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Invited Perspectives

# Professor Ernst Bresslau, founder of the Zoology Departments at the Universities of Cologne and Sao Paulo: lessons to learn from his life history

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ABSTRACT

In this article, the life history of the founding father of the departments of Zoology at the Universities of Cologne and Sao Paulo, Prof. Ernst Bresslau, is described on occasion of the establishing of the "Ernst Bresslau Guest Professorship" at the University of Cologne. His main scientific achievements are discussed, in particular his research on the evolutionary origin of the mammary apparatus, in addition to his broad interest in biological topics. Among the many technical advancements that he introduced was the micro slow-motion camera developed together with the Zeiss Company which allowed to film ciliary beats at high speeds.



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## 1. Introduction

Scientific achievements and progress usually arise from the solid base of knowledge accumulated by scientists living in earlier times. Therefore, to fully understand science in its present form it is necessary to know about its history, which as a biologist one may compare to an "evolutionary process". Such a process can be slow but from time to time leaps of progress may occur, usually coinciding with new technical or methodological inventions, such as the miniaturization of recording equipment or novel molecular tools. Here, I would like to draw attention to a forgotten pioneer, Ernst Bresslau, who was an excellent zoologist and well respected in his time for his developmental studies on the mammary apparatus of monotremes, marsupials and eutherians (placental mammals). He was also a pioneer in constructing new technical equipment; for example, he developed the first high-speed film camera in cooperation with the Zeiss company.

Although as scientists we know that science has a much appreciated global motif, we are, nevertheless, local citizens who depend

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on the decisions, rules and politics of a particular nation. We may believe that nowadays we are more advanced than the world one hundred years ago, but the reality in many countries proves that up to this day scientists are threatened and harassed by politics. Therefore, history should not be neglected but rather serve to reflect on present politics and to gain knowledge in order to avoid repeating mistakes. Germany's history, in particular, can serve as a case study on how politics affected the lives of scientists who were building their career at the beginning of the twentieth century. Ernst Bresslau's life is a formidable example of a person who devoted his life to science despite political repression.

The present article was instigated by a recent decision of the University of Cologne and its Department of Zoology to remember its founder, Prof. Dr. Ernst Bresslau, who as a respected and well-known scientist was dismissed from office in September 1933 shortly after the Nazis had come into power in March 1933, by creating the award of the "Ernst Bresslau Guest Professorship". As the first recipient of this award, I was particularly interested in learning more about the life of Ernst Bresslau and his scientific achievements, and soon found out how much his life was affected by European history and the political conditions of that time. However, his life may also serve as an example for the drive of a scientist who despite adverse conditions never gave up on living his dreams as a zoologist.

## 2. A short life history of Ernst Bresslau

### 2.1. Background and early youth

Ernst Bresslau (Fig. 1) was born in Berlin on July 10th, 1877. His mother was Caroline Isay, born in 1853 in the little Eifel town of Schweich, and his father was Harry Bresslau, born in 1848 in Dannenberg/Elbe, Professor of Medieval History first in Berlin and later in Strasbourg (Straßburg). He had one sister, Helene, who later was married to Albert Schweitzer, the famous founder of the Lambaréné Hospital in Gabon. As his family was of Jewish descent, his father was denied a permanent professorship in Berlin by the Prussian state and therefore moved to the more open and progressive University of Strasbourg where the family settled and where the young Ernst graduated from high school ("Abitur") in 1895. He moved in a group of intellectual friends, among them Albert Schweitzer and Elly Knapp (who later on became the wife of Theodor Heuss, the first president of the Federal Republic of Germany). He began to study medicine in Munich and then in Strasbourg where two professors influenced him strongly: Prof. Gustav Schwalbe, an anthropologist interested in the comparative anatomy of animals and humans, and Prof. Alexander Wilhelm Goette, a developmental biologist interested in comparative morphology.

### 2.2. His first years at university

He must have been a very talented student, as on the advice of his mentor Prof. Goette he published his first article, "Zur Entwicklungsgeschichte der Rhabdocölen" (*On the developmental history of Rhabdocoela*), a group of flatworms (turbellarians), in 1899 (Bresslau, 1899; continued in Bresslau, 1903). During his holidays he had an interesting "summer job" working on a zoological dictionary initiated by Geheimrat (*privy councilor*) Friedrich Alfred Krupp, which was first privately published, then in 1909 by Fischer in Jena as "Zoologisches Wörterbuch" (*Zoological Dictionary*) (Bresslau et al., 1909). In 1901 he completed his dissertation on the developmental history of the mammary organs in marsupials (Bresslau, 1902a,b; Bresslau, 1904b), which should become his main research field, and in 1902 he passed the final examination as Dr. med. (*MD*). As he was planning a career in science he became


**Fig. 1.** A portrait of Prof. Ernst Bresslau as director of the Zoological Institute of the University of Cologne (*Universität zu Köln*) taken between 1925 and 1933.

Goette's assistant from 1901 to 1907. In 1903 he habilitated with "Beiträge zur Entwicklungsgeschichte der Turbellarien" (*Contributions to the developmental history of turbellarians*), published in 1904 in Zeitschrift für wissenschaftliche Zoologie (*Journal of Scientific Zoology*; Bresslau, 1904a), and obtained the 'Venia legendi' (*qualification to teach*) in zoology.

He must have been a very adventurous and curious young man full of energy as in 1904 he signed on as a medical doctor on a HAPAG boat (*Hamburg-Amerikanische Packetfahrt-Actien-Gesellschaft*, a German shipping company) to fulfill his dream of a journey to Brazil, a country that should play a big and decisive role in his future life. Upon his return, however, things developed in a rather unforeseen direction because when he mentioned his wish to get married to his mentor Goette, the latter told him "either marriage or assistantship, but not both"! Ernst Bresslau had the guts to resist this "offer" and got married to Luise Hoff, the daughter of a wealthy Strasbourg merchant. After giving up his university position, he passed the state examination in 1907 to become a high school teacher. Apparently, Albert Schweitzer felt that in his case too much talent was wasted, and advised him to return to the university. Thus, financially supported by his father-in-law, Ernst Bresslau became a private lecturer in the department of Zoology at Strasbourg University, until, in 1909, he was finally employed as an ordinary university professor. There he continued his studies on the development of the mammary organs which were finally published in 1912 (Bresslau, 1907a; Bresslau, 1912) and later in a concise English edition (Bresslau, 1920). These studies were so up-to-date and important that Ernst Bresslau was invited in 1913 to give a series of three lectures on the development of the mam-


**Fig. 2.** Original photographs from the diary of Ernst Bresslau showing *Metachirops quica*, a South American opossum. The text in German below the left picture states that the pouch is sagging due to the weight of the embryos. The right picture shows the embryos removed from the pouch but still attached to the nipples, and trying to climb back into the pouch again.

mary apparatus of Monotremata, Marsupialia and Placentalia at the University of London, and during the 9th International Congress of Zoology in Monaco he obtained an award by the Russian Tsar Nikolaus II. In 1913 he also obtained funding from the Prussian Academy of Sciences for an expedition to Brazil.

### 2.3. First expedition to Brazil in 1913/1914

This first expedition to Brazil lasted 14 months and mainly served to study terrestrial turbellarians and the mammary apparatus of marsupials such as possums (Fig. 2). He wrote a detailed diary of 292 pages in Suetterlin (an old-style German script). During this journey he also visited the famous Butantan Institute and the Instituto Oswaldo Cruz where he met with two colleagues from London, Prof. J.P. Hill and P.G. Samson. The return journey on the steamer "Tubantia" was overshadowed by the outbreak of the First World War. The boat was stopped by the English cruiser "Highflyer", and Ernst Bresslau was interned, but later was set free in his capacity as a medical doctor.

The results of this first expedition were published in 1927 (Bresslau, 1927a), and the specimens which he had brought back to Germany were determined and analyzed by members of the Senckenberg Museum in Frankfurt (citations in Wehefritz, 1995).

### 2.4. First World War

Ernst Bresslau served in the First World War from 1914 to 1918 as a medical doctor. He was the doctor-in-charge of a military hospital in Neu-Breisach, Germany, where he organized transports of wounded soldiers and received military honors for his services. Despite the turbulent and restless times the family grew: daughter Caroline was born in 1909, son Heinrich in 1912, son Hermann in 1915 and daughter Odilia in 1919.

The end of the war was a most difficult time for him as Germany lost the Alsace and, as German nationals, the whole family including the parents of Ernst Bresslau had to leave Strasbourg. An offer to become the director of the Zoological Institute of the Osman University in Konstantinopel (Istanbul), Turkey, was also withdrawn due to the outcome of the war. For a short time Ernst Bresslau was hired by the University of Freiburg as a stand-in for the director of the Zoological Institute, Prof. Franz Doflein. Finally, in 1919, Ernst Bresslau moved to Frankfurt, to become the director of the Zoological Department of the "Chemotherapeutisches Forschungsinstitut Georg-Speyer-Haus" (*Chemotherapeutic Research Institute*), a privately financed research institution where he ventured into a new research field: protozoology. By cultivating protozoans from temporarily flooded meadows and inventing new laboratory techniques he even managed to describe new species (Bresslau, 1921a; Bresslau, 1921b; Bresslau, 1921c; Bresslau, 1922). Another, more practical branch of his research was concerned with the eradication of mosquitoes (Bresslau, 1917; Bresslau, 1918; Bresslau and Glaser, 1918; Bresslau, 1919).

Then, in 1924/1925, he was offered the chair of the newly founded Institute of Zoology at the University of Cologne. The University of Cologne had originally been founded in 1388 and existed until 1798 when it was closed down for almost 120 years. It was only reopened in 1919 and the driving force behind this was Konrad Adenauer, then mayor of the city of Cologne, who later became the first chancellor of the newly founded Federal Republic of Germany. Ernst Bresslau started from scratch, and during his years in Cologne he not only had to organize the installation of a new department but also, ten years later, the move to a new place because of the enormous increase in students. He must have been a very energetic organizer as he became the Dean of the Philosophical Faculty as early as in 1926/1927.

### 2.5. Second expedition to Brazil in 1929, flourishing years and a new start in Brazil

During his second expedition to Teresópolis in the Serra dos Órgaos of Brazil in 1929 he was accompanied by his wife who wrote a diary of 101 pages, accounting every day's highlights. On this occasion he also held some acclaimed lectures at the Brazilian Academy of Sciences in Rio de Janeiro and at the University of Sao Paulo.

Ernst Bresslau was at the height of his career when in June 1933 he hosted the 35th annual meeting of the German Zoological Society. He presented a technical sensation, a high-speed camera ("Mikro-Zeitlupe", *micro slow-motion*) which he had developed in cooperation with the Zeiss Company and which allowed speeds of up to 1000 frames/second (Bresslau, 1933).

On the horizon, however, there were already the signs of changes to come: On September 24, 1933, a few months after Hitler's National Socialists had come into power he was dismissed from his office because of his Jewish background, although he himself had been raised in the Lutheran faith. In 1934, Ernst Bresslau emigrated to Brazil, where he founded the Zoological Institute of the University of Sao Paulo. His welcome lecture in Portuguese was on "*A origen dos mammiferos*" (Bresslau, 1935). His wife with three of their children also arrived in Sao Paulo in December 1934. His eldest daughter Caroline, who was not allowed to finish her

PhD thesis (on the economy of medieval Cologne) at the University of Cologne, finally graduated in Switzerland at the University of Bern. Soon after his arrival in Sao Paulo, Ernst Bresslau was made a corresponding member of the Brazilian Academy of Sciences.

Unfortunately, in May 1935 Ernst Bresslau died of heart failure in Sao Paulo. His wife outlived him by 31 years and died in Sao Paulo in 1966. She was a gifted writer and novelist. All the children were successful in Brazil, whether in agriculture or as architects. Descendants of the Bresslau family are still living in Brazil today although some have moved to the US or returned to Europe.

## 3. The scientist Ernst Bresslau

The scientific work of Ernst Bresslau is amazingly diverse and comprises 85 publications and several books as well as a number of important technical inventions (see Wehefritz, 1995 for a complete list of publications). As a zoologist he must have been an 'all-round talent', which is underlined by his editorship, together with H.E. Ziegler, of "Zoologisches Wörterbuch" (*Zoological Dictionary*) in 1909, which was a big success, with a second edition published in 1912, and a third one in 1927. He also wrote articles for *Tabulae Biologicae* (Bresslau, 1927b), for the "Handbuch der Zoologie" (*Handbook of Zoology*; Bresslau, 1928; Bresslau and Reisinger, 1928), the "Handwörterbuch der Naturwissenschaften" (*Concise Dictionary of Natural Sciences*; Bresslau, 1932) and the "Handbuch der Biologischen Arbeitsmethoden" (*Handbook of Biological Working Methods*; Bresslau, 1936). In 1913, together with Paul Steinmann, he published a monograph on "Die Strudelwürmer" (*turbellarians*), volume 5 of the series "Monographien einheimischer Tiere" (*Monographs of Endemic Animals*; Fig. 3). This book not only described the morphology and anatomy of turbellarians but also their ecology and general biology (Steinmann and Bresslau, 1913). He also studied the taxonomy of other groups, for example, nematodes of the North Sea (Bresslau and Schuurmans Stekhoven, 1940). As a protistologist he described new species, for example the large colonial ciliate protozoan *Systilis hoffi* n. gen. n. spec. (Bresslau, 1919) from vernal pools, and he also studied questions of cell biology such as the structure of the pellicula (see Jaenicke, 1999).

Particular progress was achieved by his great talent for technical inventions or improvements. For example, his opal blue staining method revealed new cellular structures in protozoans (Bresslau, 1921c). He built his own ph-meter, invented new accessory items for cameras, and his most remarkable technical achievement was called "Mikro-Zeitlupe" (*micro slow-motion*) which in fact was a high-speed camera that allowed to take 1000 frames/second, and which he developed together with the Zeiss Company (Bresslau, 1933). With the help of this high-speed camera he was, for example, able to see and study ciliary beats.

His most influential and in many ways his main study area, however, was the origin of the mammary apparatus of monotremes, marsupials and mammals. A monograph on this subject in English was published in 1920 (*The Mammary Apparatus of the Mammalia in the Light of Ontogenesis and Phylogenesis;* Bresslau, 1920). The main work in German came in three parts under the title: "Die Entwickelung des Mammarapparates der Monotremen, Marsupialier und einiger Placentalier: Ein Beitrag zur Phylogenie der Säugethiere" (Bresslau, 1907a; Bresslau, 1912). The mammary gland is a unique feature of the mammalians and determines lactation. The pending question was from which glands the mammary glands originated as there is no homologue among reptiles. The three hypotheses were that mammary glands originated either from sebaceous, eccrine or apocrine glands. '*None of the many attempts to explain the phylogeny of the mammary apparatus, or parts of it, has been able to withstand searching criticism. They have all failed because of the discrepancies between theory and facts which come to light when one follows these speculations to their logical conclusion*', wrote Ernst Bresslau (1920,

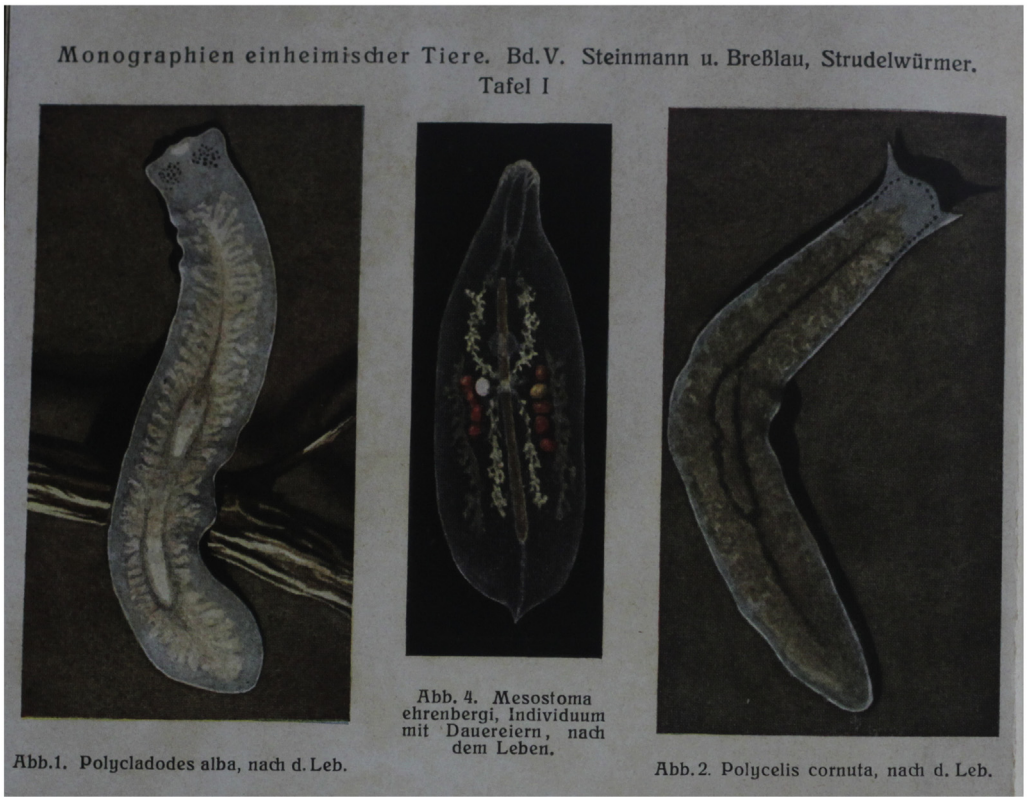


**Fig. 3.** Various drawings of turbellarians based on living specimens (*'nach dem Leben'*). Left: *Polycladodes alba*; middle: *Mesostoma ehrenbergi*, an individual with eggs; right: *Polycelis cornuta*. From the monograph by Steinmann and Bresslau (1913).

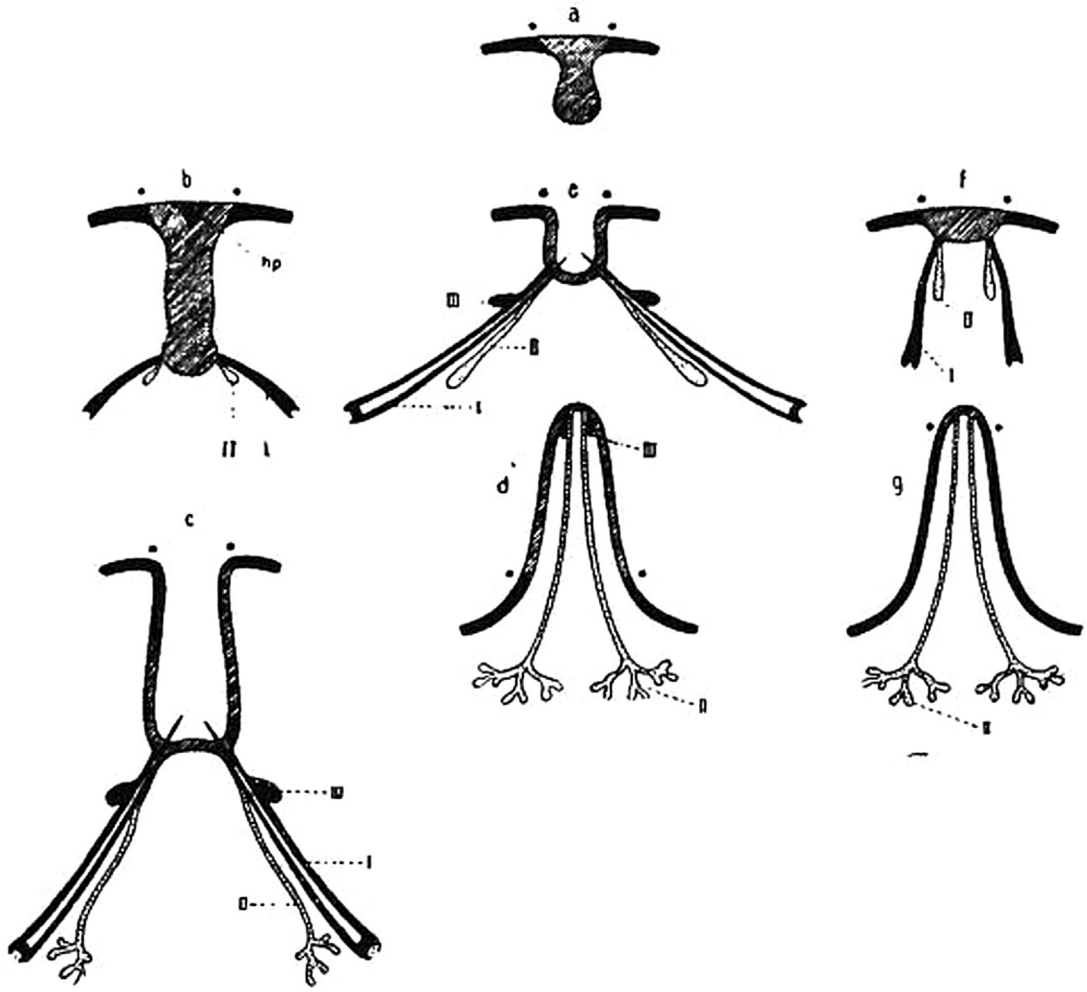


**Fig. 4.** Nipple development of the marsupials. Originally published in Bresslau (1920). I. Primary sprouts (primordia of mammary hairs). II. Secondary sprouts which give rise to milk glands. III. Tertiary sprouts (primordia of sebaceous glands). *a*, Nipple primordium; *b-d*, stages of eversion nipples; *e*, transition between eversion nipples and proliferation nipples; *f-g*, stages of proliferation nipples.

cited in Blackburn, 1991). By studying embryology, Ernst Bresslau concluded that mammary glands were not derived from any existing type of cutaneous gland but showed features of a less specialized ancestral type (Bresslau, 1907a, 1920; also see Blackburn, 1991). In particular, Ernst Bresslau showed that monotreme mammary glands are related to those of marsupials and placentals, are not different from those and, thus, mammary glands and lactation have evolved only once in mammalian history (Blackburn, 1991). One of his main findings was that the mammary gland anlagen develop in association with hair follicles in monotremes, marsupials and other Placentalia (Bresslau, 1902a,b, 1912, 1920), in some species even giving rise to a mammary hair (Fig. 4). In a recent review on mammary organs, Oftedal and Dhouailly (2013) propose *"that a preexisting structural triad, the apocrine-pilo-sebaceous unit, was incorporated into the evolving mammary structure and coupled to additional developmental processes that form the mammary line placode, bulb and primary sprout*". And later they state that *"the mammary gland appears to have coopted signaling pathways and genes for secretory products from even earlier integumental structures such as odontode (tooth-like) or odontode-derived structures".* This is in line with the idea that mammary glands evolved from innate immune systems (Vorbach et al., 2006). It is very clear that scientists like Ernst Bresslau laid the foundations for our present knowledge.

## 4. The university teacher and organizer Ernst Bresslau

Ernst Bresslau was a broad zoologist who not only taught in the laboratory and in lectures but also in field excursions. It was standard practice at the time that students had to dissect all major zoological groups, that advanced courses in zoology lasted a whole semester, and a zoological seminar and laboratory work were necessary for the final diploma thesis.

Only five years after the Zoological Institute had been established at Cologne University it became too small for the increasing number of students and a new place had to be searched for. Finally, in 1930/31, a new location was found, a former restaurant, and Ernst Bresslau exhibited a lot of organizational and creative skills: the beer cellar was transformed into a constant-temperature room and the wine cellar into a high-speed film studio. The former wedding hall became the lecture hall with the latest-technology film projector. He was well known for his effective and successful dealings with administrative people including the then mayor of Cologne, Konrad Adenauer, who was impressed by Ernst Bresslau's organizational skills and drive. It is also reported that he and his wife kept an "open house", regularly inviting colleagues and staff. A detailed account on the history of the Zoological Institute of the Universität zu Köln can be found in the documentation by Hoffmann (2001).

In addition, Ernst Bresslau wrote articles on scientific matters for the interested public, for example on "Das Wachs und die Organe der Wachsbereitung der Honigbiene" (*Wax and the organs of wax production in honey bees;* Bresslau, 1907b), on "rückenständige Milchdrüsen" (*dorsal milk glands;* Bresslau, 1913), or even on "Die Wissenschaft in Sowjet-Russland" (*Science in Sovjet Russia;* Bresslau, 1926).

## 5. Concluding remarks

As someone who only learned about Ernst Bresslau very recently, I can only admire him as a true scientist because he never lost his scientific spirit despite personal hardships. First, he had to leave the town where he grew up, Strasbourg, then, because of the outcome of the First World War, he was forced into new research areas by political circumstances. Despite losing his home and cultural grounding in Germany for a second time he did not give up, but, full of drive, started again from scratch in Brazil. Yet he must have felt betrayed by his own country, Germany, where he had been a respected member of the scientific community but, for no other reason than the Jewish origin of his family, was retired and forced to leave the country, a country which he had even served in a war. In a book series on "Universität im Exil" (*University in Exile*), Valentin Wehefritz (1995) recounted his story and entitled his booklet most appropriately: "Ein Herz leidet an Deutschland" (*A heart troubled by Germany*).

It should also not be forgotten that many German scientists who experienced a similar fate to that of Ernst Bresslau found new homes not only in the USA and Great Britain, but also in many less well-off countries such as Turkey, Argentina or Brazil. As German scientists we should never forget this painful lesson of history, and we should open our doors wide to those who experience similar hardships in their own countries at this very moment.

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