you should provide several independent lines of evidence, something Sawyer terms a 'holistic' approach. The lines of evidence they use are termed 'biosignatures'. The critical feature of a biosignature is not that it can be produced by biological activity, but that it cannot be produced non-biologically. Evaluation of McKay and colleagues' claim therefore rested on whether their lines of evidence were really biosignatures, or whether they could have been produced non-biologically.

Their observations of meteorite ALH84001 (which is firmly established as martian even though it was found in Antarctica) led McKay and colleagues to advance four potential biosignatures. Two of them — the presence of organic matter and ultra-small fossil-like forms — were quickly rebuffed. The organic matter, although partly of apparently martian origin (itself a notable achievement by the team), consisted of polycyclic aromatic hydrocarbons, which are not plausible biosignatures as they can easily be made by non-biological processes. The 'fossils' could not be reliably distinguished from textures intrinsic to their mineral hosts, which had not previously been studied at such high magnification. That left two candidate biosignatures: unusual layered globules of carbonate, and, contained within them, tiny magnetite crystals that closely resembled those in magnetotactic bacteria on Earth.

Towards the end of chapter 13, Sawyer cites several studies that "soon challenged the biological scenario anew". But then the chapter winds down without further reference to these studies, two of which turn out to be particularly important (they are briefly described in the notes). In the final two chapters, Sawyer shifts gears twice, once to discuss a marginally related controversy, and finally to report on some recent missions to Mars. Both chapters would have made interesting appendices to the book, but the claim made by McKay and colleagues is left hanging in limbo; the "detective story" ends not with a bang but a whimper. This is particularly unfortunate as the two studies mentioned above would have provided the bang of two smoking guns.

First, a team from the Johnson Space Center led by Gordon McKay, David's brother, succeeded in synthesizing identical layered carbonate globules in the absence of biological activity, thereby destroying the globules' status as a plausible biosignature (D. C. Golden *et al. Am. Mineral.* **86,** 370–375; 2001). Second, a study by David Barber and Ed Scott (*Proc. Natl Acad. Sci. USA* **99,** 6556–6561; 2002) drove the final nail into the coffin. They showed that the crystal lattices of the ultrafine magnetites within the meteorite's carbonates were topotactically related to that of the carbonate host, a point that I had made in 1999, based on findings by John Bradley and co-workers (*Meteorit. Planet. Sci.* **33,** 765–774; 1998). Note that this is a true three-dimensional relationship, as first observed synthetically by J. D. Bernal and co-workers (*Clay Mineral. Bull.* **4,** 15–30; 1959); it should not be confused with epitaxy, a two-dimensional relationship. It means that the magnetites must have formed directly by decomposition of carbonate, and could not plausibly be bacterial in origin. Barring an extraordinary coincidence, this conclusion must apply to all the nanoscale magnetites in the carbonate.

Even though I would have liked the book to conclude with closure of this tumultuous episode, this is nonetheless an outstanding popularization of science that deserves to be widely read, not least by those interested in the 'logic of scientific discovery'.

Finally, it is worth noting that, despite the demise of the biosignatures proposed by McKay and co-workers, the search for evidence of ancient life on Mars remains scientifically reasonable and, indeed, of fundamental importance. ■

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A search for meaning

The Happiness Hypothesis: Finding Modern Truth in Ancient Wisdom
by Jonathan Haidt
Basic Books: 2005. 320 pp. £34.95, £15.50.
To be published in Britain in August by William Heinemann.

Daniel Nettle

There is a striking similarity between the advice of the ancients on how to live, and the thoughts of modern psychologists on how to have a healthy mind. The Roman emperor Marcus Aurelius' dictum that life "is but what you deem it" resonates with modern research on the importance of thinking styles in coping with stress and adversity; and the Buddha's teachings on non-attachment seem to prefigure the ideas of modern cognitive therapies. The ancients, it seems, were good psychologists and understood, in an observational and intuitive way, how the mind works.

Jonathan Haidt takes this insight seriously in his new book *The Happiness Hypothesis*. The subtitle is a much better description of the fare on offer than the main title, as he takes the conclusions of classical philosophers and thinkers on ten enduringly important themes and considers their conclusions alongside the findings of modern psychology. The ten subject areas are: the idea that the mind is made up of several often-conflicting drives or mechanisms; the idea that how we think about the world is more important than how the world actually is; the importance of reciprocity in social life; the biases that blind us to our own shortcomings but not to shortcomings in others; the paradoxical nature of pursuing happiness; the importance of love; the strengthening power of adversity; the importance of virtue, in its broadest sense; the power of spirituality; and finally, the importance of coherence in life. Haidt draws principally from Greek and Roman philosophy, from Indian and Chinese traditions, as well as a peppering of

RONALD GRANT ARCHIVE

What does it all mean? Monty Python's *The Meaning of Life* may not have been far from the truth.

other sources. He has also read widely across various schools of modern psychology, including social psychology, the evolution of behaviour, and the emotions, an area to which he has made distinguished contributions.

This is a delightful book. I enjoyed Haidt's exploration of ancient texts, but was much more impressed by the breadth of his grasp of modern behavioural science. He does have occasional blind spots: for example, evaluating the Buddha's advice on non-attachment as if it were an empirical hypothesis seems to trivialize it, and his review of cultural group selection does not consider the alternatives. Despite this, Haidt's writing embraces spiritual and mystical viewpoints while retaining scientific and rational coherence. This is by some margin the most intellectually substantial book to arise from the 'positive psychology' movement, which is often characterized by having too much 'positive' and not enough 'psychology'. Haidt is thoughtful and judicious, and is always concerned to relate his points back to the evidence.

What is the big idea to arise from this book? In a sense, there isn't one. Haidt quotes from the Monty Python film *The Meaning of Life*, in which the answer is given as: "Try to be nice to people, avoid eating fat, read a good book every now and then, get some walking in, and try to live in peace and harmony with people of all creeds and nations." This spoof formulation nonetheless contains an important point: there is, in fact, no single meaning to life. However, life has a definite form, a set of recurring emotions, interactions and experiences, and even if there is no ultimate solution to the dilemmas they pose, there are ways of understanding them better and navigating them with greater wisdom and purpose. And, as Haidt has shown, the ancient sages and modern psychologists often agree on these. ■

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SCIENCE IN CULTURE

A sense of civic beauty

A Renaissance painting from Urbino reveals the ideal city.

Martin Kemp

There is a feeling in highly developed societies with centralized systems of government that an orderly society and geometrical town planning go hand in hand. This association is not exclusive to Western societies: Inca, Indian and Chinese civic planning has exhibited similar tendencies. Nor is it exclusive to totalitarian regimes, as it has featured prominently in socialist notions of 'new towns'.

The most beguiling images of a community governed by mathematical order are the surviving Renaissance representations of 'ideal cities'. None is more serenely beautiful than a painting from Urbino that is currently on show in Florence in the exhibition *L'uomo del Rinascimento* (*The Renaissance Man*), which can be seen at at the Palazzo Strozzi in Florence until 23 July. The exhibition centres on the architecture and writing of Leon Battista Alberti, author in 1435 of *On Painting*, the first book to expound the theory of linear perspective.

Many aspects of the ideal city from Urbino remain elusive. The artist and date are uncertain, and its original purpose is unclear. The most closely dated parallels are some doors, decorated with inlaid wooden panels of ideal cities, in the Ducal Palace at Urbino, which were installed between 1474 and 1482. The ruler of Urbino, Federico da Montefeltro, was shaping Urbino itself into as much of an ideal city as the existing buildings would allow.

The painting in question was also part of a decorative ensemble, as its edges show that it was built into a piece of furniture, perhaps a chest, couch or bed. Infrared reflectography has revealed the huge effort that went into drafting the carefully conceived buildings in absolutely meticulous perspective, by disclosing part of the intricate carbon-based underdrawing. One surprise is that the central 'temple' was originally conceived as a structure with a flat façade and loggia below a triangular pediment. It might have been a governmental building, like those found at the centre of squares in Tuscan new towns from the late thirteenth century onwards. It was then transformed into a centralized building, almost certainly religious in function.

Everything speaks of an orderly society. The temple refers to the majesty of God's order, and the 'parish church' behind and to the right serves for daily devotions. The palaces, with their gracious arcades, shelter pedestrians and their owners in comfort and style. Rooftop loggias provide retreats for well-ventilated relaxation, and the tiled piazza is clean and hygienic. And the beneficent rulers have provided two octagonal wells from which the citizens can draw clear water.

The whole is an essay in the geometry of perfect proportions and the good life. Only the people are missing: the ideal city is awaiting its ideal citizens. Will the city form them, shaping their values? Or have the people formed the city as their utopia?

Alberti himself, as the author of a treatise on the family, believed there was a natural order in the created world, and that we should adopt it in our lives. But he was realist enough, as was Federico, to know that human society needs the central imposition of rules.

Whether a city for contented dwellers can be planned scientifically, or whether it emerges organically from the free-market jungle, remains a mighty issue for town planners. When the Renaissance actually constructed planned cities, as they did at Urbino and Pienza, they somehow achieved a precarious balance between imposition and individuality. It is a difficult balance to contrive.

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