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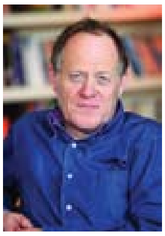

Why Us? Dualism Resurgent

James Le Fanu

The 'D' word can scarcely be uttered in the corridors of our universities. However, as James Le Fanu argues here, science has inadvertently broken the stranglehold of materialism through the surprising findings arising from the Human Genome Project and the Decade of the Brain.

'Wonders are there many,' wrote the Greek playwright Sophocles, 'but none more wonderful than Man' and rightly so, for we are (as far as we can tell) not just the sole witnesses of the splendour and beauty of the world around us, but through the powers of reason and imagination of our extraordinary minds, uniquely equipped to comprehend it. For Sophocles, as with most philosophers and scientists for the next two thousand years, this recognition of Man's 'exceptionality' and the beauty and diversity of the living world provided probably the most powerful evidence for there being a dual nature of reality encompassing both a material and non-material domain.

This is scarcely the prevailing view. Rather, the methodology of modern science is predicated on denying the reality of the non-material in favour of exclusively materialist explanations. Readers of Network Review will be more than familiar with the substantial problems and limitations of such a view. But less well appreciated, for it is only now becoming apparent, is that in the very recent past the findings of both genetics and neuroscience have turned out, quite inadvertently, to contradict the two central assumptions of materialist science – that the vast panorama of 'life' can be accounted for in terms of the material genes strung out along the Double Helix, and the human mind can similarly be accounted for in terms of the electrochemistry of the brain.

The Genomic Revolution

It all goes back to the mid 1980s when two major technical developments held out the prospect of finally and fully incorporating those twin enigmas of 'form' and 'mind' within the materialist domain. They were, first, the ability to spell out the *entire* sequence of genes (the genome) of worm, mouse, fly, man and many other organisms, and thus reveal the full set of genetic instructions that so readily distinguish one form of life from another.

'The search for this 'Holy Grail' of who we are has now reached its culminating phase,' observed Harvard University's Walter Gilbert at the launch of the Human Genome Project in 1991. 'The ultimate goal is the acquisition of all the details of our genome … that will transform our capacity to predict what we will become.' The project would, claimed Professor John Savill of Nottingham's University Hospital, 'like a mechanical army systematically destroy ignorance' while 'promising unprecedented opportunities for science and medicine'.

The second innovation was the development of the sophisticated PET brain scanning techniques that would permit scientists for the first time to go beyond localising the many functions of the brain to discrete parts of the cerebral cortex, allowing them rather to observe the brain 'in action' from the inside, thinking, imagining, reflecting and acting on the world 'out there'.

The completion of the Human Genome Project in 2001 marked 'one of the most significant days in history,' as one of its architects described it. 'Just as Copernicus changed our understanding of the solar system … so knowledge of the human genome will change how we see ourselves.' At the same time Professor Stephen Pinker, the Massachusetts Institute of Technology writing in the journal Scientific American described how neuroscientists with their new scanning techniques had investigated everything 'from mental imagery to moral sense', and confidently anticipated 'cracking the mystery of the brain'.

Nearly a decade has passed since those heady days and looking back it is possible to see how the findings of both endeavours have enormously deepened our knowledge of life and the mind – but in a way quite contrary to that anticipated. The Genome Projects were predicated on the reasonable assumption that spelling out the full complement of genes would clarify, to a greater or lesser extent, the source of that diversity of form that marks out the major categories of life. It was thus disconcerting to learn that virtually the reverse is the case.

We start with the 'numbers problem'. The final tally of 20,000 human genes is, by definition, sufficient for its task, but it seems a trifling number to 'instruct', for example, how a single fertilised egg is transformed in a few short months into a fully formed being, or to determine how the billions of neurons in the brain are wired together so as to encompass the experience of a lifetime. That paucity of genes become more puzzling still when the comparison is made with the genomes of other creatures vastly simpler than ourselves – several thousand for a single cell bacterium, 17,000 for a millimetre sized worm and a similar number for a fly.

This equivalence in the number of genes across so vast a range of 'organismic complexity' becomes yet more baffling with the discovery that the 'master' regulatory or homeotic genes are virtually interchangeable between species. The implications of this conundrum are well illustrated by the eyes respectively of flies and mice, which are 'constructed' on a very different plan. The mouse eye is the familiar camera type while flies have compound eyes composed of sheets of lens at different angles. But the same 'master gene' known as Pax 6, it emerged, brings both forms of eye (and indeed all eyes) into existence – while inserting the mouse version of the gene (which in the mouse gives rise to a camera type eye) into a fly embryo gives rise to fly-like compound eyes. And so too the limbs where the same gene (distal-less) that orchestrate the formation of a fly's egg also instructs for the limbs of crustaceans, spiders, centipedes and chickens. How then, one might reasonably ask, does the same 'master gene' orchestrate the several thousand genes to produce such diverse structures appropriate to the organism to which they belong – bringing into being a compound-type here, a camera-type eye there, a spider's leg here, a lobster's pincher there, a fly heart here, a human one there.

These findings were not just unexpected, they undermined the central premise of modern biology: that the source of form and attributes that so definitively distinguish living things one from the other must 'lie in the genes': that the 'genes for' the delicate stooping head and pure white petals of the snowdrop would be different from the 'genes for' the colourful upstanding petals of the tulip, which would be different again from the 'genes for' flies and frogs, birds and humans. But the genome projects reveal the very different story, where the genes 'code for' the nuts and bolts of the cells from which all living things are made – the hormones, enzymes and proteins of the 'chemistry of life' and those interchangeable regulatory or 'master' genes – but the diverse subtlety of form, shape and colour that distinguishes snowdrops from tulips, flies from frogs and humans is nowhere to be found.

Put another way, there is not the slightest hint in the composition of the genes of fly or man to account for why the fly should have six legs, a pair of wings and the brain the size of a full stop and we should have two arms, two legs and our own prodigious-sized brain. These 'instructions' must be there of course, for otherwise flies would not produce flies and humans humans. But we have moved over the last decade from assuming that we knew the principle, if not the details, of that greatest of marvels, the genetic basis of the near infinite variety of life, to recognising we not only don't understand the principles, we have no conception of what they might be.

We have here, as the historian of science Evelyn Fox Keller puts it:

'One of those rare and wonderful moments when success teaches us humility … we lulled ourselves into believing that in discovering the basis for genetic information we had found the 'secret of life'; we were confident that if we could only decode the message and the secret of chemicals we would understand the 'programme' that makes an organism what it is. But now there is at least a tacit acknowledgement of how large that gap between genetic 'information' and biological meaning really is.'

There is, of course, no ready explanation why the findings of these genome projects should have been so contrary to those anticipated but it is relevant that the reason why the Double Helix has so dominated biology for the last sixty years, is that the simplicity and elegance of its structure held out the promise that the genetic instructions might be scientifically 'knowable'. But, on reflection, that simplicity of structure cannot be because it *is* simple but rather because it *has* to be simple in order to replicate the genetic instructions every time the cell divides. And that *obligation* to be simple requires, by necessity, the Double Helix to condense within the sequence of chemicals strung out along its intertwining strands, both the billionfold complexities of biological function and the diversity of form and attributes of the living world. This would seem to pose an impenetrable barrier to current understanding - whose implications will be considered after reviewing the similarly perplexing findings of neuroscience of the recent past.

Neuroscience: Observing the Brain 'in action'

The opportunity provided by those sophisticated scanning techniques to observe the brain 'in action' generated many novel insights into the patterns of electrical activity of the brain that looks out on the world 'out there', interprets the grammar and syntax of language, recalls past events and much else besides. But at every turn the neuroscientists have found themselves completely frustrated in their attempt to get at *how the brain actually works*.

Right from the beginning it was clear there was simply 'too much going on'. There could be no simpler experiment than to scan the brain of a subject when first reading, then speaking, and then listening to a single word such as 'chair'. This should, it was anticipated, show the relevant part of the brain 'lighting up' – the visual cortex when reading, the speech centre when speaking and the auditory cortex when listening. But no, the brain scan showed that each separate task 'lit up' not just the relevant part of the brain but generated a blizzard of electrical activity across vast networks of millions of neurons – while just *thinking* about the meaning of a word appears to activate the brain virtually in its entirety.

It is one thing to try to work out what is involved in the brain thinking about a word, but move into the real world with its ceaseless conversation, and the problem becomes insuperable. What sort of brain processes, one might ask, must be involved when a group of football fans convening in the pub before a match discuss their team's prospects for the coming season – drawing on a vast storehouse of knowledge and judgement of the form of previous seasons, the strengths and weaknesses of their players, and assessments of the performance of their rivals. How do they pluck from the storehouse of the memories the right words, or conjure from the rules of syntax and grammar the correct sequence with which emphatically to argue their opinion? How does the electrical firing of the neurons in the brain represent words and capture the nuance of their meanings?

The task of clarifying these (relatively) elementary questions became more formidable still when it emerged that the brain functions not, as commonly perceived, as an aggregate of distinct specialised parts, but rather fragments moment by moment the sights and sounds of the world 'out there' into a myriad of separate components – no less than thirty visual areas, for example, are concerned with colour, movement, the shape and position of objects and so forth. But, having done so, the brain then has no compensatory mechanism to reintegrate all those fragments back into the unique personal subjective experience of being at the centre moment by moment, of a coherent but ever changing world. Reflecting on this 'binding' problem, as it is known, Nobel Prize Winner David Hubel of Harvard University would observe:

'This abiding tendency for attributes such as form, colour and movement to be handled by separate structures in the brain immediately raises the question how all the information is finally assembled say for perceiving a bouncing red ball. It obviously must be assembled – but where and how, *we have no idea*.'

Meanwhile the fundamental perplexity of the *quality* (or 'qualia') of subjective experience remains quite unresolved: how the monotonous electrical activity of those billions of neurons in the brain 'translate' into the limitless range of experiences of our everyday lives, where every transient, fleeting moment has its own distinct, unique, intangible *feel*; where the cadences of a Bach cantata are so utterly different from a flash of lightning; the taste of Bourbon from the lingering memory of that first kiss.

The implications are obvious enough that while it might be possible to know everything about the physical materiality of the brain, its 'product' of thoughts and ideas, impressions and emotions, would still remain unaccounted for. So, for all that neuroscience has undoubtedly revealed we are left with five seemingly irresoluble 'Cardinal Mysteries' of the mind: subjective awareness, mental causation or 'free will', memory ('the seemingly limitless and enduring capacity of human memory is a deep mystery in itself' neurobiologist Robert Doty observes), the 'higher' functions of reason and imagination; and the sense of self or personal identity that changes over time yet remains the same, presiding over the inner life of subjective impressions and actions.

These may be 'mysteries' to science, but they are certainly not to ourselves. Indeed there is nothing we can be more *certain* of than the reality of our sense of self and our everyday perceptions of the world around us, our thoughts and memories. This distinction between the electrochemical activity of the material brain that might be knowable to science and the non-material mind (of thoughts and ideas) knowable only to ourselves as being two quite different 'things' might seem so self evident as to be scarcely worth commenting on. But for neuroscientists the question of how the brain's electrical activity translates into thoughts and sensations was precisely what needed explaining – and so as the late John Maddox, editor of *Nature*, acknowledged: 'We seem as far from understanding (the brain) as we were a century ago. Nobody understands how decisions are made or how imagination is set free.'

A Premature Verdict?

The verdict on these most unexpected outcomes of the Genome Projects and neuroscience might seem a trifle premature. These are, after all, still very early days, and it is far too soon to predict what might emerge over the next twenty or thirty years. The only certainty about advances in human knowledge is that they open the door to further seemingly unanswerable questions, which in time will be resolved, and so on. The situation here, however, is rather different for while those recent advances in genetics and neuroscience offer almost inexhaustible opportunities for further research, it is possible to anticipate in broad outline what their findings will add up to. Scientists could, if they so wished, spell out the genomes of each of the millions of species with which we share this planet – snails, bats, whales, elephants and so on – but that would only confirm that they are composed of several thousand similar genes that 'code' for the nuts and bolts of the cells of which they are made, while the really interesting question, of how those genes determine the unique form and attributes of the snail, bat, elephant, whale or whatever, would remain unresolved. And so too for the scanning techniques of the neurosciences, where a million scans of subjects watching a video of bouncing red balls would not take us an iota further in understanding what needs explaining – how the neuronal circuits *experience* the ball as being red and round and bouncing.

At any other time these twin setbacks to the scientific enterprise might simply have been relegated to the category of problems for which science does not as yet have the answer. But when cosmologists can reliably infer what happened in the first few minutes following the birth of the universe, and geologists can measure the movements of vast continents to the nearest centimetre, then the inscrutability of those genetic instructions that should distinguish a human from a fly, or the failure to account for something as elementary as a thought - or how we recall a telephone number - throws into sharp relief the limits of science's claims to knowledge. There is a powerful impression that science has been looking in the wrong place, seeking to resolve questions whose answers lie somehow outside its narrow materialist domain. This is not just a matter of not yet knowing 'all the facts', rather there is the sense that something of immense importance is 'missing' that might transform the bare bones of genes into the wondrous diversity of the living world, and the monotonous electrical firing of the neurons of the brain into the vast spectrum of sensations and ideas of the human mind.

Doubts about Darwin

There is more, for along the way the recent findings of genetics have also subverted, again inadvertently, the fundamental evolutionary premise of modern biology – that natural selection acting on the random mutation of genes is sufficient to explain the history of life and its billionfold complexities. It is, of course, possible that the millions of species living and extinct are all descended by modification from a single ancestor, but the most significant consequence of the findings of the Genome Projects is to transform all-encompassing certainties of that foundational doctrine into a riddle. Where, one might reasonably ask, is the evidence in those genome projects for those random genetic mutations that might transform one form of life into another. How to square the diversity of manifold forms of life with the finding of interchangeability of those master or homeotic genes? Again, while the dramatic palaeontological discoveries of the past three decades of the fossilised remains of our distant ancestors provides compelling evidence of man's progressive evolutionary ascent, why is there not the slightest hint in the human genome of the genetic basis of those unique attributes of the upright stance and massively expanded brain that so distinguish us from our primate cousins. 'We cannot see in this why we are so different from chimpanzees,' observed the head of the Chimpanzee Genome Project, Svante Paabo, on its publication in 2005. 'Part of the secret is hidden in there, but we don't understand it yet.' So 'the obvious differences between humans and chimps cannot be explained by genetics alone,' which would seem fair comment until one reflects that if those differences of brain size and the upright stance 'cannot be explained' by genes, then what *is* the explanation.

Thus, taken together, we find the astonishing legacy of the scientific findings of the recent past is that they have subverted no less than the *four* principal tenets of the materialist view: that the panorama of life and the human mind can be reduced to, respectively, the material genes and workings of the brain, and that Darwin's proposed evolutionary mechanism is sufficient to explain the wondrous diversity of the living world and ourselves.

The corollary is obvious for if science has undermined the tenets of scientific materialism then it is reasonable to suppose the source of man's exceptionality and the diversity of life belong, as long presumed, to a parallel non material domain with the capacity to conjure the unfathomable richness of form and mind from the bare bones of those genes and the electrochemistry of the brain. Meanwhile, having stripped away the comfort blanket of Darwin's all encompassing evolutionary mechanism, we are left to stare into the abyss of our radical ignorance about virtually every aspect of the history of life: the mysterious creative evolutionary force which from the beginning has elaborated ever more complex forms of organisation from the simplest elements of matter; the inscrutable origins of the primordial cell with its capacity to bring into being every form of life that has ever existed; the sudden, dramatic emergence of new forms of life from the Cambrian explosion onwards; the mechanism of those transitions from fish to reptile, to mammals, to birds, each stage initiating a further 'explosion' of millions of new and unique species.

It would take a much longer article than this to explore the consequences of this so unexpected insight with its wider philosophical implications for our understanding of ourselves. The substantial point remains that science has quite inadvertently broken the stranglehold of the materialist view on western thought – with consequences which we will be confronted with in ever greater intensity in the decades to come.

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Earthrise from Apollo 8, supplied by NASA and NSSDC