Eberhard Hopf between Germany and the US *

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Abstract

The curriculum vitae of Eberhard Hopf was not unique, but very unusual: He was one of the very few German scientists who moved from the US to Germany in 1936, and this though he had a secure position at MIT. He accepted a full professorship at U Leipzig in 1936 and at U Munich in 1944. From 1942 on he also did research which was considered very important for the war by the authorities in Berlin. Many people thus concluded that he must have been a Nazi. With the help of Richard Courant he returned to the US in 1947 and stayed there for the rest of his life.

The behavior of Hopf and also of Courant found dismay, disapproval and understanding in the math community. As a consequence, there are many falsified references to Hopf's work, but there is also enthusiastic praise of the high quality of his mathematical results.

Eberhard Hopf zwischen Deutschland und USA Eberhard Hopfs Lebenslauf war nicht einziartig, aber doch sehr ungewöhnlich: er war einer der wenigen deutschen Wissenschaftler, die 1936 von USA nach Deutschland umzogen, und dies obwohl er am MIT eine zeitlich nicht befristete Stelle hatte. 1936 folgte er einem Ruf an die Universität Leipzig und 1944 an die Universität München. Außerdem führte er ab 1942 Forschungen durch, die von der Obrigkeit in Berlin als sehr wichtig für den Krieg eingestuft wurden. Viele haben ihn deshalb für einen überzeugten Nazi gehalten. 1947 kehrte er mit der Hilfe von Richard Courant nach USA zurück und blieb dort bis zum Lebensende.

Dieses Verhalten von Hopf und auch von Courant stieß in der Mathematiker-Gemeinschaft auf Bestürzung, Missbilligung und auch auf Verständnis. Als Folge dessen gibt es viele verfälschte Zitierungen der Hopfschen Arbeiten, aber auch begeistertes Lob für die hohe Qualität seiner Ergebnisse.

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1 Eberhard Hopf (1902-1983)

Eberhard Hopf was born in Salzburg in 1902. His father Friedrich Hopf was a chocolate manufacturer [MSS02]. He finished school in Berlin in 1920 and studied at the universities of Berlin (7 semesters) and Tübingen (one semester). In 1925/26 he finished his dissertation in mathematics in Berlin, with advisors *Erhard Schmidt (1876-1959)* and *Issai Schur (1875-1941)*. In 1927 he became *wissenschaftlicher Assistent* at the *Astronomisches Recheninstitut* of Berlin University. In 1929 he finished his habilitation and obtained the *venia legendi* for mathematics and astronomy. [Tob06] Also in 1929, he married *Ilse Wolf*, former fellow student of physics and daughter of the very influential musicologist *Johannes Wolf (1869-1947)* [MSS02], [Wikipedia articles on Wolf in 7 different languages, 2018-07-26]. Music was also very important to Ilse and Eberhard Hopf: he was an excellent piano player, and she was a singer. Daughter Barbara Hopf Offenhartz in 2006 to H.-J. Girlich: 'Meine Eltern, besonders meine Mutter, waren sehr gastfreundlich, und die vielen Musikabende waren besonders schön. Beide waren sehr musikalisch, mein Vater ein ausgezeichneter Klavierspieler, die Mutter Liedersängerin.' [Gir09]

Because of the economic situation in 1929 it was very hard to find an adequately paid position in Germany. With a Rockefeller stipend Hopf became an *International Research Fellow* at *Harvard Observatory* for 1930-1932. [RSS98, pp 38f], [Tob06]. During this time he met *Norbert Wiener (1894-1964)* of the neighboring MIT. Their famous joint paper appeared in 1931 [WiHo31]. When his stipend ended, he would have liked to go back to Germany, but letters from Berlin made clear that there were no positions available. So Norbert Wiener helped him in 1932 to get a position as assistent professor at the mathematics department of MIT.

End of January, 1933, the Nazis took over, and already in April 1933 they started to change the job situation at universities and elsewhere dramatically, by a series of laws about the *Berufsbeamtentum*: most persons who were of Jewish decent and/or politically engaged in the 'wrong' parties (especially social democrats and communists) lost their positions and later on also their pensions. In 1931, there were 197 mathematicians at German universities holding a *venia legendi*, in 1937 they were 138 (i.e. ca -30%). Among them were 97 full professors in 1931 and 68 in 1937, also ca -30%. The decay of the numbers of students was even more dramatic: in the summer semester (SoS) 1932 there were 4245 students of mathematics at German universities, in SoS 1939 there were 306, i.e. ca -92.8%. In physics, the decay was ca -74%. This was also the average of all disciplines of the math-nat sciences. The development at the German *Technische Hochschulen* was very similar [Schap90, p 17ff]; [RSS98, RSS09].

Thus there was suddenly a completely different situation: many excellent German-speaking mathematicians searched for positions in countries which they did not know, and whose language they often did not know either, and there were many open positions in Germany. Thus *Kurt Hohenemser (1906-2001)* probably was not the only one who wished that non-threatened Germans with positions abroad would return to Germany so that their positions abroad could be taken by some of those who were threatened by the Nazis (letter by Hohenemser in 1935 to von Karman [RSS09, section 7.S.2]). Though there was a reduction of university positions in Germany because of the decay of the

numbers of students, many positions had to be filled again, and this turned out to be very difficult and tedious. At several universities there were two groups of approximately the same strengths: one group, mostly the professors who still held their positions, tried to find politically inactive, qualified mathematicians as successors, and the other group, the Nazis (organized in the *Dozentenschaft*), claimed that 'political merits' clearly made up for missing mathematical abilities. Sometimes the Dozentenschaft clearly won, for instance at U Berlin, where *Richard von Mises (1883-1953)* was replaced by a person without any mathematical abilities or merits (private communication, Lothar Collatz 1988; crushing expert reports by Oskar Perron and Ludwig Prandtl when that person was considered as successor of Carathéodory in 1939, see Litten 1994 [Lit94, pp 4-5]).

The search for a successor of *Leon Lichtenstein (1878-1933)* at U Leipzig lasted from 1933 to 1936 and ended with an offer of the chair to Eberhard Hopf in 1936, who accepted. The Leipzig side of this development was discussed in detail by Karl-Heinz Schlote [Schlo08]. Though there were very active Nazis among the students and in the Dozentenschaft at U Leipzig, finally a group of professors won with their *Sondervotum* (dissenting opinion): they were the physicists *Werner Heisenberg (1901-1976)* and *Friedrich Hund (1896-1997)*, the mathematician *Bartel Leendert van der Waerden (1903-1996)* and the geophysicist *Ludwig Weickmann (1882-1961)* [Gir09]. The reaction of Eberhard Hopf at MIT to the offer from U Leipzig was discussed by Norbert Wiener [Wie56].

When Hopf got the invitation for Leipzig in the summer of 1936, he knew that he had to react very quickly: already three times (at U Bonn, U Göttingen and U Berlin) there had been intentions to appoint Hopf, but the Dozentenschaft made it impossible (e.g. *'as a student, he had a friend who was a communist'*). Hopf did not answer spontaneously to the offer from U Leipzig, but so fast that his opponents could not prevent his getting the chair, they only could delay it for several months: he received the offer for Leipzig in August 1936, he arrived in Leipzig in October 1936, assuming that he would become full professor immediately. Instead, he became administrator of the chair, and full professor during the next summer semester.

Officially, Hopf stayed at U Leipzig from 1936 to 1944, but actually the officials at Berlin deputed him in 1942 to work at the *Deutsche Forschungsanstalt für Segelflug* in Ainring near Freilassing in Bavaria. It seems that he mostly did research in fluid dynamics and turbulence in Ainring.

In 1944 a long-lasting search for a successor of *Constantin Carathéodory (1873-1950)* at LMU Munich was ended by giving the chair to Hopf. This time the Dozentenschaft vetoed other candidates, but did not oppose Hopf. [Lit94]

Officially, Hopf held the chair in Munich until 1948. But actually, he wrote a letter to *Richard Courant (1888-1972)* on 23rd of June 1945, i.e. less than 2 months after the end of WWII in Germany, telling Courant that he suffered from *a lack of political insight* in 1936 when he moved from the US to Leipzig [RSS09]. Courant offered him a position as a guest professor at Courant Institute for one year, in 1947-1948. With the blessing of Courant, Hopf became full professor at Indiana University in Bloomington in 1948. He stayed there until his death. Several times he visited Germany, e.g. U Erlangen and Oberwolfach.

In 1956 U Heidelberg offered him a chair. He thought about it and then he decided

that he did not want to do *the same mistake for a second time* [RSS09]. What did he mean by this? Did he not see the differences between the Germany of 1936 and Western Germany of 1956? If yes, then he still suffered from a lack of political insight in 1956. Or did he rather feel that being with Nazi emigrants was the better place for doing good mathematics?

In 2002, on the occasion of his hundred's birthday, *Selected Works of Eberhard Hopf with Commentaries* appeared [MSS02].

2 Was Eberhard Hopf a Nazi?

A closer look at his behavior during Nazi time may give a clou. Wiener [Wie56] and Schlote [Schlo08] gave valuable informations and discussed directly the question: *Was Eberhard Hopf a Nazi?*. Both do not simply answer 'Yes' or 'No', but their answers are closer to 'No' than to 'Yes'. Additional valuable informations were given by Siegmund-Schultze [RSS98, RSS09].

Hopf visited Germany in 1932. Back to the US, he wrote to his colleague Tamarkin, an immigrant from the Soviet Union:

'We were amazed how many Germans voted for Hitler. [...] Most of the people who voted for Hitler are dissatisfied with the general and their own situation. They follow anybody who promises them impossible things.' [letter of May 1, 1932 to Tamarkin [RSS98, p.75f]]

As mentioned in the previous section, there were four attempts of the Dozentenschaft to prevent an offer of a professorship to Hopf, three successful. Thus they did not consider him to be one of them.

As also mentioned in the previous section, Wiener discussed in detail Hopf's reaction to the offer from Leipzig. Let us start a bit earlier: the chair at U Leipzig became available in 1933 because Leon Lichtenstein died: Leon Lichtenstein was a cousin of Norbert Wiener's father, and Wiener visited him in Leipzig in 1924 and met him during the congress at Zürich in 1932. Short time later, Wiener received a desperate letter from Lichtenstein who was now in Poland, asking Wiener for a position in the US. Lichtenstein was mobbed so badly by some students and by a newspaper in Leipzig that he fled to Poland and died there a few months later, in Aug 1933 [Wie56, pp. 85-86, 142, 150], [Schlo08, pp. 250-261]. Hopf knew Lichtenstein at least mathematically: he cited results of Lichtenstein in several of his papers, for instance in [Hopf27]. Thus Hopf was probably shocked as well when Wiener told him about Lichtenstein's problems. This could have been a reason to refuse the chair in Leipzig. In 1956 *Norbert Wiener (1894-1964)* remembered about Hopf:
When Hopf got the offer from Leipzig, he first consulted the German emigrants at MIT and discussed with them the pros and contras and the current situation in Germany. Then he contacted the dean Koebe in Leipzig and discussed with him the financial side of the offer. Then he decided to accept. Wiener's comment:
'Originally he was hostile to Hitler, or at least sympathetic to those on whom Hitler had wreaked his ill will. However, there were strong family influences pulling him to the Nazi side' [Wie56], [RSS09, sec. 7.S.3].

Since Wiener did not get specific about the family influences, we can only look at the context and speculate: Wiener emphasized that the social prestige of a German professor was much higher than that of any other professional in Germany, and also much higher than that of a professor at MIT. After Hopf had accepted the chair in Leipzig, he was very proud of becoming a German professor [Wie56]. Now he had reached the social status of his father-in-law, a few months after the birth of his daughter Barbara in April 1936.

From his time in Leipzig (1936-1942), nothing is known which shows him as an active Nazi - to the contrary, he sometimes ignored or even counteracted Nazi activities, but so mildly that he never got into trouble because of this.

* Together with others he tried to place *Ernst Hölder (1901-1990)*, son of Otto Hölder and PhD student of Leon Lichtenstein, in an adequate position at U Leipzig. This turned out to be impossible because two sisters were married to Jewish mathematicians.[1] On 10th of September 1936 E. Hölder became *Assistent* of Hopf. From 1939 to 1945 Hölder worked at a research institute (Luftforschungsanstalt Braunschweig) and became full professor at U Leipzig in 1946. [Schlo08, Gir09]

* There were many controversies between Hopf and *B.L. van der Waerden* on the one side and the dean *Paul Koebe (1882-1945)* on the other side. Koebe was much closer with the Nazis. For instance he tried to replace their custom of alternating directorship at the mathematical institute by the principle of leadership, i.e. the *Führerprinzip*, with himself as *Führer*, of course. [Schlo08, pp.250-261]

* In his paper of 1942 [Hopf42] which led to the term *Hopf bifurcation* later on, Hopf discussed in detail the connection of his results with the work of *Henri Poincaré*, thus ignoring the silly theory of Bieberbach et al about 'German Mathematics' versus 'French and Jewish Mathematics'. He dedicated this paper to Koebe.[MSp17]

* *But* it should not be forgotten that he did research in Ainring which was considered very important for the war [Schlo08, Gir09].

Hopf's daughter *Barbara Hopf Offenhartz (* 1936)* remembered in 2017:
'My father was very anti-Nazi, so they made him feel that at every end of the spectrum. He was much too outspoken for his own good.' (Math for Science, [Off17]).
She is a scientist, she should know that *at every end of the spectrum* would include: he died in a concentration camp.

3 Neglect and praise of Hopf's work

In the McTutor entry on Eberhard Hopf we read: 'Hopf was never forgiven by many people for his moving to Germany in 1936 [...] As a result most of his work on ergodic theory and topology was neglected or even attributed to others in the years following the end of World War II.' [McTu]

Even today it is easy to find examples for this statement on serious websites like WoS [WoS] and Math Genealogy [MaGe]. Most of these inaccuracies look like 'normal inattentiveness', but there are too many of them. A few examples:

[1] The chemist *Irmgard Hölder* married *Aurel Wintner (1903-1958)* in 1930 and moved with him to the US.

* the authors of the Wiener-Hopf paper [WiHo31] are given as N Wiener, *E Hope* [WoS];
* the title of Hopf's paper on the maximum principle [Hopf27] *Elementare Bemerkungen über die Lösungen partieller Differentialgleichungen zweiter Ordnung vom elliptischen Typus* is translated as *Elementary comments into the solutions of partial differential comparisons of second place in elliptic typus* [WoS]. This title was clearly invented by a person familiar with the mathematical content of that paper: though there were weaker versions of maximum priciples before 1927, it was Hopf who pointed out that the maximum principle makes it possible to compare solutions if their differential equations can be compared;
* there were two dissertations at U Leipzig during E Hopf's time there, for which *Heinz Hopf (1894-1971)* of ETH Zürich is named by error as one of the referees in [MaGe], though their topics were much closer to the research of Eberhard Hopf:
1941 Heyne, Johannes, Statistik; v.d. Waerden, Hopf, Koebe (Tobies 2006 [Tob06]);
1942 Wintgen, Georg, Darstellungstheorie: B.L. van der Waerden (Tobies 2006 [Tob06]).
* The title of Hopf's most cited paper [Hopf50] (more than 1230 citations until January 2018) was misprinted by the journal - this misprint, however, was corrected in WoS [WoS]

Many mathematical subjects are named after a person who did related work, but there are no obvious rules. This was investigated in some detail in [MSp17]. A surprizing example treated there is the term *Hopf bifurcation*.

Though there are these neglects and suppressions of Eberhard Hopf's name, there is also enthusiastic praise:
* 'Hopf's great paper on the maximum principle [...] has the beauty and elegance of a Mozart symphony, the light of a Vermeer painting. Only a fraction more than five pages in length, it contains seminal ideas which are still fresh after 75 years.' James Serrin in an article commenting on Hopf's paper of 1927, [MSS02, pp 9-14].
* 'Hopf [...] was a founding father of ergodic theory and produced many beautiful and now classical results in integral equations and partial differential equations. [...] Hopf was not a prolific writer but a very large fraction of his work remains at the core of the fields he worked in and he wrote with such elegance and clarity that they are of great use today.' Morawetz, Serrin, Sinai 2002, Foreword [MSS02].

References

[Gir09] Girlich, Hans-Joachim (2009): Streiflichter auf die Mathematik an der 600-jährigen Alma mater Lipsiensis, Erweiterte Fassung eines Vortrags, gehalten auf der 11. Tagung der Fachsektion Geschichte der Mathematik der Deutschen Mathematiker-Vereinigung in Pfalzgrafenweiler (Schwarzwald) am 21.5.2009, im Cache, `www.math.uni-leipzig.de/old/prp/2009/p3-2009.pdf`, access 29.11.2018

[Hopf27] Hopf, Eberhard (1927): Elementare Bemerkungen über die Lösungen partieller Differentialgleichungen zweiter Ordnung vom elliptischen Typus, *Sitzungsberichte Preussische Akademie Wissenschaften,* Berlin 1927, pp 147-152;
reprinted with commentary in [MSS02, p.3-8].

[Hopf34] Hopf, Eberhard (1934, repr. 1964): *Mathematical Problems of Radiative Equilibrium,* Cambridge University Press, 104 pages, Series Cambridge Tracts in Mathematics and Mathematical Physics Vol. 31,

[Hopf37] Hopf, Eberhard (1937, repr 1970): *Ergodentheorie,* Springer Verlag, 83 pages;

[Hopf42] Hopf, Eberhard (1942): Abzweigung einer periodischen Lösung von einer stationären Lösung eines Differentialsystems, *Berichte der Mathematisch-Physikalischen Klasse der Sächsischen Akademie der Wissenschaften zu Leipzig,* Band XCIV, Sitzung vom 19. Januar 1942, pp.3-22,
reprinted in [MSS02], pp. 91-110, with a Commentary by Martin Golubitzky and Paul H. Rabinowitz
Howard, L.N., Kopell, N. (1976): A Translation of Hopf's Original Paper, pp. 163-193 and Editorial Comments, pp. 194-205 in [MMcC76]

[Hopf50] Hopf, Eberhard (1950): The Partial Differential Equation $u_t + uu_x = \mu u_{xx}$, Comm Pure Appl Math **3**, pp 201-230

[Lit94] Litten, Freddy (1994): Die Carathéodory-Nachfolge in München 1938-1944. *Centaurus. International Magazine of the History of Mathematics* **37**, pp 154-172; see also
`http://litten.de/fulltext/cara.htm#8b`, access on 2018-Jan-04

[MMcC76] J.E. Marsden, M. McCracken (1976): *The Hopf Bifurcation and Its Applications*, Springer Verlag

[MaGe] The Mathematics Genealogy Project,
`https://www.genealogy.math.ndsu.nodak.edu/`

[MSp17] R. Meyer-Spasche: Hidden Authors, pp. 394- 429 in:
G. Wolfschmidt (ed.), *Festschrift - Proceedings of the Christoph J. Scriba Memorial Meeting - History of Mathematics.* Hamburg: tredition 2017, see also
`http://www2.ipp.mpg.de/~rim/talks.html`

[MSS02] Morawetz, C.S., Serrin, J.B., Sinai, Y.G. (eds): *Selected works of Eberhard Hopf with Commentaries*, A.M.S., Providence, 2002

[McTu] O'Connor, J.J., Robertson, E.F. (eds.): MacTutor History of Math archive,
`http://www-history.mcs.st-andrews.ac.uk/`

[Off17] Math for Science: entry on the physical chemist Barbara Offenhartz,
`http://math4science.org/barbara-offenhartz/`, accessed on 2018-02-06

[Schap90] Schappacher, Norbert, mit Martin Kneser (1990): Streiflichter auf das Verhältnis von Mathematik zu Gesellschaft und Politik in Deutschland seit 1890, unter besonderer Berücksichtigung der Zeit des Nationalsozialismus, pp. 1-82 In: Fischer, Gerd et al (1990): *Ein Jahrhundert Mathematik*, Festschrift zum Jubiläum der DMV, Deutsche Mathematiker-Vereinigung, Friedr. Vieweg & Sohn, Braunschweig/Wiesbaden

[Schlo08] Schlote, Karl-Heinz: *Von geordneten Mengen bis zur Uranmaschine*, Zu den Wechselbeziehungen zwischen Mathematik und Physik an der Universität Leipzig in der Zeit von 1905-1945. Verlag Harri Deutsch 2008

[RSS98] Siegmund-Schultze, Reinhard: *Mathematiker auf der Flucht vor Hitler*, Deutsche Mathematiker-Vereinigung, Vieweg, Braunschweig 1998

[RSS09] Siegmund-Schultze, Reinhard: *Mathematicians fleeing from Nazi Germany*, Princeton University Press, 2009,

[Tob06] Tobies, Renate (2006): *Biographisches Lexikon in Mathematik promovierter Personen an deutschen Universitäten und Technischen Hochschulen WS 1907/08 bis WS 1944/45*, Dr Erwin Rauner Verlag, Augsburg

[WiHo31] N. Wiener, E. Hopf (1931): Über eine Klasse singulärer Integralgleichungen, *Sitzungsberichte Akad. Wiss. Berlin* (1931) pp. 696-706

[Wie56] Wiener, Norbert: *I am a Mathematician*, London 1956
Mathematik – Mein Leben, Econ Verlag, Düsseldorf Wien, 1962

[WoS] Web of Science, `https://www.webofknowledge.com`