts is also a question of judgment. Be that as it may, Brown writes: 'Judgment stability averaged .79, which *indicated that the auditors were stable in their judgments.*' In fact, about 80% stable. Or as Kahneman, neatly re-framing, would put it, 'contradict[ed] themselves 20% of the time.'

Brown notes that, though 'the current task was complex and not previously studied', this complexity did not affect the auditors' abilities to make consistent assessments, 'which', he reflects, 'has been *a general conclusion of auditor judgment studies.*' The analysis of their consistency in making decisions, he points out, required them always to make the same bald 'yes' or 'no' judgment on a matter in which such sharply delineated boundaries do not exist. Here, nonetheless, in a difficult area which involves problematic, cut and dried, responses on imprecise matters, they were impressively consistent. They were 100% consistent across all the judgments 80% of the time: if, under these circumstances, they had been more consistent, one might have thought they were accounting machines. Particularly note that this study confirms that it is in line with other auditor judgment studies.

So with some unease, and a growing fascination, I turned to the third of Kahneman's papers, one by James Shanteau on expertise across a number of fields, and which therefore promised to be the most revealing.[80] To remind you, this was the 'review of 41 separate studies of the reliability of judgments made by auditors, pathologists, psychologists, organizational managers, and other professionals [which] suggests that this level of inconsistency is typical, even when a case is re-evaluated within a few minutes.' Shanteau, whose special area of expertise is experts, and who has studied experts for decades, had at this stage (1988) been looking at the question of expert judgment for the previous 10–15 years. He had originally, he tells us, come to the area with a bias against expertise, but 'surprisingly' discovered that the experts he looked at

> were observed to be careful, skilled, and knowledgeable decision makers … Since then, my emphasis has been on investigating factors which lead to competence in experts, as opposed to the previous emphasis on incompetence.

There is no mention of ‘41 separate studies’ of the reliability of judgment, which the naïve reader was entitled to expect. However, there are 46 papers listed. Nine of the papers are critical of experts. 37 are either neutral or supportive of experts. Shanteau makes no reference to ‘a few minutes’, so that must be an embellishment by Kahneman. However, what he does say is:

> Current expert systems typically take much of the communication and confidence away from decision makers. Such systems, in effect, alienate the expert from his/her normal psychological environment. It should not be surprising, therefore, to find that decision makers are unwilling to work with systems which are fundamentally incompatible with their perceived roles as experts. If this analysis is correct, then more attention should be directed to preserving the role of the decision maker in expert systems. That is, *systems should be designed about the needs of the experts, rather than expecting experts to adapt to the needs of the system.*

This is directly relevant to the role of experts today.

Kahneman’s last sentence is also worth noting: ‘Unreliable judgments cannot be valid predictors of anything.’ Well, yes – but that seems a bit like loading the dice. Most expert judgments are not predictions, but assessments or diagnoses. Prediction is another matter, and very difficult – especially about the future, as Niels Bohr is said to have said. We all make projections: it’s a necessary part of life. But it’s wise not to do it any more than you have to, and to admit your uncertainty. Whitehead was a bit fiercer:

> The world’s experience of professed seers has on the whole been very unfortunate. In the main, they are a shady lot with a bad reputation … On the whole, the odds are so heavily against any

particular prophet that, apart from some method of testing, perhaps it is safer to stone them, in some merciful way.[81]

Not all, or even many, expert judgments make predictions. Though expert judgments cannot always be correct, they are definitely not so uncertain as to be worthless – even as a basis for prediction, which mainly they do not pretend to be. One reason that experts in economics and politics are so often ridiculed is that their role makes prediction almost inevitable, and it can turn out to be disastrously wrong. It should not be forgotten, however, that their judgment is not in *opposition* to that of computerised algorithms, but, as in the disastrous failure to predict the financial crisis of 2008, reliant on sophisticated theoretical models *operated by* computer algorithms. But then, why have a superstitious reverence for computers? They are only an externalisation of an extreme form of one kind of human thinking, not known for its wisdom, and dependent entirely on the human mind that gave them their instructions. George Soros does better attending to sensations in his back.[82]

And, if you want an example of successful prediction, the judgment of Franck Mourier is about as non-analytical as it gets, and as typical of the embodied skill of an expert as you could want; the accuracy of his predictions is clearly demonstrated by the very good living he makes from them.

Most expertise, to the extent that it involves prediction at all, is about choosing the right *next* move, not the ultimate outcome. A wise physician can advise on the next step of treatment, but can't tell you when, or of what precisely, you will die. A chess Grandmaster can see the best next move, but not usually how the game will end. A military strategist can see what needs to be done now, but not, with any degree of certainty, what will happen at a later stage – and would consider it foolish to think that you could.

Most tests of expertise are, in the nature of things, highly artificial. One recent study of physicians is typical. It found that 'although expert physicians outperform all other groups [at medical diagnosis], their accuracy is far below the maximum score.'[83] Well, there's a surprise – on both counts. And the finding needs to be contextualised. The study involved the diagnostic process relating to four patients' case histories, each containing about a hundred pieces of information, abstracted from notes and

anonymised: any information that was thought to make the diagnosis too easy for an expert was deliberately withheld. It is well known that experienced doctors – in fact, in proportion to their experience – make extensive use of contextual information, such as how the patient looks and comes across (rather like Franck's intuition about horses), so that a decontextualised case, especially one in which vital information has been withheld, is not a good model of what doctors do.[84]

What's more, only half the cases lay within any one expert's field (eight pulmonary physicians and eight cardiologists). One of the findings of the study, which should hardly surprise anyone, was that medical experts construct a representation of a clinical case much more rapidly and more accurately than those who are not experts. Oddly, the authors confess to having no idea why this would be the case.

Meanwhile, the 'maximum score' would involve making maximally detailed and accurate diagnoses on all cases, inside and outside your speciality. For example, for a correct diagnosis of carcinoma of the lung you would get only 3/6: to get 6/6 you would have to have 'small cell lung cancer with metastases in the mediastinal lymph nodes'. Given that cardinal signs of the condition – such as weight loss – were omitted, and given that clinicians approach diagnosis from a view of the whole patient, precisely *not*, as the learner does, from a mass of data, it is surely not a poor outcome that more than 15% of the pulmonary experts and more than 6% of the cardiologists nonetheless achieved a perfect 6/6 in *every* case, within and without their expert area, merely from abstract scripts.

Not only do experts need a lot of experience, so as to have enough patterns to match, and so as to know how much weight to attach to each, they also need to be acting intuitively if they are to display the effects of their expertise. Experts acting intuitively are clearly better than *non*-experts acting intuitively, as might be assumed; but, importantly, they are also clearly better than experts who are making systematic, operationalised judgments – which is how one is forced to proceed in studies of the kind just described, and increasingly in day-to-day practice in the 'enlightened' bureaucracy that is Western medicine in the twenty-first century.[85]

That experts don't know how they do what they do is evident, from the confabulations, and *post hoc* rationalisations, that they proffer when asked – if they can find anything to say at all. When the articulate left hemisphere

knows nothing about what is going on elsewhere in the brain, it makes up plausible theories, which happen to be entirely false.

RULES OF THUMB

Another cause of mistrust in intuition is another of Kahneman's targets: heuristics – effectively, rules of thumb. These are assumptions made on the basis of what usually seems to be the case in similar circumstances, and are not infallible – eg, that when you have a headache it is caused by tension, not a tumour. The majority of the time, like prejudices, they will be accurate, so they are far from useless. Indeed, we couldn't possibly get by without them.

I am also including here what are known as cognitive biases. They are different, in that the rule of thumb, while generally serviceable, works well, but not in every situation; while cognitive biases are always distortions. An example is 'framing' – in other words, the way in which the same information is presented influences how we decide. Thus, a classic case from Kahneman and Tversky goes like this. Subjects are asked to imagine preparing for the outbreak of a disease which is expected to kill 600 people. They are divided into two groups. Each group can choose one of two regimes to combat the disease. One group is told that the options are a regime whereby 200 people will be saved, or one in which there is a 1/3 probability that 600 people will be saved, and a 2/3 probability that no people will be saved. Under these circumstances, 72 % of participants preferred the first regime, only 28% the second. The other group is told that the options are a programme whereby 400 people will die, and one in which there is a 1/3 probability that nobody will die, and a 2/3 probability that 600 people will die. In this situation, 78% preferred the second programme, only 22% opting for the first. The problem is that these choices are effectively the same.[86]

As a psychiatrist, I am only too well aware how many cognitive errors lie in wait for the unwary. Rarely are these actually a matter of 'intuitions', more of fixed ideas or beliefs (a left hemisphere speciality). It seems to me that some sorts of cognitive trap are so widespread and lead to such misery that we should be taught about them in school. I am thinking here of those distortions that the process of cognitive therapy helps to illuminate (and, with luck, almost eliminate), and which are applicable in almost anyone's

thinking: if you think they don't apply to you, congratulations – your bias blind spot is working well. These include:

- *selective abstraction*

  dwelling on the small thing that went wrong, not the whole that went well:
  'I overcooked the beans, so the whole evening was a failure'

- *arbitrary inference*

  jumping to conclusions on no evidence:
  'I just know from her tone of voice that she thinks I am fat'

- *minimisation*

  inventing grounds to dismiss your successes:
  'OK, I got good grades, but that was a fluke – probably someone else's papers'

- *magnification*

  exaggerating one's shortcomings:
  'I forgot her birthday – what a selfish bastard I am'

- *personalisation*

  exaggerating one's part in the responses of others:
  (awaiting a reply to a long letter): 'I must have offended him – what did I say?'

- *dichotomous thinking*

  taking black and white, all or nothing views:

‘Either it’s perfect, or it’s worthless’.

Usually a moment’s reflection shows how unreasonable they are.

But the sort of cognitive biases that I am writing about in this chapter are less global, less emotional, less a failure to observe the evidence. They are more local, more purely cognitive, more clearly failures of the reasoning process itself. The thrust of *Thinking, Fast and Slow* is that in many situations we make quick and dirty decisions which are inferior to those we would take if we thought more carefully and took our time. Kahneman also points out that we need both approaches, since having a repertoire of more or less automatic responses that tend to work most of the time is necessary for survival, life often presenting us with situations that afford no time for reflection. He therefore constructs a two-system model, ‘system 1’ being quick and dirty (unreliable), and ‘system 2’ slower, more deliberative (reliable).

Thus, for example, you have bought a ticket to a football match. On the day, it is wet and you feel unwell. Getting there requires three changes of public transport and a walk. It would be much more enjoyable to stay at home and watch it on TV. But you don’t: you don waterproofs and go – because, after all, you have paid £75 for the ticket.

But you’ve paid that anyway. You can either have paid £75 and be comfortable, or have paid £75 and be miserable. Apparently the thought of having unnecessarily paid £75, which can’t now be undone, weighs more heavily than anything else, and leads to us making a bad decision. (By the way, we are often swayed by such considerations: that we should not waste is a stronger consideration with some than that we should eat only what we need and want – and indeed it is not entirely irrational.)

Then there are some strictly logical mistakes. One that is interesting for what it reveals about the way we think is the so-called Wason test, one of the most famous in cognitive psychology

(see Plate 16[c]). Most people do not get this right on the first attempt. Try it for yourself before reading on.

The correct answer is: you need to turn over the 8 and the brown card. Whatever is on the other side of the red card doesn’t matter, since the claim is not about what is on the other side of a red card, but what is on the other side of an *even* card. So if the brown card should turn out even, it violates the rule (as would the 8 if it turned out brown).[87]

However, if the test is set in a social context, most people get it right (see Plate 16[d]).[88] This test has exactly the same logical structure as the earlier one, but is much easier to solve.

Yes, it's the 16 and the beer-mug. It is argued that this is easier because we reason better in circumstances that have human meaning – which is probably why we teach children not just to take two from five, but to imagine Mary having five apples, giving two to Bob, and then seeing how many Mary still has.

There is an interesting rider to this, from a social point of view, which is that when groups attempt the problem in its original form, they do very much better than single subjects. In studies, only 9% of the individuals made the right selection on their own, by contrast with 75% of the groups. And the superior performance of the groups was due to collaboration, rather than to imitation or peer pressure.[89] This sounds like unexpected good news. As another paper from the same field puts it:

> This 'Truth Wins' scenario is in total contrast to what psychologists will normally tell you about group function. In most domains, from creativity to tug-of-war, a phenomenon called 'social loafing' holds, whereby the performance of the group is less than the sum of expected effect of individuals acting alone … The groups in these experiments have a common goal, and – we must assume – trust each other and are committed to the task. Furthermore the solutions can be demonstrated to be correct. In these circumstances rational argument is productive.[90]

However wrong our quick and dirty assumptions may be occasionally, there may, in general, be more to be said for them than we are allowed to think. Heuristics are highly adaptive and all living creatures employ them in some form. Ant colonies, for example, send out 'scouts' in search of a potential nest – say, a narrow crack in a rock. Such a scout has to estimate whether the area is big enough to house the colony. Not having a tape measure and a slide rule, it does this by using a heuristic. It runs around randomly, leaving pheromone trails of a certain length, then leaves. After a period, it returns, this time moving on a different random path. By noting the frequency with which it encounters the old trail, it can estimate the size

of the cavity. The heuristic is remarkably accurate: in a laboratory experiment, a ‘nest’ of half the area produced almost exactly twice (1.96 times) as many encounters.[91]

It is obvious that heuristics are universal because they are generally on target. They are not, as now seems widely to be believed, the product of a flawed mental system.

Most problems of interest in the real world are intractable to computation. That is why artificial intelligence researchers and engineers often rely on heuristics to make computers smart. However, according to Gigerenzer, who is the Director of the Max Planck Institute for Human Development in Berlin, in the 1960s and ’70s the term heuristic acquired a different meaning. No longer regarded as a way to make computers seem smart, it became a way of making people seem dumb. Statistical tools run by computers became the models of cognition, with the consequence that human thinking became viewed as a weak approximation to statistical procedures.[92] Heuristics were now viewed as preventing one from finding out or discovering correct answers to problems assumed to be in the domain of probability theory – poor substitutes for computations that are too demanding for ordinary minds to carry out.

Although in the literature it was repeatedly emphasised that heuristics are sometimes good and sometimes bad, by an odd coincidence virtually every experiment was designed to show that people violate laws of logic, or probability, or some other standard of rationality. Thus there arose, Gigerenzer continues, widespread misconceptions that heuristics are always second best, that we use heuristics only because of our cognitive limitations, and that more information, more time, and more computation (which computers ought to make possible), would always be better.

In many situations, it’s not just that finding the optimal result – assuming, and it is a big assumption, that there is such a thing to find – would be time-consuming. It’s that it is intrinsically impossible, either because we do not have, and can never have, enough data, or because the goals defy simple definition. Heuristics are indispensable for good decisions in uncertain situations, which is what life mainly offers. In an uncertain world, good decisions require ignoring part of the available information. The more noise in the observations, the more likely a simple heuristic will outperform more flexible strategies.[93] Complex problems do not always require complex solutions.[94]

In a situation where there is low uncertainty, few alternatives to choose between, and a lot of good quality data to go on – sure, adopt a computational model. However, in the considerably more likely circumstances that there is a good deal of uncertainty, there are many alternatives, and relatively few reliable data (small sample sizes relative to the number of factors involved and their possible interdependence), you would be wise to adopt a heuristic. Even 'one reason' decision-making can, under certain circumstances, be more effective than analyses that use more information – and those circumstances tend to be common in the world outside the lab.[95] Sometimes less information and computation can actually lead to higher accuracy.

Note it's not that, in these situations, we make a trade-off of accuracy against effort. A 'less is more' effect holds: the mind would not gain anything from relying on complex strategies, *even if* the costs (including opportunity costs) of such strategies were zero – which, of course, they never can be.

Nonetheless, Gigerenzer developed the concept of the 'ecologically rational' heuristic, by which he meant the selection of the right heuristic for the context, so as to make accurate inferences in a 'fast and frugal' way. Thus the rationality of a particular decision depends not just on its *internal* logical structure, but on its selection for the *circumstances* in which it takes place. What is considered rational under the 'rational choice' account thus might not be considered rational under the 'ecological rationality' account, and vice versa. This is reminiscent of, and possibly formed by analogy with the psychologist Egon Brunswik's idea of 'ecological validity', namely that an organism cannot be considered separate from its environment. That environment is always uncertain, and adaptation to an uncertain world requires learning to employ uncertain evidence. As before, precision can be inaccurate.

The attempt to find the optimal result itself leads to errors. Because of this we rely on heuristics not just in routine decisions of little importance, but – and perhaps especially – in those of great significance, such as where to live, whom to marry, and how to invest. It is also a mistake to imagine that clever people don't use heuristics. Intelligence seems to manifest itself in the choice of heuristic, rather than in abandoning them altogether in favour of some less efficient form of decision-making. [96]

A nice example concerns Harry Markowitz, who received the Nobel Prize in economics for finding the investment strategy that produces maximum return for a specified level of risk, called mean-variance analysis. Its general expression is contained in these formulae:

$$\mathrm{E}(R_p) = \sum_i w_i \, \mathrm{E}(R_i)$$

$$\sigma_p^2 = \sum_i w_i^2 \sigma_i^2 + \sum_i \sum_{j \neq i} w_i w_j \sigma_i \sigma_j \rho_{ij}$$

However, when he made his own retirement investments, he did not use this strategy. Instead he relied on a traditional rule of thumb known as naïve diversification. This means dividing the investment equally between a small number of funds and hoping for the best. This strategy was first proposed by a fourth-century Rabbi, Issac bar Aha; fund managers not having been invented, the aptly named Rabbi Aha recommended having a third of your wealth in property, a third in merchandise and a third in cash. [97] Of course, he didn't win a Nobel Prize, but according to some measures his method apparently outflanks every subsequent complex strategy.[98]

It is not always rational to act according to the dictates of logic:

> Behavior is often called rational if and only if it follows the laws of logic or probability theory, and psychological research has consequently interpreted judgments that deviate from these laws as reasoning fallacies. From a Darwinian perspective, however, the goal of an organism is not to follow logic, but to pursue objectives in its environment, such as establishing alliances, finding a mate, and protecting offspring. Logic may or may not be of help.[99]

For instance, in any series of Prisoner's Dilemma games, two supposedly 'irrational' players, using the heuristic 'tit for tat', fare better than do two rational players who cannot escape the conclusion that the

logical thing has to be to defect.[100] Tit for tat is a shorthand for the reciprocity that helps cement a stable society. And others, like the ‘recognition heuristic’, help us keep track of complex patterns of information in a continually changing world.

Even cognitive distortions, such as the so-called ‘framing’ effect, are the price we pay for seeing things in context; if we did not, as a rule, we would be much more deluded than we are. If you have to choose a quick route you will take the one that *in all probability* works best, not necessarily the best one on this occasion. You just can’t, usually, have it all ways. Having to reason everything out is as disastrous as never doing so at all: the upshot is that we need to know when to do what. And there isn’t a formula for that.

Our choices rarely follow a calculus, which makes us look more irrational than we are. For example, not jumping in to save a life when you could have is equivalent, on a consequentialist calculus, to killing – even jumping in and ducking someone under till they drowned – since both result in a death that could have been obviated had you acted otherwise; but a person who could not see the difference would surely have to be severely functionally autistic. And presented by a psychologist in a test situation with choices involving risk, an experienced person is more likely to focus narrowly on what is stated as certain, because things that are probabilistic only, or implied only, carry less weight when we are not taking a decision in a situation of trust – a sensible heuristic itself, which applies in the ‘treatment regime’ example mentioned earlier. How we respond depends on a whole raft of incidental factors that are hard to control for. We would expect people to take less risky-sounding options as they get more experience of life, and that is indeed the case:

> Mature adults apparently resist taking risks not out of any conscious deliberation or choice, but because they intuitively grasp the gists of risky situations, retrieve appropriate risk-avoidant values, and never proceed down the slippery slope of actually contemplating trade-offs between risks and benefits. [101]

This is in part because what is called *qualitative* reasoning – human reasoning, in effect, which takes into account such matters as relevancy of factors, factors that can’t be quantified, elements that are ambiguous, and so

on – increases with age. Very young children are more likely to make decisions based on quantitative properties only. The use of heuristics markedly increases in line with cognitive capacity during child development.[102]

This not to say that we don't make egregious errors through unconscious cognitive biases: they are important to understand. One of the most comical examples is that people given a heavier clipboard to hold papers judged the matter to which the papers referred to be 'weightier' than those who were given a light one.[103] On the other hand, holding in your hand a document that is supported by more information and in which arguments are more thoroughly explored will usually mean more weight of paper, so it's not *quite* as daft as it seems. And subjects carrying a weight on their backs judge an incline to be steeper than those who are not similarly encumbered[104] – but we naturally interpret circumstances in an embodied way: a hill is an invitation to climb (perhaps especially when we are primed by carrying a backpack), and our bodies sensibly register the effort we are invited to make. Highly artificial circumstances produce highly artificial results.

In a certain test, subjects are invited to read the following display (in which the word 'the' is repeated),

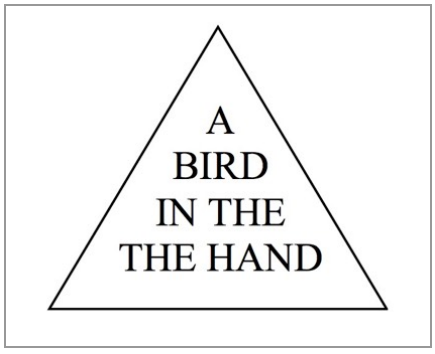


Fig. 36. The effect of expectation on perception

John Kay writes, of those who miss the repetition:

> This is a mistake – or so the experimenter thinks. But who is really making the mistake: the pedant who offers the direct answer and reads 'a bird in the the hand'? Or the person with a life, who

approaches the problem obliquely and valiantly finds sense in nonsense?[105]

This has its parallel with visual illusions. Visual illusions are in fact short cuts that come with experience, and involve seeing the context. Hence the chequerboard illusion at the outset of this chapter. And appreciation of context comes not from theory but from experience. The left hemisphere does not have it. There is an illusion known as the Ebbinghaus illusion in which context alters our perception (see Plate 16[e]: in children, susceptibility to the Ebbinghaus illusion is rarely present before 6 years old.[106]

In schizophrenic subjects, who have many right hemisphere-typical deficits, reduced sensitivity to the illusion is related to an increase in what are called ‘disorganised’ (effectively, bizarre) symptoms;[107] more normal performance (being ‘deceived’ by the illusion) is related to a higher level of *depressive* symptoms – which are associated with the right hemisphere.

And we shouldn’t feel bad about the fact that scents shape our impressions of a person or a situation; millions of years’ worth of information from experience is encoded in scent. That unscrupulous people can use scents to alter our shopping behaviour is hardly different from any other form of deceit. In one study carried out at a clothing store, the scent of vanilla doubled the sales of women’s clothes.[108] And so? Supermarkets use lighting that makes the colours of tired vegetables look more vibrant. We don’t assume *we’re* at fault somehow.

There are many more reasons we behave ‘irrationally’, and they are too numerous, and too well reviewed elsewhere, for me to need to go into them all here. The interested reader will find most of them beautifully covered in Kahneman’s book. But there are two main things to say about them.[109]

One I have addressed already: it is easy to run away with the idea that all occasions on which we can be deceived are a proof that we are hopelessly fallible, and our brains are an inferior sort of machine. Those entertaining studies bulk large in social psychology research because this is what social psychologists enjoy studying. It is also, in an era of mass media, what big business, advertising and government propagandists want to know about, for obvious and unwelcome reasons, which makes it a fashionable and lucrative area of research. In reality, while they are assuredly not

insignificant, they are the intermittent downside associated with our being able to do far more than a machine can, or will ever be able to do, until it has blood coursing through its chips. To be wholly rationalistic, and incapable of knowing how to blend logic with all that emotional, social and embodied intelligence tells us, would spell disaster for a human being, as the rare cases where, by some unhappy accident of nature, someone comes even near to such a condition confirm. You will remember Damasio's patient 'Elliot'. But since, unlike logic, such social and emotional intelligence is simply not open to quantification, the downside of it is that at times, inevitably, we appear to 'miscalculate'.

The other is that I am not sure how strong a case can be made for calling such miscalculations 'intuitions', rather than cognitive errors. I have included them here because they are often attributed to intuition. But not reasoning correctly does not, of itself, imply intuition at work. Indeed, it is claimed by some psychologists and philosophers of choice theory that the association between heuristics and intuition is 'unwarranted'.[110] Essentially, it is argued, we make almost all decisions in life unconsciously, using a holistic, parallel processing system that is aimed at producing the highest level of consistency between an array of possible elements. Unlike the picture we get when we try to reconstruct after the event what went on, we do not at any point have fixed elements that have to be then weighted, and combined according to 'rational' rules – *whether accurately or fallaciously*. Instead, the system is unconscious, ceaselessly dynamic and recursive, making attempts to recontextualise what information we have so as to make it cohere, and as each element shifts because of its new position in this network, the other elements too must shift however slightly, until a system of optimal integration is achieved.

It has been possible repeatedly to distinguish experimentally between reliance on heuristics, which are sequential and rule-based, and reliance on parallel, holistic but compensatory modes of decision-making, which are taken to characterise the intuitive mode.[111] And studies have reported that errors resulting from framing effects (as in the disease problem, above) actually increase, rather than decrease (as the traditional view would have predicted) with the requirement to deliberate.[112] Another case where less is more.

Evidence suggests that things are likely to be more complex than Kahneman's two-system model suggests. Contrary to his assumption,

reasoning based on beliefs, assumed to be automatic, can, it turns out, be effortful; while reasoning on the logical structure of an argument can be accomplished fairly automatically.[113] 'Given this analysis', ask Simon Handley and colleagues, 'why is it so commonly assumed that belief-based reasoning is automatic and logical reasoning effortful?' They set out to test this assumption and found that

> certain logical inferences are accomplished relatively automatically and are immune to the influence of beliefs. In contrast, judging the believability of a conclusion appears to be a slower process that can be readily interfered with and inhibited by logical analysis. This pattern is exactly the opposite of what would be expected if belief-based judgments were based on fast, automatic, Type 1 processes and logic-based judgments were based on slow, deliberate, Type 2 processes … At the very least the present findings suggest that it is overly simplistic to associate beliefs with default responses and judgments of logical validity with effortful cognition. The reality is much more complex and suggests a major re-evaluation of dual-process theories of reasoning and judgment is required. [114]

In line with a series of recent studies,[115] they found that a certain degree of logicality must in fact be achieved through intuitive processing: 'This result paints a rosier picture than what we could infer from all the investigations of the pitfalls of human rationality … Our findings present intuitions and logical reasoning not as two competing forces (which usually act in opposition) but as two complementary sources of human rationality.'[116] A conclusion with which I would strongly agree.[117]

The Harvard and Oxford philosopher Hao Wang has something to say on this that both helps bring together the ideas of intuition and analysis, and to some degree exonerates philosophers from the indictment, with which we are familiar, that they already have their conclusions before they start. He holds that they might do so by intuition, but that philosophy is the somewhat blunt instrument with which they *quite rightly and necessarily* have to justify their position, given the world view of their interlocutors – namely, ourselves:

> A familiar experience in mathematics is that one is often convinced of the truth of a proposition or something close to it but cannot quite prove it or gets only a defective proof. A good and experienced mathematician seldom errs far in such situations because intuition seems to be *a less exact but more dependable* guide than a formally exact proof, just as the human brain can tolerate more error and indefiniteness than a computer. More generally, we often have perfectly reasonable beliefs but cannot give good reasons for the beliefs … I agree that we should try hard to see whether our deeply held beliefs can be disproved, especially when we make crucial decisions on the basis of such beliefs. But for me a more fruitful approach to philosophy than systematic doubt would seem to be to search for reasons to support our basic beliefs, which may be somewhat indefinite …[118]

And he goes on to give the example of Kant, whose philosophical development was a 'continued attempt to give a structure to his *Weltanschauung*, which remained pretty much invariant throughout Kant's changes in his doctrines'. He quotes the philosopher LW Beck:

> By *Weltanschauung* I mean here: a set of philosophical ideas and opinions held together in a personal attitude, but without the benefit of the technical discipline of analysis and argumentation … We find a high degree of likeness between conclusions reached in works written [by Kant] over five decades during which profound changes occurred in his premises and modes of argumentation.[119]

Before we leave this section, what about the time course and hemisphere contributions?

The typical time course of heuristic thinking is instantaneous, or at any rate brief. That is its advantage. It is largely unreflective and usually involves 'snap' judgments. However, it may take years of experience for the foundations of those judgments to evolve to their established condition. In this it is analogous to prejudice.

In terms of the hemispheres, this is not a clear issue. Kahneman's system 1 and system 2 cut the cake 'horizontally' (top brain versus bottom

brain), whereas I am cutting it ‘vertically’ (left versus right). His systems 1 and 2 don’t map onto left and right hemispheres, but rather slice the brain at right angles to the interhemispheric fissure: both hemispheres are involved in heuristics, and both in deliberation, a point on which Kahneman agrees, though he does not deal with hemispheric differences in his book.[120] As far as ‘fast’ and ‘slow’ thinking goes, jumping to conclusions (LH) is fast, but so is flawless intuition, as in the case of Franck Mourier (RH); following algorithms is slow (LH), but so, at least relatively speaking, is acting as devil’s advocate (RH).

However, as I have already suggested, it is the left hemisphere that is considerably more prone to settle for its heuristics, the right hemisphere more inclined to be cautious. When urgent, target-oriented action is even contemplated, this activates the left hemisphere. So the left hemisphere is prone both to make swift judgments and to stick to them unreasonably.

And as if to emphasise the point about speed, time pressure impairs the all-important re-balancing activity of the right lateral prefrontal cortex: deliberative rationality – Salk’s third stage – not calculative rationality.[121] So what Kahneman is pointing to seems to be that when we are not given sufficient time for reasoning, we rely on the ‘fast heuristic system’ (the quick and dirty approach, to you and me), which both hemispheres subserve, but the left hemisphere more extensively. If the heuristic is a good fit, which it often is, this is fine; if not, it leads to entrenchment of bias.

THE PERILS OF MISTRUSTING INTUITION

Intuitions are a kind of feeling, we say – which is probably little more than an acknowledgment that they are not examples of explicit thinking. But if they were to partake of the nature of feelings, would that be to discount them? Reason is not opposed to feeling, but dependent on it. ‘There is no such thing in practice as a desire without a belief or a belief without a desire’, writes philosopher Robert Ellis:

> We need to start seeing alienated boffins not as ‘unemotional’ but as people with over-abstracted metaphysical beliefs that interfere with their emotional integration. Similarly, an ‘emotional’ person has lots of beliefs which they are reasoning about a good deal: just on the basis of over-narrow assumptions. It is this false dichotomy between rationality and emotion that, I think, more than anything, is responsible for moral failures in the history of Western thought.[122]

Hume would have agreed. ‘By reason we mean affections’, he wrote, ‘… but such as operate more calmly, and cause no disorder in the temper: which tranquility leads us into a mistake concerning them, and causes us to regard them as conclusions only of our intellectual faculties.’[123] As CS Peirce puts it, ‘Man is endowed with a form of emotional rationality; he has the ability to cognize from his disposition to feel; what is valuable seems to be immediately felt and cognized.’[124] Remember that Peirce was a logician and mathematician. Any dichotomy is too harsh: even the impulse towards a certain kind of logic suggests an emotional reaction to the intersubjective experience of the world, even if the primary emotion is sometimes negative. It is feeling that taught mankind to reason, as Vauvenargues observed during what is often called the Age of Reason.[125] An irrational fear of emotion leaves us cognitively impaired.

There is a difference between the irrational – something that is defined by its opposition to reason – and that which transcends, reaches beyond, rationality, where rationality no longer can hold sway. This is not to exalt the irrational, but to pay due respect to what one might call the ‘supra-

rational'. In this realm lies intuition, and by one's openness to it no claim is made that it is somehow infallible.

Intuitions can change with time and place, rather as moral codes do: yet neither should be thought of as for that reason random, or as something entirely invented, rather than in part discovered through experience. To both intuitions and moral codes there is a remarkably consistent core over time and place, though much may change 'around the edges'. For the health of any society, one of the most important senses is that of the *reasonable*, one of the best examples of something that is clearly context-dependent, not just in its proper functioning, but in its constitution: a combination of rationality with intuitive understanding. The reasonable is enormously hard to reduce to rules or principles, yet without it we cannot function properly as a society: it is a vital concept in law, and ironically, since the law is often conceived to be about rules and principles, the law may be one of the last places left in which it is evident. But it should be, and largely was, evident in many other areas of life, where systems have now become mechanical, inflexible, black and white, entirely neglectful of context – in other words attuned to the computer, not to the human person. It is a worrying reality that we could lose our intuitive sense of what is reasonable altogether if it gets no reinforcement from day-to-day experience.

Intuitions are laid down in strata, like layers deposited on a river bed, precipitating slowly out of experience, and therefore shaping ongoing experience – but over time they can be washed away. When the water that flows in the river changes sufficiently in its rate of flow, or its composition, the river bed changes. And that water – our experience – is changing rapidly, as I have suggested, because we attend to the world differently; and from different attention comes, inevitably, different experience of the world.

But, like the river bed, intuitions have, as I suggest, layers. And the layers may differ in their nature. Thus it is possible to speak of our 'now intuitive' belief in the mechanistic world-picture, but this is a recent accretion on top of much older intuitions about the world as living, organic, responsive, whole – intuitions that I believe science may be in the process of validating once more.

Speaking of the intuitionist logic of the mathematician and philosopher LEJ Brouwer, Karl Gustafson, a professor of mathematics at Boulder, Colorado, writes:

> I would like to … assert, far beyond just mathematical logic, the same larger, richer value of intuition over formal reasoning as a general proposition in physical science and human affairs … Just because we cannot codify our intuition does not mean that it does not exist. It may be inconsistent, but it may also be more complete. And as an accumulated underlying partially conscious, partially unconscious, experience and knowledge base, its overall intellectual value far exceeds any single rational deductive process that one may bring to bear on a scientific or human problem.[126]

And yet we are intent on a process the aim of which is to banish intuition from all aspects of our lives. In doing so we drastically simplify what we inspect, and cut it off from the roots by which it lives. ‘At all levels of society computer-type rationality is winning out’, wrote Hubert and Stuart Dreyfus over 30 years ago:

> Experts are an endangered species. If we fail to put logic machines in their proper place, as aids to human beings with expert intuition, then we shall end up servants supplying data to our competent machines. Should calculative rationality triumph, no one will notice that something is missing, but now, while we still know what expert judgment is, let us use that expert judgment to preserve it.[127]

By now, it may be too late. Some people already seem to believe we are better off in the hands of our new masters, the machines. The fact that machines have been trained to make accurate assessments of, for example, skin lesions does nothing to weaken, but instead strengthens, the case that humans should not be discouraged from using intuition. What these machines have been given is a vast bank of already humanly diagnosed images and made to find measurements that correlate: the advantage of the machine is speed. It carries out a mechanistic procedure, but at prodigious speed. If humans behave mechanistically, they fail: intuition is faster and smarter. A constant insistence on dis-attending to intuitions and placing reliance instead on standard assessment forms and checklists replaces the unmeasurable but often astute assessment of a real human being with the bogus precision and lack of individual flexibility of a machine.

Analytic processes are helpful only when something has gone wrong, or because we are complete beginners. Philosophers and psychologists who have championed the view that our mental processes are akin to those of a computer seem not to notice that we become dependent on analysis only when things are not going smoothly or when someone performing an experiment has given us a task in which we have no prior experience or skill.[128]

'To participate in the construction of a model', according to Dreyfus and Dreyfus,

> an expert must regress to seeing the world like an advanced beginner or, in some cases, a novice. If experts fail to appreciate the extent and importance of their unrationalised know-how, they may not realise how seriously their own understanding is being degraded; they may even be flattered into believing that the model constructed on the basis of their answers to the model builder's questions captures and amplifies their expertise … The increasingly bureaucratic nature of society is heightening the danger that in the future skill and expertise will be lost through over-reliance on rationality. [129]

Medical expertise is once again a fruitful example. 'Doctors are among the most highly skilled of human experts', the authors continue, 'and we would expect that they would recognise the intuitive factors in their decision-making: they are, however,

> tempted to rationalise their intuitive decisions not only to justify them to themselves and their peers, but also in order to explain them to their patients … Yet there is a danger of overvaluing explicable forms of knowledge if the patient makes the ultimate decision regarding treatment, based on the facts furnished by the doctor … In reality, a patient is viewed by the experienced doctor as a unique case and treated on the basis of intuitively perceived similarity with situations previously encountered. That kind of wisdom, unfortunately, cannot be shared and thereby made the basis of a patient's rational decision … To confuse the common sense, wisdom

> and mature judgment of the expert with today's artificial intelligence, or to value them less highly, would be a genuine stupidity.[130]

There is a complete misunderstanding of what it means to 'know' something nowadays. Thus grand claims are made by clever psychologists that we ordinary folk say we know how something works without 'really' *knowing* it at all.[131] But different kinds of knowledge are here being confused. In relation to everyday matters, we know what we need to know in order to interact with an object. Thus if I say I know how a fridge works (in the sense that I know it is a heat exchanger that creates a cool environment for food), I am not suddenly revealed to be a charlatan just because I can't explain in detail, when asked, how heat exchange is accomplished. It's a matter of the level of appropriate detail. But it's also a matter of embodied versus verbally explicit knowledge. When I say I know how to tie a bow tie, my fingers can accomplish the task easily, but my tongue won't offer a satisfactory account. That is not a 'folksy' failure of the human mind: it is a triumph of the human mind over engagement with unnecessary detail and the proceduralisation of what is not naturally proceduralised. Do I know how I pick up a plate? Of course I do. The fact that I can't any longer give a detailed account of sliding filament theory (a mechanism that enables muscle contraction) doesn't have anything to do with it. This sort of thing knows no end. Is sliding filament theory enough? Or do I need to explain voltage-gated calcium channels in order to 'know'? If so, do I need to be able to distinguish between L-type, P-type, N-type, R-type and T-type calcium channels, in order to count as knowing how I move my arm? This way madness lies.

The historian Jerry Muller, in his devastating critique of contemporary managerial culture, in academia, in medicine and the other professions, *The Tyranny of Metrics*, makes many important points. One is the way in which making things explicitly measurable not only, as is very well known, distorts the practice that is being measured, focussing attention, both for the professional and for the bureaucrat, on what is measurable at the expense of the important elements that are not, but how it narrows our sense of what we are dealing with – confirming the point that an intuitive understanding takes into account far *more*, not less, than the management measures. 'Quantification', writes Muller, 'is seductive, because it organises and

simplifies knowledge. It offers numerical information that allows for easy comparison among people and institutions. But that simplification may lead to distortion, since making things comparable often means that they are stripped of their context, history, and meaning.'[132]

Real life is complex, and when we single out certain aspects for measurement, we inescapably diminish the importance of all the others; and, if they do not become actually invisible, they come to be neglected. Muller notes:

> When organisations committed to metrics wake up to this fact, they typically add more performance measures – which creates a cascade of data, data that becomes ever less useful, while gathering it sucks more and more time and resources … Because belief in its efficacy seems to outlast evidence that it frequently doesn't work, metric fixation has elements of a cult. Studies that demonstrate its lack of effectiveness are either ignored, or met with the assertion that what is needed is more data and better measurement. Metric fixation, which aspires to imitate science, too often resembles faith.' [133]

Following procedures becomes a substitute for improving practice:

> In situations where there are no real feasible solutions to a problem, the gathering and publication of performance data serves as a form of virtue signalling. There is no real progress to show, but the effort demonstrated in gathering and publicising the data satisfies a sense of moral earnestness. In lieu of real progress, the progress of measurement becomes a simulacrum of success … [134]

The left hemisphere understands quantity better than quality. Its vision is comparatively simple. It strips elements away from context and history and is ignorant of their real meaning. When it is presented with evidence that what it is doing is not working, its invariable response is first to deny that there is a problem, but, if pushed, to respond *not* that we have done too much of something that is ineffective, but that we simply need to do *more* of it: because that's what its theory dictates, and for the left hemisphere theory trumps reality.

As I have pointed out elsewhere, the left hemisphere tends to paranoia and control, not understanding the basis of the social phenomenon of trust, and desperate not to be vulnerable.

‘The demand for measured accountability and transparency waxes as trust wanes’, writes Muller. ‘There is an elective affinity between a democratic society with substantial social mobility and greater ethnic heterogeneity, and the culture of measured accountability … The quest for numerical metrics of accountability is particularly attractive in cultures marked by low social trust.’[135]

And of course its quest to transcend the vulnerability of human assessment and judgment does not succeed. As Gwyn Bevan and Christopher Hood, put it: ‘In the 2000s, governments in the UK, particularly in England, developed a system of governance of public services that combined targets with an element of terror. This has obvious parallels with the Soviet regime, which was initially successful but then collapsed.’[136] Professionals rely much more on intuition, which is anathema to managerialism. They see the human whole, which the managers don’t; and the more they are made to conform to managerial metrics, the more narrow their vision and practice becomes. Thus is killed the goose that laid the golden egg.

An obsession with counting, and accountability leads, here as elsewhere, to mediocrity. Here as elsewhere, we could learn from the wisdom traditions of the Orient. In Taoism, it is posited that only when the mind is free from pragmatic concerns, free for playfulness in thinking, and spontaneity in action, can there be creativity.[137] This is referred to as ‘uselessness’ – having no practical purpose in view. Creativity is not willed, and has no purpose. And of course what the left hemisphere particularly values is control and use: we require the right hemisphere to transcend such concerns.

COMMON SENSE

Dreyfus and Dreyfus refer to ‘common sense’, what is colloquially still known as *nous*. It is the ultimate embodied skill: something in which we all are, or all should be, experts. The existence of an equivalent to common sense exists across cultures, which does not mean that what is believed to be common sense in one culture will necessarily be so in another (although there is much common ground about essentials). Common sense can mean many things, and it is most vulnerable to criticism when it is used in the sense of folk science, eg, that the world is flat because it looks it. All the same it is, once again, not something we can afford to be without. The expression originates in the Latin *sensus communis*: the word ‘common’ here means something *shared* (‘what we have in common’), not just *usual* (‘spelling errors are common’). Intuitions evolve in our movement and engagement with the world and with one another, not in detachment and stasis. Common sense is the ultimate embodied skill that is acquired effortlessly through experience, and, to be effective, it needs to be protected from the gaze of analysis.

What on earth can I mean by that? Isn’t that *exactly* what common sense needs to be subjected to? Well, obviously, in one sense of the word, yes; but in another sense, and less obviously, definitely not. Of course, I am not suggesting that we should allow common sense to subvert, or replace, science in any way. Science might, in fact – like religion – be *defined* as that part of the mental realm in which common sense does not apply. But it is a tragedy not to have it as a basis for our day-to-day experience of the world and of one another. And excessive analysis there destroys something of enormous value.

Einstein is full of common sense, yet it is he that wrote that common sense was ‘the collection of prejudices acquired by age eighteen’. Absolutely correct. No good whatever to science, or for that matter to religion. But important for living a life. And with an almost uncanny accuracy Einstein points to the age of 18. Because it is around this point in life, precisely, that those who are never going to acquire common sense exhibit the fact most tragically. They become seriously ill and risk ending

their lives. Consider what happens in this well-known condition in which, most obviously, common sense is lost: schizophrenia.

Such a loss is perhaps the most invariable accompaniment of schizophrenia, something I touched on in Chapter 9, where I explored the experience of schizophrenia as an analogue of partial right hemisphere failure; in such patients, a return of common sense, like the return of a sense of humour, to some degree, if it can be procured, is a sign of recovery, at least from the acute psychotic phase. It is obvious that a loss of common sense can lead to delusional misinterpretations of experience. But it leads to much, much more than that – to a sort of cutting adrift of the soul from its moorings. What is lost is unreflective engagement with the world, the sense of a shared, unexamined reality. And a loss of the sense of *proportion*, which humour and common sense each imply.

The best exploration of this topic is acknowledged to be by the twentieth-century German psychiatrist and philosopher Wolfgang Blankenburg. In a paper entitled 'First steps toward a psychopathology of common sense', he demonstrated just how important to the proper functioning of a human being this lived, intuitive skill that we take for granted can be. 'Borrowing from Goethe's well-known formulation', he writes:

> one could say that common sense is an 'organ', which is formed in communication for the purpose of communication. It is formed in reciprocal interaction for the sake of this interaction.[138]

Common sense, Blankenburg says, is content with uncertainty, with the probable, as the eighteenth-century philosopher Giambattista Vico had pointed out; whereas science seeks certainty. Schizophrenic subjects require certainty in those areas of life in which it cannot be had – those where, according to Blankenburg, 'mere opinion (*doxa*) should prevail';[139] we saw that one patient thought sex could be reduced to mathematics, another had to carry a dictionary strapped to his back. There is a considerable overlap between the phenomenology of schizophrenia and that of obsessive-compulsive disorder: the love of routine and familiarity, the intolerance of ambiguity, the need for certainty above all.[140] And with modern life, where

absurdity flourishes, while the common sense and a sense of humour that might have checked its advance have been howled down.

As we saw in Chapter 9, schizophrenic subjects replace *phronesis*, an approximate embodied understanding of the world, with *episteme*, a craving for certain abstract knowledge: there is in schizophrenia too great a detachment, an almost 'scientific' detachment, from the living world. Most of us live in a world that is semi-transparent, or, as one might say, 'translucent', in the sense that the eye rests temporarily on the surface, but does not stay there, instead passing through and beyond to something deeper and broader beneath, the nexus in which it is embedded, which gives it meaning. But in schizophrenia, the plane of focus has changed: the gaze stops short, the surface obtrudes and becomes opaque. Sensing that there must *be* meaning, but not being able to see, however coolly one stares at the object in front of one, what the meaning is, or wherein it lies, one jumps to a conclusion – that it is a hidden sign, a secret mechanism, perhaps something diabolical. Or that it has no meaning whatsoever, in a world composed of similarly senseless fragments. Meaning has slipped its berth and will sail off into space – or land on whatever happens to capture the eye.

Blankenburg quotes a 20 year-old female patient from his clinic in Freiburg:

> What is it that I am missing? It is something so small, but strange, it is something so important. It is impossible to live without it. I find that I no longer have footing in the world. I have lost a hold in regard to the simplest, everyday things. It seems that I lack a natural understanding for what is matter of course and obvious to others.

She continues:

> Every person knows how to behave, to take a direction, or to think something specific. The person's taking action, humanity, ability to socialize … all these involve rules that the person follows. I am not able to recognize what these rules are. I am missing the basics … It just does not work for me … Each thing builds on the next … I don't know what to call this … It is not knowledge … Every child

> knows these things! It is the kind of thing you just get naturally … It is just a matter of mere feeling, sensing what is appropriate. One has this from nature.[141]

Note a few things here. How vital and irreplaceable this intuitive sense that ‘every child knows’ is; how deep it is (‘I am missing the basics’), and how grievous the loss; how it is nothing so conscious as ‘knowledge’ that is missing; how this has to do with getting on with other human beings in the lived world; how she assumes there must be *rules* she does not recognise (such as the left hemisphere would understand); how everything seems to ‘build on the next’ sequentially, according to the programmatic rules she does not have (as the left hemisphere would have it), not forming a skein or network of multiply interconnected intuitive feelings derived from the context (as the right hemisphere would see it); and yet how she understands that others just have it ‘from nature’, a matter of feeling and *sensing* (such as the right hemisphere would understand, if only she could access it).

As Blankenburg puts it, it must be ‘a tacit possession, as the necessary prerequisite to accomplishing one’s daily tasks’. And the patient continues:

> But I am missing something even more fundamental. These people do not even sense the necessity of common sense because they do not lack it. They simply *have* common sense. Then they are able to put two and two together. It is no longer so critical for them. They are able to create a connection with others and enter a realm in which everything functions from itself. Then, one is able to find a way. Then, it is natural and obvious. One is unable to live without it.

The poor patient in despair concludes: ‘Without it, one cannot manage at all!’[142]

This is what it is like to have to examine everything, to find out the ‘rules’, to be conscious of what *must*, if it is to be preserved, remain tacit. Louis Sass calls it a loss of ‘ipseity’, that is to say ‘of-itself-ness’, the quality of grounding itself *in itself* without requiring further grounding. Without it there is no basis for understanding the rest of our reality: without it, one is in the realm of ‘turtles all the way down’.

It is the analogue of Cartesian scepticism. We come back to Merleau-Ponty: ‘the normal, non-pathological attitude consists in having confidence above and beyond what can be proved … by means of the generosity of the *praxis*, by means of an action that proves itself in being carried out.’[143] Praxis: the embodied, active engagement with others that does not artificially create meaning, but is the condition *for* understanding the meaning; just as abstraction, detachment and disengagement, taken too far, lead directly to a failure of the means to understand, and ultimately to philosophical nihilism. And note the reference to generosity. When we act intuitively we are gracious and generous – more reflection makes us selfish and greedy.[144]

Here let me quote Sri Aurobindo:

> If the reason is not the sovereign master of our being nor even intended to be more than an *intermediary or minister* [an emissary], it cannot succeed in giving a perfect law to the other estates of the realm, although it may impose on them a temporary and imperfect order as a passage to a higher perfection. The rational or intellectual man is not the last and highest ideal of manhood, nor would a rational society be the last and highest expression of the possibilities of an aggregate human life, – unless indeed we give to this word, reason, a wider meaning than it now possesses and include in it the combined wisdom of all our powers of knowledge, those which stand below and above the understanding and logical mind as well as this strictly rational part of our nature. The spirit that manifests itself in man and dominates secretly the phases of his development, is greater and profounder than his intellect and drives towards a perfection that cannot be shut in by the arbitrary constructions of the human reason.[145]

Eugène Minkowski saw that schizophrenia involved a lack of ‘vital contact with reality’, the pre-reflective attunement to, or immersion in, the world that grounds our being. He defined the vital contact as an ability to ‘resonate with the world’, to empathise with others, to intuit how to respond affectively and to act rightly, through our partaking in an intersubjective world:

> Without ever being ever able to formulate it, we know what we have to do; and it is this that makes our activity infinitely supple, infinitely malleable, infinitely human – 'human' not in the sense 'proper to man' insofar as he is a member of the species animal but in the sense that envisages one of the supreme values, beyond which we would not be able to go.[146]

The attempt to substitute rules for tacit knowledge is doomed to failure and a sign of psychopathology. Some reflections of the Dreyfuses on the nature of the law makes it clear why:

> The law always strives for completeness but never achieves it. 'Common law' helps, for it is based more on precedents than on code. But the sheer number of lawyers in business tells us that it is impossible to banish ambiguity and judgment by specifying a code of law so complete that all situations are specified and prejudged. *Ceteris paribus* ['other things being equal'] conditions and incompleteness are not merely annoyances showing analysis to be what Edmund Husserl, a philosophical precursor of AI, called an 'infinite task'. Rather those problems point to something taken for granted: namely, a shared, human background that alone makes possible all rule-like activity. To explain our actions and our rules, we must eventually fall back on our everyday practices and simply say 'this is what one does' or 'that's what it is to be a human being'. Thus in the last analysis all intelligibility and all intelligent behaviour must hark back to our sense of what we *are*, which is, necessarily, on pain of regress, something we can never explicitly *know*.[147]

Something of the same grounds our moral acts. If someone insists on reasons and rules, there comes a point where one has to say: 'this is what it means to be a human being'. Virtue ethics, then, not utilitarianism.[148] There are certain things that, if I have to explain them to you, you will never get them at all.

CONCLUSION

Reason's progeny are abstraction, precision and linearity; intuition's progenitors are embodiment, the intrinsically imprecise, and complexity. Intuitions are of different kinds, but they are all subject to being discounted by a culture that relies overmuch on the left hemisphere's take. Once again, the more reliable of them appear to depend on right hemisphere function. They are due a degree of rehabilitation.

In a culture in which computation was not grossly over-prized, an experienced individual would function in almost every aspect of life according to embodied skills, unconscious reasoning, and intuition, with, of course, incursions of analytic thinking, but only when an obstacle was encountered. And the passing on of these skills, through shared experience, attention and imitation, would be the whole purpose of a culture and its traditions. In our culture, all mores have been abandoned; and what should remain implicit and in the realm of embodied skill is foregrounded as a 'problem' to be consciously solved – with the result that we grossly simplify and omit what is beyond calculation. I remind you of Whitehead's insight: 'civilization advances by extending the number of important operations which we can perform without thinking about them.'[149] The implication is clear: when it throws the process into reverse, and impels into the spotlight processes that should be going on in the background, it produces a sort of technically clever, but in reality ignorant, barbarism. Or something that seems very like a species of mental illness.

In Part I, I explored the hemisphere contributions to intuitive insight, making reference to the role played by it in the great discoveries of science and mathematics. In the next chapter I will look at intuitive insight as the most precious means we have to access truth about the world, across the board, itself both grounding and bringing to fruition the important work to be done by science and reason.

INTUITION, IMAGINATION AND THE UNVEILING OF THE WORLD

> It cannot be too often repeated: from intuition one can pass on to analysis, but not from analysis to intuition.
>
> —*Henri Bergson*[1]

> The imagination of nature is far, far greater than the imagination of man.
>
> —*Richard Feynman*[2]

> To the eyes of the man of imagination, nature is imagination itself.
>
> —*William Blake*[3]

THE PRODUCT OF INTUITION IS INSIGHT. IT HAS BEEN DEFINED AS 'ANY sudden comprehension, realisation, or problem solution that involves a reorganisation of the elements of a person's mental representation of a stimulus, situation, or event to yield a non-obvious or non-dominant interpretation.'[4] But there are other ways of describing where intuition takes us that may seem more in tune with what is actually experienced. We saw that Bergson called intuition 'the *sympathy* by which one is transported into the interior of an object in order to coincide with what there is unique and consequently inexpressible in it.' Bergson captures the idea of seeing

into the heart of things that the word ‘insight’ itself suggests, but goes beyond that to point out that what it finds there is inexpressible, an aspect of insight to which we shall return.

Insight is what intuition generates both in the world of everyday (as we saw in the example of Franck Mourier in the chapter before last) and in our attempts to understand, at a more fundamental level, the *nature* of the world. In both cases the insights it produces often surprise us: they can be, as the first definition put it, ‘non-obvious or non-dominant’. You could say they sometimes seem counterintuitive. As an ‘everyday’ example, consider this.

On 5 August 1949 firefighters were called to a canyon fire at Mann Gulch in Montana. The men parachuted in and were deployed on the other side of the canyon from the fire, but as they worked their way downwards, a gust of wind suddenly whipped the fire across to the side where they were stationed. As the fire began to spread rapidly up the hillside toward them, they ran upwards in an attempt to escape. Their team leader, Wag Dodge, however, realising that the fire was moving too fast for them to escape it, had a sudden insight. He lit a fire between himself and the advancing wall of flame, which burnt the ground bare, lay down in the burnt area, and waited for the fire to pass. He was almost the only survivor that day.

His insight was in one sense intuitive, in that it occurred to him in a flash without any conscious deliberation, yet it was also deeply counterintuitive in another sense: to fight fire with fire. It turns out that the Native Americans had discovered this strategy long before him, but Dodge had no knowledge of that fact. Intuition, then, is not conservative in the limiting sense of that word, that we are tied to the familiar. Although, as I discussed earlier, intuition delivers a form of common sense, a background sense of shared (and therefore conventional) understanding, without which neither we nor our society can flourish, it also explores – true to its origins in the right hemisphere – at times new, imaginative ways of looking at the familiar.

But intuition’s power to produce insights that are very far from obvious functions too in our efforts to understand in the most fundamental way the cosmos in which we live. Einstein’s theory of relativity is – or certainly was – deeply counterintuitive. And yet he relied on intuition to guide him there. ‘All great achievements of science must start from intuitive knowledge. I believe in intuition and inspiration’, wrote Einstein:

> At times I feel certain I am right while not knowing the reason … Imagination is more important than knowledge … It is, strictly speaking, a real factor in scientific research.[5]

There is no mistaking the passion here. And how did Einstein think of intuition? What sort of a thing was he referring to?

He told the violinist Shinichi Suzuki that ‘the theory of relativity occurred to me by intuition, and music is the driving force behind this intuition’.[6] Indeed, he said to the poet George Viereck ‘I often think in music’; [7] and his sister Maja reported that when working on a problem he would play the piano, and then get up saying ‘there, now I’ve got it’.[8] He is said to have told the psychologist Max Wertheimer that he never thought in logical symbols or mathematical equations, but in images, feelings, and musical architecture.[9] He called mathematics ‘the poetry of logical ideas’, an ‘effort toward logical beauty’ in which ‘spiritual formulas are discovered necessary for the deeper penetration into the laws of nature.’[10]

Einstein is making several points here, it seems to me. That for him scientific and mathematical discovery involves intuition is clear; that the intuition uses shapes (‘musical’ or ‘architectural’) as metaphors for ideas; and is led on by a deep attraction towards beauty. The beauty was, certainly, bound up with logic – but not just with logic: it also involved feeling, and a sense of something spiritual.

He said a number of other things that reflect on the process of scientific or mathematical discovery:

> the mind can proceed only so far upon what it knows and can prove. There comes a point where the mind takes a leap – call it intuition or what you will – and comes out upon a higher plane of knowledge, but can never prove how it got there. All great discoveries have involved such a leap.[11]

This discontinuity, the necessity for a leap or sudden shift of thinking, is often mentioned by creative problem-solvers: and on another occasion Einstein wrote: ‘The supreme task of the physicist is to arrive at those universal elementary laws from which the cosmos can be built up by pure deduction. There is no logical path to these laws; only intuition, resting on

sympathetic understanding of experience, can reach them.'[12] This sounds as if it has much in common with the 'pragmatic' approach to truth I tried to articulate in an earlier chapter. In both the chapters on creativity and on science's claims on truth, I have given numerous examples of scientists and mathematicians describing their discoveries as intuitive, every bit as much as those of poets and painters. As Gleiser puts it, 'to go beyond the known, both Newton and Einstein had to take intellectual risks, making assumptions based on intuition and personal prejudice … to a greater or lesser extent, every person engaged in the advancement of knowledge does the same.'[13]

Yet clearly maths and science do involve equations, chains of reasoning and verbal explanations. Those, however, must come later, according to Einstein, and are added after the fact: 'Conventional words or other signs have to be sought for laboriously *only in a secondary stage*', he wrote, 'when the mentioned associative play is sufficiently established and can be reproduced at will.'[14] Reaffirming that his thought was 'visual and motor', he continued: 'in a stage when words intervene at all, they are, in my case, purely auditive, but they interfere only in a secondary stage as already mentioned …'

Einstein did not always listen to his own advice. According to Freeman Dyson,

> The great discoveries of Einstein's earlier years were all based on direct physical intuition. Einstein's later unified theories failed because they were only sets of equations without physical meaning.[15]

What separates insight from analysis is that it is seen 'at once', not arrived at through a chain of distinct steps. By 'at once', I don't mean 'right away', because the insight may take a very long time to incubate; it may well involve recasting the problem in a host of different ways over long periods. But, when it 'hatches', it is sudden, and it is, by all accounts, utterly convincing. Subliminal priming (cues of which we are unaware) can spark a later insight, after a considerable incubation period.[16] William Wilson Morgan, who discovered the spiral structure of galaxies, did so while walking home one evening from the Yerkes Observatory, in what he

described as a ‘flash inspiration … a creative intuitional burst’. He substantiated that moment’s insight with data that he presented at a conference a few months later. But that inspiration didn’t come from nowhere. Years of apparently ‘unsuccessful’ effort lay behind it, and were necessary to it. Necessary, mind you – but by no means *sufficient*. Interestingly, it was in the period of relaxation that followed concentrated effort, when the mind is elsewhere, that the insight came.[17]

Obviously just because an idea comes suddenly and seems utterly convincing does not mean that it is right. One day, while teaching in Graz, Kepler had an immediate and overwhelmingly convincing insight that the five Platonic solids contained the secret to the orbital paths of the then known planets. He felt ‘as though an oracle had spoken to him from heaven.’[18] Alas, he was wrong.

Hao Wang, who was a pupil of Quine, an authority on Gödel, and Professor of Mathematical Logic and Applied Mathematics at Harvard (he also headed the logic research group at Rockefeller University, New York, for good measure) acknowledged that, of course, intuitive insights can be wrong, but insisted that intuition is indispensable in intellectual endeavour, just as much as in ordinary life:

> There is no implication that intuition cannot make mistakes or that it cannot be improved by discipline or by the cooperative effort at advancing human experience. Hence, an appeal to intuition need not exclude, indeed to some extent often depends on, evidence from consensuses and pragmatic consequences … When faced with an appeal to intuition, the natural response is not to reject it offhandedly on the ground of unclarity, but to ask oneself whether one does share the intuition and how strongly and detachably. In the ultimate sense *we have no absolutely certain knowledge at all, and a careful reliance on intuition is absolutely indispensable in daily life and in all intellectual pursuits*. There is no reason why, and indeed it is curious that, anybody should, only in doing philosophy, choose to dispense with explicit and conscious (public and private) appeals to intuitions.[19]

In fact, although intuitive insights are fallible, they may well be less so than other ways of apprehending truth. In a paper entitled ‘Insight solutions are correct more often than analytic solutions’,[20] Carola Salvi and colleagues build on earlier findings by the psychologist Janet Metcalfe. She had asked problem-solvers during a task to rate how ‘warm’ (close to a solution) they felt. The study threw up two interesting findings. The first was that those who solved analytically described gradually increasing ‘warmth’ during the task; but those who solved by insight remained ‘cold’ until the final 10 seconds before the solution (on that ‘10 seconds’, remember that the brain shows signs of a problem having been solved about eight seconds before the insight dawns). And the second was that responses associated with sudden jumps in ‘warmth’ were correct more often than responses associated with incremental increases in ‘warmth’. In other words intuitive solving had a higher success rate than analytic solving.[21]

Science and mathematics both attest to this intuitive form of understanding – and in the case of mathematics it is clearly the most important form of understanding. It happens not by going through intermediary steps, but by seeing the whole in a new way, and this often means seeing a visual image, certainly an analogy of some kind, similar to metaphorical understanding. So Anna Sfard, herself a mathematician, speaks of the mathematicians she recorded: 'All the mathematicians I talked to said they just could not think without making pictures. All of them drew different shapes when trying to explain to me certain mathematical theorems or conjectures.' And she continues:

> When the abstract construct is supported by an image schema, the perception of its salient characteristics may become much more like our perception of the properties of physical bodies: it is immediate, it is holistic, and it is not mediated by a long chain of inferences. It is this ability to grasp ideas in a direct quasi-synthetic way, which, according to the mathematicians I talked to, gives them the feeling of 'true' understanding.[22]

All the mathematicians she spoke to, she reports, talked of an image or metaphor: 'The role of the metaphor of an object in this process cannot be overestimated'. One, for example, said:

> To understand a new concept I must create an appropriate metaphor. A personification. Or a spatial metaphor. A metaphor of structure. Only then can I answer questions, solve problems … without the metaphor I just can't do it.

And once we find an answer, we remember what we perceived by insight better than anything we arrived at by more everyday means.[23]

It may seem rather odd to non-mathematical readers that mathematicians should even talk about metaphor, let alone think it central

to the processes of mathematical insight. After all, we tend to think of metaphor as a purely linguistic concept, the standard ‘tool of the trade’ for poets and writers. But as I argued, both in *The Master and his Emissary* and in Chapter 15 above, metaphor is far, far more than that. It is fundamental to how we understand the world. It is only by seeing something as in some sense and however dimly ‘like’ something else that we build knowledge, and insight consists in perceiving likeness in dissimilar things. Poetic metaphor – describing one thing in terms usually associated with something quite different – is simply the most familiar use of metaphor and it is, of course, linguistic. But linguistic metaphor is, as it were, only a subset of a much broader mode of human perception which, as the mathematicians attest, includes what might be called non-linguistic metaphor. This broader conception of metaphor is central to insight. In his *De arte poetica*, Aristotle wrote about the role of metaphor and intuitive perception for poets, but he could have been writing about all those whose intuitive insights extend our knowledge of the world. He wrote: ‘the greatest thing by far is to be a master of metaphor. It is the one thing that cannot be learnt from others; it is also a sign of genius, since a good metaphor implies an intuitive perception of the similarity in dissimilars’.[24] In short, insight precipitates a new *Gestalt.*

That something of the same process is involved in mathematics and science as in poetry and art – the seeing of similarity within dissimilars – should not surprise us. They are all fundamentally creative processes, involving seeing patterns. As we saw in the testimony of Einstein, ‘seeing patterns’ took for him the form of images, feelings and musical architecture: it was certainly not linguistic and still less analytic: all that came later. To those of us who lack, or who have not been permitted to develop, this intuitive capacity to ‘see patterns’ and ultimately to be rewarded with sudden insight, what actually goes on may seem something of a mystery, as it does to a large extent to those who receive the insights. But they give us some clues. What draws them and what also seems to shape the patterns they see within the dissimilar is a sense of beauty. Mathematics, said Einstein, was an ‘effort toward logical beauty’.

He was not alone in thinking so. Anna Sfard again: ‘The role of aesthetic judgment in mathematical reasoning is a recurrent motif in mathematicians’ accounts of their own thinking.’ One of her subjects said:

> Sometimes I make a certain ‘leap of thought’ only because I say to myself that in order for things to be beautiful they must behave in exactly this way and no other. It must be true this way, because otherwise it won’t be beautiful enough. I would even go so far as to say it wouldn’t be ethical if it wasn’t so.

The great French mathematician Jacques Hadamard, had a number of interesting observations to make on the process of invention in physics and mathematics after soliciting the views of over a hundred practitioners. ‘Invention is a choice’, he wrote: and ‘this choice is imperatively governed by the sense of scientific beauty’.[25] He later described the sense of beauty as ‘almost the only useful’ drive for mathematical discovery that exists.[26]

Beauty is a test of correctness that many mathematicians, philosophers and scientists have experienced as a touchstone in their work. GH Hardy, in his *A Mathematician’s Apology*, wrote: ‘Beauty is the first test; there is no permanent place in the world for ugly mathematics.’ Similarly Henri Poincaré wrote that ‘the feeling of mathematical beauty, of the harmony of numbers and forms and of geometric elegance … is a real aesthetic feeling that all true mathematicians know.’[27] According to Bertrand Russell, ‘mathematics, rightly viewed, possesses not only truth, but supreme beauty.’[28] Paul Dirac even pronounced, in relation to the discovery by Schrödinger of the wave equation: ‘It is more important to have beauty in one’s equations than to have them fit experiment’. This is because initially Schrödinger’s equation did not fit the data, given the state of knowledge at the time, and he lost heart: but once electron spin was discovered, it fitted the data perfectly. Schrödinger, according to Dirac, got this ‘very beautiful equation … by pure thought, looking for some beautiful generalization of De Broglie’s ideas … It seems that if one is working from the point of view of getting beauty in one’s equations, and if one has really a sound insight, one is on a sure line of progress’. [29]

Again Poincaré sees the essential facts:

> It is impossible to study the works of the great mathematicians, or even those of the lesser, without noticing and distinguishing two opposite tendencies, or rather two entirely different kinds of minds. The one sort are above all preoccupied with logic: to read their

> works, one is tempted to believe they have advanced only step by step … the other sort are guided by intuition and at the first stroke make quick but sometimes precarious conquests …[30]

Anna Sfard, too, comments that there seem to be two types of mathematicians. What she calls the *operational* types have ‘highly developed manipulative skills and use them as a principal means in their quest after meaning’. By contrast, for *structurally* minded mathematicians, having a metaphor ‘is the dominant need’:

> … the manipulative skills, the ability to draw a systematic argument, are sometimes quite secondary … The structuralists are more capable of direct-grasp understanding than those who think and understand in an operational way. This is probably why the belief that structural thinking is superior to operational was implicit in the opinions of the mathematicians I talked to.[31]

Vadim Krutetsky (or Krutetskii) who made a special study of gifted children, and mathematically gifted children in particular, concluded that the most able students strive ‘for the cleanest, simplest, shortest and thus most “elegant” path to the goal’, whereas average students pay little attention to the aesthetics of their solutions.[32]

Even if we did not have the scientific evidence, each aspect of this would suggest a key role for the right hemisphere: its newness, its sensitivity to beauty, its presentation as a form rather than as a statement of any kind, its implicit nature, and its ability to allow something to ‘presence’, not merely to be represented. As Shelley so memorably said of the imagination:

> it purges from our inward sight the film of familiarity which obscures from us the wonder of our being. It compels us to feel that which we perceive, and to imagine that which we know. It creates anew the universe, after it has been annihilated in our minds by the recurrence of impressions blunted by reiteration.[33]

INSIGHT: LANGUAGE AND SLEEP

In *The Master and his Emissary*, I argued that it is fallacious to suppose that we need language in order to be able to think, and that indeed in some aspects of mental life, language can act as an impediment. Anthropologist Ellen Dissanayake argues that those who belong to pre-modern cultures think in pictures, as well as using direct perception and sensory memory, patterns of smell, light and sound intuitively, in ways that we have lost. Thinking in pictures may, also, be accentuated in some kinds of autism (more commonly, the opposite seems true): Temple Grandin tells us that she thinks in pictures, and when she learnt that others thought with words, could not imagine what that would be like.[34] Dissanayake comments:

> Perhaps in all of us, thought and memory are more pictorial than verbal … try an experiment of thinking, say, of a beloved person far away or of remembering an incident from the past. Do words come to mind first? If we are tracking an animal or preparing a meal, do we think in words or do we use some kind of non-verbal spatial and pictorial mentation? [35]

When it comes to problem-solving, visual thinking is far more important than verbal: but, for this very reason, during problem-solving visual *perception* can get in the way of visual *imagery*. This may be one of the reasons that we close our eyes when working on a problem: closing the eyes to sight really does increase insight.[36] There is an interesting sidelight here. Right hemisphere-damaged patients could easily follow the instruction to ‘close your eyes’, but if asked to do anything new, their eyes reopened involuntarily:

> a reminder that eyes should be closed did not work though the patient was perfectly inclined to follow it: as soon as attention switched to another task, the eyes reopened to the astonishment of the patient.[37]

And one fascinating study shows that because visual perception does play an important part in problem-solving, higher areas of the visual cortex, involved in re-imagining the perception, need to be disconnected from the lower areas that are simply engaged in presenting the current picture in front of you. We need to see it – but then to see it *differently*. For that, we must no longer be presented with it as it is. The delicate process of re-imagining needs to be protected from potentially interfering perceptions.[38] We need to 'close' the literal eye in order the better to *see* with the metaphorical eye.[39] This interpretation is consistent with research which shows that there is attenuation of visual input in the right parietal and occipital region immediately before a moment of 'insight' while problem-solving: no such effect is noted in pursuing analytic solutions.[40]

Conscious executive processes play little role in insight.[41] Using language brings things to consciousness and makes them explicit: for this reason, we need to get language out of the way for the time being. Having to verbalise impedes visual memory; [42] it does so not only for faces, and visual image processing,[43] but including things as basic as colour, as well as remembering and identifying tastes and pieces of music, which are obviously not primarily visual at all.[44] Thinking out loud while solving a problem markedly impairs the ability to find solutions to problems using insight, though it has no effect on analytical problems.[45]

Roger Sperry and his colleague Jerre Levy carried out some problem-solving tests using split-brain patients. Sperry writes that the performance of the left hand (thus the right hemisphere) was

> rapid, silent, and direct, whereas that with the right hand was more hesitant and accompanied by a running verbal commentary that was difficult to inhibit … it was concluded that the disconnected left hemisphere was applying a verbal analytic mode of thinking in contrast to the right hemisphere that had reasoned by direct perceptual, synthetic, or Gestalt, processing.[46]

Elsewhere he elaborates:

> The left hand–right hemisphere combination performed about twice as well as did the right hand–left hemisphere … The thinking

> seemed very different depending on whether the subject worked with the left or with the right hand. The performance with the left hand was silent and rapid, while that with the right hand was drawn-out, and accompanied generally by a running, overt vocalisation as the subjects talked and reasoned aloud to themselves, with comments like ‘two lines up, need three dots, spreads to the right’, etc.[47]

Levy noted that linguistic and *Gestalt* thinking appeared to inhibit one another. She reasoned that the need to keep these styles of thinking separate might explain bi-hemispheric structure:

> it was as if the speaking hemisphere processed stimulus information in such a way that the stimulus could be described in language. Gestalt appreciation seemed to be actively counteracted by a strong analytic propensity in the language hemisphere. It is therefore not illogical to suppose that during the evolution of the hominids Gestalt perception may have lateralised into the mute hemisphere as a consequence of an antagonism between functions of language and perception.[48]

She then tested IQ in subjects believed to have less lateralised language functions, and found that though their verbal intelligence was unimpaired, their performance (non-verbal) intelligence was dramatically lower (25 points). Language dominated at the expense of *Gestalt* thinking. This is the so-called ‘crowding’ effect by language which I described in Part I.

We also need to get conscious reason out of the way, if we are to make use of insight. One way to do that effectively is, of course, to go to sleep. Research has shown sleep to help produce insight. Individuals trained on insight problems were either allowed to sleep for eight hours before testing or were kept awake for 12 hours. Perhaps unsurprisingly, those that had slept performed twice as well on the insight problems as those who stayed awake.[49]

When it comes, then, to actively solving a problem, rather than just being in touch with one’s gut feelings, it’s not just distraction, or time off, that one needs, but specifically sleep (Franck Mourier described this). In

one study, two groups of subjects were invited to take part in a gambling experiment: the secret to staying ahead of the game was to figure out an underlying rule that was not made explicit. One group got to see the task, then had a full night's sleep, and returned the next day. The other group, after seeing what was involved in the task, got on with their normal daily routine, and came back after 12 hours. Of those who had worked out the rule, twice as many had slept.[50] And it would appear that it is not just any old sleep, either, but REM (rapid eye movement) sleep, the type of sleep which occurs several times a night, typically in 90-minute bursts, during which one dreams. 'Aha' moments commonly follow REM sleep. It has been suggested by Deirdre Barrett, a psychologist at Harvard who specialises in the study of sleep and dreaming, that sleep has many functions. Sleep, just like waking, she says, is not just for one thing, but for everything. And she proposes that one function of REM sleep is problem-solving. Dreams help us see things anew, so as to see solutions that aren't apparent to our conscious minds.[51]

During this phase of sleep, the logical mind retires – in particular, the control normally exerted by the dorsolateral prefrontal cortex is relinquished; the posterior visual cortex is hyperactive; the body and its emotions are engaged. Ideal conditions for trying out intuitive solutions to a problem, as she suggests. And one reason for believing she is likely to be right is something that has puzzled me since medical school: paralysis while dreaming. For this abdication of control by the frontal cortex, which is effectively what happens in dreaming, is all very well, provided the body – its own feelings, memory and intuition engaged – is not going to act on what it intuits immediately, while conscious inhibition is switched off. And, guess what? Nature has thought of that. During REM sleep you are paralysed (as are other mammals, and birds, the only other classes we know from EEG traces to have REM sleep – birds and mammals also happen to be nature's principal problem-solvers).[52]

There is also some evidence that the right hemisphere is dominant throughout sleep. From the onset of sleep, 'a clear reversal' of left hemisphere dominance can be observed, followed by 'a steady right hemisphere superiority' during both REM and non-REM sleep, as well as at the morning sleep-wake transition. Which may explain why so many good ideas come to us on waking.[53]

IMAGINATION

Just as the process by which insight comes about seems something of a mystery (as we saw, it seems to be drawn by a sense of beauty), so also there is a degree of mystery about where the imaginative capacity comes from. ‘Poetry, wrote Byron, ‘won’t come when called, – you may as well whistle for a wind … I have thought over most of my subjects for years before writing a line.’[54] And thereby he suggests two things: that it is not under control, but that it also does not come out of the blue – years of thought eventuate in the written words: something perhaps most obvious in scientific insights.

The initial stirrings of an insight may be very dim, and provide little indication of where they may lead. Pushkin, at the end of *Yevgeny Onegin*, writes:

> Now many, many days have flown,
> Since the time when young Tatyana first,
> In a misty dream with her Yevgeny
> Both dimly appeared in front of me,
> And the outspread distance of a story
> Through the magic of a crystal ball
> I scarcely could discern at all.[55]

Shelley, in his *A Defence of Poetry*, goes further in suggesting not only that poetry cannot be willed but that the poet’s efforts to express the insight weaken its force, that what is immediately if inchoately intuited fades in the process of creation:

> Poetry is not like reasoning, a power to be exerted according to the determination of the will. A man cannot say, ‘I will compose poetry’. The greatest poet even cannot say it; for the mind in creation is *as a fading coal*, which some invisible influence, like an inconstant wind, awakens to transitory brightness; this power arises from within … but *when composition begins, inspiration is already on the decline,* and the most glorious poetry that has ever been

> communicated to the world is probably a feeble shadow of the original conceptions of the poet.[56]

The process of articulation, Shelley tells us, already begins the business of direction by the conscious mind, the mind that threatens to wrest the vast, living penumbra of latent meaning into the pedestrian, deadening language of everyday. His remarks are reminiscent of those of William Blake, that honest, wise and completely unsophisticated observer, on the process of creation, that he

> cannot previously describe in words what I mean to design, for fear I should evaporate the spirit of my invention … And tho' I call them mine, I know that they are not mine …[57]

This is not just a Romantic trope. I suspect that this evanescence is part of the experience of any great artist, and faltering and pondering return us to the pedestrian world of the familiar (which is not to deny that, once contact has been made, we may need to ponder and refine). Thus the seventeenth-century Japanese poet Bashō writes:

> Once one's mind achieves a state of concentration and the space between oneself and the object has disappeared, the essential nature of the object can be perceived. Then express it immediately. If one ponders it, it will vanish from the mind … When you are composing a verse, quickly say what is in your mind; never hesitate a moment. Composition must occur in an instant, like a swordsman leaping at his enemy.[58]

All these testimonies express the conviction of the poets themselves that what they imagine has a life of its own even to the point of them doubting their own authorship. 'It thinks in me', wrote Schelling.[59] A degree of unknowing appears essential to the creative act. Thus Thackeray wrote: 'I have been surprised at the observations made by some of my characters. It seems as if an occult Power was moving the pen. The personage does or says something, and I ask, how the dickens did he come to think of that?'[60]

Indeed Dickens' own experience was similar: 'some beneficent power shows it all to me, and tempts me to be interested, and I don't invent it – really do not – *but see it*, and write it down'.[61]

This something that is seen, not invented, thereby enjoys its own freedom.[62] It is the artistic generosity that accommodates such freedom that is intrinsic to the genius of Shakespeare.[63] And it suggests not something alien to the artist, but something nonetheless distinct within the artist's mind at a level below consciousness, involving both what our senses 'half create, and what perceive' as Wordsworth puts it.[64]

That phrase is of the deepest significance to the argument of this book. It captures the idea that the creative imagination neither 'just' sees nor 'just' creates, but brings the new into existence through the combination of both, so rendering the authorship of what emerges ambiguous. And this is how we bring *all* our world into being: all human reality is an act of co-creation. It's not that we make the world up; we respond more or less adequately to something greater than we are. The world emerges from this dipole. We half perceive, half create.

The philosopher Friedrich Waismann gives one of the best accounts I know of poetic creation – and he thought that philosophical insights were of this kind, too. In fact I would argue that it is one of the best accounts of how the world as a whole comes into being for us:

> … a poem, when it comes, comes of itself. One often feels its approach in a curious sort of way as if something from deep down were to rise up and to become a word. Something as yet unknown, faceless, begins to stir, setting up vibrations in the deeper layer of one's being, as it were, and these vibrations pass to the lips in a rhythmic movement. A number of floating words begin to solidify, and as the poet murmurs the verses over he feels a sonnet, or some other poem take shape. So long as this enchanted state lasts, he may get the poem finished; or else the impulse spends itself, the rhythm dies down: the cry is broken. The experience varies a good deal. Some poets find themselves suddenly in the grip of a particular rhythm out of which words gradually precipitate themselves, others have the impression as if some inner voice dictated the poem to them, as if they were eavesdropping rapturously on themselves, spellbound not to miss a single word … Thus it would not be quite

> true to say of a poem that *I* have been writing it, since this would assign too active a part to me, nor that it got itself written *through me* as though it was endowed with a life of its own, nor that it has been written by a mysterious third one who was at work inside me, making use of the mechanism of my body. None of these expressions seems to fit. In order to describe such things more adequately one needs, perhaps, a language in which the boundary between 'I' and 'it' is fluid – of notions, anyhow of terms, that are less definite and held, as it were, in solution.[65]

This notion of a fluid boundary between 'I' and 'it' will be as important to later discussion as Wordsworth's idea that we half perceive and half create the world.

In this process, the detached ego is an impediment. It thinks it can make something happen, when it is best employed in keeping out of the way. Since we don't know what it is the imagination is trying to reach and disclose, our wilful attempts are negative. By contrast negation is positive. Resting in a state of *not* doing and *not* knowing *permits* us to be the agents of revelation. It is not often enough remarked that science establishes what is *not* the case; that we are propelled into philosophy similarly, by the feeling that something widely held to be the case cannot, in reality, be the case. The sculptor achieves the statue not by putting something together, but by discarding what surrounds it so that it is revealed. And this is not just true of creation but of interpretation: good literary critics and good theatre directors know that it is their job not to obtrude in their cleverness between us and the work of art they are supposedly serving, but to efface themselves, along with the accretions that obscure the beauty of the work, which speaks for itself. Clarification works by a process of un-obscuring: as mentioned, the Greek word for truth, *aletheia*, means an un-concealing or dis-covering of what it is that exists.

'What a strange force this intuitive power of negation is!' wrote Henri Bergson:

> How is it that the historians of philosophy have not been more greatly struck by it? Is it not obvious that the first step the philosopher takes, when his thought is still faltering and there is nothing definite in his doctrine, is to reject certain things

> definitively? Later he will be able to make changes in what he affirms; he will vary only slightly what he denies. And if he varies in his affirmations, it will still be in virtue of the power of negation immanent in intuition or in its image.

The philosopher responds to intuition by a process of 'complication which provoke[s] more complication', so as 'to convey with an increasing approximation the simplicity of his original intuition:

> All the complexity of his doctrine, which would go on ad infinitum, is therefore only the incommensurability between his simple intuition and the means at his disposal for expressing it … You recall how the demon of Socrates proceeded: it checked the philosopher's will at a given moment and prevented him from acting rather than prescribing what he should do. It seems to me that intuition often behaves in speculative matters like the demon of Socrates in practical life; it is at least in this form that it begins, in this form also that it continues to give the most clear-cut manifestations: it forbids.[66]

Once again, negation initiates creation.

In summary, a great work of art does not itself originate in consciousness at all, though the disposition to receive it may often be preceded by an act of conscious effort or will. It is the fruit of an encounter with a form, often at first indistinct, in a realm outside of consciousness. The artist, by opening himself to it, provides a path through which it can flow, and thereby midwifes it into being: it comes out of an unconscious realm, *through* his consciousness, where it is fashioned into being by the artist's skill.

This something that is brought into being fulfils itself only when another human being encounters it in a similar spirit, opening himself to it, so that something is evoked in him and comes *through* him in response to the work of art. Although communication is central to the experience, it is no more predictable than any other unscripted encounter: it is something new on every occasion. The meaning cannot be fixed and made explicit, but that does not mean it could be just *any* old meaning. Its not being precise is

what allows it to be a true act of creation, rather than merely a repetition or reordering of elements already familiar. In the words of Emerson, ‘The power which resides in [each person] is new in nature, and none but he knows what that is which he can do, nor does he know until he has tried.’ [67]

IMAGINATION AND THE CO-CREATION OF THE WORLD

For some reason, people feel much happier nowadays talking about creativity than they do talking about the I-word, imagination. This may be because creativity is thought to be dealing with possible realities in a way that imagination is not. There is a story told of a Fellow of Merton College, a mathematician, who was irritated by the attention paid to JRR Tolkien, a Fellow of the same Oxford college, by the fawning guests of other Fellows. One day in the Common Room yet another guest was introduced to the great man, and gushed: 'Oh, Professor Tolkien, I do so admire your writing, it's so – so full of imagination!' The mathematician could bear it no longer, and from behind a newspaper was heard to snort indignantly: 'Imagination? Imagi*na*tion?! *Made* it all up.'

From the left hemisphere's point of view, imagination, like metaphor and myth, is a species of lying: from the right hemisphere's point of view, it is, like metaphor and myth, *necessary* for access to truth. True human creativity is inseparable from the use of the imagination; I suspect that one of the reasons we found that more creative subjects rely more heavily on the right hemisphere, and less creative ones on the left hemisphere, was that the first group were truly imaginative, while the second were not. And imagination is inextricably bound up with reality, in a way that its bedfellow, fantasy, is not. Fantasy is projected, full-blown, from the workings of our mind. In imagination, rather, we experience intimations of matters that are glimpsed, but only partly seen; our conscious minds obscure them. They resist explicit formulation, because thereby they become something else. This tentative, but rapt, attraction toward something that is not cognised, but at some deep level re-cognised, is not the work of fantasy, but of imagination. Imagination is far from certain, of course; but the biggest mistake we could make would be never to trust it – never to believe in it – for fear of being mistaken. For truth *requires* imagination. It alone can put us in touch with aspects of reality to which our habits of thought have rendered us blind. It leads not to an escape from reality, but a sudden seeing into its depths, so that reality is for the first time truly present, with all its import, whether that occur in the context of what we call science or what we call art.

This sounds like a radical shift in attention (the most fundamental hemispheric difference) whereby what is normally re-presented at last becomes present again. D.H. Lawrence, who, I believe, had great insight into imagination, wrote that 'the essential quality of poetry is that it makes a new effort of attention, and "discovers" a new world within the known world.'[68]

The distinction between imagination and fantasy is one that was central to the thought and work of the poet and philosopher Coleridge. His is the best expression in English of ideas that were already current in German philosophy for 20–30 years at the time of his writing, and are expressed in the works of Herder, Fichte, Schelling, Hegel and Jean Paul (Richter) in the early nineteenth century. These ideas had seismic repercussions in contemporary philosophical thought and are every bit as striking, and strikingly relevant, today as they were 200 years ago.[69] Coleridge found crystallised in their writings what he felt to be a deep truth about experience, and egregiously 'borrowed' it for himself. It is the central insight encapsulated in his *Biographia Literaria*. What was that truth? That we contribute to the creation of the world we experience, and that we do so in *two fundamentally different ways.*

First, some scene-setting. The nature of everyday perception, although we would not normally call it creative, shares something with the work of the imagination we recognise in the poet or other artist. This may sound odd, but it has to do with the manner in which the experiential world is brought into being for each one of us. That coming into being inevitably depends, even if only in a routine fashion, on what we know, what we already have in memory, and can bring to the process.

I have covered some of this in the Introduction. The whole experiential world is constantly being created afresh. When we 'perceive' the world, we are neither passively receiving 'data' from the 'environment', as a camera or computer would; nor, on the other hand, simply projecting the contents of our mind on a screen.

Our current perceptions are governed by past perceptions and preconceptions; yet these too are always influenced reciprocally, if more weakly, by the new perception, the new experience. Much of what goes on seems to us pretty humdrum, largely the confirmation of our current perception (and conception) of the world. But even that is unbelievably complex and rich, and is born of *embodied interaction*. Clearly what we see

depends on the whole context – where we are, with whom and why we are there, the mood we are in, and so on – and also on what our motivations are: are we searching for something? Bored and filling in time? Hungry? Longing for something? What we see is neither subjective nor objective: the terms are irrelevant relics of a superseded Cartesian way of thinking about experience. There is no such thing as perception without such ramifications, because we are not just creating a Cartesian *representation* of the world, but are involved in the process of the experiential world *coming into being*. One of the besetting sins of our age is the belief that sensory experience is somehow less real than our abstracted mentalisations about it. But, as William James put it:

> These percepts, these termini, these sensible things, these mere matters-of-acquaintance, are the only realities we ever directly know, and the whole history of our thought is the history of our substitution of one of them for another, and the reduction of the substitute to the status of a conceptual sign. Contemned though they be by some thinkers, these sensations are the mother-earth, the anchorage, the stable rock, the first and last limits, the *terminus a quo* and the *terminus ad quem* of the mind. To find such sensational termini should be our aim with all our higher thought.[70]

Turning to the current science of perception, according to Luiz Pessoa and colleagues:

> perceptual content has to do with the world, not with representations (pictorial or otherwise) in the brain … at the personal level, there are no pictures, images, or other representations in visual perception; there is simply experience of the world … vision is not a 'snapshot' phenomenon; vision is a temporally extended process of looking constituted through eye-, head-, and whole-body- movements.[71]

Neither is this something that involves just one of the senses – say, vision – or just senses at all, unconnected with memory, emotion and imagination. Areas of the brain are not independent modules, but interact reciprocally, using dense forward and backward projections, as well as

hierarchical and parallel strategies, and reciprocal cross-connexions, in an unimaginably complex awareness of the world we experience.[72]

Even an area such as the primary visual cortex has less to do with external stimuli than with centrally generated hypotheses. A large majority of its input is not from the visual pathway but from areas of the cerebral cortex involved with making sense of ongoing experience, generating expectations and testing them against sensation.[73] This confirms, a century on, William James's 'general law of perception … that whilst part of what we perceive comes through our senses from the object before us, another (and it may be the larger part) always comes … out of our own head.'[74] We half perceive, half create; or, as Waismann put it, 'the boundary between 'I' and 'it' is fluid.'

At times, however, we are aware that what we experience is something authentically new that comes into being entirely uniquely in the coming together of our individual consciousness with the world. And although things seem superficially unchanged – by contrast with fantasy, where everything has been bizarrely re-presented – the core is now seen and experienced as quite 'other'. These are moments of uncanniness, awe, inspiration, insight – or perhaps one should say merely *sight.* As we say, visionary.

To return to Coleridge, fantasy, or, as he put it, 'Fancy', is, according to this distinction, something passive (with no life of its own) and mechanical, following known procedures, and dealing with finished entities – a *clothing* of reality, where the core of the reality remains unchanged. It recombines, in novel fashion, what is already familiar, just in a different arrangement or a different dress. Something is added from the outside, that, while altering its object's appearance, does not alter its essence; a 'drapery', as Coleridge puts it, which is just one thing added on top of another, without transforming the whole: it

> has no other counters to play with, but fixities and definites … It must receive all its materials ready made from the law of association.

To use a phrase of Wordsworth's, its product is already 'finished to our hands', laying 'the whole creative powers of man asleep'.[75] It is a

combinatory faculty, which, Coleridge says, is ‘emancipated from the order of time and space’; and ‘blended with, and modified by … the will, which we express by the word CHOICE.’[76]

The action of Imagination, by contrast, is seen by Coleridge as the ‘soul’ that is diffused throughout whatever it informs, ‘every where and in each; and forms all into one graceful and intelligent whole’.[77] It is not added on top of reality, but brings reality into being as it were from within. Its result is not a chain of association, one thing added to the next, but a single seamless process: not a mixture or combination, either, but a compound, in which the parts are no longer separate but integrated into a new whole.

Coleridge made a further distinction which does not at first sight reveal its true significance: that between what he calls primary and secondary Imagination. In fact the distinction is not so much remarkable for separating two elements, as for joining them boldly together. It’s as if I were to say: ‘There is *secondary* music, which is what you hear when you go to a concert, but really that is just a special case of *primary* music, which is what you hear when you listen to the sound of the wind and the rain.’ Not notable, then, for separating two things you thought were one, but for linking two things you had never associated – and, indeed, one of which you most likely had never thought of as music at all.

The force, then, of the distinction he is making is that between, on the one hand, imagination as we generally think of it, the creative force within the poet, in human creativity; and, on the other, imagination as the fundamental creative force in the coming into being of the whole of the world as we know it – and we can know the world *only* as we know it. The latter he calls primary: it reflects its nature in our daily experience of everything, in our perceptions of ourselves and the cosmos, and he takes it to be primary in the sense that it affords our only mode of access to reality. The former he calls secondary, since it is derived from the first, in that human beings are already themselves a part of nature; and therefore our creativity is secondary because it is just part of the fundamental creative force in the whole world:

> The primary IMAGINATION I hold to be the living Power and prime Agent of all human Perception, and as a repetition in the finite mind of the eternal act of creation in the infinite I AM. The

> secondary I consider as an echo of the former, co-existing with the conscious will, yet still as identical with the primary in the *kind* of its agency, and differing only in *degree*, and in the *mode* of its operation … It is essentially *vital*, even as all objects (*as* objects) are essentially fixed and dead.[78]

Let us just pause for a moment to take in the features of the distinction between Fancy and Imagination which Coleridge intuited to be so fundamental to the human condition.

Fancy is passive; it sees *objects*, which are fixed, definite, known and 'dead'. Imagination, by contrast, is active, vital, and is already part of what it sees (there is no subject-object divide here). Fancy puts together things already known in a novel way; imagination recreates the known and familiar as something unique and new, by a process of inhabiting, or permeating from the inside – not by combination or addition from the outside. Fancy is subject to conscious choice. Primary Imagination (the mode whereby the world comes into being for us) is not; even secondary Imagination (the work of the human creator) although 'co-existing' with the conscious will, 'yet', as Coleridge is careful to underline, shares the 'kind of its agency' and 'mode of its operation' with the primary imagination, and thus is largely not a matter of conscious control. And, amazingly enough, Coleridge even specifies that Fancy, unlike Imagination, is outside the realm of time and space. I do not wish to labour the obvious: but those of you who have followed me thus far will see that these two aspects of the way our minds work on reality bear an extraordinary resemblance to the modes of operation of the two hemispheres.

Coleridge called Imagination 'the Laboratory, in which Thought elaborates Essence into Existence'.[79] I understand this to mean that imagination is creative in the most literal sense, since it is the faculty that precipitates into being whatever *is*, and would otherwise only exist *in potentia*. He invented the rather cumbersome term 'esemplastic power' to describe the work of imagination. (In fact he took Schelling's almost equally cumbersome term *Ineinsbildung*, and since, to be fair, it would not work as a single word in English, turned it into Greek before anglicising it: *eis*, in, + *en*, one + *plastikos*, moulding: 'moulding into one'.) What this idea suggests is, according to Coleridge's editors James Engell and Walter Jackson Bate, not just a process of shaping, but 'the organic interpenetration

of parts, and the formative union of shaping and being shaped' (NB: thereby transcending the subject-object divide); and it suggests not only a power that unifies, but one that specifically synthesises opposites.[80] Hence Coleridge writes:

> This power … reveals itself in the balance or reconciliation of opposite or discordant qualities: of sameness, with difference; of the general, with the concrete; the idea, with the image; the individual, with the representative; the sense of novelty and freshness, with old and familiar objects; a more than usual state of emotion, with more than usual order …[81]

Here are surely, at one level, the oppositions of the tendencies of the two hemispheres: sameness (LH), difference (RH); general (LH), concrete (RH); idea (LH), image (RH); representation (LH), individual (RH); old and familiar (LH), new and fresh (RH); more than usual order (LH), more than usual emotion (RH). The reconciling of these opposites at a 'meta'-level is undertaken by the right hemisphere, as the reader will know, not the left. This is especially striking when taken with Coleridge's description, that we have already encountered, of the difference between Fancy and Imagination.

What he has done here is, first, to draw attention to two dispositions towards the world, that of Fancy and that of Imagination, that have opposing qualities; and, second, to the fact that, at another level, one of these dispositions – that of Imagination – is not frightened by opposites, but has the ability to synthesise *opposites themselves – including these*. Once again this aligns perfectly with what we know of the hemispheres. They yield two distinct takes on reality; but only one of them sees the two takes as complementary parts of a whole. And that is the right hemisphere, the left hemisphere seeing opposites as mutually exclusive.

Shortly before this passage in the *Biographia Literaria*, Coleridge wrote:

> In order to obtain adequate notions of any truth, we must intellectually separate its distinguishable parts; and this is the technical *process* of philosophy. But having done so, we must then

> restore them in our conceptions to the unity in which they actually co-exist; and this is the *result* of philosophy.[82]

Analysis should always be a prelude to a synthesis, in which the original synthetic take and the subsequent analytic take are themselves synthesised. The whole purpose of division is to enrich a union. ‘Everything depends’, wrote Hegel, with his customary infelicity, ‘on the unity of differentiatedness and non-differentiatedness, or the identity of identity and non-identity.’[83]

This coming together of opposites is something I will deal with at greater length in the opening chapter of Part III.

However one looks at it, Coleridge’s description of the creative power of the imagination looks like a very good match for the way in which the right hemisphere approaches and is involved in shaping both the productions of great poets, composers, artists, mathematicians and scientists – and the everyday world. Does that give it a claim to be a more reliable guide than the left hemisphere to what *is*, to whatever we mean by the real, the true? Had he known what we know about hemisphere difference, Coleridge would have had to answer ‘yes’, as would the German philosophers whose world view he shared – and many philosophers both before and since, I suspect, from Heraclitus to Heidegger.

‘Without intellectual intuition, no philosophy!’ wrote Schelling.[84] I believe these words are important and wise. Wisdom, of which philosophy professes to be the love, cannot exist without the capacity to feel one’s way *into* what one wishes to understand, and to transcend – though by no means abandoning – the merely rational, as well as the merely partisan. But this is certainly not to forsake reason or the need for balance. It’s just that approaching it haughtily from the *outside* as something to be corrected, controlled and subdued is not enough. In Schopenhauer’s words, ‘there is in us something wiser than our head’. This is not irrationalism, but the most successful challenge to it. As Arran Gare writes of Schelling,

> The real challenge to irrationalism comes from those who are equally committed to rationality and to doing justice to variety, the particularities of existence and to creativity. Schelling was

exemplary in this regard, and those sharing this commitment are his true heirs.[85]

What is required is a synthesis of both intuition and imagination with reason: the imagined place – though one that is nonetheless with discipline achievable – where each is at its best, standing in equitable relation to each of the others, and informed, where relevant, by science. As Bergson pointed out, if philosophy is not to be merely the further propagation of the analytic tendency in the modern mind, it must mean 'to reverse the normal direction of the workings of thought.'[86] In other words, it is to reverse the normal left hemisphere take, under which we approach everything in the hope of discovering its true nature by *analysis*, in order to recapture the right hemisphere take by *synthesis*. And he commented memorably, 'criticism of an intuitive philosophy is so easy and so certain to be well received that it will always tempt the beginner.'[87] That's partly because the applauding audience are already committed to the left hemisphere take – and therefore can't see that they are missing anything. And partly because an analytic take is so terribly easy to express, whereas an intuitive take is something that some people largely lack, and even where they don't, is much harder to express in everyday language.

My contention is that imagination, far from deceiving us, is the only means whereby we experience reality: it is the place where our individual creative consciousness meets the creative cosmos as a whole. (It is no coincidence that the same Indo-European root, present in classical Greek, indicates both 'to know' and 'to generate' or 'to be born'.)[88] It is the virtual, re-presented world of the left hemisphere that is the deceit. Imagination is not, as it is sometimes conceived, the capacity to conjure the *un*real, but, for the first time, to see the *real* – the real that is, for reasons of deeply ingrained habit, no longer present to us. It is not a means of placing something else between us and the world, but of removing the accretions that prevent us from that world's fuller realisation. To see is not just to register sense-data, but to see 'into' the life of what is seen; and 'through' it to the greater picture that lies beyond it, is implicit in it, and makes sense of it in terms of the totality of experience. This might seem rather rarefied, but it is what Nobel Prize winner Barbara McClintock, amongst other things an expert in plant morphology, meant when she told her students that 'first you

must learn to see.'[89] Goethe repeatedly said the same – generally using plant morphology, as it happens, as an illustration of what he meant.

CONCLUSION

A just sense of how little we understand, and of how we can best approach what lies beyond our current understanding so as not to destroy it in the discovering, is an essential foundation for every great human enterprise. Here the reflections of the biochemist Erwin Chargaff cannot be bettered. Scientist that he was, he realised that if we lose the sense of just how much we do not know, we lose understanding of even the little that we *do* know. He called this sense of fruitful potential ‘darkness’, because it is where we have not reduced the heavens around us to the deceptive clarities disclosed by a flashlight. As a young man he wrote

> One could say, the great biologists work in the very light of darkness. We have been deprived of this fertile night …

He felt that our great scientific and technological exploits had ‘diminished irreversibly’ the points of contact between humanity and reality, but anticipated being misunderstood for saying so. And indeed he was:

> Somebody who had read these words said to me: ‘You seem to appreciate the natural sciences only as long as they are not successful. Darkness illuminated becomes light.’ I could only answer: ‘What is success in science? Illuminated darkness is not light. We find ourselves in the cavern of limitless possibilities. Take a flashlight with you, and you may find you are only in a lumber room. If I know what I shall find, I do not want to find it. Uncertainty is the salt of life.’ And he said: ‘When you say darkness, you mean obscurity’. This I denied; but I do not think we achieved conciliation.[90]

The essential point is that every disclosure is also a concealment. Every closing down of potential into an actuality – itself a necessary, even fruitful step – is *by the same token* a limiting of reality to what has been selected. If

it had not been selected, one might have discovered something immensely larger within that field of potential – now forever narrowed to what it is we think we clearly know. Remaining with the ‘fertile night’ means not closing down too soon, too readily, on something that looks familiar – the lumber room that shows up by the light of the torch immediately round us – but instead allowing our eyes gradually to become adapted to the dark so that we see the starlit mantle of the heavens immeasurably further beyond. That, not the lumber room, is where science is destined to take us; revealing, if it is successful, not mere clarity, but ever deeper mystery.

I quoted earlier the logician Waismann’s saying ‘for my part, I’ve always suspected that clarity is the last refuge of those who have nothing to say’. His insight had been anticipated by Coleridge, who praised ‘the elder Languages’ as being ‘fitter for Poetry’, because of the tact with which ‘they expressed only prominent ideas with clearness, others but darkly’. He contrasts this with French, in which he felt that all was forced into a sterile clarity. And he asks ‘whether or no the too great definiteness of Terms in any language may not consume too much of the vital & idea-creating force in distinct, clear, full made Images & so prevent originality – *original* thought as distinguished from positive thought’.[91]

Every insight into the depths of reality *requires* imagination. It is not an optional extra, still less an impediment. We must not be blinded by our limited words and concepts to what imagination alone has the power to reveal – though it can only do so to those who are actively receptive of it. Chargaff went on to try to explain his younger self, referring to the most famous image of creation in the history of the West:

> What I had at that time – and it has never left me – was a dream of a reality that we could only touch tangentially, an awe of the numinous of nature whose power rested in its very unattainability. It was a feeling for the necessity of darkness in the life of man. In the Sistine chapel, where Michelangelo depicts the creation of man, God’s finger and that of Adam are separated by a short space. That distance I called eternity; and there, I felt, I was sent to travel.[92]

That short space signals the infinite realm in which the life-giving imagination of our intellect leads us onwards.

What, then, can the testimony of poets, composers, painters, mathematicians and scientists tell us about the business of creation? That a new, intrinsically beautiful, form, just as much in maths or physics as in the arts, is sensed intuitively. That it is not seen precisely at first, and that the dragging of it into the realm of precision too early in order to work on it, brings the danger of its loss. That it takes back something from the realm of the worn and familiar, the wonder of which has been lost, and makes it live. Imagination is literally creative: it brings everything we can know into being for us – and it is only as it is for us that we can know anything at all. To quote Richard Feynman: 'Our imagination is stretched to the utmost, not, as in fiction, to imagine things which are not really there, but just to comprehend those things which *are* there.'[93] Imagination is the path whereby our eyes are opened so that we see something, for the first time, as it really *is* – at least as close to what is as we can ever know.

CODA TO PART II

The problem of how our experience relates to reality is one of the most fundamental and long-standing questions in all philosophy. But it develops a particularly keen edge if it turns out that the hemispheres deliver different versions of the world. Could this in part explain some of the paradoxes that philosophy repeatedly encounters?

Should we accept both versions or only one? If, as I believe, we have to accept that both disclose an aspect of reality, should we give them equal weight? Is their relationship symmetrical, or does one disclose the world more richly, more deeply than the other? These questions are ones to which I gave some preliminary consideration at the outset of Part II. I suggested that we should expect that the disposition of each hemisphere towards the world would affect its very idea of truth; and put forward some evidence that each hemisphere does indeed see truth differently. I also indicated why the left hemisphere's version of truth was likely to be a less trustworthy guide than that of the right hemisphere.

The other big question is not so much about which hemisphere we are better to rely on, but which route of enquiry we should use. This has been the focus of the rest of Part II. Should we trust only science, as some people seem to believe? Or only reason, as others might insist? Or only, ultimately, what accords with our intuition, as still others would say? I think we would have to conclude that no one of them can, on its own, be relied on, because of limitations in the scope, kind and degree of knowledge each is capable of offering; but that each has something valuable to contribute, and cannot safely be neglected – that is the point that seems so clear, and yet so hard

for some people to accept. For them, one path has to win at the expense of the others. Such a conveniently simple solution is not, however, open to us.

In the process, I suggested that we should reject the common, simplistic idea that science and reason are the domain of the left hemisphere and intuition that of the right hemisphere. Instead we saw that each hemisphere contributes to each of them, but in a consistently different way, and to different degrees depending on what is meant by each term. In the case of science and reason, a distinction can be made between an internally consistent, self-directed, already fixed *procedural mode* – prepared to sacrifice truth in the pursuit of consistency, an approach I identified with the left hemisphere; and an outwards turned, receptive, open *process* – prepared to sacrifice consistency, where absolutely necessary, in the pursuit of truth, an approach I identified with the right.[1]

It was then that we came to consider imagination, which plays a special role in the argument of this book. There we were looking at something on a higher level – or a deeper level – but at any rate not on the same level: not a methodology or a pathway to knowledge, but the gateway to an understanding; something on which science just as much as art, reason just as much as intuition, depends, if any of them is to make real progress. In short it is foundational to all other approaches.

In Part III, I will attempt to address the question what is truth the truth 'of'? How can we get some idea of what the stuff of reality is like, and how it is formed? Again I will be seeking to disclose what the lens of the hemisphere hypothesis can tell us. In particular I will suggest that the stuff of reality looks different when we break out of the cultural habit of subordinating what the right hemisphere knows to the take of the left hemisphere in addressing these almost – but not wholly – imponderable questions.

Donne believed that truth could not be approached in a linear fashion by direct assault, but only by climbing one's way up a rugged path which circles as it approaches its goal, for

> … on a huge hill,
> Cragged, and steep, Truth stands, and hee that will
> Reach her, about must, and about must goe …[2]

In the arduous climb towards Donne's crags, we are rewarded with different, but coherent, views of Truth as they come to be disclosed from different angles. From the day I first read those words 50 years ago, I have been continuously mindful of the wisdom contained in the image. Although having widely different methodologies, I believe that neurology, philosophy and physics each help us get closer to an understanding of the reality we experience, providing three confluent paths, circling the same reality, and disclosing different aspects of it, at different times, leading to an account that, *at last*, is true to experience, to science and to philosophy: an account that is nonetheless wholly unforeseen from within the standard reductionist model in which we are now invited to 'live'. It is on this climb that I invite the reader to accompany me in Part III.

APPENDIX 1

HEMISPHERE DIFFERENCES AND CREATIVITY: AN EXAMINATION OF DIETRICH AND KANSO'S EVIDENCE

This evidence should not be read in isolation from its context in the overall argument of Chapter 8.

Before we start, a few caveats. It isn't enough, in order to discredit the idea of the predominant role of the right hemisphere in creativity, just to show that both hemispheres are involved, for a number of reasons.

Firstly, and most obviously, if you are waiting for a situation in which you find only one hemisphere to be active, you will wait forever. The criterion is wholly unrealistic. The issue is whether the right hemisphere plays the crucial role, not the only role. The overall evidence suggests that the right hemisphere is essential to the process of creativity; the left hemisphere, though it may play a part at some point, is of secondary importance, when it does not actually impede creativity.

Secondly, the mode of investigation makes a significant difference. Thus, an investigation relying on event-related potentials (ERPs) in the brain is a particularly poor guide to localisation.[1] Experienced electrophysiologist Geoffrey Woodman writes: 'ERPs have excellent temporal resolution but poor to unknown spatial precision … It is unknown whether the relevant activity we are measuring is generated near the electrode or across the entire cortical sheet'.[2] Clearly this can lead to a real, significant localising effect being masked by false negative or insignificant findings.

Thirdly, the task matters: as we will see, tasks that are minimally creative often engage left hemisphere regions, while highly creative tasks show a strong tendency to engage right hemisphere regions.

Fourthly, the nature of the participant matters: evidence I will come to shortly suggests that more highly creative individuals rely on the right

hemisphere to a considerably greater extent than less creative individuals.

Fifthly, many of the studies on creativity are wholly or partly linguistic in nature, involving reading, speaking or generating words – or all three. Even where trouble is taken to avoid an expressly linguistic task, and very often it is not, the inner experience of the subject usually has to be verbalised in order to be taken into account by the experimenter at all. It is only to be expected that any such task will involve the left hemisphere, even if the task is no more creative than reading a till receipt.

And finally, we are not engaged in an exercise of totting-up papers that do and don't support a position, and claiming to make a decision on that basis. Although that would indeed definitely count in the right hemisphere's favour, it is fallacious. Many studies, but not all, point to localisable areas; however, they do keep on pointing to them. Let me put it this way. If I am overseeing the investigation of the 500 murders recorded in Britain last year, I will naturally be interested in their distribution. If I find they are fairly randomly scattered over the country, once population density is taken into account, but that there is an area round a small village in rural Wales where there have been 47, I will not say 'well, there's no need to pay any attention to that, because the other 453 count against there being anything to worry about there'. Finding a murder that is not in this tiny area of Wales doesn't count against the extraordinary fact that they keep happening *right there*. And, a further, related but distinct, point: absence of evidence is not evidence of absence. Particularly when you are dealing with something as fickle and variable as the human brain, and as multifarious and complex as the processes involved in creativity, to find consistent, rather than invariable, evidence that, for example, the right superior temporal region is involved in the moment of creative illumination is something remarkable. No other single area has a similar murder rate.

As an example of the last of these, Dietrich and Kanso (2010) are keen to discount the large body of evidence that we looked at in Chapter 8 suggesting the crucial role for the right hemisphere, and more specifically the right superior temporal region, in creativity. In pursuit of this goal, they say that 'although there are several studies that point to a special role of the right superior temporal gyrus for insight events … there are more studies that do not support this contention.' There is, needless to say, a difference between not supporting a finding and contradicting a finding. Dietrich and Kanso point here to seven papers.[3] None of these papers contradicts the

finding, and indeed one offers support. Only the first two of these are standard EEG studies, potentially providing reliable localisation; the other seven are event-related potential (ERP) studies that do not. That being said, what do these studies, singled out for our attention by Dietrich and Kanso, show? The first (Dan'ko *et al*) reveals 'the EEG spatial synchronization in the majority of frequency bands increases over the right temporal areas and decreases greatly over the prefrontal and frontal areas, predominantly in the midline and left-hemispheric areas'. The second (Kounios *et al*) investigated not the moment of insight, but the phase of preparation (as did the last two papers, both by Qiu *et al*), which is expected to involve quite different networks from those in involved in incubation and illumination. All the other papers are ERP papers, with all that that means for unreliable localisation; and either did not look at the moment of insight, but at the preparation phase; or did not separate the data in terms of lateralisation (Lang *et al* and Mai *et al*); or showed that more analytic solving, as expected, involved more frontal and left-lateralised activity by comparison with insight (Lavric *et al*).

I could adduce a large body of evidence that suggests Dietrich and Kanso are misguided. But rather than rely on data that I can adduce, let me look at the full data Dietrich and Kanso adduce to support their position. Inclusion in their study was inevitably subjective (that is by no means intended as a criticism), because they had to whittle down 1,910 papers that resulted from a literature search, and they did so, reasonably enough, by looking at titles and abstracts. They excluded

> brain studies reporting on domains that are manifestly relevant to creative thinking, such as metaphorical reasoning, mental imagery, perceptual restructuring, the perception of music, or various processes involved in cognitive flexibility—set-shifting, planning, inhibition of existing knowledge, counterfactual thinking, or perseverance … unless there was specific mention in the title or abstract of the keywords *creativity*, *creative thinking*, *hypothesis generation*, *aha effect*, *Eureka experience*, *novel ideas*, *original ideas*, *innovation*, *insight problem-solving*, or *insight.*

Fair enough; though practically every one of these 'manifestly relevant areas' would undoubtedly have provided significant evidence of crucial

right hemisphere involvement, as we know. And so would inclusion of studies of brain abnormalities, such as stroke or tumour, which were also explicitly excluded by Dietrich and Kanso: a major omission, but one they were, again, clearly entitled to make – they are the architects of their own study – though in my view it weakens their case.

Not all 63 papers that are finally selected deal with laterality, which is only one, albeit a principal, focus of the zeal for demolition in their review. On laterality, however, they cite 37 studies: 23 electrophysiological (essentially EEG-based, including ERP) studies and 14 functional neuroimaging studies.

Let's turn, as they do, to the EEG/ERP group first. Of these 23, I tracked down and read all but one, the proceedings of a symposium in Novosibirsk in 2005.[4]

I found that eight had nothing to say about laterality, either because the study did not investigate it, or because, more rarely, no conclusions could be drawn.[5] One study clearly leant towards the left hemisphere, though it found that 'the right hemisphere seems to engage in weakly and diffusely activating meanings and a retrieval of unusual interpretations of words during the Remote Associates Test [a verbal test of divergent thinking]'.[6] The right hemisphere's greater capacity to find remote associations is a very well-validated finding.[7]

That leaves 13 papers, selected by Dietrich and Kanso, from which I give relevant extracts. Each paragraph is from a separate study:

1. '…the data obtained in this study point to the particular role of **right**-hemispheric cortices in creative thinking. This is consistent with literature which suggests that the **right** hemisphere is involved in a broad range of creative thinking tasks'.[8]
2. 'The common effect was a greater activity of the **right** hemisphere, which did not depend on the sex, task type, or instructions for performance of the tasks … This was consistent with data in literature evidencing the dominance of the **right** hemisphere'.[9]
3. '… divergent thinking was generally accompanied by increases in alpha power … most prominent in posterior cortices of the **right** hemisphere'.[10]

4. '…the general trend was that HIQ [highly intelligent] individuals in comparison with AIQ [averagely intelligent] displayed higher co-operation between brain sites mainly located in the **right** hemisphere, showing rather short distance co-operation between brain areas in the **right** frontal, temporal and central sites … In the **right** frontal site, an additional interaction effect between the factors, creativity and intelligence, was observed'.[11]
5. '…the correlations for intelligence scores were positive and mostly distributed over the **right** hemisphere … in keeping with studies relating intelligence and creativity with **right** hemisphere functioning.'[12]
6. '… good performance is related to … increased functional connectivity of central-parietal areas of both hemispheres, and greater ipsilateral connections between the cortex regions of the **right** hemisphere'.[13]
7. '… during improvisation dance, professional dancers exhibited more **right**-hemispheric alpha synchronisation than the group of novices did … novice dancers display a comparatively low level of alpha synchronization which is somewhat more pronounced in the **right** than in the left hemisphere …professional dancers, in contrast, exhibit comparatively strong alpha synchronisation in posterior brain regions, especially in the **right** hemisphere'.[14]
8. '… we predicted that highly creative people should exhibit greater **right** hemisphere than left hemisphere EEG activity during creative performance and that this pattern would not be found in less creative people. All three experiments supported this prediction. This difference in asymmetry was specific to creative performance. It was not present during basal recordings or during a non-creative task … highly creative subjects exhibited more **right** than left hemisphere activation; those of medium creativity showed strong asymmetry in the opposite direction; and very uncreative subjects showed about equal activation in both hemispheres … Creative [subjects] tend to show high levels of **right** hemisphere activity (as compared to left hemisphere activity) during creative production'.[15]
9. '… the total divergent-thinking-induced effect of more co-operation between cortex areas in the **right** hemisphere indicates a

substantial contribution of the right hemisphere in creative thinking'.[16] [The authors found that in overall analyses, the right-hemispheric coherence increased in highly creative individuals, but decreased in averagely creative individuals, compared to baseline.]

10. '… analyses revealed that more, as compared with less, original ideas elicited a stronger event-related synchronisation of alpha activity … and higher phase coupling in the **right** hemisphere. These findings corroborate the importance of **right**-hemispheric cortical networks in creative idea generation … the present findings point to the importance of **right**-hemispheric cortical networks in creative cognition'.[17] [The authors found increased **right**-hemispheric coherence in 'high originality' subjects and no hemispheric difference in those of 'average originality'.]
11. '… those participants who produced more original ideas showed pronounced hemispheric differences in posterior regions of the brain … with more upper alpha synchronisation in the **right** than in the left hemisphere, while in the lower originality group no hemispheric differences were observed'.[18] (Plate 12[b] is taken from the paper, illustrating their point graphically.)

Of the two remaining papers, one found that, in highly creative subjects, thinking up a plot caused alpha synchronisation in the **right** hemisphere, whereas thinking of random words caused alpha synchronisation in the **left** hemisphere, a difference the authors attributed to the verbal nature of the second task, but which might also be attributed to its barely 'creative' nature.[19] For example in another study, when participants generated unusual verbs for nouns, as opposed to the first verb that came into their head, there was, as one might expect, increased activity in the **right** middle and superior frontal gyri and **right** medial frontal gyrus.[20] The final study found greater complexity of the EEG during divergent than convergent thinking, commensurate with the fact that the first is broad, and the second narrow, in its recruitment of neuronal networks, but they draw no hemisphere-related inferences.[21]

An aside on the EEG, asymmetry and alpha activity. Neither the recording nor the interpretation of EEG data is easy. I could not begin to outline its intricacies here, but what the reader needs to know is this.

The electrical impulses in the brain generate waves that are by convention divided up into bands, on the basis of their frequency (that means their wavelength, not how often they are found). The alpha band, which is what we are principally concerned with here, is the dominant element of the normal EEG in the resting state. For that reason it was thought to be a sign of idling, because ‘nothing is going on’. When we focus on something particular, and engage in a task, beta waves become dominant. When we stop, beta is replaced by alpha again, and the normal state of things is restored. But EEG alpha band synchronisation during creative thinking is a sign of active cognitive processes rather than cortical idling.[22] Another way of looking at this is that the normal, resting state is not when ‘nothing’ is going on, but when, to use an equivalent caricature, ‘everything’ is going on; and that ‘everything’ has to be reduced to ‘one thing’ in order to focus attention temporarily on an external source. Alpha suggests a high degree of readiness of potential: beta a collapse of potential into specificity.[23] Alpha rhythm, it turns out, is closely linked to issues of attention.

The idea that alpha is straightforwardly inhibitory – nothing is going on – first began to look like a cock-eyed story when it became clear that, when the imagination is working on memory (rather than just retaining a memory), alpha activity increased.[24] Growing evidence suggests that alpha is not by any means simply inhibitory, but, in a theme that readers of this book will begin to recognise, and with which readers of *The Master and his Emissary* will already be familiar, there is a kind of inhibition that is actually creative. Negation at one level can allow something at another level to flourish untrammelled. Alpha activity seems to be of this kind; and, to take an example, right posterior alpha seems to be involved with suppressing *external* visual processing and thereby releasing that very same part of the brain to deal with *internal* visual imagery. Alpha activity increases immediately we close our eyes. Closing one’s eyes when using the imagination is a commonly observed phenomenon. Alpha activity is consistently higher during the *imagination* of images (internal attention) than during their presentation (external attention).

The upshot of a complicated story is that, as far as we know at the moment, alpha synchronisation is involved with inner directed attention, with imagination, facilitating the combination of distantly related elements, and with creativity.[25]

On that last crucial point, alpha activity has been found to be involved in ‘creative cognition’ in a series of studies employing a variety of methodological approaches.[26] ‘Taken together’, writes Matthias Benedek, one of the world’s leading EEG researchers,

> there is evidence that alpha synchronization, especially in frontal and posterior parietal brain regions of the **right** hemisphere, is related to (1) creative task demands; (2) inter-individual level of creativity (more creative individuals show higher alpha activity); (3) originality of ideas (the generation of more original ideas is accompanied by higher alpha activity); (4) the subjective experience of insight (more alpha activity in insight vs non-insight solutions); and (5) stimulation of creativity.[27]

The other point that needs to be appreciated is that, just as voltage is always the *difference* in electrical potential between two points, EEGs always measure *differences* in activity between any one point of interest and an electrical ‘reference point’. The choice of that reference point can make a significant difference to the detection or otherwise of asymmetry in EEG findings (as do a host of other things such as handedness, mood, personality and the exact nature of the task observed).[28] What this means is not that EEG data are useless, of course; just that the expectation that the same picture will emerge on every occasion is naïve. It makes the degree of consistency we *do* find more impressive than it would be if the situation were more clear-cut. If there is a lot of noise, but still a discernible signal, as in a poor quality TV transmission, it means (a) what you see is only a hazy outline of a clearer picture, and (b) you would be wrong to focus on the ‘snow’ as if it were part of the picture. Only one paper cited by Dietrich and Kanso saw broadly a left hemisphere picture; all the rest saw either no picture, or, much the most frequently, a broadly right hemisphere picture.

Returning to the papers listed above, one particularly interesting finding is common to the five papers referred to in paragraphs 7–11: namely, that there is a difference between what are termed highly creative individuals and averagely creative individuals, a difference which is not *linear* – that is to say, not just a difference of degree, but of kind. It is a matter of huge significance: that of right hemisphere dominance versus ‘no hemisphere

difference'. Indeed in one case (paragraph 8) the pattern was: high creativity – right>left; average creativity – left>right; and low creativity – no hemisphere difference.

This overall has two major implications. First, not dealing with truly creative individuals will dilute the obvious right hemisphere dominance, muddying the waters of creativity research. Second, not posing tasks that are truly creative, rather than at most minimally creative, is likely to have a similar effect – you won't really be testing what is special about creativity.

Overall then, I don't know about you, but on the evidence they've called so far, I feel Dietrich and Kanso have some work to do if they want to impress us with their view that the right hemisphere has no special role in creativity. But they now turn to the imaging data: perhaps it is here, after all, that we are in for the surprise of our lives. Introducing this section of their paper, they write: 'On the issue of hemispheric differences, the neuroimaging studies amplify the EEG data'. That hardly seems like a good thing from their point of view, but there we are. 'With the possible exception of two studies implicating the right prefrontal cortex,' they continue, 'none of the other 12 studies in this group can be viewed as supporting a dominant role for the right hemisphere, in part or whole'.

Let's take a look at the papers they proffer. The two that are 'possible exceptions' to this apparent complete lack of support for a dominant role of the right hemisphere are worth a look at the outset.

It has been noticed that schizotypes (a personality type characterised by what is called 'magical' thinking) are particularly creative. The first study looks at this in relation to the hemispheres.[29] Although, as Dietrich and Kanso concede, it supports a special role for the **right** hemisphere in creativity, I wouldn't rely on it myself. It is too difficult to know what we are looking at here. Schizotypes might in some cases have non-standard lateralisation of the brain, so that caution needs to be exercised in interpreting the study.

However, the paper does emphasise that, in normal subjects, the **right** frontal lobe is involved in generating unusual or distant verbal associations, while the left frontal lobe is involved in generating usual associations;[30] and that while divergent and creative thinking may be characterised by increased co-operation of the two hemispheres,[31] there is evidence that it is specifically the **right** hemisphere that matters in creative thinking.[32] It may also be, though they don't speculate on this, that 'increased co-operation of

the hemispheres' may refer to the left hemisphere not inhibiting the contribution of the right hemisphere to the same degree, since in the normal situation the left hemisphere does inhibit the right more than the right inhibits the left.[33]

The second paper is more pertinent, because it looks at normal subjects.[34] It emphasises that the **right** hemisphere makes more distant and unusual connections than the left hemisphere.[35] Its own findings are that 'areas of the **right** prefrontal cortex are *critical* to the types of divergent semantic processing involved with creativity'. So a 'possible' exception to the total failure of support? No risk of overstatement there, at any rate.

Do the other 12 really offer no support, 'in part or whole', for a dominant role for the right hemisphere in creativity? Let's see.

Of those 12, two were unpublished conference presentation posters. I tracked down one. Sure enough, it had nothing to say about laterality at all.[36] The other I could not trace.[37] Another paper had little of its own to say about laterality, largely citing earlier literature in support of the right hemisphere's role.[38] A further paper I have referred to earlier, the study which found that the size of the corpus callosum was *inversely* associated with creativity; other than that it had nothing to say about laterality.[39]

That left eight published papers.

1. One paper found **right** prefrontal activity in schizotypals doing creative tasks: schizotypals are more highly creative than normals.[40] But, once again, caution is required in interpreting this.
2. Another study found that the **right** prefrontal cortex was a 'critical component' of the neural systems responsible for set-shifting (thinking flexibly), and that a different part of the same **right** hemisphere region was importantly involved in generating and maintaining hypotheses.[41] Right hemisphere areas in prefrontal cortex and cerebellum were active in proportion to the number of new solutions generated: the authors conclude that the **right** prefrontal cortex is playing a 'critical', and 'necessary (though not sufficient)' role.
3. A further study provides evidence which according to its authors 'partly' favours the **right** hemisphere over the left, and possibly 'non-conscious' processes.[42]

4. A study of musicians found that (a) they were better at divergent thinking than non-musicians, and (b) recruited the **right** hemisphere, in addition to the left hemisphere that was relied on by non-musicians. ‘Non-musicians may rely on a more left-lateralised, verbally mediated strategy that might hinder divergent thinking in this experimental context’.[43]
5. Another paper[44] shows that of the areas activated in highly creative individuals, the two largest and most significant were both in the **right** hemisphere, despite the fact that the task was a verbal one. ‘The score on the three creativity dimensions – fluency, originality, and flexibility– correlated with activation in **right** middle frontal gyrus and **right** rectal gyrus.’ The authors also cite their own previous study,[45] which found that creativity was associated with the **right** precentral gyrus, **right** postcentral gyrus, the **right** gyrus rectus, **right** inferior parietal lobule, **right** parahippocampal gyrus and **left** middle frontal gyrus. ‘Most of the brain areas that showed correlation were in the **right** hemisphere; however, correlations were observed in both cerebral hemispheres suggesting that creative thinking involves bilateral activation’, they conclude.
6. A further paper showed results ‘in line with the view that the **right** frontal lobe is more involved in spontaneous production of non-verbal representations, whereas the left lobe may exert control and secondary evaluative and verbal analysis’, expressing the sensible view that the left hemisphere comes in at a secondary level as a checking mechanism. They found that their ‘non-creative’ group relied predominantly on the left hemisphere, whereas what distinguished the ‘highly creative’ group was that they recruited the **right** frontal cortex in addition.[46] This has been borne out in other studies of creativity.[47]
7. A study of a neurochemical marker for cognitive ability, *N*-acetyl-aspartate, in relation to creativity found that it was its distribution in the **right** hemisphere, not the left, that ‘predicted higher levels of creative potential as measured by divergent thinking tests.’[48] However, the authors reasonably enough conclude that anything ‘as complex as creativity will never be localised in the brain’. I’d emphasise the word ‘localise’: we need to look at the global hemispheric picture, as always.

8. The last paper[49] we have looked at already: it found an association in the posterior right hemisphere EEG with a high degree of originality. It did not, however, find the association on functional imaging scans, where it found, instead, strong activations across most subjects in the **left** frontal region.[50]

Once again, there is the finding in four papers (paragraphs 4–7) that the pattern is critical reliance on the right hemisphere in high creativity, less so or not at all in low creativity, and in one case actually reversed (paragraph 6) in low creativity, replicating a finding in the EEG series that we have just seen. This is likely to indicate that less creative people rely more on linear, sequential, mechanical processes for coming up with new ideas.

Imaging studies in this sort of situation are less reliable than almost any other sort of information. This is because it is not the mere *fact* of involvement, but the *nature* of the involvement that counts – something that requires interpretation. When you switch on a car engine, the fan starts busily whirring, but it doesn't propel the car. Compare the pre-ignition and the post-ignition states, however, and it will stand out as an area of reliable, highly localised and consistent change, compared with, say, the more diffuse, intermittent activity of the system of gears. The particular problems with functional imaging are legion, and many of them I have discussed already, so I won't recap them here. But, more generally, it's hard to tell from looking at a scan what is crucial. The extent of the involvement *on its own* can't be the key, not just because diffuse but significant activity over a larger area will not show up, compared to local but persistent activity in a less significant one; but because, even in contrasting a scan during the resting state with one during the activity under investigation, it may not be the *absolute* extent of an area's involvement in the second condition that matters, but the change *relative* to baseline that is likely to matter (for example, a change from 50 to 600 is more significant than a change from 1,500 to 1,600). And then there is what I have called the SAS effect– an apparently small addition may be the critical factor. I have discussed all of these previously. What that all adds up to is this: the scans are far from worthless, of course, but one needs, as always, to be guided in how to interpret a scan by as much information *from sources other than neuroimaging* as one can find. As we have seen most of that evidence,

much of it from lesion studies, roundly supports the key role of the right hemisphere: but Dietrich and Kanso ruled that out from the start.

How could Dietrich and Kanso have got it so wrong? Easy. Dietrich, at any rate, is an evangelical graduate of the School of Nothing Buttery. A look at the chapter titles from his book on creativity is revealing: ‘Flow experiences: from mystery to mechanism’, ‘The brief and frightening reign of the right hemisphere’, ‘Linearising pandemonium’, ‘Exorcising the ghost in the machine’. Poor chap – clearly terrified by anything that is not linear, mechanical and under control. Elsewhere he writes:

> There is nothing *mystical* or *sacrosanct* about the *mechanisms* giving rise to this mental phenomenon. Progress on the neuroscience of creativity can only occur if we fully expose Cartesian muses for what they are: *teddy bears for grownups*. This is not to say that neuroscientists understand yet what happens in the innards of the *machine* when we are creative, but I hope to show here where we are and where we are going on this matter … Without a path towards such an ersatz explanation, we have little hope to lift the dense fog enveloping our beliefs in the specialness of the creative process, the instinctive tug we feel that the creative spark comes from on high.[51]

‘Teddy bears for grownups’? Sounds more like a case of toys being thrown out of the pram to me. The cards are a little stacked here, so there’s not much point in taking this intriguing paragraph apart, since I am sure my readers can see for themselves its merits; though I note the obligatory cheery promise that we will find the innards of a machine if we only look a little harder for a little longer.

APPENDIX 2

HOAXES ARE NOT CONFINED TO THE FIELD OF SCIENCE

After making only minor changes to the opening chapter and plot synopsis of one of Jane Austen's novels, journalist David Lassman sent it to 18 of the biggest publishing houses in Britain. Every one turned it down. He then repeated the experiment with a further two of her novels, with the same result. Only on one occasion did anyone show signs of having spotted the theft from Jane Austen, and that, possibly, only because one of the proffered texts cheekily began with the unaltered opening line of *Pride and Prejudice*, probably the most famous such line in the English language: 'It is a truth universally acknowledged, that a single man in possession of a good fortune must be in want of a wife.'[1]

It is worth devoting a few paragraphs to the two most celebrated hoaxes in the world of humanities publishing: the Malley affair and the Sokal affair.

Back in 1943, two decriers of modernism, James McAuley and Harold Stewart, invented a poet called Ern Malley, and 16 poems which they attributed to him, submitting them to the Melbourne magazine *Angry Penguins*. The editors of the magazine were so taken with the poems that they devoted a whole issue to them, presumably enraptured by the fact that they could make no sense out of them, since, according to the authors, none was put there consciously by themselves: 'We opened books at random, choosing a word or phrase haphazardly. We made lists of these and wove them in nonsensical sentences. We misquoted and made false allusions. We deliberately perpetrated bad verse, and selected awkward rhymes from a *Ripman's Rhyming Dictionary.*'[2]

Readers of *The Master and his Emissary* will know that I am not a fan of pretentious nonsense in contemporary art, and I accordingly applaud the audacity of McAuley and Stewart, much as I applaud the exhibition of the Parisian painter Pierre Brassau in 1964.[3] Art critics, journalists, and students, glasses of wine in hand, silently contemplated Brassau's creations. Their praise was almost unanimous. Rolf Anderberg of the *Göteborgs-Posten* later wrote that most of the works at the show were 'ponderous', but not those of Brassau:

> Pierre Brassau paints with powerful strokes, but also with clear determination. His brush strokes twist with furious fastidiousness. Pierre is an artist who performs with the delicacy of a ballet dancer.

One lone critic panned Brassau's work, declaring 'only an ape could have done this'. As it turned out, this was correct. Pierre Brassau was, in fact, an ape. Specifically, he was a four-year-old West African chimpanzee named Peter, from Sweden's Borås Djurpark zoo.

But of course the difficulty here is in adjudicating value: McAuley and Stewart may have consciously tried to be nonsensical, but unconscious associations are what poetry is about – and they wouldn't have been conscious of them, would they? They might have produced, despite themselves, some good lines (the chimp might even have daubed a good daub). I've read considerably worse. After all, one strand in modernism, absurdism, actually advised such 'aleatory' processes as a way of writing. In 1961, as a gesture of defiance, the editor of *Angry Penguins* re-published the Ern Malley poems, maintaining that whatever McAuley and Stewart had intended to do, they had, in fact, produced some memorable poems, presumably confirming the absurdist point the authors had hoped to deflate.

Another famous example of such a sting from the humanities is that perpetrated by Alan Sokal, a professor of mathematics at University College London, and of physics at New York University. In 1996 he submitted an article, which he considered to be a farrago of pretentious nonsense, to a journal called *Social Text*. He presented himself as someone from the science world who was prepared to rethink its dogmas in a postmodernist framework. What he submitted was not computer-generated, but it was pretty richly interspersed with fashionable jargon and unverifiable claims. Its thrust was that the findings of science were more or

less entirely socially constructed (not at all a position, incidentally, that I would support, though I would not support the idea that they were always wholly immune from social construction, either: in philosophy things are rarely cut and dried).

However, the impartial observer cannot help noticing that this is not in the same league as the cases from science publishing. First of all, it was, at least, written by a human being, and read and considered by real, human, editors: that is, it got to first base. It made at least superficial sense, even if Sokal had made an effort to be vacuous, delivering what he called ‘a pastiche of left-wing cant, fawning references, grandiose quotations, and outright nonsense’.[4] In addition Sokal’s claim for his article’s vacuity relies partly on having invoked ideas that are just ‘known’ by all right-thinking scientists to be false, such as that of morphic resonance, an idea formulated by Rupert Sheldrake, and that therefore just mentioning them should be enough to evoke dismissive hilarity. Sheldrake is an unashamedly controversial scientist. He is a man who, with five publications in *Nature*, a journal in which most scientists would be overjoyed at getting even one publication in an entire lifetime, a Frank Knox Fellowship at Harvard in science and philosophy, a Fellowship at Cambridge University in biochemistry and cell biology, and a Research Fellowship of the Royal Society (Britain’s most ancient, and most prestigious, scientific body) behind him, is quite capable of practising conventional science at the highest level. However, because he dared to take seriously ideas that are commonplace in oriental traditions, as well as being found in the writings of, in the West, for example, Goethe, the editor of *Nature* John Maddox entitled his review of Sheldrake’s thoughtful and confessedly speculative book on morphogenetic fields, ‘A book for burning?’ Maddox lived to express regret at this turn of phrase. But this is what scientists, unfortunately not quite as devoid of dogma as their own dogma suggests, sometimes inflict on one another, to the detriment of openness and scientific progress.

Sokal’s editors claim that they ‘requested him (a) to excise a good deal of the philosophical speculation and (b) to excise most of his footnotes’, in which some of his riper remarks featured, but apparently he declined. While some of the ideas that Sokal just assumed must be nonsense may indeed be so, some may not. I do not say that a more robust piece of nonsense could not get past editorial scrutiny and into print in some humanities journal. I

am sure it could. Indeed Peter Boghossian's brilliant hoax piece, 'The conceptual penis as a social construct', was published in a journal called *Cogent Social Sciences* without a murmur, claiming that 'the penis *vis-à-vis* maleness is an incoherent construct'.[5] In retrospect the name of the journal would appear to have given hostages to fortune. But given some of the material that gets into print in science, the Sokal affair can't, at the very least, be claimed to be a problem exclusive to 'far out', fringe leftist publications in the humanities, never mind of the humanities in general.

More recently the Sokal hoax has been repeated with blatant nonsense being submitted by three scholars to journals in fashionable subdisciplines. At least seven such papers were accepted for publication. Their offerings include ones that argue that dogs experience rape culture, and might 'suffer oppression based upon (perceived) gender', that men who masturbate while thinking about a woman without obtaining her consent are perpetrators of sexual violence, and that 'western astronomy' is sexist and imperialist, such that physics departments should study feminist astrology – or practise interpretative dance – instead. This has been dubbed Sokal Squared.[6]

APPENDIX 3

WHY WE SHOULD BE SCEPTICAL OF 'PUBLIC SCIENCE'

This evidence should not be read in isolation from its context in the overall argument of Chapter 13.

Wider political and economic forces outside the world of science have their impact, and may contribute to undermining the credibility of science itself. For instance, it has been known for years that low fat regimens lead to no improvement in all-cause mortality figures – partly because low fat makes people anxious, and increases levels of accidents and suicides. More recently 20 years of public 'health management' on this issue, in the name of science, was declared not just to require reformulation in the light of new evidence, but never to have had any basis in fact.[1] Meanwhile an investigation by the *BMJ* had produced suggestive evidence that the official US government advice on diet had deliberately ignored inconvenient science:

> The overall lack of sound science and proper methods in the 2015 report could be seen as a reluctance to depart from existing dietary recommendations. Many experts, institutions, and industries have an interest in keeping the status quo advice, and these interests create a bias in its favour … it's important to note that in a field where public research dollars are scarce, nearly all nutrition scientists accept funding from industry.

But, the author continues: 'of far greater influence is likely to be bias in favour of an institutionalized hypothesis [one widely accepted by the

science establishment] as well as a “white hat” bias to distort information for what is perceived as righteous ends.’ [2]

The prevalence of the ‘white hat’ phenomenon is extraordinary and fascinating in its own right.[3] This refers to the tendency for people in positions of influence in science policy units to think that because they just know, without going through the tedious process of examining the evidence, that, for example, fat, or salt, or alcohol, must be, in general, dangerous to the health of a nation, the very respectability of science would be at stake were these private fantasies not to be supported (in the early twentieth century similar attitudes could be found applying to homosexuality, masturbation and refusal to wear a vest). This tendency inevitably produces the opposite result, because unjustified claims redound to the discredit of science. It is not science, may I reiterate, that is at fault here, but the irresistible urge in some people to exert power, especially if it involves interfering with pleasure. Damagingly, it takes place in the name of science. And much of it, because it is the public face of science, is taken by the public at large as being the voice of ‘science’ – when it is really the voice of over-regarded bureaucrats. For this reason health recommendations deserve a little scrutiny.

I do not set myself up as any kind of authority on dietary health, nor am I giving any kind of health advice. Fortunately that is not my job. Nor do I have to attempt to give a full and impartial summary of the scientific evidence on these matters: that is the onerous duty of public science bodies. Mine is the very much easier task of demonstrating how blatantly they fail: to act, if you like, for a while, the gadfly on the opulent rump of public science.

Recently the salt issue has come back into focus. Despite clear evidence that we are focussing on the wrong white crystals – salt, rather than sugar – there is still, according to many experts, ‘a very strong need’ to raise awareness of the adverse consequences of *low* salt intake, in order to ‘facilitate better clinical guidance.’[4] I have no privileged information on this topic, but it has been suggested that the sugar industry put a lot of money into turning the spotlight on salt and fat, partly in order to deflect attention from the damaging effects of sugar, and partly because commercially produced food that is low in fat and salt has to be rendered palatable by the addition of sweetness.

Most people would be surprised to learn that low sodium actually causes the laying down of fatty plaque in arteries.[5] A 16-year follow-up study found people with *higher* combined intakes of sodium and potassium had the lowest blood pressure.[6] A major study in the *Journal of the American Medical Association* in 2011 found that higher salt consumption not only did not increase risk for hypertension (abnormally high blood pressure) and did not increase risk for cardiovascular problems, but on the contrary low salt consumption predicted higher cardiovascular mortality.[7] The fairest assessment appears to be that there is a J-shaped distribution, with very low levels and (in some people) very high levels carrying risks.[8] But blanket reductions in the general population, rather than in a small, carefully targeted population, are not justified, and may actually cause harm.[9] Even in patients with congestive heart failure, those on a normal, rather than a reduced, sodium diet required significantly fewer readmissions to hospital and did better on a range of markers.[10]

James DiNicolantonio, a cardiovascular research scientist who is also Associate Editor of *BMJ Open Heart*, the *British Medical Journal*'s specialist cardiology publication, points out that contemporary levels of salt consumption are at a historic low, and that consumption of salt in periods for which we have estimates – Roman times, and during the last several hundred years throughout Europe – was probably at least twice, and even up to 10 times, what it is today, since it was a principal means of preserving food in an era before freezers.[11] During the last 100 years hypertension has tripled in the US, while salt consumption has remained stable. Hypertension and heart disease simply do not parallel salt consumption – indeed if anything, as he demonstrates, they are inversely proportional. According to him, the salt–blood pressure hypothesis was invented by two French scientists in 1904 based on just six patients.[12] Since then, 'research mis-steps, arrogance, funding conflicts, [and] a stubborn refusal to relent' have resulted in bad science – and these factors are, according to DiNicolantonio, still present today. The story makes fascinating, if troubling, reading.

Our bodies carefully regulate the amount of salt, through taste, to make sure they get what they need. Our own age is no exception to the historical norm. Animals and humans die without salt, as it is essential to normal human physiology; it is dangerous to try to eliminate it, or even severely to reduce it, in human diet. A low sodium regime is associated with

depression, as well as with reduced libido and fertility, not to mention erectile dysfunction, fatigue and sleep problems.[13] We have been actively harvesting or mining salt for at least 8,000 years, and it is no doubt far from coincidental that wars have been fought over it, and that, according to Pliny, soldiers were once paid in it (the origin of the term *salary*).[14] We need it in order to be healthy, and that is, no doubt, one of the reasons that nature has ensured we sense that food without salt is unspeakably dreary.

But this has not stopped public scientists telling us that we should drastically reduce salt intake in the interests of health. One influential mid-twentieth-century doctor and research scientist intoned:

> There must be total war. Attacking one factor is not enough. Reducing the sodium is not enough; reducing cholesterol is not enough; reducing fluid and amino acids is not enough. Simple reduction is not enough … [15]

A cross-sectional study of salt levels and blood pressures in 52 populations, called 'Intersalt', is often cited as support for the hypothesis that salt consumption parallels rises in blood pressure, but the data are contradictory.[16] Four of the populations (Kenya, Papua, and two Indian tribes in Brazil) do have low levels of salt and blood pressure. Across *the other 48* populations, however, blood pressures go down as salt levels go up —contradicting the hypothesis. This aspect is not often reported. Nor is a large well-conducted general population study at the individual level, contradicting the salt hypothesis, which happens to have been published in the very same issue of the *BMJ* as Intersalt– but has received much less publicity (about a sixth the number of citations to date).[17] Why? David Freedman, a professor of statistics and mathematics at the University of California, Berkeley, and Diana Petitti, an epidemiologist, think they may know one reason:

> One segment of the public health community—funded by the National Heart Lung and Blood Institute and endorsed by many journals in the field—has decided that salt is a public health menace. Therefore, salt consumption must be drastically curtailed. The force with which this conclusion is presented to the public is not in any

> reasonable balance with the strength of the evidence. Programs, once in place, develop a life of their own; the possibility of health benefits becomes probability, and probability becomes certainty. After all, the public is easily confused by complications, only professionals can weigh the evidence, and where is the harm in salt reduction? The harm is to public discourse. The appearance of scientific unanimity is a powerful political tool, especially when the evidence is weak. Dissent becomes a threat, which must be marginalized. If funding agencies and journals are unwilling to brook opposition, rational discussion is curtailed. There soon comes about the pretence of national policy based on scientific inquiry—without the substance. In our view, salt is only one example of this phenomenon.[18]

And in any impartial observer's view there are numerous others. The case against salt is not proven. Let us turn to the problem of alcohol.

In Britain, warnings about the risks of alcohol are frequent and repetitive. Recently both men and women have been warned to limit alcohol intake to 14 units a week, and reduce the number of drinking days. How scientific is all this?

In July 2015 an 'epidemic' of alcohol abuse was reported among the better-off middle class in Britain. This was a somewhat puzzling time to detect an epidemic, since alcohol consumption in Britain had been falling steadily, year on year, for the previous 10 years. Moreover, the paper, which triggered a flurry of newspaper reports, stated that 'people in better health, higher income, with higher educational attainment and socially more active are more likely to drink at harmful levels'. (Apologies for the grammar, which is not mine.) Though presented as news, it was anything but: similar findings had, in fact, been available for 25 years from all over the world – certainly from Sweden, Belgium, the US and even India. The report concluded:

> people aged 50 or over ageing 'successfully' in England are more at risk of drinking at harmful levels … than those who fit less well into the paradigm of ageing 'successfully'.[19]

How, one wonders, could this have been seen as a problem, let alone an epidemic? The facts presented lead to the conclusion that the inverted commas should be round the word ‘harmful’, not ‘successfully’. When the data don’t fit a study’s assumptions, the preferred response is to review the assumptions, not struggle to make the data say something they – clearly – don’t. I wondered if journalists had simply failed to report something crucial here, such as that these successful, well-educated, sociable, healthy people were in for a terrible shock. In a few years’ time they would be dying early of their habit. After all, cancer has been known for a long time to have an association with alcohol in some cases, though to a relatively small extent. Interestingly, impressive data on cancers and alcohol were published a few days later in the same prestigious journal, the *BMJ*.[20]

This was a definitive study, involving over 88,000 subjects followed up over 24–30 years: it would be hard to find a better data set. One of the declared aims of the study was specifically to separate the effects of drinking alcohol from those of smoking, an issue that had hitherto ‘not been settled’. They found, as expected, a risk from drinking and smoking. But having separated out the risk from drinking from the risk from smoking, they conceded that the ‘independent influence of alcohol, especially in the range of light to moderate drinking, could be minimal’. That is probably an understatement, since their own data show that, after removing the effect of smoking, in men there is not only no significant overall increased risk of cancer of all kinds at light to moderate drinking levels, but none in the group of those termed ‘harmful drinkers’, either. In women there is a small rise in the risk of ‘alcohol-related’ cancers, a relative risk of between 1.1 and 1.2, ‘driven’ by breast cancer. But that must itself be contextualised. The annual risk in the UK of dying of breast cancer (for women) in 2017 was 33 in 100,000 – presumably lower now, as it has been dropping for years.

Most people die of cancer or cardiovascular disease. You might wonder, since cancer is not responsible, if there was, then, a significant tendency for alcohol to increase death from cardiovascular causes. This seems highly unlikely. According to the Harvard School of Public Health,

> more than 100 prospective studies show an *inverse* association between moderate drinking and risk of heart attack, ischaemic (clot-caused) stroke, peripheral vascular disease, sudden cardiac death,

and death from all cardiovascular causes. The effect is fairly consistent, corresponding to a 25% to 40% reduction in risk.[21]

Now that is far from being a negligible effect: a considerably larger *protective* effect than even the more highly publicised 10–20% increase in risk of breast cancer for women, and one that would make a pharmaceutical company, if it could patent and market alcohol, rich.

Another candidate might have been diabetes. However, a huge follow-up study from Denmark, looking at over 77,000 people over a period of five years, confirmed previous extensive evidence of the protective effect of alcohol,[22] demonstrating that no level of drinking included in their study (their cut-off was 40 units a week for men, 28 for women) was associated with as high a risk as not drinking at all. The maximum benefit was associated with drinking 14 units a week in men, and 9 units a week in women, associated with a very large reduction in risk – 40% in men and 60% in women. At no level did the risk return to, still less exceed, the level of risk associated with not drinking.[23] This did not, as far as I am aware, get much coverage. I imagine this has to do with the 'white hat' syndrome: everyone just knows that alcohol can only cause harm.

In October 2015 there were warnings of dementia. 'Health authority urges people to reduce alcohol intake, stop smoking and eat more healthily when they hit 40 to avoid ill-health in later life', read a headline in *The Guardian*, a respected liberal British newspaper, referring to new 'guidance' from NICE, the government-sponsored National Institute for Clinical Excellence. Since smoking and gross obesity are certainly important risk factors for ill-health, I was curious to know what effect alcohol contributed.

I consulted each of the four papers proffered by NICE in evidence. Three of them referred to socioeconomic factors affecting drinking and access to 'treatment', without however presenting evidence that 'treatment' was necessary. The authors at the same time acknowledged that getting people to change is difficult because of the 'pleasure associated with drinking'. When the evidence about the impact of drinking on 'health and quality of life' was explicitly addressed, the authors concluded: 'No evidence found'. The fourth report advised that no recommendations should be made about drinking levels, since the authors had no way of identifying what safe or unsafe meant here.[24]

Early in 2015, a study had reported in the *BMJ* that, in a group of Alzheimer's patients, moderate alcohol consumption was associated with a significantly lower mortality over the year and a half of the study.[25] But NICE could hardly have done better than refer to a huge systematic meta-analysis of the evidence from 45 studies on alcohol and dementia, also published in 2015 in *Current Clinical Pharmacology*.[26] It found that 'light to moderate drinking may decrease the risk of Alzheimer's disease and dementia, whereas heavy to excessive drinking does not affect the risk'. The authors conclude that there is insufficient evidence to suggest abstainers should actually take up drinking on health grounds.

In February 2016 *The Times* reported Britain's then Chief Medical Officer, Dame Sally Davies, as saying that a 'single drink is one too many', advising that consumers should think of cancer every time they held a glass of wine or poured a can of beer. This bizarre pronouncement has done little to improve the credibility of public science.

As I write, a study of the US population has been published online, looking at factors that determine longevity, and a life free from disability, in a large sample of 'nationally representative' subjects aged between 50 and 74, taken from the Health and Retirement Study, 'a high-quality ongoing longitudinal survey on health among Americans aged fifty and older and their spouses that began in 1992'. This particular study focussed on three factors: obesity, tobacco use and drinking habits, yielding seven possible categories: obese, non-obese; never smoked, ever smoked; and heavy, moderate and 'non- or irregular' drinkers.

In both men and women, hardly surprisingly, the earliest onset of disability was in the obese group. But of all seven groups, in women the *latest* onset of disability was in the moderate drinkers, followed by the heavy drinkers. In terms of longevity, moderate drinkers were the longest lived of all, *followed* by never smokers, and, next, heavy drinkers. The shortest lived were smokers, followed by 'non- or irregular drinkers'. In men, of the seven groups, those with the latest onset of disability and the longest lived were the never smokers. In terms of longevity, non-smokers were, however, closely followed by the moderate, and then by the heavy, drinkers. Once again, apart from smokers, the shortest lived were the 'non- or irregular drinkers'.[27]

This is a powerful study whose results are worth knowing. Not only can I not remember it being reported in the press, but the abstract of this paper,

which is all that most people will read, or the final section, which is actually entitled ‘Policy Considerations’, says nothing of the effect of alcohol on both postponing disability and increasing longevity. Instead the only mention of alcohol under ‘Policy Considerations’ is that there is ‘solid evidence of the effectiveness of financial “sticks” such as taxes’ on decreasing its consumption, and a suggestion that policies should discourage ‘immoderate alcohol consumption’. ‘Immoderate’ is, of course, one of those words that brooks no argument and begs all the questions, and of course there is evidence that at some point it becomes harmful: but the point is that, from a purely scientific point of view, this paper does not contain any. It has only positive things to say about drinking at all levels – except the lowest, which could be construed as a serious risk. If the paper’s authors are really concerned either with science or with helping people lead long and happy lives this should be one of their most publicised findings.

The latest paper to hit the headlines is from the Institute for Health Metrics and Evaluation (IHME) funded by the Gates Foundation.[28] The fashionable but unscientific message seems to have blinded the editors of *The Lancet* to the quality of the research, which they, for some reason, decided to publish. The study, using a methodology described by Sir David Spiegelhalter, Winton Professor for the Public Understanding of Risk at the University of Cambridge, as ‘complex (and rather opaque)’, concludes there is no safe level of drinking, and, as is often the case, calls for a concerted campaign of excise taxes on alcohol, limited physical availability of alcohol, reduced hours of sale, and curbed alcohol advertising, amongst ways of reducing alcohol consumption. According to Spiegelhalter, if the authors had looked at all-cause mortality they would have found ‘a dramatically higher risk in non-drinkers’ – which is in keeping with what we have consistently seen. He calls the authors’ conclusions ‘bizarre, to say the least’, and having looked at some of the reasons why they reached such deeply flawed conclusions, concludes ‘whatever the cause, it would seem inappropriate that this paper, as it stands, is part of the scientific literature’. He noted that the paper’s ‘apparently spurious conclusion is now being quoted uncritically in media stories in the *Daily Mail*, *Daily Express* and *Evening Standard*’.[29] Which indeed it was.

The report begins by identifying a range of conditions to which alcohol can be a contributory factor and then estimates what that means in terms of the global contribution of alcohol to risk. It neither takes into account the

benefits, nor, contrary to good practice, reports absolute risks (rather than relative risks), nor asks what level of risk we are willing to tolerate. This is like starting from the observation that there is a range of illness or injury to which football can contribute, ranging from joint injuries, to fractures, to heart attacks, to head injuries, and then multiplying up by the number of people who play football worldwide. Unsurprisingly you will discover that there is no level of football that does not carry a risk, and that its worldwide burden is significant. The implication then would be that the government should do everything in its power to prevent football. Such a report might state that you increase your chances of breaking a limb *threefold*, without telling you that your chances of breaking a limb are generally very low, about 0.5%, and that a threefold increase still means only 1.5%, not a high risk – and one that many would willingly accept in order to have the pleasure of taking part in a sport (hence the need to report absolute, not relative risks). And it doesn't tell you that football carries benefits – as even the riskier businesses of swimming, riding and skiing do.

An alcohol study based on these principles doesn't take into account the benefits that are uncovered only by longitudinal studies of individuals, such as the Health and Retirement Study discussed above, or a scientifically superior paper published only four months earlier in *The Lancet*, which found that 'in current drinkers of alcohol in high-income countries, the threshold for lowest risk of all-cause mortality was about 100 g/week.'[30] You need to follow real individuals, not make a lot of assumptions from aggregated data from grossly different cultures and fail to include comparisons with all-cause mortality.

As Spiegelhalter commented, the data in the IHME study showed only a very low level of harm in moderate drinkers and suggested UK guidelines were very low risk:

> Given the pleasure presumably associated with moderate drinking, claiming there is no 'safe' level does not seem an argument for abstention … There is no safe level of driving, but government do not recommend that people avoid driving. Come to think of it, there is no safe level of living, but nobody would recommend abstention.[31]

My purpose, clearly, is not to argue that alcohol is harmless: of course not. I am a physician. I know how gross excess can destroy careers and families, health and happiness. It can be lethal. At one time I was the medical consultant to a team of skilled therapists that helped many alcoholic patients to quit their habit, which for them had become damaging. But there are pleasures, even virtues, in alcohol, known since the dawn of civilisation. This is an area for balance, not hysteria.

The hectoring by bureaucracies is unhelpful. The original recommended levels for the safe consumption of alcohol in Britain are known to have been plucked from thin air (I have that on the authority of someone who sat on the committee that produced the recommendations). Reducing them is about as scientific. The only thing that had a basis in science, and a well-established one, was that women tolerate alcohol less well than men.[32] That was removed from the 'guidance', presumably because political correctness trumps reality.[33]

I have spent a little time on this because it so beautifully exemplifies two things germane to my overall argument: that true science is not at fault, but is brought into disrepute by the arrogant claims of those who speak in its name, claims which often flatly contradict the evidence; and that balance and harmonisation are less important in a left hemisphere-dominated culture than linear thinking. Such thinking gives power to bureaucrats and administrators, without simultaneously furnishing them with an understanding of what life is about. Science, both in the specialist research arena, and in the public arena, is being betrayed by such left hemisphere ways of thinking.

In Britain, the pub has for a thousand years been one of the mainstays of community life. Social connectedness is, for the health of a people, more important than anything else – and that means for both their mental and physical health.[34] So marked are the effects of social connectedness on health, not to mention happiness (without which there is little point in health), that they outstrip even those of diet, exercise and smoking. Laws that aim to reduce risk to zero are pursued by committees whose raison d'être is to carry on pushing until they succeed in enforcing total abstinence. It is not to be expected that they will think about the massive downside associated with trying to shield us from risk, so as eventually to die without having lived. We should push back.

Somebody memorably described life as a sexually transmitted terminal disease. Nothing in this world is safe: the art of life is balancing risk with richness. As Paracelsus said, ‘Everything is poison – only the dose makes the difference’. Surely not water, you might say? Yes, even water can be toxic in gross excess, leading to a rare condition (not, however, so rare that I have not seen it in clinical practice more than once), known as central pontine myelinolysis, a degradation of the nerves in part of the brainstem called the pons, which is potentially fatal.

And so can food be fatal. Clearly the obese die young, as well as impairing their quality of life in a host of ways: that is uncontested. But is it good to be thin? And what is fat? A major study published in March 2016 suggested that ‘a large proportion of US adults are misclassified as cardiometabolically unhealthy according to BMI [body mass index] categories’: overall misclassification in both directions caused by relying on BMI affected about 75 million individuals in the US alone – almost a quarter of the entire population.[35] In 1985 two British scientists, JS Garrow and JD Webster, had decided which BMI should be officially classified as overweight. It was a rough estimate, and one that fitted the leaner 1970s population. One scientist is quoted as saying: ‘The cut-off for overweight was made to be a BMI of 25. Partly it was a nice round number.’[36]

Finally, there is the successfully marketed idea that we are all dehydrated. Much of the ‘research’ into this area is funded by water bottling companies, that cause huge pollution by freighting water round the globe, contribute to the plastic detritus that ends up in the oceans, and leave people feeling anxious and vulnerable. Though it has never been a consistent pronouncement of public science, the craze for bottled water reveals the deleterious impact of commerce on common sense. No-one knows where the idea that you need to drink ‘8 × 8’ (8 glasses of 8 oz of liquid per day), or even the more modest six to eight glasses of water a day, comes from.[37] Possibly it comes from the fact that that’s about what you consume anyway, including in food, if you don’t think about it. But the idea that explicitly more and more is better for you is baseless. The idea is promoted by organisations that have the backing of Danone (who produce Volvic, Evian, and Badoit) and other bottled water manufacturers. There is no good evidence that you need to do any of this, or that bottled water is better for you than tap water, although it undeniably causes significant harm to the environment through the needless generation of plastic waste and the

transport of huge volumes of water from place to place – something that only started happening, ironically enough, when tap water became safe to drink almost everywhere in the developed world for the first time in history. It is also the same people who are keen on ‘listening to’ their bodies that carry round bottles of water; in this, oddly like mothers that believe in their children’s independence, yet make sure that they are independent by following their every move. Thirst alone is apparently no longer good enough as a suitable measure of water requirement. If you lose sight of your water bottle in spite of all warnings, you can now download a drinking app for your mobile phone. A shrill beep then reminds you at regular intervals that the body’s water level has fallen again, and that urgent replenishment is needed.

In all processes there is a balance to be struck. There is always such a thing as enough. One rarely hears, however, of an administrative body concluding that it has now done enough. Once invented, it carries on pushing in the same direction, marching to the same slogan, even if the reason for adopting the slogan no longer applies – and currently there are few mechanisms for stopping its progress. This is not just a problem in science, of course: it is a prevailing problem of modern life.