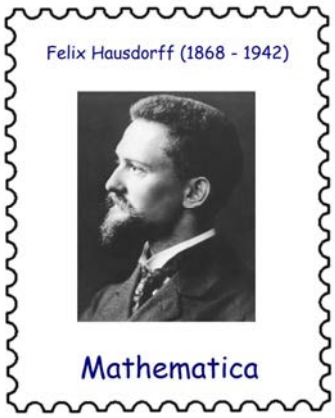
FELIX HAUSDORFF (November 8, 1868 – January 26, 1942)



Portrait picture by courtesy of Hausdorff Center for Mathematics (HCM), Bonn

by HEINZ KLAUS STRICK, Germany

Dear friend Wollstein!

When you get these lines, the three of us have solved the problem in a different way – the way you have been trying to keep us from ... What has happened against the Jews in the past few months gives rise to justified fear that we will no longer be able to experience a situation that was bearable for us ...

FELIX HAUSDORFF's farewell letter to his friend and confidante begins with these words.

FELIX HAUSDORFF, born in Breslau (now Wrocław) as the son of the respected Jewish merchant LOUIS and his wife HEDWIG (née TIETZ), grew up in Leipzig and attended the humanistic *Nicolai Gymnasium*. After passing the *Abitur* exam as the best of the year, he expressed the wish to study music in order to become a composer, but decided at the father's instigation to study mathematics and the natural sciences.

Nevertheless, during his studies (in Leipzig as well as one semester each in Freiburg and Berlin), the multi-talented young man also attended lectures on music history, philosophy and linguistics.

Finally, he concentrated on the application of mathematical methods in astronomy and completed his studies in 1891 with a doctorate from the director of the Leipzig observatory HEINRICH BRUNS *Zur Theorie der astronomischen Strahlenbrechung* (On the theory of astronomical refraction). After military service, he received his *habilitation* in 1895 with the work *Über die Absorption des Lichtes in der Atmosphäre* (On the Absorption of Light in the Atmosphere).

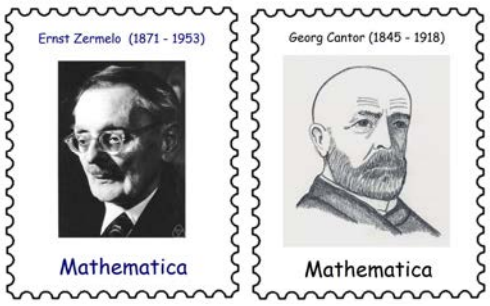
From 1897 onwards HAUSDORFF published – under the pseudonym Dr PAUL MONGRÉ – literary-philosophical works, including an examination of NIETZSCHE's idea of eternal return *Das Chaos in kosmischer Auslese* (The Chaos in Cosmic Selection), a volume of poetry *Ekstasen* (Ecstasies), a satirical play about the nature of duelling and the concept of honour of the nobility *Der Arzt seiner Ehre* (The Doctor of His Honour), which was performed successfully in many cities.

In 1899 he married CHARLOTTE GOLDSCHMIDT, daughter of a Jewish doctor. The happy marriage produced a daughter who survived the Holocaust.

Since HAUSDORFF had considerable assets, especially after his father's death in 1896, he was not dependent on the income from a well-paid job. Therefore, he could devote himself to the sciences and topics that were of particular interest to him.

With his *habilitation*, he acquired the right to hold lectures. He took advantage of this, but also left a lot of time for his literary-philosophical interests. For his lectures, he selected topics from very different areas of mathematics: analytical geometry, statistics, higher geometry, actuarial mathematics, probability calculation, set theory, projective geometry, non-Euclidean geometry and analytical mechanics.

His lectures on set theory in the summer semester of 1901 were only the second on this topic that were given at universities (only ERNST ZERMELO had lectured previously in the 1900/01 winter semester in Göttingen). He had regular contact with GEORG CANTOR, the "discoverer" (according to CANTOR) of set theory, following the first International Congress of Mathematicians in Zurich (1897).



(drawing © Andreas Strick)

At the end of 1901, HAUSDORFF was elected *Extraordinary Professor* by 22 votes to 7 against the resistance of some faculty professors – the seven members justified their rejection solely on the argument that the applicant was Jewish. Since the foundation of the *German Reich* in 1871, Leipzig was a centre of the anti-Semitic movement within the *Reich*, especially among the student body. In this context it should be noted that HAUSDORFF described himself as an agnostic.

In 1910 he moved to the University of Bonn as *Associate Professor*; In 1913 he took up a position as *Ordinarius* in Greifswald. In contrast to Leipzig, where the professorships had always emphasised the academic hierarchy, he enjoyed the collegial cooperation in Bonn. As he wrote: *In Bonn one feels, even as a non-Ordinarius, formally entitled to exist, a feeling to which I have never been able to rise to at Leipzig.* In Greifswald, he had to limit his research work because he was the only mathematician there at times.

From 1904 onwards, HAUSDORFF concentrated on set theory and in 1914, after he had given two further lectures (still in Leipzig) on this subject, he published his opus magnum, the *Grundzüge der Mengenlehre* (Fundamentals of Set Theory), a work of almost 500 pages, "*dedicated in grateful veneration to the creator of set theory*, GEORG CANTOR".

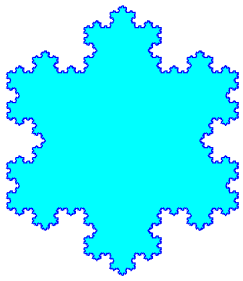
Due to the outbreak of the World War and its catastrophic effects, the importance of his book, which today is considered one of the standard works of mathematical literature, was not recognised.

In the first part, HAUSDORFF dealt with the fundamentals of set algebra, introduced the (now common) set-theoretical functional concept, then developed the theory of the power-set and of well-order ("A set A is well-ordered if each non-empty subset A' has a first element"). In the second part of his work, HAUSDORFF dealt with the fundamentals of the topology of point sets, gave an introduction to *metric spaces* (this term was coined by HAUSDORFF) and examined the measurability of point sets.

The proof of the theorem that it is not possible to define a "content" for all bounded subsets of $\mathbb{R}^n$ was sensational. Its paradox was made more concrete in 1924 by the Polish mathematicians STEFAN BANACH and ALFRED TARSKI, who showed how a sphere could be broken down into a "dust-like cloud of point sets" in such a way that they could be combined to form two spheres, each of which was the same size as the original sphere, i.e. the volume of the sphere was doubled.

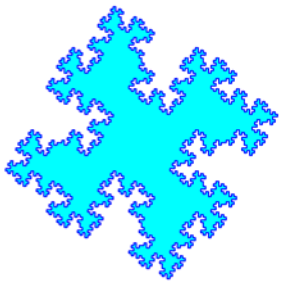
HAUSDORFF's work only developed its impact after the end of the World War. In Poland, WACŁAW SIERPIŃSKI and ZYGMUNT JANISZEWSKI founded the journal *Fundamenta Mathematicae*, which was devoted to set theory, topology, and measure and integration theory, among other things. Many of the articles printed refer to HAUSDORFF's *Grundzüge*. The second (heavily edited and shortened to half) 1927 edition of the book was translated into Russian and English.

HAUSDORFF himself continued to deal with questions of the characterisation of "strongly disconnected sets". This was followed in 1919 by the work *Dimension und äusseres Mass* (Dimension and External Measure), which made it possible to assign a so-called HAUSDORFF dimension to fractal formations.



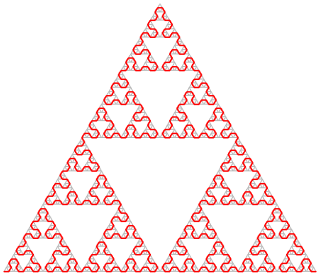
KOCH
Snowflake

$D = \frac{\log(4)}{\log(3)} \approx 1{,}26$



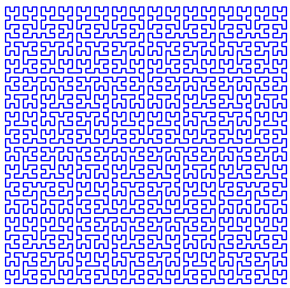
KOCH
Antisnowflake

$D = \frac{\log(8)}{\log(4)} = 1{,}5$



SIERPIŃSKI
Arrowhead curve

$D = \frac{\log(3)}{\log(2)} \approx 1{,}58$



HILBERT
curve

$D = \frac{\log(4)}{\log(2)} = 2$

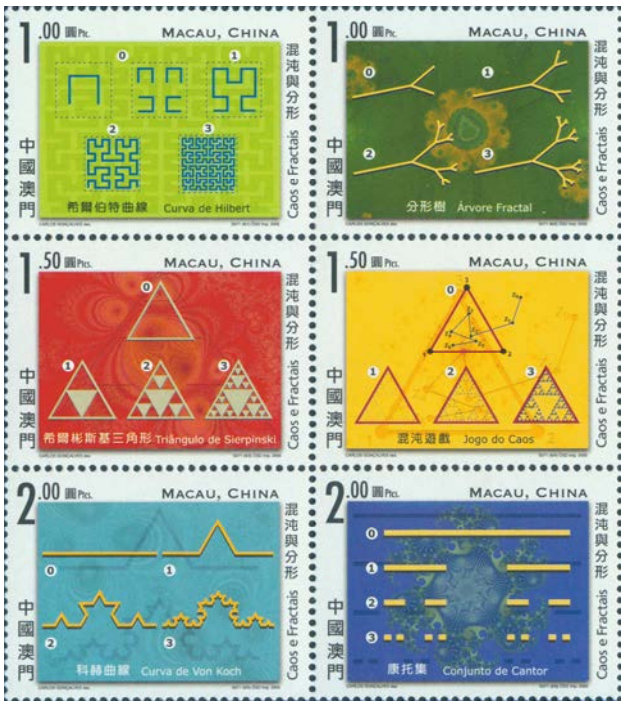
In the 1920s HAUSDORFF, who returned to Bonn in 1921, developed a method, named after him, for the investigation of divergent series.

One of his lectures in 1923 dealt with an axiomatic theory of probability – ten years before KOLMOGOROV.

The situation for HAUSDORFF changed with the takeover of power by the National Socialists. Although he was not directly affected by the *Law on the Restoration of Professional Civil Service*, since he was a Prussian civil servant before 1914, his retirement in 1935 also followed the previous rules, but without the usual thank-you letter and with considerable restrictions on his work in the subsequent years. For his own publications, he had to switch to Polish journals, and since he was denied access to the university facilities, he could only be supplied with current literature in secret.

In 1939 he tried in vain to obtain a "research fellowship" in order to be allowed to emigrate to the USA. In 1941 the deportation of the Jews in the Bonn area began. In January 1942, HAUSDORFF, his wife and his sister-in-law living in the house received the order to move to the internment camp in Bonn-Endenich. The three of them decided to end their lives by taking an overdose of sleeping pills. Today special *Stolpersteine* (literally *stumbling stones*) commemorate the former inhabitants of the house in Bonn.

The lawyer WOLLSTEIN, HAUSDORFF 's friend whose letter was mentioned above, died in the Auschwitz concentration camp.



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https://www.spektrum.de/wissen/felix-hausdorff-meister-der-masstheorie/1602848

Translated 2020 by John O'Connor, University of St Andrews

Here an important hint for philatelists who also like individual (not officially issued) stamps. Enquiries at europablocks@web.de with the note: "Mathstamps".