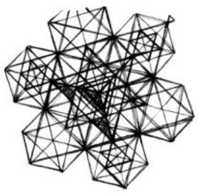
SURPRISING SCIENCE

James Le Fanu



There is something really fascinating going on in science at the moment, of particular interest to those for whom – to paraphrase Hamlet – “there is more in Heaven and Earth than can be dreamt of in [materialist] philosophy”. It is just ten years since the bastions of genetics and neuroscience were on the brink of resolving the most fundamental questions about ‘life’ and the ‘human mind’. The astonishing achievement of spelling out the full sequence of human genes, the Human Genome Project completed in 2001, marked “The closing phase of the search for the Holy Grail of who we are”, observed Harvard University’s Walter Gilbert; “Just as Copernicus changed our understanding of the solar system” remarked another of its architects, “so the knowledge of the human genome will change how we see ourselves”.

Simultaneously, positron emission tomography (PET) and similar scanning techniques were revolutionising neuroscience with their capacity to observe, for the first time, the brain ‘in action’ from the inside – thinking, imagining and looking out on the world ‘out there’. Professor Stephen Pinker of the Massachusetts Institute of Technology, writing in the journal Scientific American noted how these techniques had investigated everything “from mental imagery to moral sense”, and confidently anticipated “cracking the mystery of the brain”.

Both disciplines have proved immensely productive, generating thousands of millions of ‘bytes’ of basic biological data every week and a tidal wave of papers in scientific journals. Meanwhile the ingenious techniques of biotechnology have provided us with a range of useful therapeutic compounds – genetically engineered human insulin and growth factor, protease inhibitors for the treatment of AIDS, Herceptin and similar anti-cancer drugs and much more besides.
Yet, looking back over the last decade it is possible to see how the really significant findings of this great endeavour lie in a rather different direction, deepening our understanding of ourselves certainly – but in a way quite contrary to that anticipated.

The Human Genome Project, together with research describing the genetics of mice, flies, chimps and many others, were all predicated on the reasonable assumption that elucidating the full sequence of genes would clarify, to a greater or lesser extent, the source of that near infinite diversity of forms and attributes that mark out the major categories of life. However that is certainly not how it has turned out – rather the reverse, with a near equivalence of a modest 20,000 genes across the vast range of organismic complexity from the millimetre long worm C. elegans to ourselves. It is no less disconcerting to learn that the same regulatory or homeotic genes that cause a fly to be a fly cause humans to be humans. There is, in short, nothing in the genomes of fly or man to explain why the fly should have two wings, four legs and a dot sized brain and we should have two arms, two legs and a mind capable of understanding the origins of the universe. The genetic instructions must exist for otherwise those diverse forms of life would not reproduce themselves with such fidelity from generation to generation. We have moved in the light of these, and similar extraordinary findings, from supposing those instructions are at least knowable in principle to recognising we have no conception of what they might be.
It might seem futile to enquire why this might be so but the explanation must lie, at least in part, in the simple elegance of the double helix - the structure that for so long has held out the promise that its discovery might reveal ‘the secret of life’. On reflection, the simple elegance of that double helix structure cannot be because it is simple but because it has to be simple – if it is to copy the genetic material every time the cell divides. That obligation to be simple requires the double helix to condense, within the one dimensional sequence of nucleotides strung out along its intertwined strands, the billion fold biological complexities that determine the unique three dimensional form and attributes that so readily distinguish flies from ourselves and the tens of millions of other species, living and long since extinct. The semblance of simplicity of the double helix then becomes a measure of its inscrutable profundity, or, as Philip Gell, Professor of Genetics at the University of Birmingham anticipated so presciently twenty years ago: “The gap in our knowledge is not merely unabridged, but in principle unbridgeable and our ignorance will remain ineluctable”.

It has been a similar story for neuroscientists observing the active brain which, clear from the beginning, must work in ways radically different from those supposed. The simplest of tasks, such as associating the noun 'chair' with the verb 'sit' cause vast tracts of the brain to be activated, prompting a sense of bafflement at what even the most mundane conversation must entail. Again the sights and sounds of every transient moment, it has emerged, are fragmented into a myriad of separate components without the slightest hint of the mechanism that would reintegrate those fragments back into that personal experience of living at the centre of a coherent, unified, ever-changing world.

Meanwhile, the great conundrum remains how the monotonous electrical activity of the billions of neurons in the brain translate into the limitless range and quality of the subjective experience 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 the taste of bourbon or the lingering memory of that first kiss.

The implications are obvious enough. While it might be possible to know everything about the physical materiality of the brain down to the last atom, its product (the five cardinal mysteries of the non-material mind) would remain unaccounted for: subjective awareness; mental causation or 'free will' (how our non-material thoughts cause us to choose one course of action over another); how memories are stored and retrieved; the 'higher' faculties of reason and imagination; and that unique sense of self or personal identity that changes and matures over time but also remains the same.

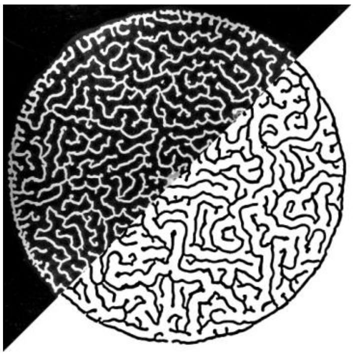
These may be mysteries to science, but they are certainly not to ourselves. Indeed there is nothing we can be more certain of than the reality of our sense of self and our everyday perceptions of the world around us, our thoughts and memories. This distinction between the electrochemical activity of the material brain that might be knowable to science and the non-material mind (our 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. However for neuroscientists, the question of how the brain's electrical activity translates into thoughts and sensations was precisely what needed explaining – and so 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".

The usual response to such perplexities is to acknowledge that perhaps things have turned out to be rather more complex than originally presumed, and to insist it is still too early to predict what might yet emerge over the next two decades. Certainly both genetics and neuroscience could continue generating further megabytes of basic biological and neuroscientific data almost indefinitely, but it is possible, in broad outline, to anticipate what they will reveal. Biologists could, if they so wished, spell out the genomes of each of the millions of species with which we share the planet, but that would only confirm they are composed of several thousand similar genes that code for the nuts and bolts of the cells from which all living things are made. Meanwhile the really interesting question of how genes determine the unique form and attributes of those diverse creatures would remain unsolved. So too for observing the brain 'in action', whereby a million scans of subjects watching a bouncing red ball would not progress understanding an iota further of what needs explaining – how those neuronal circuits experience the ball as being round, red and bouncing.

At any other time these twin setbacks of 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.

It is impossible, of course, to know what that missing factor might be but if, as would seem to be the case, it lies beyond the reach of material science then the Holy Grail of who we are would remain as elusive as ever.

From this perspective the supreme achievement of the great endeavour of the last ten years has been to compel us to confront that profound truth – so familiar to philosophers and scientists of the past, historically so powerful an impetus to the religious view and yet so long neglected – that there is 'more in Heaven and Earth' than we can know.



Physicists in Norway have created beautiful maze-like patterns by simply allowing a mixture of tiny glass beads, water and glycerol to dry out slowly. Computer simulations suggest that the labyrinthine patterns are formed when "fingers" of air invade the solid-liquid mixture and push the beads apart. Bjornar Sandnes and colleagues at the University of Oslo created such patterns by combining glass beads (50-100 µm diameter) with water and glycerol and injecting the mixture into the narrow gap between two circular plates. The liquid was slowly pumped from a hole at the centre of the disk. After about three hours, the first fingers of air pushed into the edges of the disk and gradually moved towards the centre. After about three days, the entire disk was covered by a labyrinthine pattern made by dried beads that were pushed aside by the air

Courtesy: reproduced from an article by Hamish Johnston in http://physicsworld.com/cws/article/news/30704

***James Le Fanu** has combined working in General Practice with writing a weekly column for the Sunday and Daily Telegraph for the last twenty years. His books include 'The Rise & Fall of Modern Medicine' and 'Why Us? How Science Rediscovered the Mystery of Ourselves'.*