PHYSICS Digest

Philosophy Reference, Philosophy Digest, Physics Reference and Physics Digest all contain information obtained from free cites online and other Saltafide resources.

Our focus in these profiles is on the subject's philosophical thinking as it applies to scientific spiritualism and universal consciousness. Occasionally text will be set in **bold,** to indicate a direct connection with the leap of faith laid out in Saltafide.
Greater detail on the subject's work can be found in the more copious Physics Reference and Philosophy Reference documents.

NOTE highlighted words can be clicked to link to relevant information in WIKIPEDIA.

EINSTEIN

Albert Einstein 14 March 1879 – 18 April 1955) was a German-born theoretical physicist who developed the theory of relativity, one of the two pillars of modern physics (alongside quantum mechanics). His work is also known for its influence on the philosophy of science.He is best known to the general public for his mass–energy equivalence formula $E = mc^2$, which has been dubbed "the world's most famous equation".He received the 1921 Nobel Prize in Physics "for his services to theoretical physics, and especially for his discovery of the law of the photoelectric effect", a pivotal step in the development of quantum theory.

On the eve of World War II, he endorsed a letter to President Franklin D. Roosevelt alerting FDR to the potential development of "extremely powerful bombs of a new type" and recommending that the US begin similar research. This eventually led to the Manhattan Project. Einstein supported the Allies, but he generally denounced the idea of using nuclear fission as a weapon. He signed the Russell–Einstein Manifesto with British philosopher Bertrand Russell, which highlighted the danger of nuclear weapons. He was affiliated with the Institute for Advanced Study in Princeton, New Jersey, until his death in 1955.

Einstein–Podolsky–Rosen paradox
EPR paradox
In 1935, Einstein returned to quantum mechanics, in particular to the question of its completeness, in the "EPR paper". In a thought experiment, he considered two particles which had interacted such that their properties were strongly correlated. No matter how far the two particles were separated, a precise position measurement on one particle would result in equally precise knowledge of the position of the other particle; likewise a precise momentum measurement of one particle would result in equally precise knowledge of the momentum of the other particle, without needing to disturb the other particle in any way.

Given Einstein's concept of local realism, there were two possibilities: (1) either the other particle had these properties already determined, or (2) the process of measuring the first particle instantaneously affected the reality of the position and momentum of the second particle. Einstein rejected this second possibility (popularly called "spooky action at a distance").
Einstein's belief in local realism led him to assert that, while the correctness of quantum mechanics was not in question, it must be incomplete. But as a physical principle, local realism was shown to be incorrect and the “spooky action at a distance” real when, long after Einstein’s death, the Aspect experiment of 1982 confirmed Bell's theorem, which J. S. Bell had delineated in 1964.

Unified field theory

Classical unified field theories

Following his research on general relativity, Einstein entered into a series of attempts to generalize his geometric theory of gravitation to include electromagnetism as another aspect of a single entity. In 1950, he described his "unified field theory" in a *Scientific American* article titled "On the Generalized Theory of Gravitation". Although he continued to be lauded for his work, Einstein became increasingly isolated in his research, and his efforts were ultimately unsuccessful. In his pursuit of a unification of the fundamental forces, Einstein ignored some mainstream developments in physics, most notably the strong and weak nuclear forces, which were not well understood until many years after his death. Mainstream physics, in turn, largely ignored Einstein's approaches to unification. Einstein's dream of unifying other laws of physics with gravity motivates modern quests for a theory of everything and in particular string theory, where geometrical fields emerge in a unified quantum-mechanical setting.

Music and Einstein

Einstein developed an appreciation for music at an early age. In his late journals he wrote: "If I were not a physicist, I would probably be a musician. I often think in music. I live my daydreams in music. I see my life in terms of music... I get most joy in life out of music."[1 Einstein taught himself to play
without "ever practicing systematically". He said that "love is a better teacher than a sense of duty."[129]

Although the idea of becoming a professional musician himself was not on his mind at any time, among those with whom Einstein played chamber music were a few professionals, and he performed for private audiences and friends. Chamber music had also become a regular part of his social life while living in Bern, Zürich, and Berlin, where he played with Max Planck and his son, among others.

Near the end of his life, when the young Juilliard Quartet visited him in Princeton, he played his violin with them, and the quartet was "impressed by Einstein's level of coordination and intonation".

Quantum Theory and God

Einstein played a major role in developing quantum theory, beginning with his 1905 paper on the photoelectric effect. However, he became displeased with modern quantum mechanics as it had evolved after 1925, despite its acceptance by other physicists. His objection had to do with the mysterious particle entanglement and the "uncertainty" resulting from the observation of subatomic particles. He felt that the governing law was undiscovered rather than non-existent. His famous quote "God doesn't play dice with the universe" insists that there is a definite plan which can be ascertained, and Bohr's famous response: "Stop telling God what to do," admits to the fallibility of human intelligence when it comes to universal understanding. The gap created by the two remarks cries out to our next web page philosophy. At the head of the philosophy intrusion is Plato with his distinction between truth and belief, where the

former is light hidden from humans and the latter, shadows created by that light which appears, to cave bound humans, to be all there is. And at the tail end of philosophy is Wittgenstein, who would have pointed out that the difference in the two positions is word play, “tautology”. Like his friend and pupil Heisenberg (see below)Bohr knew a great deal about philosophy, but I cannot say whether Einstein knew about Plato and Wittgenstein. One has to wonder how much semantics contribute to this momentous dispute in the philosophy of science.

Max Planck

Max Karl Ernst Ludwig Planck, 23 April 1858 – 4 October 1947) was a German theoretical physicist whose discovery of energy quanta won him the Nobel Prize in Physics in 1918.

Planck made many contributions to theoretical physics, but his fame as a physicist rests primarily on his role as the originator of quantum theory, which revolutionized human understanding of atomic and subatomic processes.

Black-body radiation
In 1894 Planck turned his attention to the problem of black-body radiation.
Planck black-body radiation law, which described the experimentally observed black-body spectrum.

Planck's constant enabled him to define a new universal set of physical units (such as the Planck length and the Planck mass), all based on fundamental physical constants upon which much of quantum theory is based. In recognition of Planck's fundamental contribution to a new branch of physics, he was awarded the Nobel Prize in Physics for 1918

Planck was among the few who immediately recognized the significance of the special theory of relativity. Thanks to his influence, this theory was soon widely accepted in Germany. Planck also contributed considerably to extend the special theory of relativity. For example, he recast the theory in terms of classical action.

The "Hauptamt Wissenschaft" (Nazi government office for science) started an investigation of Planck's ancestry, claiming that he was "1/16 Jewish", but Planck himself denied it.

In 1944 Planck's son Erwin was arrested by the Gestapo following the attempted assassination of Hitler in the 20 July plot. He was tried and sentenced to death by the People's Court in October 1944. Erwin was hanged at Berlin's Plötzensee Prison in January 1945. The death of his son destroyed much of Planck's will to live.
After the end of the war Planck, his second wife, and his son by her were brought to a relative in Göttingen, where Planck died on 4 October 1947.

Music
Planck was gifted when it came to music. He took singing lessons and played piano, organ and cello, and composed songs and operas.

Religious views
Planck said in 1944, "As a man who has devoted his whole life to the most clear headed science, to the study of matter, I can tell you as a result of my research about atoms this much: There is no matter as such. All matter originates and exists only by

virtue of a force which brings the particle of an atom to vibration and holds this most minute solar system of the atom together. We must assume behind this force the existence of a conscious and intelligent spirit (orig. geist). This spirit is the matrix of all matter."
Planck regarded the scientist as a man of imagination and Christian faith. He said: "Both religion and science require a belief in God. For believers, God is in the beginning, and for physicists He is at the end of all considerations… To the former He is the foundation, to the latter, the crown of the edifice of every generalized world view".

Planck was a member of the Lutheran Church in Germany. He was very tolerant towards alternative views and religions. In a lecture in 1937 entitled "Religion und Naturwissenschaft" (Religion and Natural Science) Planck expressed the view that God is everywhere present, and held that "the holiness of the unintelligible Godhead is conveyed by the holiness of symbols." He suggested the importance of these symbols and rituals related directly with a believer's ability to worship God, but that one must be mindful that the symbols provide an imperfect illustration of divinity. **He criticized atheism for being focused on the derision of such symbols, while at the same time warned of the over-estimation of the importance of such symbols by believers**. He was a churchwarden from 1920 until his death, and believed in an almighty, all-knowing, beneficent God (though not necessarily a personal one). Both science and religion wage a "tireless battle against skepticism and dogmatism, against unbelief and superstition" with the goal "toward God!" Planck questioned some of the unexplainable miracles touted by organized religion, and though he did not at first believe in a personal God as depicted in organized religions, he may have changed his mind. Later in life, Planck's views on God were that of a deist. For example, six months before his death a rumor started that he had converted to Catholicism."

Niels Bohr

Niels Henrik David Bohr 7 October 1885 – 18 November 1962) was a Danish physicist who made foundational contributions to understanding atomic structure and quantum theory, for which he received the Nobel Prize in Physics in 1922. Bohr was also a philosopher and a promoter of scientific research. His three papers, which later became famous as "the trilogy", were published in *Philosophical Magazine* in July, September and November of that year. He adapted Rutherford's nuclear structure to Max Planck's quantum theory and so created his Bohr model of the atom. He introduced the idea that an electron could drop from a higher-energy orbit to a lower one, in the process emitting a quantum of discrete energy. This became a basis for what is now known as the old quantum theory.

Complementarity
Bohr became convinced that light behaved like both waves and particles and, in 1927, experiments confirmed the de Broglie hypothesis that matter (like electrons) also behaved like waves. He conceived the philosophical principle of complementarity: that items could have apparently mutually exclusive properties, such as being a wave or a stream of particles, depending on the experimental framework. He felt that it was not fully understood by professional philosophers.

Bohr developed the Bohr model of the atom, in which he proposed that energy levels of electrons are discrete and that the electrons revolve in stable orbits around the atomic nucleus but can jump from one energy level (or orbit) to another. Although the Bohr model has been supplanted by other models, its underlying principles remain valid. He conceived the principle of complementarity: that items could be separately analyzed in terms of contradictory properties, like behaving as a wave or a stream of particles. The notion of complementarity dominated Bohr's thinking in both science and philosophy.

Bohr versus Einstein
Main article: Bohr–Einstein debates
The Bohr–Einstein debates were a series of public disputes about quantum mechanics between Einstein and Niels Bohr, who were two of its founders. Their debates are remembered because of their importance to the philosophy of science. Their debates would influence later interpretations of quantum mechanics. Bohr's famous reply to Einstein's determinism, where
Einstein said "God doesn't play dice with the universe" and
Bohr replied: "Stop telling God what to do" (discussed in the above section on Einstein).

Bohr the Philosopher

Heisenberg said of Bohr that he was "primarily a philosopher, not a physicist". Bohr read the 19th-century Danish Christian existentialist philosopher, Søren Kierkegaard (covered in this Digest), and was influenced by Kierkegaard. In 1909, Bohr sent his brother Kierkegaard's *Stages on Life's Way* as a birthday gift. In the enclosed letter, Bohr wrote, "It is the only thing I have to send home; but I do not believe that it would be very easy to find anything better ... I even think it is one of the most delightful things I have ever read." Bohr enjoyed Kierkegaard's language and literary style, but mentioned that he had some disagreement with Kierkegaard's philosophy. We don't know exactly what the disagreements were, but nevertheless some of Bohr's biographers suggested that this disagreement stemmed from Kierkegaard's advocacy of Christianity. These same biographers say that Bohr was an atheist. It is hard to imagine how a complete atheist could enjoy the work of Kierkegaard, or advise Einstein to "stop telling God what to do." More importantly there is a spiritualism implicit in his globalism and love of mankind. He practiced what Christ preached whether or not he every subscribed to any church.

Bohr the global Activist

During the 1930s Bohr helped refugees from Nazism. After Denmark was occupied by the Germans, he had a famous meeting with Heisenberg, who had become the head of the German nuclear weapon project. In September 1943, word reached Bohr and his brother Harald that the Nazis considered their family to be Jewish, since their mother was Jewish, and that they were therefore in danger of being arrested. The Danish resistance helped Bohr and his wife escape by sea to Sweden where Bohr persuaded King Gustaf V of Sweden to make public Sweden's willingness to provide asylum to Jewish refugees. On 2 October 1943, Swedish radio broadcast that Sweden was ready to offer asylum, and the mass rescue of the Danish Jews. Eventually, over 7,000 Danish Jews escaped to Sweden.

Later Bohr went to Britain, where he joined the British Tube Alloys nuclear weapons project, and was part of the British mission to the Manhattan Project.

On 8 December 1943, Bohr arrived in Washington, D.C., where he met with the director of the Manhattan Project, Brigadier General Leslie R. Groves, Jr. He visited Einstein and Pauli at the Institute for Advanced Study in Princeton, New Jersey, and went to Los Alamos in New Mexico, where the nuclear weapons were being designed. For security reasons, he went under the name of "Nicholas Baker" in the United States. Bohr did not remain at Los Alamos, but paid a series of extended visits over the course of the next two years. Robert Oppenheimer credited Bohr with acting "as a scientific father figure to the younger men", most notably Richard Feynman. Bohr is quoted as saying, "They didn't need my help in making the atom bomb." Oppenheimer gave Bohr credit for an important contribution to the work on modulated neutron initiators. "This device remained a stubborn puzzle," Oppenheimer noted, "… in early February 1945 Niels Bohr clarified what had to be done."

Bohr recognized early that nuclear weapons would change international relations. In April 1944, he received a letter from Peter Kapitza, written some months before when Bohr was in Sweden, inviting him to come to the Soviet Union. The letter convinced Bohr that the Soviets were aware of the Anglo-American project, and would strive to catch up. He sent Kapitza a non-committal response, which he showed to the authorities in Britain before posting. Bohr met Churchill on 16 May 1944, but found that "we did not speak the same language". Churchill disagreed with the idea of openness towards the Russians to the point that he wrote in a letter: "It seems to me Bohr ought to be confined or at any rate made to see that he is very near the edge of mortal crimes."

Oppenheimer suggested that Bohr visit President Franklin D. Roosevelt to convince him that the Manhattan Project should be shared with the Soviets in the hope of speeding up its results. Bohr's friend, Supreme Court Justice Felix Frankfurter, informed President Roosevelt about Bohr's opinions, and a meeting between them took place on 26 August 1944. Roosevelt suggested that Bohr return to the United Kingdom to try to win British approval. When Churchill and Roosevelt met at Hyde Park on 19 September 1944, they rejected the idea of informing the world about the project, and the aide-mémoire of their conversation contained a rider that "enquiries should be made regarding the activities of Professor Bohr and steps taken to ensure that he is responsible for no leakage of information, particularly to the Russians".

After the war, Bohr called for international cooperation on nuclear energy. He was involved with the establishment of CERN and the Research Establishment Risø of the Danish Atomic Energy Commission and became the first chairman of the Nordic Institute for Theoretical Physics in 1957.
In June 1950, Bohr addressed an "Open Letter" to the United Nations calling for international cooperation on nuclear energy. In the 1950s, after the Soviet Union's first nuclear weapon test, the International Atomic Energy Agency was created along the lines of Bohr's suggestion. In 1957 he received the first ever Atoms for Peace Award.

Schrodinger

Erwin Rudolf Josef Alexander Schrödinger 12 August 1887 – 4 January 1961), sometimes written as **Erwin Schrodinger** was a Nobel Prize-winning Austrian-Irish physicist who developed a number of fundamental results in quantum theory: the Schrödinger equation provides a way to calculate the wave function of a system and how it changes dynamically in time. In addition, he was the author of many works on various aspects of physics: statistical mechanics and thermodynamics, physics of dielectrics, colour theory, electrodynamics, general relativity, and cosmology, and he made several attempts to construct a unified field theory. The philosophical issues raised by Schrödinger's cat are still debated today and remain his most enduring legacy in popular science, while Schrödinger's equation is his most enduring legacy at a more technical level. Schrödinger is one of several individuals who have been called "the father of quantum mechanics". The large crater Schrödinger, on the far side of the Moon, is named after him. The Erwin Schrödinger International Institute for Mathematical Physics was established in Vienna in 1993.

In the first years of his career Schrödinger became acquainted with the ideas of quantum theory, developed in the works of Max Planck, Albert Einstein, Niels Bohr, Arnold Sommerfeld, and others. The first publications of Schrödinger about atomic theory and the theory of spectra began to emerge only from the beginning of the 1920s, after his personal acquaintance with Sommerfeld and Wolfgang Pauli and his move to Germany. In January 1921, Schrödinger finished his first article on this subject, about the framework of the Bohr-Sommerfeld effect of the interaction of electrons on some features of the spectra of the alkali metals. In autumn 1922 he analyzed the electron orbits in an atom from a geometric point of view, using methods developed by the mathematician Hermann Weyl (1885–1955). This work, in which it was shown that quantum orbits are associated with certain geometric properties, was an important step in predicting some of the features of wave mechanics. Earlier in the same year he created the Schrödinger equation of the relativistic Doppler effect for spectral lines, based on the hypothesis of light quanta and considerations of energy and momentum.

In January of 1926, Schrödinger published in *Annalen der Physik* the paper "*Quantisierung als Eigenwertproblem*" (Quantization as an Eigenvalue Problem) on wave mechanics and presented what is now known as the Schrödinger equation This paper has been universally celebrated as one of the most important achievements of the twentieth century and created a revolution in most areas of quantum mechanics and indeed of all physics and chemistry. In a later paper he demonstrated the connection of his approach to that of Heisenberg

Schrödinger was not entirely comfortable with the implications of quantum theory. He wrote about the probability interpretation of quantum mechanics, saying: "I don't like it, and I'm sorry I ever had anything to do with it." Critical of the Copenhagen interpretation of quantum mechanics he contrived the famous thought-experiment

called Schrödinger's cat paradox. A hypothetical cat that may be simultaneously both alive and dead, as a result of being linked to a random subatomic event that may or may not occur. The idea involves a state of reality he calls quantum superposition. A cat, a flask of poison, and a radioactive source are placed in a sealed box. If an internal monitor detects radioactivity (i.e. a single atom decaying), the flask is shattered, releasing the poison, which kills the cat. The Copenhagen interpretation of quantum mechanics implies that after a while, the cat is *simultaneously* alive *and* dead. Yet, when one looks in the box, one sees the cat *either* alive *or* dead, not both alive *and* dead. This poses the question of when exactly quantum superposition ends and reality collapses into one possibility or the other.The thought experiment is also often featured in theoretical discussions of the interpretations of quantum mechanics, particularly in situations involving the measurement problem.

Following his work on quantum mechanics, Schrödinger devoted considerable effort to working on a unified field theory that would unite gravity, electromagnetism, and nuclear forces within the basic framework of General Relativity, doing the work with an extended correspondence with Albert Einstein.[41] In 1947, he announced a result, "Affine Field Theory,"[42] in a talk at the Royal Irish Academy, but the announcement was criticized by Einstein as "preliminary" and failed to lead to the desired unified theory.[41] Following the failure of his attempt at unification, Schrödinger gave up his work on unification and turned to other topics.

At the close of his book, *What Is Life? (discussed below)* Schrodinger reasons that consciousness is only a manifestation of a unitary consciousness pervading the universe. Schrödinger is sympathetic to the Hindu concept of Brahman, by which each individual's consciousness is only a manifestation of a unitary consciousness pervading the universe
Schrödinger then states that this insight is not new and that Upanishads considered this insight of "ATHMAN = BRAHMAN" to "represent quintessence of deepest insights into the happenings of the world. Schrödinger rejects the idea that the source of consciousness should perish with the body because he finds the idea “distasteful". **Schrodinger believes that consciousness is a singular** of which the plural is unknown; that there is only one thing and that what seems to be a plurality is merely a series of different aspects of this **one thing**… Any intuitions that consciousness is plural, he says, are illusions.

Schrodinger singularity of consciousness might explain the connection of his ideas to the momentous discovery of DNA. Schrodinger’s *What Is Life?*, was written in In 1944. It contains a discussion of negentropy and the concept of a complex molecule with the genetic code for living organisms. According to James D. Watson's memoir, *DNA, the Secret of Life*, Schrödinger's book gave Watson the inspiration to research the gene, which led to the discovery of the DNA double helix structure in 1953. Similarly, Francis Crick, in his autobiographical book *What Mad Pursuit*, described how he was influenced by Schrödinger's speculations about how genetic information might be stored in molecules.

Schrodinger is discussed in my books The Blink of An I and in Saltafide where I discussed the connection of consciousness to a universal consciousness. It is important to point out that I wrote this before I knew about Schrödinger's singularity of consciousness. The serendipity is important because it is an example of what Jung calls "synchronicity" (discussed in the Philosophy Digest under Jung and Physics Digest under Pauli), and what I have called "consciousness entanglement", borrowing from quantum physics.

Wolfgang Pauli

Wolfgang Ernst Pauli 25 April 1900 – 15 December 1958) was an Austrian theoretical physicist and one of the pioneers of quantum physics. In 1945, after having been nominated by Albert Einstein, Pauli received the Nobel Prize in Physics for his "decisive contribution through his discovery of a new law of Nature, the exclusion principle or Pauli principle". The discovery involved spin theory, which is the basis of a theory of the structure of matter.

At the end of 1930, shortly after his postulation of the neutrino and immediately following his divorce and the suicide of his mother, Pauli experienced a personal crisis. He consulted psychiatrist and psychotherapist Carl Jung who, like Pauli, lived near Zurich. Jung immediately began interpreting Pauli's deeply archetypal dreams,[and Pauli became one of Jung's best students. He soon began to criticize the epistemology of Jung's theory scientifically, and this **contributed to a certain clarification of the latter's thoughts, especially about the concept of** synchronicity. A great many of these discussions are documented in the Pauli/Jung letters, today published as *Atom and Archetype*. Jung's elaborate analysis of more than 400 of Pauli's dreams is documented in *Psychology and Alchemy*.

He seldom published papers, preferring lengthy correspondences with colleagues such as Niels Bohr and Werner Heisenberg, with whom he had close friendships. Many of his ideas and results were never published and appeared only in his letters, which were often copied and circulated by their recipients.

He formulated the Pauli exclusion principle, perhaps his most important work, which stated that no two electrons could exist in the same quantum state, identified by four quantum numbers including his new two-valued degree of freedom.

In 1926, shortly after Heisenberg published the matrix theory of modern quantum mechanics, Pauli used it to derive the observed spectrum of the hydrogen atom. This result was important in securing credibility for Heisenberg's theory.
Pauli introduced the 2 × 2 Pauli matrices as a basis of spin operators, thus solving the non-relativistic theory of spin. This work, including the Pauli equation, is sometimes said to have influenced Paul Dirac in his creation of the Dirac equation for the relativistic electron

In a letter of 4 December to Lise Meitner *et al.*, beginning, "Dear radioactive ladies and gentlemen", he proposed the existence of a hitherto unobserved neutral particle with a small mass, no greater than 1% the mass of a proton, to explain the continuous spectrum of beta decay. In 1934, Enrico Fermi incorporated the particle, which he called a neutrino,

In 1940, he re-derived the spin-statistics theorem, a critical result of quantum field theory which states that particles with half-integer spin are fermions, while particles with integer spin are bosons.

Werner Heisenberg [in *Physics and Beyond*, 1971] recollects a friendly conversation among young participants at the 1927 Solvay Conference, about Einstein and Planck's views on religion. Wolfgang Pauli, Heisenberg, and Dirac took part in it. Dirac's contribution was a poignant and clear criticism of the political manipulation of religion, that was much appreciated for its lucidity by Bohr, when Heisenberg reported it to him later. Among other things, Dirac said: "I cannot understand why we idle discussing religion. If we are honest – and as scientists honesty is our precise duty – we cannot help but admit that any religion is a pack of false statements, deprived of any real foundation. The very idea of God is a product of human imagination. [...] I do not recognize any religious myth, at least because they contradict one another. [...]" Heisenberg's view was tolerant. Pauli had kept silent, after some initial remarks. But when finally he was asked for his opinion, jokingly he said: "Well, I'd say that also our friend Dirac has got a religion and the first commandment of this religion is 'God does not exist and Paul Dirac is his prophet'". Everybody burst into laughter, including Dirac (Dirac changes his views on spirituality- see Digest section on Dirac, below).

He held visiting professorships at the University of Michigan in 1931, and the Institute for Advanced Study in Princeton in 1935. He was awarded the Lorentz Medal in 1931.

Pauli may have been unconcerned that much of his work thus went uncredited, but when it came to Heisenberg's world-renowned 1958 lecture at Göttingen on their joint work on a unified field theory, and the press release calling Pauli a mere "assistant to Professor Heisenberg", Pauli became offended, denouncing Heisenberg's physics prowess. The deterioration between them resulted in Heisenberg ignoring Pauli's funeral, and writing in his autobiography that Pauli's criticisms were overwrought, though ultimately the field theory was proven untenable, validating Pauli's criticisms.

Throughout his life, Pauli had been preoccupied with the question of why the fine structure constant, a dimensionless fundamental constant, has a value nearly equal to 1/137. Pauli died in room 137 of the Rotkreuz hospital in Zurich on 15 December 1958

Heisenberg

Werner Karl Heisenberg 5 December 1901 – 1 February 1976)[3] was a German theoretical physicist and one of the key pioneers of quantum mechanics. He is known for the Heisenberg uncertainty principle, which he published in 1927. Heisenberg was awarded the 1932 Nobel Prize in Physics "for the creation of quantum mechanics". In 1928, Albert Einstein nominated Heisenberg, Born, and Jordan for the Nobel Prize in Physics

He was a principal scientist in the German nuclear weapons program during World War II. After Adolf Hitler came to power in 1933, Heisenberg travelled to occupied Copenhagen where he met and discussed the German project with Niels Bohr. Heisenberg explained that he had visited Copenhagen to communicate to Bohr the views of several German scientists, that production of a nuclear weapon was possible with great efforts, and this raised enormous responsibilities on the world's scientists on both sides.

Some doubt on the extent of his collaboration with the Nazis is raised by the fact that he was condemned as the “white jew” by the Nazi’s physicists. This might have to do with the fact that he supported Einstein’s ideas. Supporters of *Deutsche Physik*, or Aryan Physics, launched vicious attacks against leading theoretical physicists, including Arnold Sommerfeld and Heisenberg, and the theory of relativity. In the university environment, political factors took priority over scholarly ability.

Farm Hall transcripts
Alsos mission of the allies arrested Heisenberg in 1945 and held him and others at Farm Hall in England. The facility had been a safe house of the British foreign intelligence MI6. During their detention, their conversations were recorded. Conversations thought to be of intelligence value were transcribed and translated into English. The transcripts were released in 1992. On 6 August 1945, the scientists at Farm Hall learned from media reports that the USA had dropped an atomic bomb in Hiroshima, Japan. At first, there was disbelief that a bomb had been built and dropped. In the weeks that followed, the German scientists discussed how the USA may have built the bomb.

The Farm Hall transcripts reveal that Heisenberg, along with other physicists interned at Farm Hall including Otto Hahn and Carl Friedrich von Weizsäcker, were glad the Allies had won World War II. Heisenberg told other scientists that he had never contemplated a bomb, only an atomic pile to produce energy. The morality of creating a bomb for the Nazis was also discussed. Only a few of the scientists expressed genuine horror at the prospect of nuclear weapons, and Heisenberg himself was cautious in discussing the matter.

Following World War II, he was appointed director of the Kaiser Wilhelm Institute for Physics, which soon thereafter was renamed the Max Planck Institute for Physics.

In January 1937, Heisenberg met Elisabeth Schumacher (1914–1998) at a private music recital. Elisabeth was the daughter of a well-known Berlin economics professor, and her brother was the economist E. F. Schumacher, author of Small Is Beautiful. Heisenberg married her on 29 April. Fraternal twins Maria and Wolfgang were born in January 1938, whereupon Wolfgang Pauli congratulated Heisenberg on his "pair creation"—a word play on a process from elementary particle physics, pair production. They had five more children over the next 12 years: Barbara, Christine, Jochen, Martin and Verena.

Music
Heisenberg enjoyed classical music and was an accomplished pianist. His interest in music led to meeting his future wife.

Uncertainty
The development of quantum mechanics, and the apparent contradictory implications in regard to what is "real" had profound philosophical implications, including what scientific observations truly mean. His “uncertainty principle” which successfully refuted the beliefs of Albert Einstein and Louis de Broglie, who believed that particles had an objectively true momentum and position at all times (even if both could not be measured), changed not only the philosophy of science, all philosophy.

Spiritualism

When Heisenberg accepted the Romano Guardini Prize in 1974, he gave a speech, which he later published under the title *Scientific and Religious Truth*:
“In the history of science, ever since the famous trial of Galileo, it has repeatedly been claimed that scientific truth cannot be reconciled with the religious interpretation of the world. **Although I am now convinced that scientific truth is unassailable in its own field, I have never found it possible to dismiss the content of religious thinking as simply part of an outmoded phase in the consciousness of mankind, a part we shall have to give up from now on. Thus in the course of my life I have repeatedly been compelled to ponder on the relationship of these two regions of thought, for I have never been able to doubt the reality of that to which they point.”**
—Heisenberg 1974, 213

The breadth of Heisenberg’s intra-consciousness and the connections he made deserve an entire book, which may spring from this work. His connection to music and his familiarity with philosophy as evidenced in his books are quite remarkable and clearly place him in the pantheon of minds that were connected to the ultra-consciousness.

His book Physics and Philosophy, in this writers opinion, is the most important book of the twentieth century, and unfortunately is unknown to most. It is a compendium in the fewest possible words of all that is relevant in philosophy and science the two ledges of the chasm that confronts human consciousness. This book causes one to marvel that any scientific mind could have such a mastery of philosophy and also that any philosopher could have such a complete understanding of science. The book foretells the merger of philosophy and science, of matter and energy, of energy and consciousness. This is the springboard of the leap of faith to scientific spiritualism.

Paul Dirac

Paul Adrien Maurice Dirac 8 August 1902 – 20 October 1984) was an English theoretical physicist who is regarded as one of the most significant physicists of the 20th century.

Dirac made fundamental contributions to the early development of both quantum mechanics and quantum electrodynamics. Among other discoveries, he formulated the Dirac equation which describes the behavior of fermions and predicted the existence of antimatter. Dirac shared the 1933 Nobel Prize in Physics with Erwin Schrödinger "for the discovery of new productive forms of atomic theory". He also made significant contributions to the reconciliation of general relativity with quantum mechanics.

He was the Lucasian Professor of Mathematics at the University of Cambridge, a position held by Isaac Newton, Charles Babbage and Stephen Hawking, to name a few. He was also a member of the Center for Theoretical Studies, University of Miami, a stone's throw from where I now sit writing this digest.

Quantum theory

Dirac's first step into a new quantum theory was taken late in September 1925, based the work of Heisenberg and Bohr. This led him to a more profound and significant general formulation of quantum mechanics than was achieved by any other worker in this field. Dirac's formulation allowed him to obtain the quantisation rules in a novel and more illuminating manner. This formed the basis for Fermi-Dirac statistics that applies to systems consisting of many identical spin 1/2 particles (i.e. that obey the Pauli exclusion principle), e.g. electrons in solids and liquids, and importantly to the field of conduction in semi-conductors.

The Dirac equation

Dirac equation

In 1928, building on 2×2 spin matrices which he purported to have discovered independently of Wolfgang Pauli's work, he proposed the Dirac equation as a relativistic equation of motion for the wave function of the electron. This work led Dirac to predict the existence of the positron, the electron's antiparticle, which he interpreted in terms of what came to be called the *Dirac sea*. The positron was observed by Carl Anderson in 1932. Dirac's equation also contributed to explaining the origin of quantum spin as a relativistic phenomenon.

The necessity of fermions (matter) being created and destroyed in Enrico Fermi's 1934 theory of beta decay led to a reinterpretation of Dirac's equation by Werner Heisenberg, as a (quantum) field equation accurately describing all elementary matter particles – today quarks and leptons – this Dirac field equation is central to theoretical physics. Dirac is regarded as the founder of quantum electrodynamics, being the first to use that term. He also introduced the idea of vacuum polarisation in the early 1930s.

Dirac established the most general theory of quantum mechanics and discovered the relativistic equation for the electron, which now bears his name. The remarkable notion of an antiparticle to each fermion particle – e.g. the positron as antiparticle to the electron – stems from his equation. He was the first to develop quantum field theory, which underlies all theoretical work on sub-atomic or "elementary" particles today, work that is fundamental to our understanding of the forces of nature. He proposed and investigated the concept of a magnetic monopole, an object not yet known empirically, as a means of bringing even greater symmetry to James Clerk Maxwell's equations of electromagnetism.

Gravity
He quantized the gravitational field, and developed a general quantum field theory with dynamical constraints, which forms the basis of the gauge theories and superstring theories of today. Physicists use the concepts and equations that he developed daily.

Religious views

Heisenberg recollected a conversation among young participants at the 1927 Solvay Conference about Einstein and Planck's views on religion between Wolfgang Pauli, Heisenberg and Dirac. Dirac's contribution was a criticism of the political purpose of religion. Among other things, Dirac said:

I cannot understand why we idle discussing religion. If we are honest—and scientists have to be—we must admit that religion is a jumble of false assertions, with no basis in reality. The very idea of God is a product of the human imagination. It is quite understandable why primitive people, who were so much more exposed to the overpowering forces of nature than we are today, should have personified these forces in fear and trembling. But nowadays, when we understand so many natural processes, we have no need for such solutions. I can't for the life of me see how the postulate of an Almighty God helps us in any way. What I do see is that this assumption leads to such unproductive questions as why God allows so much misery and injustice, the exploitation of the poor by the rich and all the other horrors He might have prevented. **If religion is still being taught, it is by no means because its ideas still convince us, but simply because some of us want to keep the lower classes quiet.** Quiet people are much easier to govern than clamorous and dissatisfied ones. They are also much easier to exploit. **Religion is a kind of opium** that allows a nation to lull itself into wishful dreams and so forget the injustices that are being perpetrated against the people. Hence the close alliance between those two great political forces, the State and the Church. Both need the illusion that a kindly God rewards—in heaven if not on earth—all those who have not risen up against injustice, who have done their duty quietly and uncomplainingly. That is precisely why the honest assertion that God is a mere product of the human imagination is branded as the worst of all mortal sins.

Heisenberg's view was tolerant. **Pauli,** raised as a Catholic, had kept silent after some initial remarks, but when finally he was asked for his opinion, said: **"Well, our friend Dirac has got a religion and its guiding principle is 'There is no God, and Paul Dirac is His prophet.'"** Everybody, including Dirac, burst into laughter. In a few years Dirac moved from the Marxist view to what could be called an idealist or even Platonic view.

Dirac's views towards the idea of God were dramatically changed in the May 1963 edition of Scientific American, he wrote: It seems to be one of the fundamental features of nature that fundamental physical laws are described in terms of a mathematical theory of great beauty and power, needing quite a high standard of mathematics for one to understand it. You may wonder: Why is nature constructed along these lines? One can only answer that our present knowledge seems to show that nature is so constructed. We simply have to accept it. One could perhaps describe the situation by saying that God is a mathematician of a very high order, and He used very advanced mathematics in constructing the universe. Our feeble attempts at mathematics enable us to understand a bit of the universe, and as we proceed to develop higher and higher mathematics we can hope to understand the universe better." This sounds like the fallible human "belief" aspiring to the Ideal, Platonic "truth".

Sir Roger Penrose

OM FRS (born 8 August 1931) is an English mathematical physicist, mathematician and philosopher of science. He is Emeritus Rouse Ball Professor of Mathematics at the University of Oxford, an emeritus fellow of Wadham College, Oxford and an honorary fellow of St John's College, Cambridge.
Penrose has made contributions to the mathematical physics of general relativity and cosmology. He has received several prizes and awards, including the 1988 Wolf Prize for physics, which he shared with Stephen Hawking for the Penrose–Hawking singularity theorems

Penrose is the Francis and Helen Pentz Distinguished Visiting Professor of Physics and Mathematics at Pennsylvania State University

(Excerpt from Saltafide, Ciampa)

Roger Penrose, another philosophical mathematician and physicist, (famous for the black hole work with Stephen Hawking) suggested that the slack created by the "uncertainty principle could be the hole in the plan for "free will". In his book Shadows of the Mind, (page 414), he connects the Platonic world of ideals with the mental world and the physical world.

If not a spiritualist, Penrose is at least an idealist in that he insists that consciousness and machine intelligence are categorically different and will never be the same. In both his books: Shadows of the Mind, and The Emperor's New Mind, and in his fascinating YouTube presentations, he refutes the artificial intelligence promise that eventually computers will be able to mimic consciousness. According to Penrose, mechanical intelligence is the limit of computers and it is always and only algorithmic. Computers can only follow algorithms; they can't create them. Only human minds can do that. Penrose makes it clear that human intelligence is different from the paint by numbers, algorithmic artificial intelligence. Algorithms can be invented by human minds but can only be followed by computers.

That's as far as his faith goes. Unlike Einstein or Bohr, or Schrodinger, Penrose does not believe that any god is involved, Penrose cites the law or the plan which makes sublime thinking possible for humans, but refuses to call it 'divine'. The connection of human consciousness to divine consciousness can be deduced from what Penrose says, but not by him. No, Penrose's insists: "the human mind is neither a gift of God nor a cosmic accident." (You Tube). He believes we just need time to bring the ocean home in our tea cup. He believes that physics will one day find a new theory that explains the micro universe of the brain where subatomic, micro-tubules are "entangled" and there, in that current mystery, non-computational consciousness will be proven and there will be no need for a leap of faith.

Penrose points out that no artificial intelligence could have had Einstein's inspirational leap which led to the theory of general relativity. In his book Shadows …(ibid), Penrose talks about how each of us has a consciousness and how they are all connected and how some few of us (he names the greats of science and literature and philosophy) are also connected to a supreme universal consciousness calle "ultra-consciousness" in Saltafide. This is as far into metaphysics as this physicist is willing to go, which is actually pretty far; interestingly it happens on the very last page of his book.

Stephen Hawking

Stephen William Hawking CH CBE FRS FRSA (8 January 1942 – 14 March 2018) was an English theoretical physicist, cosmologist, and author who was director of research at the Centre for Theoretical Cosmology at the University of Cambridge at the time of his death. He was the Lucasian Professor of Mathematics at the University of Cambridge between 1979 and 2009. The power of his will is as remarkable as his scientific achievements. His continuation to a full life of the mind in spite of the loss of his bodily controls, is well know to all, and stands as the ultimate miracle of mind over matter, ironically enshrined in one who doubted miracles.

Hawking's scientific works included a collaboration with Roger Penrose on gravitational singularity theorems in the framework of general relativity and the theoretical prediction that black holes emit radiation, often called Hawking radiation. Initially, Hawking radiation was controversial. By the late 1970s and following the publication of further research, the discovery was widely accepted as a significant breakthrough in theoretical physics. Hawking was the first to set out a theory of cosmology explained by a union of the general theory of relativity and quantum mechanics. He was a vigorous supporter of the many-worlds interpretation of quantum mechanics

In 1970, Hawking postulated what became known as the second law of black hole dynamics, that the event horizon of a black hole can never get smaller

Initially, Hawking radiation was controversial. By the late 1970s and following the publication of further research, the discovery was widely accepted as a significant breakthrough in theoretical physics

In 2011, narrating the first episode of the American television series *Curiosity* on the Discovery Channel, Hawking declared:
We are each free to believe what we want and it is my view that the simplest explanation is there is no God. No one created the universe and no one directs our fate. This leads me to a profound realization. There is probably no heaven, and no afterlife either. We have this one life to appreciate the grand design of the universe, and for that, I am extremely grateful.

At Google's Zeitgeist Conference in 2011, Hawking said that "philosophy is dead". He believed that philosophers "have not kept up with modern developments in science" and that scientists "have become the bearers of the torch of discovery in our quest for knowledge". He said that philosophical problems can be answered by science, particularly new scientific theories which "lead us to a new and very different picture of the universe and our place in it"

Hawking did not rule out the existence of a Creator, asking in *A Brief History of Time* "Is the unified theory so compelling that it brings about its own existence?" In his early

work, Hawking spoke of God in a metaphorical sense. In *A Brief History of Time* he wrote: "If we discover a complete theory, it would be the ultimate triumph of human reason – for then we should know the mind of God."In the same book he suggested that the existence of God was not necessary to explain the origin of the universe. Later discussions with Neil Turok led to the realization that the existence of God was also compatible with an open universe.