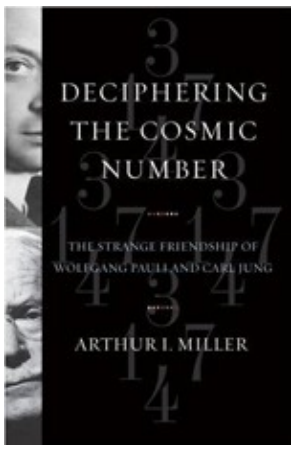
June 2009
Reviews

'Deciphering the cosmic number'

reviewed by Marianne Freiberger



Deciphering the cosmic number: The strange friendship of Wolfgang Pauli and Carl Jung

by Arthur I. Miller

If the quest for a physical theory of everything, and some of the strange concepts that have sprung from it, strikes you as somewhat mystical, then this is just the book you need to explore the idea further. *Deciphering the cosmic number* examines the friendship between the physicist Wolfgang Pauli and the psychologist Carl Gustav Jung. Disparate though their fields may appear at first, the two men's search for the ultimate building blocks of human reality led them onto common ground: in Jung's words "the no−man's land between physics and the psychology of the unconscious".

The seeds for this extraordinary relationship were sown during the first two decades of the twentieth century, both culturally and scientifically one of the richest periods of recent history. Freud had only recently developed his ideas on the unconscious and psycho−analysis, which were now being popularised, as well as criticised, by Jung. In 1905 Einstein revolutionised the world of physics with his special theory of relativity, while artists were reassembling notions of reality by delving into cubism and expressionism. Wolfgang Pauli was born into this "ferment of ideas", in 1900, and first burst on the physical scene at the tender age of 21,

with a paper on relativity theory that even impressed Einstein himself. He soon joined the celebrated physicist Niels Bohr in his quest to describe the fundamental structure of atoms. Pauli is today lesser known than his colleagues Werner Heisenberg and Erwin Schrödinger, respectively his friend and foe, but he made fundamental contributions to the development of particle physics and quantum mechanics. They include the prediction of a new particle the *neutrino* 26 years before it was detected in experiments, and his formulation of the *exclusion principle*, which explains why electrons orbit the nucleus of an atom in precisely the pattern they do, and which won him the 1945 Nobel Prize in Physics.

Alongside a bent for rational reasoning and a talent for "mathematical fireworks", Pauli had always nurtured an interest in the irrational as a driving force of scientific creativity. Science, as Pauli's mentor Arnold Sommerfield pointed out, had grown out of mysticism, and the bewildering patterns that emerged from the study of atomic structure seemed no less esoteric in fact, Sommerfield described the numerical arrangement of electrons as "somewhat kabbalistic" and likened the rules of atomic physics to "the teachings of alchemists and the witches' kitchen of Faust".

Inspired by his mentor's interest in the occult, Pauli became fascinated by the work of two medieval thinkers, Johannes Kepler and Robert Fludd. Kepler, inspired by the harmonious symmetry of Copernicus' heliocentric world view and Pythagoras' reverence for geometry and number, sought to derive a complete description of the cosmos primarily in terms of mathematics. To him geometry was the "archetype of beauty in the world". His writings, in keeping with the spirit of the times, were permeated with mysticism, but his bent for mathematics produced some truly "scientific" results his laws of planetary motion are still in use today.

Fludd, on the other hand, remained firmly routed in the traditions of mysticism and alchemy. Rather than debasing nature with "vulgar mathematics", he endeavoured to describe the "true philosophy" by means of pictures. Not mere illustrative diagrams, but universal forms what you might call *mandalas* which, in the alchemist tradition, depict the whole as made up of opposing parts. Kepler and Fludd duly clashed over their different world views.

Pauli, surprisingly for a physicist, harboured sympathy for Fludd as well as Kepler. Perhaps anticipating Jung's later diagnosis of an extremely unbalanced personality, he felt attracted to the universality of Fludd's view of the world, which encompassed the human mind as well as science. But there was another feature of the Kepler/Fludd clash that resonated with Pauli. To Kepler, the most perfect number of them all was three, but to Fludd it was four. Pauli, too, had been torn between these two numbers in his own work: to derive his exclusion principle he had to allow four, rather than three *quantum numbers*, a break with convention which Bohr admiringly described as "complete insanity". The two numbers, together with another number that mystifies physicists to this day, the *fine structure constant* with a value close to 1/137, made frequent appearances in Pauli's dreams, whose analysis was to become a central feature in his relationship with Jung.

Jung, too, was interested in the occult. Like Freud, Jung believed that dreams held the key to an individual's psyche, but unlike Freud, he viewed them as a portal to a collective unconscious which transcends individual experience. The vocabulary of this collective unconscious is made up of archetypes: symbolic notions, or units of meaning that are common to all humans and transcend language, culture and rationality. Jung's work with patients led him to think of the psyche as an interplay of opposing pairs: introversion/extroversion on one level, and thinking/feeling and sensation/intuition on another. Psychological suffering, according to Jung, was a result of an imbalance between these components a healing of the rift would be signalled by the appearance of mandala−like images, balanced arrangements of opposing forces, in a patient's dream.

His ideas naturally led Jung to study the alchemists who were also "talking in symbols", and believed that ultimate wisdom the philosopher's stone would be achieved through a unification of opposing states, for example the male and the female. Jung went on to incorporate alchemy into his analytic psychology. He made great progress, but his journeys into the occult brought derision from colleagues. To avoid ridicule, and also to

build a more universal theory, he needed to give his mystical theories some kind of "scientific" footing. In 1932, an opportunity to do so was delivered to his door step in the shape of Wolfgang Pauli, who, plagued by bouts of depression, hypersensitivity to perceived failure and a tendency to excess, had decided to seek the help of an analyst.

Arthur I. Miller's thoroughly researched book gives a fascinating account of the two men's journey into the unexplored territory between the physical and the psychic the "most fascinating, yet the darkest hunting ground of our times," as Jung put it. Jung immediately recognised in Pauli an imbalanced mind heavily geared towards the rational, a diagnosis that eventually brought Pauli some relieve from his emotional troubles. Pauli made dream analysis, whether conducted by himself or by Jung, a long−term habit. The symbols he encountered in his dreams, and the parallels between Jung's philosophy of archetypes on the one hand, and the dualities and symmetries that occur in physics on the other, led Pauli to believe that science may also be fuelled by archetypes, and that it can be approached "from behind" by investigating them. This would open up new avenues for the exploration of physics which rationality alone couldn't reach.

Pauli re−examined Kepler and Fludd in the light of Jungian psychology, focusing on the role of the irrational in scientific creativity. He argued that the link between sensory experience and the rational concepts that make up a scientific theory is formed by archetypes, "inner images pre−existent in the human psyche". It's an individual's pleasure in understanding nature that allows these archetypes to emerge from the unconscious and create knew knowledge. He interpreted Kepler as a thinking type, seeking a mechanical understanding of the Universe, and Fludd as a feeling type with a desire for greater completenes. To Pauli, the way forward lay in a unifying approach, as exemplified by alchemy. "To us, unlike Kepler and Fludd," he wrote, "the only acceptable view appears to be one that recognises both sides of reality, [...] , the physical and the psychical, as compatible with each other, and [one that] can embrace them simultaneously." Pauli published the culmination of his work on Kepler and Fludd in a book written jointly with Jung, *The Interpretation of Nature and Psyche*.

Jung, for his part, sought confirmation for his quasi−mystical ideas from the insights into physics provided to him by Pauli. Among other things, Jung was developing *synchronicity*, the idea that simultaneous events all over the world are linked in a mysterious way that enabled telepathy and clairvoyance. Jung found this idea mirrored in Heisenberg's uncertainty principle, which asserts that at a quantum level, the world is not deterministic, that is determined by causal relationships, but random: if the physical world could be acausal, then might there be a connection to psychic synchronicity? Jung and Freud embarked on a detailed study of this idea, which was also published in *The Interpretation of Nature and the Psyche*.

But despite the lofty, and sometimes downright crazy, ideas covered by Jung and Pauli (even UFOs make an appearance), this book won't give you headaches. Miller's account of their adventures is captivating, succinct and accessible. You don't need any previous knowledge of physics or psychology or alchemy for that matter to enjoy it. The two personalities are central to this story and Miller provides plenty of personal detail to keep you smiling, even in the face of some heavy physics, which Miller expertly condenses into digestible chunks accessible to novices. Miller's explicit descriptions of Pauli's dreams and their analysis by Jung paint a visceral picture of the two men's approach not just to treating Pauli's emotional troubles, but also to unravelling the archetypes that underly science.

Today, science has little room for adventures like Jung and Pauli's, and now as then their validity would be heavily questioned on account of their unscientific nature. Jung's reputation is somewhat dented by his interest in the occult, and Pauli is remembered exclusively for his contributions to physics. Interestingly, and perhaps ironically, it was Pauli's insights into particle physics, rather than his journeys into the "dark hunting grounds", that have had a lasting impact on psychology: PET and fMRI scans, prime tools in understanding the neural connections in the brain, are based on particle physics. But whatever you may think of Pauli and Jung's joint work, the fact remains that no−one has yet cracked the mystery of the human mind, and physics is

still without a theory of everything. Their questions are just as open now as they were then, and their attempts to answer them whether you consider them a bold attempt to transcend boundaries or dangerous pseudoscience make a fascinating read.

Book details:

Deciphering the cosmic number: The strange friendship of Wolfgang Pauli and Carl Jung
Arthur I. Miller
hardback 368 pages (2009)
W. W. Norton &Co
ISBN−10: 0393065324
ISBN−13: 978−0393065329

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