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Morphic Resonance and the Memory of Nature: An Update

The hypothesis of morphic resonance proposes that memory is inherent in nature, and the so-called laws of nature are more like habits. I first put this idea forward this idea in my book *A New Science of Life: The Hypothesis of Formative Causation*, published in 1981 (third edition, 2009). This hypothesis was developed further and more fully in the *The Presence of the Past*, in 1988 (second edition, 2011).

In the 1980s, many scientists were confident that all the outstanding problems of science would soon be solved, confirming the assumptions of the prevailing paradigm of mechanistic materialism. Biologists would explain the nature of life mechanistically through molecular biology, especially through sequencing the genomes of humans and other organisms. Psychologists would understand the nature of the mind through brain scanning and computer modelling. In the computer sciences, artificial intelligence would be created in machines rivalling and even exceeding the intelligence of humans themselves. In physics, through the development of the ultimate theories of everything, such as superstring theory, the origin of the universe and everything in it would be explained in terms of mathematical equations involving multiple dimensions. In 1996, the American science writer John Horgan published a book entitled The End of Science: Facing the Limits of Knowledge in the Twilight of the Scientific Age. After talking to leading scientists in many areas of research, he concluded

> My guess is that this narrative that scientists have woven from their knowledge, this modern myth of creation, will be as viable a hundred or even a thousand years from now as it is today. Why? Because it is true… There will be no great revelations in the future compared to those bestowed upon us by Darwin or Einstein or Watson and Crick. [1]

[1] Horgan (1996), *The End of Science: Facing the Limits of Knowledge in the Twilight of the Scientific Age*. London: Little, Brown and Co., p.16.

When many scientists thought that all the most fundamental problems were already solved, ot almost solved, it was difficult to persuade biologists and chemists to take up morphic resonance research, and almost impossible to find funding for it. There was more openness among some psychologists, and several experiments were carried out to test for morphic resonance in human learning, mostly with positive results, as summarized in the new edition of *A New Science of Life.*

However, confidence in the promises of materialist science is fading fast, as I show in my book *The Science Delusion* (2012; second edition, 2020). The prospects for the sciences now look very different.

The laws of nature as habits

Twenty-first century physics has run into seemingly intractable problems. Superstring and M (for Master) theories, with ten and eleven dimensions respectively, take science into completely new territory in that they are untestable. One of their critics wrote a book called *Not Even Wrong*,[2] and a growing number of eminent physicists are worried that theoretical physics has lost its way. [3]

Meanwhile, cosmologists have come to the conclusion that known kinds of matter and energy constitute only about 5% of the universe. The rest consists of dark matter and dark energy. The nature of 95% of physical reality is literally obscure. [4]

Within cosmology, there has been much discussion about the Cosmological Anthropic Principle, which asserts that if the laws and constants of nature had been slightly different at the moment of the Big Bang, biological life could never have emerged, and hence we would not be here to think about it. So did a divine mind fine-tune the laws and constants in the beginning? Many cosmologists are atheists and prefer to believe that our universe is one of a vast, and perhaps infinite number of parallel universes, all with different laws and constants. All these other universes actually exist, even though there is no evidence for them. We just happen to live in the one that has the right conditions for us.

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[2] Woit, P. (2007). *Not Even Wrong: The Failure of String Theory and the Continuing Challenge to Unify the Laws of Physics.* Vintage, London.
[3] Smolin, L. (2006), *The Trouble With Physics: The Rise of String Theory, The Fall of a Science, and What Comes Next*, Allen Lane, London.
[4] Davies, P. (2006), *The Goldilocks Enigma: Why is the Universe Just Right For Life?*, Allen Lane, London.

In the eyes of sceptics, the multiverse theory is ultimate violation of Occam's Razor, the principle that entities should not be multiplied unnecessarily. But even so, it does not succeed in getting rid of God. An infinite God could be the God of an infinite number of universes. [5]

But if the regularities of nature are evolving habits rather than eternal laws, there is no need to assume that all the laws and constants were fixed at the moment of the Big Bang, like a kind of cosmic Napoleonic Code. Hence there is no need to suppose that all these laws and constants were intelligently designed at the moment of creation, or that there are an infinite number of unobserved universes. These extravagent hypotheses become unnecessary if nature is radically evolutionary, as the hypothesis of morphic resonance proposes. This is now a matter of serious discussion within physics.

In 2013, the cosmologist Lee Smolin published a book called *Time Reborn: From the Crisis of Physics to the Future of the Universe*, in which he argued that the laws of nature are more like habits, and proposed a 'principle of precedence' which depends on a new kind of interaction acreoss space and time 'whereby a physical system can interact with copies of itself in the past.' [6] The result would be something very like morphic resonance. Smolin appears to have come to this conclusion independently, based on a consideration of the principles of physics within an evolutionary universe.

The genome wager

From the point of view of morphic resonance, much of the inheritance of form and behaviour depends on resonance with previous organisms of the species, through a kind of collective memory. It is not coded in the genes, which have a relatively limited role: they code for the sequence of amino acids in proteins, and some genes are involved in the control of protein synthesis. But there is a huge gap between the amino-acid sequences in protein molecules and, say, the shape of an eagle's wing or the web-spinning instincts of a spider. Nevertheless, many biologists were confident that genes would enable all aspects of living organisms to be predicted. One of them was the late Lewis Wolpert, an eminent British developmental biologist. In 2009, he

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[5] Collins, R. in Carr, B. (ed.) (2007), *Universe or Multiverse?* Cambridge University Press, Cambridge.

[6] Smolin (2013) *Time Reborn: From the Crisis in Physics to the Future of the Universe*, p.151.

and I entered into a wager about the predictive power of the genome, published in New Scientist magazine. At stake is a case of fine port, for which we paid half each, and which experts say will be in peak condition by 2029. It is being strored in the cellars of the British Wine Society. Wolpert bet that the folowing will happen, and I bet that it will not:

> By 1 May 2029, given the genome of a fertilised egg of an animal or plant, we will be able to predict in at least one case all the details of the organism that develops from it, including any abnormalities.

If the outcome is not obvious, then the Royal Society will be asked to adjudicate.[7]

Wolpert's wager was based on the assumption that genes 'program' or 'code for' almost all aspects of an organism's development and behaviour. They enable organisms to make their proteins, by coding for the sequence of amino acids that are strung together to form the primary structure of these proteins, which then fold up into complex three-dimensional forms. Then these proteins interact and catalize biochemical reactions in such a way that they somehow give rise to adult organisms. However, random molecular permutations simply cannot explain how organisms work. Instead, cells, tissues and organs develop in a modular manner, shaped by morphogenetic fields, first recognised by developmental biologists in the 1920s. Wolpert himself acknowledged the importance of such fields. Among biologists, he is best known for the idea of 'positional information', by which cells 'know' where they are within the field of a developing organ, such as a limb. But Wolpert believed that morphogenetic fields could be reduced to standard chemistry and physics. I disagree. I believe these fields have organising abilities, or systems properties, that involve new scientific principles and also include an inherent memory given by morphic resonance.

In the 1980s, there was great excitement when a family of genes called homeobox genes was discovered in fruit flies. Homeobox genes determine where limbs and other body segments will form in a developing embryo or larva; they seem to control the pattern in which different parts of the body develop. Mutations in these genes can lead to the growth of extra, non-functional body parts; for example a leg may

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[7] Wolpert, L. and Sheldrake, R. (2009) What can DNA tell us? Place your bets now. *New Scientist*, 8 July.

develop instead of an antenna. [8] At first sight, homeobox genes appeared to provide the basis for a molecular explanation of morphogenesis: here were the key switches. At the molecular level, homeobox genes act as templates for proteins that 'switch on' cascades of other genes.

However, research on other species soon revealed that these molecular control systems are very similar in widely different animals. Homeobox genes are almost identical in flies, reptiles, mice and humans. Although they play a role in the determination of the body plan, they cannot themselves explain the shape of the organisms. Since the genes are so similar in fruit flies and in us, they cannot explain the differences between flies and humans.

It was shocking to find that the diversity of body plans across many different animal groups was not reflected in diversity at the level of the genes. As two leading developmental molecular biologists have commented, 'Where we most expect to find variation, we find conservation, a lack of change.' [9]

This study of genes involved in the regulation of development is part of a growing field called evolutionary developmental biology, or evo-devo for short. Once again, the triumphs of molecular biology have shown that morphogenesis itself, the coming into being of specific forms, continues to elude a molecular explanation. That is why the idea of morphogenetic fields is more important than ever. These fields, shaped by morphic resonance, mould the development of organs and tissues; development is modular.

The homeobox genes seem to affect the tuning of developing systems to one morphogenetic field rather than another, rather than coding for the structures of these organs, rather like the tuning system of a TV set selects one channel rather than another. The details of the TV programs are not contained within the tuning circuit; the TV set tunes in to them, just as organisms tune in to morphogenetic fields, which shape the development of form, or tune in to behavioural fields, which underlie the organization of instincts.

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[8] Carroll, S. B., Grenier, J. K. and Weatherbee, S. D. (2001), *From DNA to Diversity: Molecular Genetics and the Evolution of Animal Design*, Blackwell, Oxford.
[9] Gerhart, J. and Kirschner, M. (1997), *Cells, Embryos and Evolution*, Blackwell Science, Oxford.

Epigenetic inheritance

One of the biggest controversies in twentieth-century biology concerned the inheritance of acquired characteristics, the ability of animals and plants to inherit adaptations acquired by their ancestors. For example, if a dog were trained to learn a new trick, its offspring would tend to learn it more easily. The opposing view, promoted by August Weismann and by the science of genetics, denied that organisms could inherit features their ancestors had acquired; they only passed on 'determinants' or genes that they had themselves inherited.

In Charles Darwin's day, most people assumed that acquired characteristics could indeed be inherited. Jean-Baptiste Lamarck had taken this for granted in his theory of evolution published more than fifty years before Darwin's, and the inheritance of acquired characters was often referred to as 'Lamarckian inheritance'. Darwin shared this belief and cited many examples to support it. In this respect Darwin was a Lamarckian, not so much because of Lamarck's influence but because he and Lamarck both accepted the inheritance of acquired characteristics as a matter of common sense.

Lamarck placed a strong emphasis on the role of behaviour in evolution: animals' development of new habits in response to needs led to the use or disuse of organs, which were accordingly either strengthened or weakened. Over a period of generations, this process led to structural changes that became increasingly hereditary. In this respect too, Darwin agreed with Lamarck, and he provided various illustrations of the hereditary effects of the habits of life. For example, ostriches, he suggested, may have lost the power of flight through disuse and gained stronger legs through increased use over successive generations. Darwin was very conscious of the power of habit, which was for him almost another name for nature.

The neo-Darwinian theory of evolution, which became orthodox in the West in the twentieth century, differed from the Darwinian theory in denying the inheritance of acquired characteristics in favour of genes. Lamarckian inheritance was treated as a heresy.

However, he taboo against the inheritance of acquired characteristics began to dissolve around the turn of the millennium. There is a growing recognition that some acquired characteristics can indeed be inherited. This kind of inheritance is now called 'epigenetic inheritance'. In this context, the word 'epigenetic' signifies 'over and above genetics'. Some kinds of epigenetic inheritance depend on chemical attachments to genes, particularly of methyl groups. Genes can be 'switched off ' by the methylation of the DNA itself or of the proteins that bind to it.

This is a fast-growing field of research, and there are many examples of epigenetic inheritance in plants and animals. For example, in *Daphnia*, the water flea, when predators are around, the water fleas develop large defensive spines. When they reproduce, their off spring also have these spines even if they are not exposed to predators. [10] In a recent study with mice, males were made averse to a synthetic chemical, acetophenone, by receiving electric shocks after smelling it. After mating, they had no further contact with the mothers of the next generation, nor with their offspring. But their children and even their grandchildren showed a strong aversion to acetophenone: they had inherited the fears of their fathers and grandfathers. [11] These effects could involve a combination of chemical changes in the sperm cells and morphic resonance. Epigenetic inheritance also occurs in humans.

Many biologists now argue that the gene-centred neo-Darwinian theory of evolution is too limited, if only because it ignores epeigentic inheritance, which can have major evolutionary effects, enabling adaptive changes to be occur much quicker than they would through random genetic mutations and many generations of natural selection alone. The new 'Extended Evolutionary Synthesis' gives a much more comprehensive and inclusive view of evolution than neo-Darwinism. [12]

In his genome wager, Wolpert ignored epigenetic inheritance entirely, and based his prediction on the gene-centered, neo-Darwinian ideas that still dominated biology in the early twenty-first century, and which underlay the high hopes engendered by the Human Genome Project, the sequencing of all the genes in the human hereditary material. When the first draft was published in the year 2000, in a celebratory speech President Clinton described it as 'the book in which all human life is written.'

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[10] Young, E. (2008) Rewriting Darwin: the new non-genetic inheritance, *New Scientist*, 9 July.

[11] Dias, B.G. and Ressler, K.J. (2013) Parental olfactory experience influences behaviour and neural structure in subsequent generations. *Nature Neuroscience* 17. 89-96.

[12] Müller, G.B. (2017) Why an extended evolutionary synthesis is necessary. *Interface Focus,* 720170015

The missing heritability problem

Despite the great technical triumph that it represented, the results of the Human Genome Project have themselves set back the hopes the project engendered. First, our genome contains only between 20,000 and 25,000 genes, far fewer than the 100,000 expected. In contrast, sea urchins have about 26,000, and rice plants 38,000. Moreover, our genome differs very little from the chimpanzee's genome, the sequencing of which was completed in 2005. As Svante Paabo, director of the Chimpanzee Genome Project, commented: 'We cannot see in this why we are so different from chimpanzees.' [13]

Second, in practice, the predictive value of human genomes turns out to be low. Everyone knows that tall parents tend to have tall children, and studies on the genomes of 30,000 people identified about 50 genes associated with being tall or short. Yet together these genes accounted for only about 5 per cent of the inheritance of height. More recent and ever larger studies have identified many more genes with very small effects that improve the predictive power of individual genomes, and the most successful so far have been with height. On the basis of 5.4 millions people's genomes, a total of 12,111 genetic variants were found to be associated with height, and the researchers claimed that they could predict a maximum of 40% of the variation in height for people of European ancestry, and 10% of those of African ancestry. [14] This is an impressive achievement, but it still leaves much of the inheritance of height unexplained genetically.

The situation is more extreme for many common diseases. For example, genomic studies of the genetic basis of schizophrenia, which is known to be highly heritable, show that a large number of genes are involved but together they predictive accuracy is only about 3%. [15] Steve Jones, professor of genetics at University College London commented that as a result of the missing heritability problem, 'hubris has been replaced with concern'. [16]

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[13] Olsen, M. V. and Varki, A. (2004) The chimpanzee genome – a bitter- sweet celebration. *Science*, 305, 191–2.
[14] Yengo et al. (2022) A saturated map of common genetic variants assocaited with human height. *Nature* 610, 704-712.
[15] Woo, H.J. et al. (2017) Large-scale interaction effects reveal missing heritability in schizophrenia, bipolar disorder and posttraumatic stress disorder. *Translational Psychiatry* 11;7(4):e1089
[16] Jones, S. (2009) One gene will not reveal all life's secrets. *Daily Telegraph*, April 20.

The predictive power of genomes is reduced still further by the recognition of epigenetic inheritance. However, the missing heritability that is so puzzling in the light of the genome project may become easier to understand through a combination of epigenetic inheritance and morphic resonance, both of which make major non-genomic contributions to heredity.

More surprising discoveries

Although there have few direct tests of morphic resonance, in chemistry and biology, there has been a series of unexpected discoveries that provide very promising lines for further enquiry. One is an effect discovered by Miroslav Hill in a cell biology laboratory in France, in which cells seemed to influencing other similar cells at a distance. When some cells were subjected to poisons or to high temperatures, and managed to adapt, other similar cells became more resistant even though they had no contact with the first cells, and were not descended from them. The Hill Effect may well be a morphic resonance phenomenon. I discuss further experiments and outline ten new tests for morphic resonance in the new edition of *A New Science of Life.* [17]

An open question

I do not claim that morphic resonance is an established fact. It is still controversial within the scientific world. But the advances of science over the last 42 years have made the hypothesis more, rather than less, plausible. I think it very unlikely that the conventional materialist approach to science can survive much longer. It will inevitably be superseded, and I think it is very likely that a memory principle will have to be recognized within nature, whether it is called morphic resonance or by some other name.

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[17] Sheldrake, R. (2009) *A New Science of Life: The Hypothesis of Formative Causation* (third edition) Icon Books, London (published in he US under the title *Morphic Resonance: The Nature of Formative Causation*. Park Street Press, Rochester, VT).

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