The Life and Work of Kurt Gödel – Part I

Sandra Takano

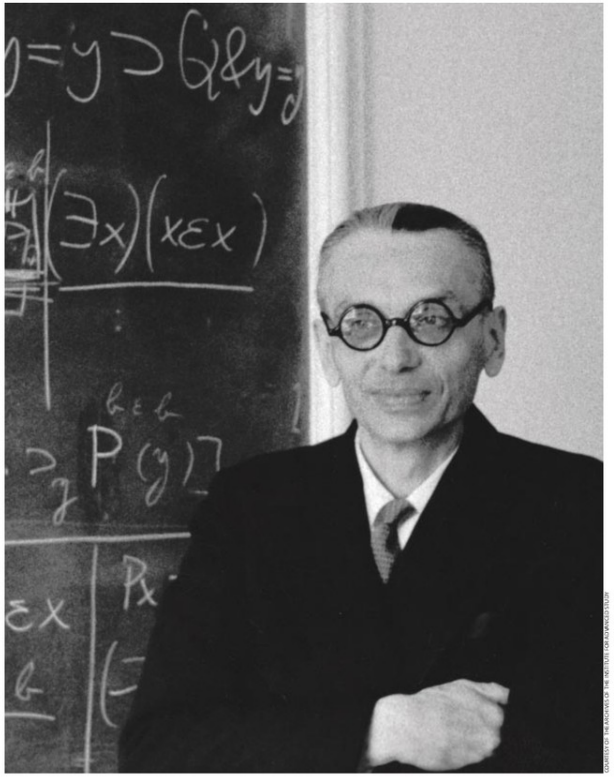
Gödel‘s Life

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

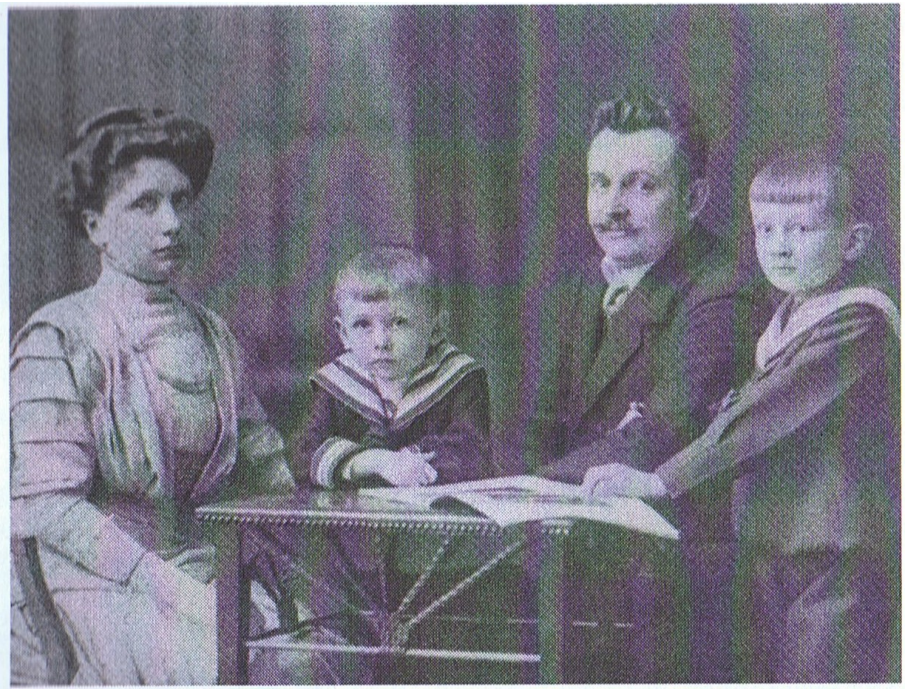
- „der Herr Warum“
- Asking „answarable“ questions and searching for rationality throughout his life
- Deanne Montgomery (colleague) recalls:
  - childlike naivieté
  - neded to be looked after just like a child
  - unsophisticated tastes
  - dependent on other people



KURT GÖDEL proved that mathematical systems are essentially incomplete: not everything that is true can be proved to be so. In later life he turned his attention to a variety of other problems, including relativity. This photograph was taken in May 1958 in Gödel's office at the Institute for Advanced Study in Princeton, N.J., by Finnish logician Veli Valpola.

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 i*n 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

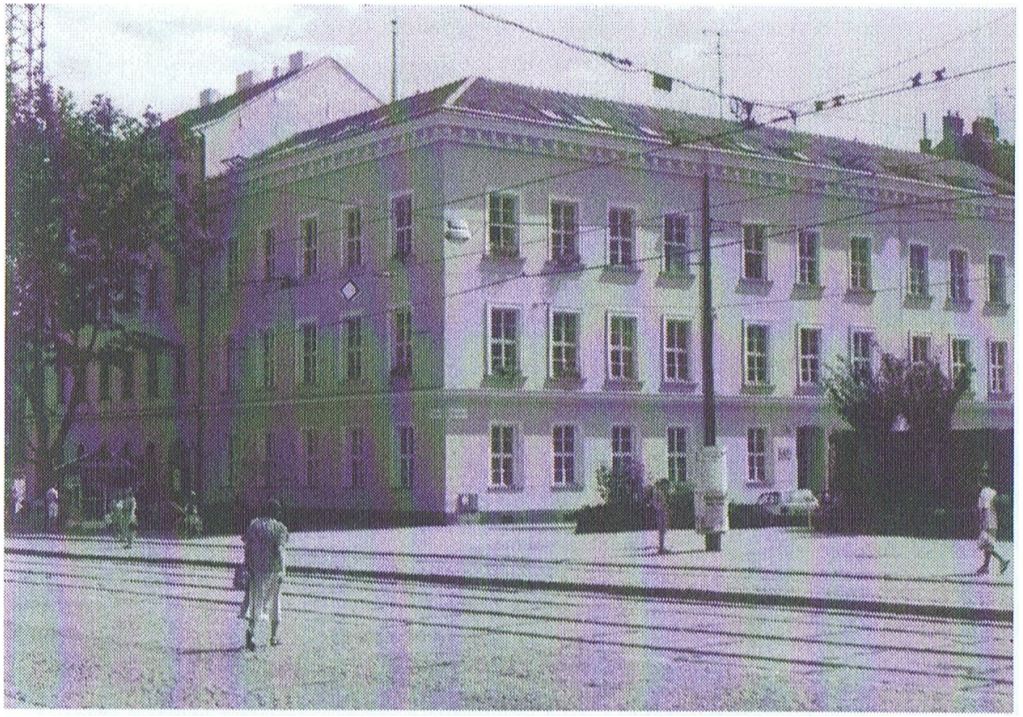
Childhood

Gödel‘s birthplace, Brno, 1993

The Gödel villa, Brno, 1983

Childhood

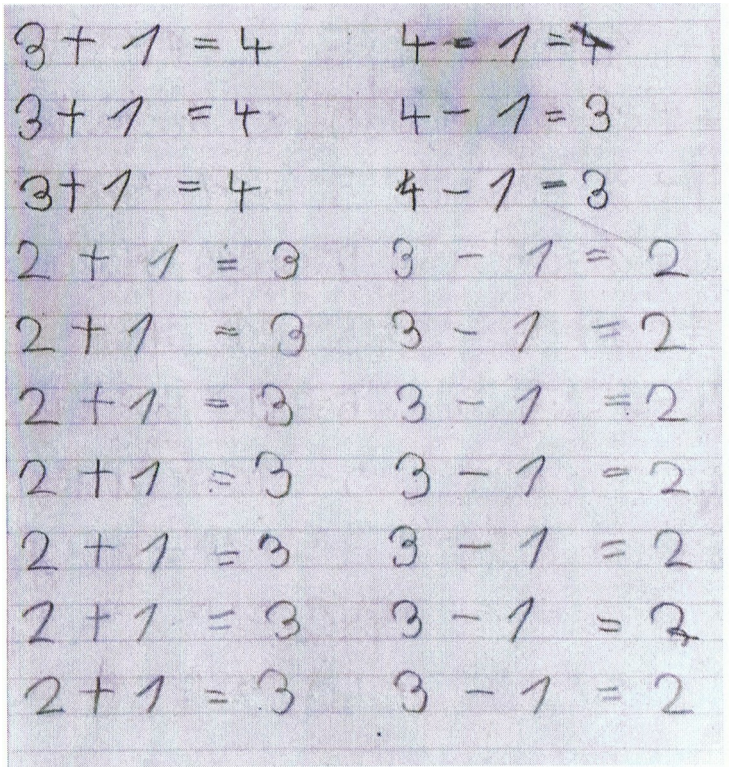
- At the age of 6, 16 September 1912, Gödel was enrolled at the *Evangelische Privat-Volks- und Bürgerschule.*



The *Evangelische Privat-Volks- und Bürgerschule, Brno, 1993*

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 arithmethic book, 1912-1913

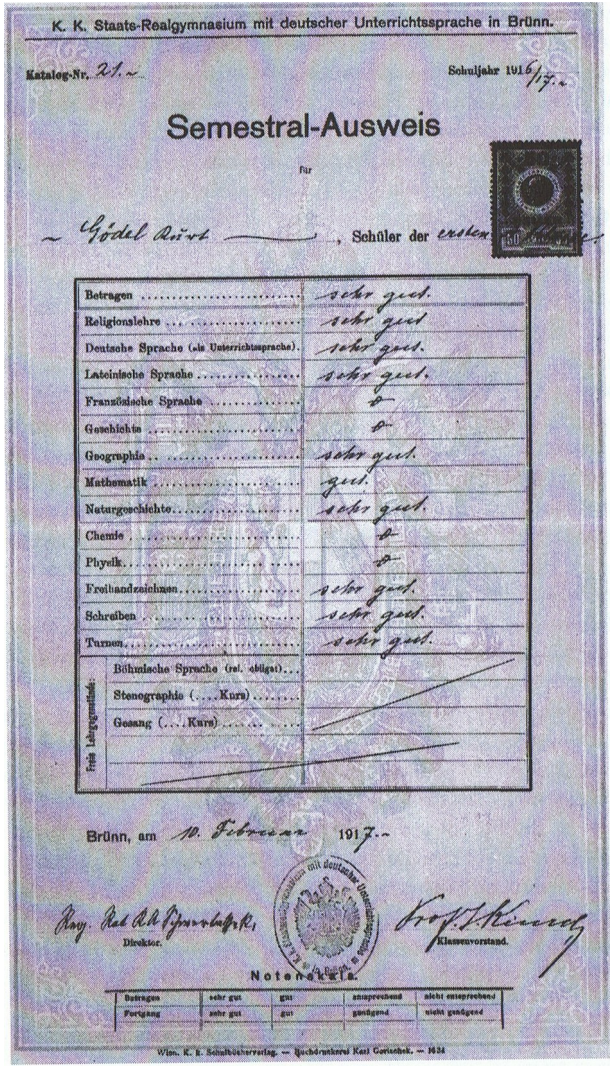
Gymnasium

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

Gymnasium that Gödel attended and Redlich textile factor

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



K. K. Staats-Realgymnasium mit deutscher Unterrichtssprache in Brünn.

Katalog-Nr. 21.

Schuljahr 1916/17.

Semestral-Ausweis

für

Gödel Kurt, Schüler der ersten

Betragen	sehr gut.
Religionslehre	sehr gut
Deutsche Sprache (als Unterrichtssprache)	sehr gut.
Lateinische Sprache	sehr gut.
Französische Sprache	—
Geschichte	—
Geographie	sehr gut.
Mathematik	gut.
Naturgeschichte	sehr gut.
Chemie	—
Physik	—
Freihandzeichnen	sehr gut.
Schreiben	sehr gut.
Turnen	sehr gut.
Freie Lehrgegenstände: Böhmische Sprache (rel. obligat.)	
Stenographie (...Kurs)	
Gesang (...Kurs)	

Brünn, am 10. Februar 1917.

Reg. Rat R. Pfaundler, Direktor.

Prof. J. Kienzl, Klassenvorstand.

Notenskala.

Betragen	sehr gut	gut	anspruchend	nicht entsprechend
Fortgang	sehr gut	gut	genügend	nicht genügend

Wien, K. k. Schulbücherverlag. — Buchdruckerei Karl Gerlach. — 1624

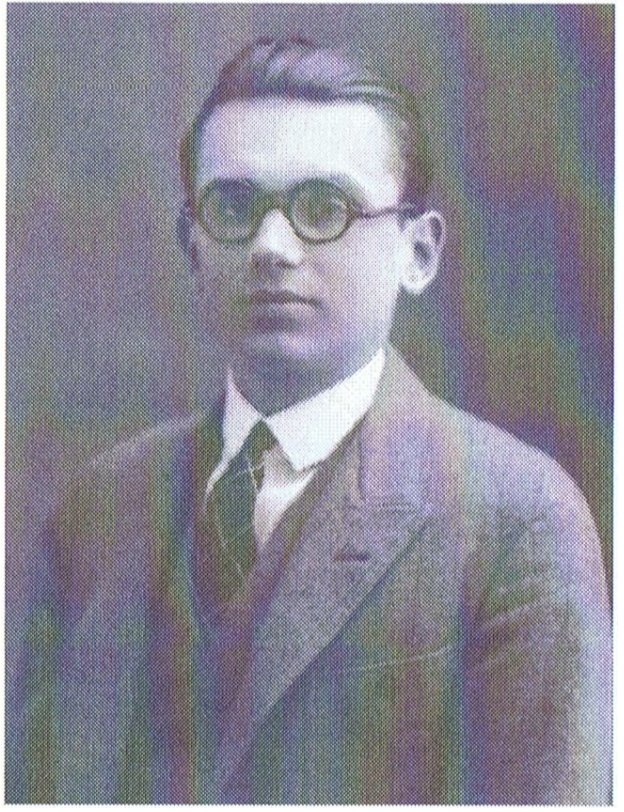
Semester report for Gödel, 1917

Gymnasium

- Czechs were for the most part country folk
- Germans were better educated
- Gödel considered himself Austrian and an exile in Czechoslovalia
- 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
- *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 Gynmasium in a letter to his mother on September 1960 (then 54)
- Awakening of his interets 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

Postcard of Vienna in 1920s

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

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

University of Vienna

- 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 Infinitorium*
  - Lagrange‘s *Mécanique Analytique*
  - Dirichlet‘s *Vorlesungen über Zahlentheorie*
  - Kant‘s *Metaphysische Anfangsgründe der Naturwissenschaft*
- Olga Taussky recalls Gödel attended a seminar about Betrand Russel‘s *Introduction to Mathematical Philosophy: f*irst 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

Prof. Hans Hahn, 1905

The Vienna Circle

- Prof. Hahn belonged to a small group that gathered once a week in a small Vienna coffehouse
- 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

Manifesto, 1929


Cafe Central in Vienna

Mathematical Seminar, University of Vienna

The Vienna Circle

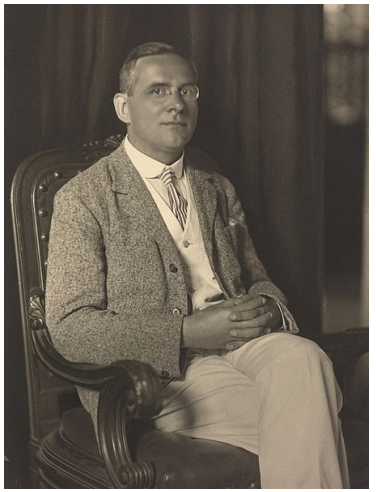
- Gödel‘s closest members:
  - Carnap was a student of Gottlob Frege
  - Menger was one of Hahn‘s students. He became *Privatdozent* and *ausserordentlicher Professor*
  - Feigl was a student with whom Gödel „met frequently for walks through the parks of Vienna […] endless discussions about logical,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

Rudolf Carnap, 1960

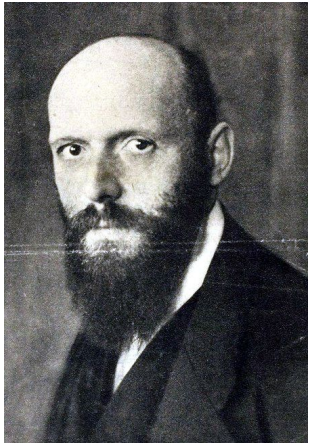
Karl Menger, 1970

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



Moritz Schlick, 1930



Otto Neurath, 1919

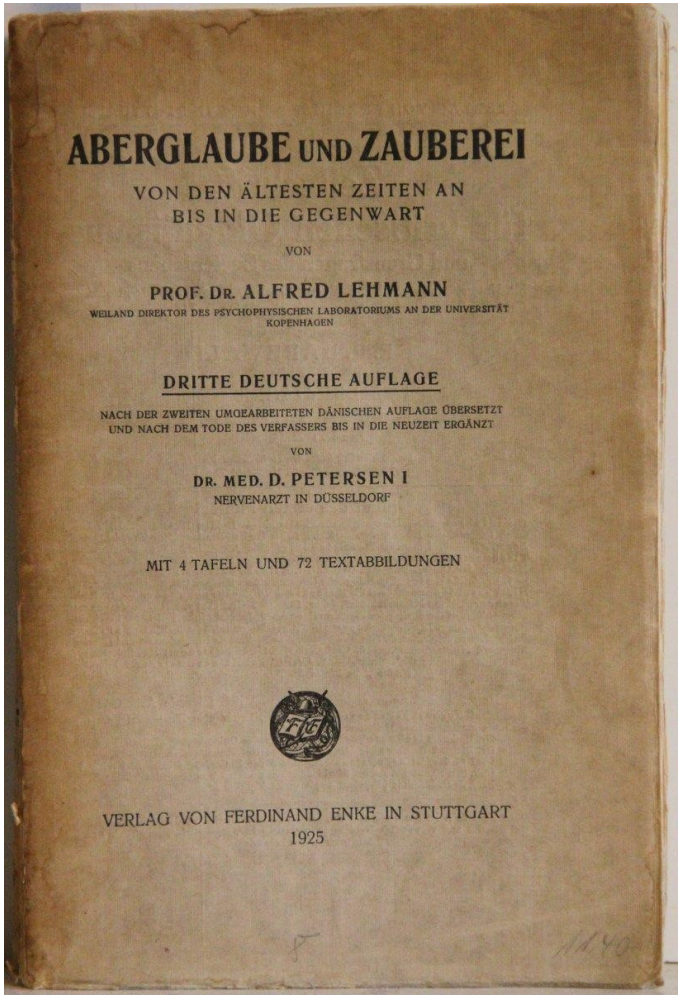
The Vienna Circle

- 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“

Mediums, Vienna, 1920s

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


ABERGLAUBE UND ZAUBEREI

VON DEN ÄLTESTEN ZEITEN AN
BIS IN DIE GEGENWART

VON

PROF. DR. ALFRED LEHMANN

WEILAND DIREKTOR DES PSYCHOPHYSISCHEN LABORATORIUMS AN DER UNIVERSITÄT KOPENHAGEN

DRITTE DEUTSCHE AUFLAGE

NACH DER ZWEITEN UMGEARBEITETEN DÄNISCHEN AUFLAGE ÜBERSETZT UND NACH DEM TODE DES VERFASSERS BIS IN DIE NEUZEIT ERGÄNZT

VON

DR. MED. D. PETERSEN I

NERVENARZT IN DÜSSELDORF

MIT 4 TAFELN UND 72 TEXTABBILDUNGEN

VERLAG VON FERDINAND ENKE IN STUTTGART
1925

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

Gödel, 1933

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

ADELE PORKERT and Gödel were an unlikely but devoted couple. This photograph, taken at an outdoor Viennese cafe, is from the period of their long courtship. Porkert shielded Gödel from the worst of his irrational fears and was often the only person who could persuade him to eat. More than anyone else, she was responsible for keeping him alive and productive.

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 distinciton 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 severly 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

Ph.D

- 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 completenes 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

Königsberg, 1900

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

David Hilbert, 1886

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 dicovery
- 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 dicoveries .On the second occasion, Stephen C. Kleene was present and that was the first time he heard of Gödel

Stephen Kleene

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

Ernst Zermelo, around 1900

Pukersdorf Sanatorium, Interior Hall, 1906

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 colloquim, 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 Gödels 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*