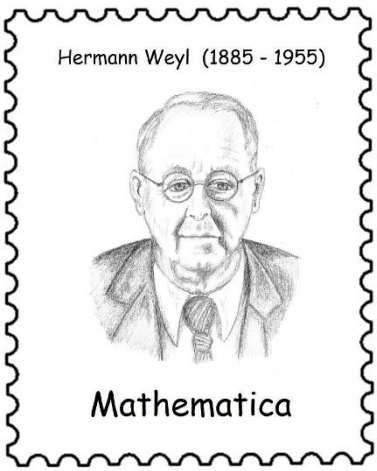
HERMANN WEYL (November 11, 1885 – December 8, 1955)

by HEINZ KLAUS STRICK, Germany

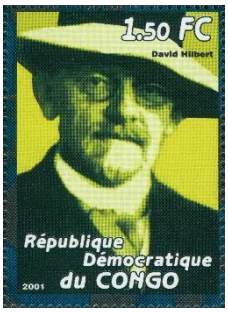


(drawing © ANDREAS STRICK)

HERMANN KLAUS HUGO WEYL is considered one of the last mathematicians who still had an overview of all the topics that were being researched in the different areas of mathematics, and in many fields it was more than a mere overview. Through his contributions to complex analysis (function theory), differential geometry and topology, algebra and number theory, he contributed significantly to the further development of these fields; this applies equally to topics related to the philosophical foundations of mathematics.

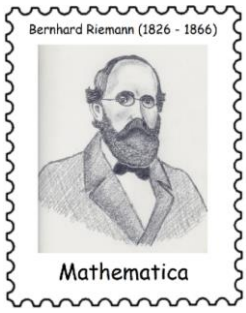
His publications on applied mathematics were also of particular importance.

HERMANN WEYL grew up in Elmshorn, Schleswig-Holstein, and attended the *Christeaneum* grammar school in Altona, Hamburg, whose headmaster, a cousin of DAVID HILBERT, became aware of the pupil's special mathematical talent.



After passing his school-leaving exams, he began studying mathematics with a minor in physics in Göttingen in 1904. Without any previous knowledge, he worked through the *Zahlbericht*, HILBERT's summary work on algebraic number theory, during his first semester break and was enthusiastic.

In 1908 he completed his doctorate under DAVID HILBERT on *Singular Differential Equations*, a topic in Functional Analysis, and extended his doctoral thesis for the habilitation (*Differential Equations with Singularities*, 1910).



While working as a private lecturer in Göttingen, he wrote *Die Idee der Riemann'schen Fläche* (The idea of the RIEMANN surface) a work in which he consistently developed BERNHARD RIEMANN's ideas on complex analysis and coined the concept of the two-dimensional differentiable manifold.

HERMANN WEYL, who was also very interested in philosophical questions, attended the lectures of the philosopher and mathematician EDMUND HUSSERL, the founder of *phenomenology*. (*Philosophy, when considering things, should stick only to what appears "phenomenal", i.e. immediate to consciousness.*)

There he met the student HELENE JOSEPH, his future wife, who later made a name for herself as translator of the works of MIGUEL CERVANTES and JOSÉ ORTEGA Y GASSET.

In 1913 he accepted an appointment to a chair of mathematics at the Technical University of Zurich (now the ETH) where ALBERT EINSTEIN was in the process of developing his ideas on the general theory of relativity.

After EINSTEIN's departure, WEYL took over the lectures in theoretical physics from him and he also lectured on the mathematical foundations of the theory of relativity.

In 1918, he published a book entitled *Raum – Zeit – Materie* (Space – Time – Matter) and extended editions of this work followed in 1919, 1920 and 1923. In 1925, the University of Kazan honoured him with the LOBACHEVSKY Prize.

After the outbreak of the World War, as a German citizen WEYL was called up for military service, and his lectures were temporarily cancelled. While he was still training to be a soldier, the Swiss government was able to negotiate the cancellation of his conscription.

In 1916 he published in the *Mathematische Annalen* the proof of a theorem that is significant for the generation of random numbers:

If α is an irrational number, then the sequence $(n \cdot \alpha)_{n \in \mathbf{N}}$ is equally distributed mod 1, i.e.,

if one considers only the decimal parts of multiples of an irrational number, then these lie not only densely in the half-open interval [0 , 1), as LEOPOLD KRONECKER had already proved, but distribute themselves equally over any subintervals of equal length of [0 , 1).

For example, the elements of the sequence $\left(n \cdot \sqrt{2} \bmod 1\right)_{n \in \mathbf{N}}$ are distributed with equal frequency over the ten subintervals [0 , 0.1), [0.1 , 0.2), ... , [0.9 , 1).

In 1918, apart from the above-mentioned book *Raum – Zeit – Materie*, he published another important work: *Das Kontinuum – kritische Untersuchungen über die Grundlagen der Analysis* (The Continuum – Critical Investigations on the Foundations of Analysis), in which he distanced himself from DAVID HILBERT's purely formalistic-axiomatic approaches (later he took a less radical stand on this).

HERMANN WEYL's reputation grew from year to year. Since he felt at home in Zurich and was satisfied with the working conditions there, he turned down offers of professorships in Karlsruhe, Breslau, Göttingen, Berlin and Amsterdam (and later also to Leipzig and Columbia University, New York).

WEYL became friends with ERWIN SCHRÖDINGER, who came to Zurich in 1922 as EINSTEIN's successor and developed quantum mechanics there in the following years. Their friendship and the close scientific collaboration between the two were not affected when WEYL and SCHRÖDINGER's wife ANNY began a sexual relationship. SCHRÖDINGER himself also had extramarital affairs, as did HELENE WEYL.

Works published in the 1920s included *Mathematical Analysis of the Space Problem* (elaborations of lectures given during a visiting professorship in Barcelona and Madrid) and *Group Theory and Quantum Mechanics*, about which the mathematician HANS FREUDENTHAL remarked that from this book physicists could learn *group theory* and mathematicians could learn *quantum mechanics*.

Over many years WEYL tried to develop a unified theory to describe gravitational fields and electromagnetic fields – with the aim of deriving fundamental properties of matter from such a field theory alone. He gave up the hope of being able to develop such a theory in 1929 (in the article *Electron and Gravitation*) – and such a theory has not been found to this day.

In 1930 he accepted a renewed call to Göttingen, as HILBERT's successor – but with great political misgivings:

Only with some trepidation do I find myself returning from ... [*the*] *freer and more relaxed atmosphere* [*of Switzerland*] *to the yawning, gloomy and tense Germany of the present.*

The following year he was elected President of the *German Mathematical Association* (DMV) for one year.

When the National Socialists took over in 1933, WEYL asked the responsible National Socialist Minister of Education to dismiss him from his office in October – not only because his wife HELENE had Jewish ancestors.

Through the mediation of ALBERT EINSTEIN he moved to the *Institute for Advanced Study* in Princeton, where he had already been a visiting professor in 1928/29. He taught and researched there until his retirement in 1951. In 1939 he became an American citizen.

During his work at Princeton, several books were published as elaborations of his lectures, including *The Classical Groups, Their Invariants and Representations* (1939), *Algebraic Theory of Numbers* (1940) and, finally, *Symmetry* (1952).

In the latter work, his "Swan Song", he succeeded in spanning a range – from the description of symmetrical phenomena in nature (such as in snow crystals) to the symmetry of the solutions of equations in GALOIS theory, to symmetrical structures of transformations in quantum mechanics.

In the course of his life, HERMANN WEYL wrote a total of about 200 journal articles on mathematics, physics and philosophy, as well as contributions to the philosophy of mathematics and natural science, which were printed in a handbook of philosophy.

He received numerous honorary doctorates and honorary memberships in scientific societies. After the death of his wife in 1948, he married a sculptor from Zurich, and he spent the last years of his life alternating between Zurich and Princeton

Death overtook him in Zurich on his way home from the post office, where he had just posted letters of thanks and replies to the numerous congratulations on the occasion of his 70th birthday.

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https://www.spektrum.de/wissen/hermann-weyl-1885-1955-mathematischer-universalgelehrter/1371662

Translated 2023 by John O'Connor, University of St Andrews

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