

Topic Page: [Gödel, Kurt](#)

Definition: **Gödel, Kurt** from *Philip's Encyclopedia*

US logician, b. Moravia. He is best known for his 'undecidability' or 'incompleteness' theorem, first published in 1931. **Gödel's theorem** states any axiom-based mathematical system contains statements that can neither be proved or disproved within the system. In 1940, he emigrated to the USA, joining Albert Einstein at the Institute of Advanced Study at Princeton. See *also* number theory

Summary Article: **Gödel, Kurt (1906-1978)**

From *Encyclopedia of Time: Science, Philosophy, Theology, & Culture*

Kurt Gödel was a mathematical logician who is best known for his incompleteness theorem. He also developed a theory of time travel based on Einstein's theory of relativity.

Gödel was born on April 28, 1906, in Brunn, Austria (now known as Brno, Czech Republic), and was baptized as a Lutheran. He began studying physics at the University of Vienna in 1924, but in 1926 he switched to mathematics, in which he excelled. Eventually he settled into the field of mathematical logic, which originated in the work of Gottlob Frege and was more fully developed by David Hilbert, Bertrand Russell, and Alfred North Whitehead.

In 1926, Gödel began participating in the Vienna Circle, a group of mathematicians and philosophers headed by Moritz Schlick. The group's members devoted themselves to propagating logical positivism, the philosophy that all that can be known about nature or reality must be deduced from immediate sensory experience. In spite of his participation, Gödel, like Albert Einstein, would become a lifelong opponent of positivism, arguing that intuition has a proper role to play in science and mathematics. Both he and Einstein rejected the Kantian notion that one can know only the appearances of things and not the things themselves. Because of Gödel's preference for the idealistic philosophies of Plato and Husserl, the philosophical establishment, dominated by the philosophy of Wittgenstein, either ignored or scorned much of his philosophical work.

In 1930, Gödel obtained his Ph.D. In 1931, Gödel published a response to David Hilbert's formalist attempt to develop a system of first principles (or axioms) from which one could apply rules of syntax to derive all the theorems of a mathematical domain. He undermined Hilbert's program by showing that no set of formalist axioms can ever fully capture the complete set of mathematical truths. There will always be some truths about integers, grasped intuitively, that cannot be proved true or false by any fixed set of axioms. He also showed that a system of axioms for arithmetic could not prove its own consistency. His incompleteness theorem (also known as Gödel's proof) ranks with Einstein's theory of relativity and Heisenberg's uncertainty principle as one of the three most revolutionary scientific findings in the 20th century. The recursive functions that he developed as part of this work were later used by Alan Turing and others in the development of the computer.

From 1933 to 1938, he alternated teaching stints between the University of Vienna and the Institute for Advanced Study (IAS) in Princeton, New Jersey. In 1938, he married Adele Porkert, a divorced nightclub performer. They had no children. After being declared fit for German military service, he and his wife emigrated to America in the winter of 1939-1940 by way of Siberia, Japan, and San Francisco, arriving in March at Princeton where he became a temporary member of the IAS. This status was renewed

annually until he became a permanent member in 1946. In 1948, he became a citizen of the United States.

Gödel and Einstein became close friends in 1942 and remained so until Einstein's death in 1955. They joined each other in daily half-hour walks to and from the institute, during which they discussed politics, philosophy, and physics. During this time, Gödel's work focused on proving that Georg Cantor's continuum hypothesis (which dealt with the number of points on a line) was consistent with set theory and therefore could not be disproved.

In 1949, Gödel wrote an essay on the connection between the theory of relativity and idealistic philosophy, which was included in a volume in honor of Einstein's 70th birthday. Gödel developed solutions to the field equations of general relativity that resulted in a possible world (called the Gödel universe) whose spacetime structure is warped or curved so extremely as to form a closed, rotating loop. If a spaceship traveled fast enough along one of the continuous time-like paths in this structure, it could travel to the past or to the future. He then concluded that, if one could travel to the past, then time does not exist as an objective reality. Like Parmenides and Kant, he challenged the intuitive understanding of time as a linear ordering of events in which the past no longer exists, the future is yet to exist, and only the present truly exists. In essence, he showed that if relativity theory is true, then time understood as a succession of never-ending "nows" cannot exist as an objective reality.

Einstein was impressed with the results but doubted that physical data would support the existence of such a universe. In fact, lack of evidence for the rotation of the universe suggests that time travel is not possible in the actual universe (unless scientists can figure out how to create wormholes, which are shortcuts between two points in spacetime). Since its publication, the essay has received some attention from those interested in the topic of time travel, but its conclusion that time is an illusion has been largely ignored. In 1992, Stephen Hawking proposed the "chronology protection conjecture" in order to refute Gödel's argument and other theories of time travel. Hawking postulated that the laws of physics rule out the physical possibility of macroscopic bodies carrying information to the past.

In 1951, Gödel was co-recipient with Julian Schwinger of the first Einstein Award and delivered the Gibbs Lecture for the American Mathematical Society. After that, he became increasingly reclusive and isolated. In 1953, he was elected to the National Academy of Sciences and was promoted to professor at IAS. He published his last paper in 1958. During the 1960s, he developed an ontological argument for the existence of God, building on the arguments of his favorite philosopher, Leibniz. He never published it, perhaps for fear of damage to his reputation if his sympathies toward theism became known. He also continued his quest to develop axioms that would settle the continuum hypothesis. In 1975, he was awarded the National Medal of Science.

After Einstein's death, the economist Oskar Morgenstern became Gödel's friend and caretaker. The logician Hao Wang also became a close associate in the closing years of Gödel's life, and after his death Wang published recollections of conversations with Gödel.

Throughout adulthood, Gödel was plagued by depression, hypochondria, anorexia, and paranoia, and his symptoms worsened as he grew older. He retired from the IAS on July 1, 1976. In 1977, Morgenstern's death and his own wife's deteriorating health exacerbated Gödel's mental and physical disorders. He died of self-starvation on January 14, 1978, weighing only 65 pounds, and was buried in Princeton Cemetery. His wife died in 1981.

See also

Einstein, Albert, Hawking, Stephen, Idealism, Intuition, Kant, Immanuel, Leibniz, Gottfried Wilhelm von, Relativity, General Theory of, Russell, Bertrand, Space and Time, Spacetime, Curvature of, Time, Illusion of, Time, Nonexistence of, Time, Relativity of, Time Machine, Time Travel, Time Warps, Whitehead, Alfred North, Worlds, Possible, Wormholes

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