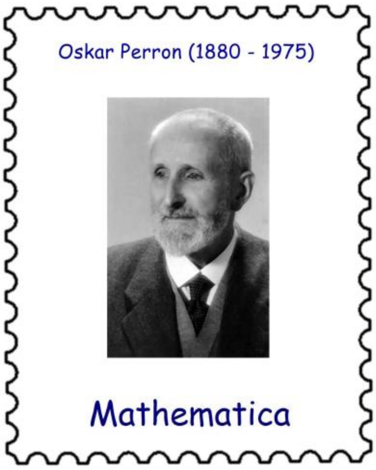
OSKAR PERRON (May 7, 1880 – February 22, 1975)

by HEINZ KLAUS STRICK, Germany

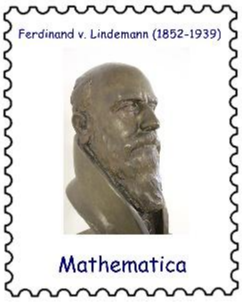


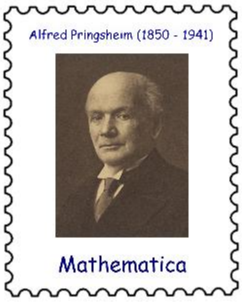
Source: Universitätsarchiv Heidelberg

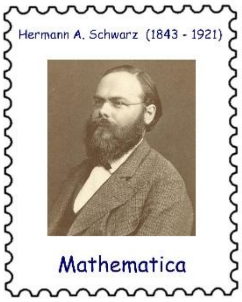
OSKAR PERRON came from a family of former Huguenots who had emigrated to Germany after the revocation of the Edict of Nantes in 1698. One of his ancestors had settled in Frankenthal (Palatinate). OSKAR's father initially ran a leather business there, later founding a bank, which his son, born in 1880, would eventually join. After attending elementary school and a Latin school, the boy transferred to the Humanistic Gymnasium in Worms, where he successfully completed his *Abitur* (University entrance qualification) in 1898.

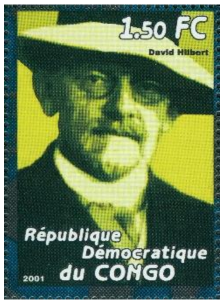
Even during his school years, OSKAR showed a particular interest in mathematics and physics and was eventually able to convince his father to allow him to study these subjects.

At the Ludwig Maximilian University (LMU) in Munich, OSKAR PERRON attended lectures by FERDINAND VON LINDEMANN and ALFRED PRINGSHEIM, whose "meticulous precision" left a lasting impression on him. As was common at the time, he changed universities for individual semesters and enrolled in Berlin (GEORG FROBENIUS, LAZARUS FUCHS, HERMANN AMANDUS SCHWARZ) as well as in Tübingen and in Göttingen (DAVID HILBERT).









After passing his teaching examination, he received his doctorate with distinction in 1902 at the University of Munich with a thesis *On the rotation of a rigid body around its centre of gravity when subjected to external forces* (doctoral supervisor: LINDEMANN). In 1906 he obtained his *habilitation* (*Foundations for a theory of the Jacobian continued fraction algorithm*) and subsequently worked as a private lecturer.

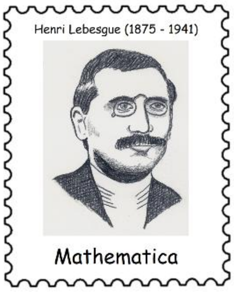
PERRON was appointed extraordinary professor in Tübingen, and in 1914, full professor in Heidelberg, not least due to the publication of the work *The Theory of Continued Fractions* the previous year (see below).

His teaching career was interrupted after the outbreak of World War I; he was drafted into military service in the "Landsturm" (reserve unit) on the Eastern Front; later, he worked in the Army's Surveying Department.

On PRINGSHEIM'S retirement, PERRON was appointed his successor at the LMU Munich in 1922; the three professors at the university, CONSTANTIN CARATHÉODORY, HEINRICH TIETZE and OSKAR PERRON, were soon generally referred to as the *Munich triumvirate of mathematics.*

Through his work in various fields (a total of 218 publications), he gained international renown; he was honoured for his services numerous times – through membership in the academies of Heidelberg and Göttingen, the Leopoldina, the Bavarian Academy of Sciences, and honorary doctorates from the universities of Mainz and Tübingen.

In addition to contributions to integral calculus (the so-called PERRON integral represents a generalization of LEBESGUE's concept of the integral), to the summation of infinite series (the so-called PERRON formula), and to differential equations (including solution using numerical methods), the PERRON-FROBENIUS theorem is particularly noteworthy. It deals with matrices with exclusively positive elements, such as those found in population processes and MARKOV chains. (FERDINAND GEORG FROBENIUS generalised PERRON's results to non-negative matrices.)



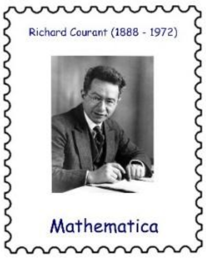
His textbooks are still considered exemplary today. In particular, his work *Irrational Numbers* (Editions: 1910, 1921, 1947, 1960), which is particularly suitable for beginning students due to its clarity and numerous examples, and *The Theory of Continued Fractions* (1913, 1929, 1954/1957 in two volumes), still a widely cited reference work in number theory, are among the "classics of mathematical literature" and have been repeatedly reprinted unchanged. In addition to these two books, the two volumes on *Algebra* (1927 and 1950) and *Non-Euclidean Elementary Geometry of the Plane* – a work he wrote at the age of 82 and dedicated to his wife, who had died the previous year – are also worth mentioning.

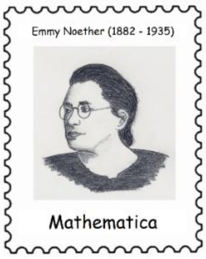
OSKAR PERRON had been married since 1906; his wife, HERMIONE PERRON, was a distant relative. Their happy marriage produced three daughters, who cared for their father when his wife died in 1961.

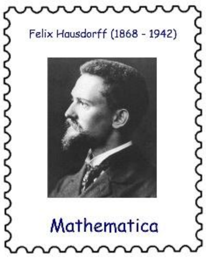
When the Allies attempted to "denazify" the German population after the war, PERRON wrote on his registration form: "I was an uncompromising opponent of the Nazis. In the fight against the contamination of the university with Nazis, I was sometimes successful, but mostly only caused trouble."

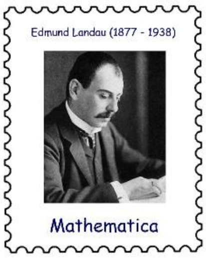
In fact, he was one of the few university professors who strove to keep the area under their responsibility as free as possible from political influences and to prevent "coordination".

When the National Socialists seized power in 1933, PERRON was the current chairman of the DMV (German Mathematical Society). Following the enactment of the *Law for the Restoration of the Professional Civil Service* on April 7, 1933, numerous university professors, such as RICHARD COURANT and EMMY NOETHER lost their positions and their teaching qualifications – PERRON refused until the end of his presidency to “clean up” the membership lists, i.e. to exclude these people from the DMV.









For as long as possible, he tried to keep the association politically neutral; exclusion based on religious affiliation or origin was unacceptable to him.

In board meetings, he therefore regularly clashed with LUDWIG BIEBERBACH, who was highly competent in his field but extremely ideologically fanatical.

He vehemently rejected Bieberbach's views ("*There is a* German mathematics *that is fundamentally different in nature and essence from* Jewish mathematics*. German mathematics is based on intuition, on an inner connection with space and number; Jewish mathematics is formalistic, speculative, detached from reality*.")

After the regular end of PERRON's presidency, an "adjustment in the spirit of the new era" took place from 1934 onwards under the succeeding president HELMUT HASSE.

PERRON was considered politically unreliable, not only because he consistently refused to give the "Hitler salute"; however, because of his high reputation, the regime did not dare to take concrete measures against him. When a successor to CONSTANTIN CARATHÉODORY was sought in 1944, he pushed through the appointment of EBERHARD HOPF, who was not close to the Nazi regime but was professionally qualified.

His response to an invitation from the leader of the Reich Lecturers' Association to attend an academic ceremony at the University of Munich in 1939 was certainly courageous:

"Since I am neither a member of a Dozentenbund academy nor of the Dozentenbund in general, my participation can only be considered in the role of a scientific guest of honour. However, I am a member of various German scientific academies, and in his ceremonial speech at the founding of the Dozentenbund academy in Kiel, the Reichsdozentenbund leader expressed his contempt for these bodies and their members by declaring that the German academies have achieved nothing scientifically since LEIBNIZ and can today be viewed merely as societies of calcified scientific veterans.

Two possibilities are conceivable. Either the Reich Lecturers' Association Leader is right in this low assessment, or he is wrong. In the first case, it certainly cannot please the Reich Lecturers' Association Leader to see such inferior academic personalities among his guests of honour; I would certainly like to spare him this sight, as far as I am concerned. In the second case, however, I cannot be expected to be the guest of honour in the presence of a man who has unjustly denigrated the academies and their members in such a way, and presumably to listen helplessly as the guests of honour are again treated with contempt in the same way."

OSKAR PERRON was able to resume his teaching activities immediately after 1945, continuing for another ten years after his retirement in 1950. During his many years of teaching, the widely respected and popular professor supervised a total of 34 doctoral students.

Finally, the so-called *PERRON paradox* should be mentioned, the solution of which is left to the reader:

- Suppose that the largest natural number is *n*. If $n > 1$, then it would follow that $n^2 > n$, which contradicts the definition. Consequently, $n = 1$.

Addendum: The internationally renowned algebraist HELMUT HASSE was classified as a "fellow traveller" of the Nazi regime by the denazification commission in 1948 and was thus deemed "exonerated". LUDWIG BIEBERBACH, on the other hand, showed little insight into his behavior and political views; after his objection, he was also classified as a "fellow traveller" in 1949, but was no longer permitted to teach.

Some information about continued fractions (with examples)

All positive **rational numbers** $\frac{p}{q}$ (with $p, q \in \mathbb{N}$) can be uniquely written as **finite continued fractions**; the coefficients that occur are obtained according to the **Euclidean algorithm**.

- $\frac{225}{157} = 1 + \frac{68}{157} = 1 + \cfrac{1}{2 + \frac{21}{68}} = 1 + \cfrac{1}{2 + \cfrac{1}{3 + \frac{5}{21}}} = 1 + \cfrac{1}{2 + \cfrac{1}{3 + \cfrac{1}{4 + \frac{1}{5}}}}$; shorthand notation $\frac{p}{q} = [1;2,3,4,5]$.

  By omitting summands one obtains **approximate fractions**; these form an **interval nesting** for $\frac{p}{q} = 1.433121...$:
  $[1;2,3,4] = \frac{43}{30} = 1.4333...$, $[1;2,3] = \frac{10}{7} = 1.428571...$, $[1;2] = \frac{3}{2} = 1.5$, $[1] = 1$.

If a continued fraction $[a_0; a_1, a_2, ..., a_n]$ is given, then the corresponding rational number can $\frac{p_n}{q_n}$ be determined **iteratively:**

$p_0 = a_0$, $q_0 = 1$, $\frac{p_0}{q_0} = a_0$; $p_1 = a_1 \cdot p_0 + p_{-1} = a_0 \cdot a_1 + 1$, $q_1 = a_1 \cdot q_0 + q_{-1} = a_1$, $\frac{p_1}{q_1} = \frac{a_0 \cdot a_1 + 1}{a_1} = a_0 + \frac{1}{a_1}$ etc.

in general: $p_n = a_n \cdot p_{n-1} + p_{n-2}; q_n = a_n \cdot q_{n-1} + q_{n-2}$, where $p_{-2} = q_{-1} = 1, p_{-1} = q_{-2} = 0$.

- $\frac{p_6}{q_6} = [1;2,3,4,5,6] = \frac{n \cdot p_5 + p_4}{n \cdot q_5 + q_4} = \frac{6 \cdot 225 + 43}{6 \cdot 157 + 30} = \frac{1393}{972} = 1.433127...$

If $x = [a_0; a_1, a_2, ..., a_n]$ is a continued fraction, then $[0; a_0, a_1, a_2, ..., a_n]$ is equal to the **reciprocal** $\frac{1}{x}$.

For the numerators and denominators of **consecutive approximate fractions** of a continued fraction expansion, the following applies: $p_n \cdot q_{n-1} - p_{n-1} \cdot q_n = (-1)^{n-1}$ This results in a **solution method for the linear Diophantine equation** $px - qy = \pm 1$: If one expands $\frac{p}{q}$ into a continued fraction $[a_0; a_1, a_2, ..., a_{n-1}, a_n]$, then the denominator and numerator of the *penultimate* approximate fraction $[a_0; a_1, a_2, ..., a_{n-1}]$ satisfy the equation $px - qy = +1$ and $px - qy = -1$.

- The pair $(30;43)$ is the solution to the Diophantine equation $225x - 157y = -1$. The pair $(7;10)$ is the solution to the Diophantine equation $43x - 30y = 1$.

All positive **irrational numbers** can be written as **infinite continued fractions** ; the sequence of continued fractions $x_0 = [a_0]$, $x_1 = [a_0; a_1]$, $x_2 = [a_0; a_1, a_2]$, $x_3 = [a_0; a_1, a_2, a_3]$, ... forms an **interval nesting** , the sequence of terms with even index a strictly monotonically increasing sequence $x_0 < x_2 < x_4 < ...$, the sequence of terms with odd index a strictly monotonically decreasing sequence $x_1 > x_3 > x_5 > ...$ In order to obtain an approximate fraction with *the smallest possible* denominator, the continued fraction expansion is best terminated before a large partial denominator.

- $[1;2,1,3,8,1,2] = \frac{402}{295} = 1.362711...$, $[1;2,1,3] = \frac{15}{11} = 1.363636...$

Periodic continued fractions: There are no periodic continued fractions except those that occur as solutions to a quadratic equation; in particular, the continued fractions of square roots are periodic.

- $\sqrt{2} = [1;2,2,2,...] = [1;\overline{2}]$, $\sqrt{3} = [1;1,2,1,2,...] = [1;\overline{1,2}]$, $\Phi = \frac{1}{2} \cdot (\sqrt{5} + 1) = [1;\overline{1}]$

Palindrome property: In the continued fraction expansion of the square root of a natural number $r > 1$ that is not itself a square number, the middle digits of the period form a *symmetrical* sequence. The last digit of the period is twice as large as the first digit: $\sqrt{r} = [a_0; \overline{a_1, a_2, ..., a_2, a_1, 2a_0}]$.

- $\sqrt{7} = [2;\overline{1,1,1,4}]$, $\sqrt{19} = [4;\overline{2,1,3,1,2,8}]$, $\sqrt{31} = [5;\overline{1,1,3,5,3,1,1,10}]$

Pell's equation: The Diophantine equation is solvable $x^2 - n \cdot y^2 = 1$ for all non-square natural numbers *n*.
A suitable pair of solutions results from the approximate fractions of the *penultimate* digits of the period.

- $x^2 - 7 \cdot y^2 = 1$: The approximate fraction $[2;1,1,1] = \frac{8}{3}$ gives a solution: $8^2 - 7 \cdot 3^2 = 1$.

Examples of special infinite continued fractions: (OEIS = On-Line Encyclopedia of Integer Sequences)

Algebraic, non-regular CF: $\sqrt[3]{2} = [1;3,1,5,1,1,4,1,1,8,1,14,1,10,2,1,\ldots]$ (OEIS 002945),

Transcendental, regular CF: $e = [2;1,2,1,1,4,1,1,6,1,1,8,1,1,10,1,1,\ldots]$ (OEIS 003417),

Transcendental, non-regular CF: $\pi = [3;7,15,1,292,1,1,1,2,1,3,1,\ldots]$ (OEIS 001203).

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https://www.spektrum.de/wissen/oskar-perron-und-der-widerstand-gegen-die-nazis/2293664

Translated by John O'Connor, University of St Andrews

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