The Life and Work of Kurt Gödel – Part I

Sandra Takano
Gödel‘s Life

Divided in 3 phases

1) Childhood in Brno

2) Years in Vienna as a student and Dozent – when he obtained his greatest mathematical achievements

3) Emigration to America – when his interests turn to philosophy and physics
Kurt Gödel‘s Personality

• „der Herr Warum“

• Asking „answarable“ questions and searching for rationality throughout his life

• Deanne Montgomery (colleague) recalls:
  - childlike naivété
  - needed to be looked after just like a child
  - unsophisticated tastes
  - dependent on other people
Childhood (1906-1924)

- Norn April 28, 1906, in Brünn, Austria-Hungary (now Brno, Czech Republic)
- German family of Rudolf Gödel (1874–1929) and Marianne Gödel (1879–1966)
- Mother attended a French lyceé in Brno
- Father fulfilled many of son‘s wishes and „provided plentifully“ for their education

The Gödel family, ca. 1910: Marianne, Kurt, father Rudolf, son Rudolf
Childhood

Gödel's birthplace, Brno, 1993

The Gödel villa, Brno, 1983
Childhood

- At the age of 6, 16 September 1912, Gödel was enrolled at the Evangelische Privat-Volks- und Bürgerschule.
Childhood

- Courses in religion, reading, writing (in the old script), German grammar, arithmetic, history, geography, natural history, singing and physical education

- Highest marks, although frequently absent because of rheumatic fever

- No lasting effects, but beginning of his hypocondria

A page from Gödel's first arithmetic book, 1912-1913
Gymnasium

- In 1916, Gödel enrolled at the *Staatsrealgymnasium mit deutscher Unterrichtssprache*
Gymnasium

- introvert and isolated, most of time reading, exempted from sport class and did not travel with his parents to the countryside

- preferred mathematics and languages (Latin, French and English) to literature and history

Semester report for Gödel, 1917
Gymnasium

- Czechs were for the most part country folk
- Germans were better educated
- Gödel considered himself Austrian and an exile in Czechoslovakia
- He did not choose to learn Czech in school. Harry Klepetar recalls he never heard him saying a word in Czech
- Maybe prejudice? Gödel writes in a letter to his mother in 1954, that he did not find Slavs „unsympatisch“
Gymnasium

- Gödel was particularly interested in foreign languages
- \textit{Nachlaß} contains books in Italian, Dutch, Greek, Latin, French and English. Personal library contained several foreign-language dictionaries and grammars
- Scientific works found only in German, French and English

School portrait, 1922
Gymnasium

• Gödel‘s notebooks of science courses have been preserved

• In physics, there are notes on
  – Units of measurement, basic astronomy, motions of pendulums, second-order linear differential equations

• In mathematics, there are notes on
  – Algebra, geometry, some calculus

• His brother attests that Gödel „mastered University mathematics by his final Gymnasium years“ through independent study
Gymnasium

- Gymnasium was „one of the best schools in the Austrian monarchy and later in Czechoslovakia“. Gödel himself spoke disdainfully of the Gymnasium in a letter to his mother on September 1960 (then 54)
- Awakening of his interests in mathematics not due to the school
- Goethe‘s color theory and the conflict with Newton led him to the choice of his profession
- Gödel graduated from the *Realgymnasium* in 1924
Vienna (1924-1929)

- In the autumn of 1924, Gödel matriculates at the University of Vienna
- Vienna had been the cultural and political capital of the Austro-Hungarian Empire
- After the partitioning of the empire, Vienna became just a poor capital
- Still, the city’s intellectual heritage remained intact and the University retained its prestige
University of Vienna

- Austrian universities based on the German model
- University of Vienna had 4 faculties:
  - Theology, Law and Medicine
  - Philosophy
- No tuition fees
- No required curricula
- No grades
- Necessary to pass a state examination
- No distinction between undergraduate and graduate students
- Common to study at several universities at that time
University of Vienna

• Some of the courses Gödel attended from WS 1925/26 to WS 1928/29:
  – History of European philosophy
    • pre-Socratics to the Reformation
  – Sequel of history of European philosophy
    • Bacon, Schopenhauer, Decartes, Leibniz, Spinoza, Hobbes, Locke, Rousseau, Kant, Hegel
  – *Einführung in die Zahlentheorie* by Prof. Furtwängler
  – Kinetic theory by Prof. Kottler
Another important source of information are his library requests slips, that he rigorously saved:
- Bernhard Riemann’s works on partial differential equations
- Euclid’s *Elements*
- Euler’s *Introductio in Analysin Infinitiorium*
- Lagrange’s *Mécanique Analytique*
- Dirichlet’s *Vorlesungen über Zahlentheorie*
- Kant’s *Metaphysische Anfangsgründe der Naturwissenschaft*

Olga Taussky recalls Gödel attended a seminar about Bertrand Russel’s *Introduction to Mathematical Philosophy*: first contact with Russel’s writings
Prof. Hans Hahn

- 1925 or 1926, Gödel meets Prof. Hahn
- Main influence, second only to Prof. Furtwängler
- Hahn made contributions to set theory, set-theoretic geometry, calculus of variations, theory of real functions, Fourier integrals and functional analysis (Hahn-Banach theorem)
- No deliver of any proof in logic, but offered several courses in the subject
The Vienna Circle

- Prof. Hahn belonged to a small group that gathered once a week in a small Vienna coffeeshouse
- Schlick was the leader of the group
- Group gained more members and became known as The Vienna Circle
- Admission was invitation-only
- Later years, Gödel disagrees with the Circle’s view of mathematics
- Gödel avoids open criticism and mostly listens
The Vienna Circle

- Gödel‘s closest members:
  - Carnap was a student of Gottlob Frege
  - Menger was one of Hahn‘s students. He became *Privatdozent* and *ausserordentlicher Professor*
  - Feigl was a student with whom Gödel „met frequently for walks through the parks of Vienna […] endless discussions about logical, mathematical, epistemological and philosophy-of-science issues – sometimes deep into […] the night“

Karl Menger, 1970

Rudolf Carnap, 1960
The Vienna Circle

- Other members:
  - Hahn was less familiar with traditional philosophy. Favorite author was Hume and was a great admirer of Leibniz. Contrary to Gödel, disliked Kant
  - Schlick was "calm and unassuming", although "aristocratic", "authoritarian" and "conservative"
  - Carnap and Neurath were "somewhat utopian reformers"
- Such different personalities caused disagreements
The Vienna Circle

- After WWI, Vienna had an influx of mediums
- Carnap’s and Hahn’s interest in parapsychological phenomena
- Neurath irritated that Hahn was trying to use „scientific methods of experimentation“, which only strengthen „super-naturalism“.
- Carnap and Hahn defended that scientists should have the „right to examine objectively … all processes or alleged processes“
Occult phenomena

- Gödel clearly interested in occult phenomena
- Library slips include *Aberglaube und Zauberei* borrowed twice
- „the result of the fraud [in occult phenomena] is … not that it simulates, but that it masks the genuine phenomena“
- Gödel believed in the possibility of telepathy
- Remark to Oskar Morgenstern
Mathematical Intuition

• Gödel believed mind is distinct from matter
• “despite their remoteness from sense experience, we do have something like a perception of objects of set theory“
• no reason „why we should have less confidence in that kind of perception, i.e. in mathematical intuition, than in sense perception“
• intuition should not be regarded as something „purely subjective“ just because „they cannot be associated with actions of certain things on our sense organs“
How Gödel was perceived by other members of the Vienna Circle

- Menger, 1981
- Taussky-Todd, 1987
- Feigl, 1969
Adele

• Gödel meets his future wife Adele Thusnelda Porkert

• Family strongly disapproved the match

• Adele was divorced, 6 years older than Gödel, catholic, came from a lower class family, her face was disfigured, and, worst of all: she was a dancer!

Wedding portrait, Vienna, 1928
Dissertation

- Not clear when he started writing. Sometime in 1928 or 1929
- Borrowed books from the University of Vienna:
  - Schröder's *Vorlesungen über die Algebra der Logik*
  - Frege's *Grundlagen der Arithmetik*
  - Leibniz's *Philosophische Schriften*
  - Schlick's *Naturphilosophie*
- Purchased a copy of Whitehead and Russells‘ *Principia Mathematica*
- Borrowed books from the *Technische Hochschule* in Brno:
  - Dirichlet on number theory
  - Bierbach on function theory
  - Blaschke on differential geometry
- Gödel tells Hao Wang he had completed the dissertation before ever showing it to Hahn
Dissertation

• Gödel asserted that at the time of his completeness and incompleteness papers, „a concept of objective mathematical truth … was viewed with greatest suspicion and was widely rejected as meaningless“

• 1935 at International Congress for Scientific Philosophy, Carnap and Tarski confirmed Gödel's sentiment

• Nevertheless, Gödel recognized early the distinction between provability and truth (and its formal undefinability) independently from Tarski
Dissertation

• His father passes away
• During the writing, already in 1926, „socialist and Jewish students were dragged out of the classrooms and severely beaten“
• Although not Jewish, Gödel’s advisor was
• According to Carnap, Gödel was at that time for socialism and was reading Lenin and Trotsky
• By 6 July 1929, the dissertation was approved by Prof. Hahn and Furtwängler.

After Nazi domination, Jews being forced to scrub the streets in Vienna, 1938
By 1929, economic situation in Austria was severe

Rudolf and Gödel were spending their inheritance freely „in order to be able to live well“

Gödel had his Ph.D, but that was no guarantee of an academic career

Gödel had to make his results known to a wider audience: Conference on the Epistemology of the Exact Sciences, Königsberg, East Prussia and Vienna Mathematical Society

His completeness theorem was a great accomplishment, however, employed methods similar to those Löwenheim and Skolem employed

For the Habilitation, Gödel need a topic that would attract more attention
Habilitation

• The topic of choice: the second problem from the list of problems Hilbert proposed in 1900
• The problem of giving a finitary consistency proof for the axioms of analysis as the first step to secure the foundations of mathematics
• Hilbert‘s legendary lecture „Naturerkennen und Logik“ declaration
• Gödel was in Königsberg that day, maybe in the audience?
• By the fall of 1930, Gödel had found the answer
The Incompleteness Theorem

- Gödel confided the discovery to Carnap, Feigl and Waismann at the Cafe Reichsrat on 26 August 1930
- On the Conference on the Epistemology of the Exact Sciences
  „one can give examples of propositions that, while contentually true, are unprovable in the formal system of classical mathematics“
- Carnap and Hahn pretended being unaware of Gödel’s discovery
- Evidence suggest that only one person grasped the importance of what Gödel had said: von Neumann

John von Neumann
The Incompleteness Theorem

• On 23 October, Gödel submitted to the Vienna Academy of Sciences both incompleteness theorems
• On 20 November, von Neumann wrote Gödel he had come to a remarkable result!
• „Since you have established the unprovability of consistency as a natural continuation of your earlier results, of course I will not publish on that subject“
• Von Neumann on two occasions lectures on Gödel‘s discoveries. On the second occasion, Stephen C. Kleene was present and that was the first time he heard of Gödel
The Incompleteness Theorem

• Outside Vienna, first lecture was at German Mathematical Union in Bad Elser in 1931.

• Ernst Zermelo „felt ill treated … and had no wish to meet Gödel“

• Rudolf reported that „shortly after the publication of his famous work“, his brother showed signs of severe depression

• Fearing a suicide, the family comitted him against his will to a sanatorium in Pukersdorf bei Wien for a few weeks
Dozentur

- Gödel submitted the incompleteness theorems as *Habilitationsschrift* 9 months later, on 25 June 1932
- Prof. Hahn writes „an achievement of the first rank“ that made its mark on the history of mathematics. Gödel’s accomplishments exceeded by far what was expected from a *Habilitationsschrift*
- For the *Dozentur*, Gödel had 51 „yes“ and 1 „no“. The no vote was from Prof. Wirtinger
- *Probevortrag* was approved by simple majority and *Venia legendi* was granted. Gödel had become *Privatdozent*
Invitation to Princeton

- Paul Bernays writes in his article on David Hilbert in the *Encyclopedia of Philosophy* about Gödel's work. It showed that "proof theory could be fruitfully developed without fully keeping to [Hilbert's] original program."
- Menger sent this paper to a colloquium, where Oswald Veblen was an invited guest.
- Oswald Veblen was involved with plans for the organization of the Institute for Advanced Studies in Princeton.
- Veblen was so impressed by Gödel's work, that he sent an invitation to Gödel to work at the institute during its first year (1933-34).
- At that time, Nazis came to power and Austria was disintegrating politically.
Institute of Advanced Studies in Princeton

- Haven for scholars throughout the world to work with the greatest intellects.
- The “timing could not have been more propitious“, as “the rise of Nazism and Fascism sent to America‘s shores a flood of refugee scholars“
- October 1932, Einstein and Veblen appointed first professors

Original mathematics faculty at the IAS, 1933. James Alexander, Marston Morse, Albert Einstein, Aydelotte, Hermann Weyl, Oswald Veblen. Missing is John von Neumann
Institute of Advanced Studies in Princeton

- IAS and Princeton were entirely distinct institutions
- Princeton’s administration feared it would lose too many professors to IAS. It had already hired Veblen and von Neumann, who were receiving higher salaries and were not required to teach
Based on the book

**Logical Dilemmas, The Life and Work of Kurt Gödel** by John W. Dawson Jr., 2006

**Main Sources**

- Family correspondences between Gödel, his mother and brother, held by the *Wiener Stadt- und Landesbibliothek*
- *Rudolf Gödel (Kurt Gödel's brother)*
- *Nachlaß held by the Institute for Advanced Study, Princeton*
- *Diaries of Oskar Morgenstern*