

“Congo” Red Out of Africa?

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● **Context.**—Congo red is the essential histologic stain for demonstrating the presence of amyloidosis in fixed tissues. To the best of my knowledge, nothing has been written about why the stain is named “Congo.”

Objective.—To understand the etymology and history of the Congo red histologic stain.

Design.—Primary sources were consulted extensively, including 19th-century corporate documents, newspapers, legal briefs, patents, memoirs, and scientific papers.

Setting.—Sources were obtained from multiple university libraries and German corporate archives.

Results.—To Europeans in 1885, the word *Congo* evoked exotic images of far-off central Africa known as The Dark Continent. The African Congo was also a political flash-

point during the Age of Colonialism. “Congo” red was introduced in Berlin in 1885 as the first of the economically lucrative direct textile dyes. A patent on Congo red was filed by the AGFA Corporation of Berlin 3 weeks after the conclusion of the well-publicized Berlin West Africa Conference. During these important diplomatic talks, German Chancellor Otto von Bismarck presided over a discussion of free trade issues in the Congo River basin. A challenge to AGFA’s Congo red patent led to a precedent-setting decision in intellectual property law.

Conclusions.—The Congo red stain was named “Congo” for marketing purposes by a German textile dyestuff company in 1885, reflecting geopolitical current events of that time.

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More than 100 years after its discovery, the Congo red histologic stain is still of fundamental importance in the laboratory. “Congophilic” staining of fixed tissue and the detection of apple-green birefringence when viewed under polarized light remain essential for the diagnosis of amyloidosis.^{1,2} Few other laboratory tests have been used so widely and for such a long period of time. Despite Congo red’s popularity, to the best of my knowledge nothing has been written about how the stain got its name. This article explores the history of the Congo red stain, focusing on its etymology.

CONGO RED AND THE TEXTILE INDUSTRY

Congo red began its life as an extremely valuable textile dye—a dye of such importance that it not only revolutionized the textile industry but also resulted in a patent challenge that changed intellectual property law.

Until the middle of the 19th century, only natural dyestuffs were available for use by dyers.³ These offered a fairly limited color palette, and many stains faded easily upon washing and exposure to light. The synthetic dye industry was born in 1856, when an English chemist, Sir William Henry Perkin, inadvertently created the first aniline dye while attempting to make quinine from coal-tar derivatives.⁴ Perkin named his new dye *aniline purple*, but it soon became known as *mauve* after the French name for a flower with a similar color. Mauve was an instant tri-

umph, and soon the European fashion centers of London and Paris bustled with purple garments. In subsequent decades, a rainbow of other aniline dyestuffs were synthesized and made available to textile colorists. German companies created almost all of these dyes, and the center of the textile industry quickly shifted away from Perkin’s England.

The first aniline dyes were limited by the need to use a substance known as a *mordant* to fix the dye permanently to the textile fiber, a requirement that added an extra step to the dyeing process.^{5,6} In 1883, an obscure young chemist named Paul Böttiger found a more direct method.⁷ At the time of his discovery, Böttiger was working in the dyestuff chemical laboratory of the Friedrich Bayer Company in Elberfeld, Germany. While attempting to synthesize a substance that would serve as a pH indicator, Böttiger created a novel, brilliant red dye that did not require a mordant to stain textile fibers. This dye, which only later became known as Congo red, was the first of many so-called *direct dyes*. Unfortunately for the Friedrich Bayer Company, Böttiger’s supervisors showed little interest in the young chemist’s project. The company objected to the new red dye on the grounds that it was not acid-fast. Bayer’s chemists probably failed to recognize the value of the direct dye because they were much more interested in finding a synthetic replacement for the expensive natural dye indigo.⁸

Böttiger left Bayer in December of 1883, ostensibly to work for his father, who owned a small factory in the industrial city of Łódź in present-day Poland. On February 24, 1884, Böttiger filed for a patent on the new red dye in his own name.⁹ After the patent was issued, the young

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chemist offered the patent rights to 3 large chemical companies (Bayer again, BASF [Badische Anilin- & Soda-Fabrik], and Hoechst), but was rejected by all 3.^{8,10} He subsequently sold the patent for an undisclosed amount of money to the Actiengesellschaft (Aktiengesellschaft) für Anilinfarbenfabrikation (AGFA), a Berlin dye-manufacturing company and Bayer rival. In 1885, AGFA began selling the dye under the trademark Congo red; the source of this name is discussed below.

AGFA made a fortune from Congo red, exporting it to textile manufacturers all over the world. Other dye companies soon found themselves unable to compete. AGFA's product was so successful that competitors had to close factories and lay off workers. By November of 1885, matters had become so bad for Bayer that a major Berlin financial newspaper forecast the company's imminent doom and advised investors to sell their shares of Bayer stock.¹¹ But Bayer was soon rescued by the "discovery" of their own direct dye, actually only a minor chemical alteration of Congo red.⁸ After prolonged secret negotiations, Bayer and AGFA avoided a costly patent lawsuit by forming a cartel for the purpose of sharing the profits from each other's dyes, including Congo red. Bayer's financial recovery was rapid, and the company's future was permanently secured by the marketing of aspirin in 1899.

Other chemical companies who had been left out of the direct-dye trade were still experiencing an economic crisis. In 1889, a desperate rival company named Ewer & Pick brought a major patent lawsuit against AGFA.¹² Ewer & Pick alleged that the Congo red dye should be in the public domain because one of their chemists had found an alternative way to synthesize the dye. The chairman of another struggling AGFA and Bayer competitor, BASF, argued as an expert witness on behalf of Ewer & Pick. He testified that the synthesis of Congo red was so obvious that his laboratory assistants were able to manufacture the dye easily after reading only the title of the patent. BASF also produced evidence that another chemist before Böttiger had synthesized a direct dye.¹³ The German Imperial Patent Court's ruling on the case set an important precedent for patent law: technical processes and technical effects could be patented, but they had to be non-obvious.¹⁴

By 1910, there were many textile dyes bearing the Congo name: Congo rubine, Congo corinth, brilliant Congo, Congo orange, Congo brown, and Congo blue.³ Congo red is rarely used as a textile dye today because of its tendencies to change color when touched by sweaty fingers¹⁰ and to stain the fabric of other garments when washed together.

THE BERLIN WEST AFRICA CONFERENCE

A key question is why the dye was called Congo red in the first place. Unfortunately, because few internal corporate documents survive from the 19th century (for reasons that will be detailed), a definitive answer to this question is not possible. However, strong circumstantial evidence points to a connection with the geopolitical event later known as the Berlin West Africa Conference.

A major diplomatic conference was held in Berlin from November 15, 1884, until February 26, 1885, ostensibly to mediate a trade dispute between several European colonial powers concerning the Congo River basin in Central Africa.¹⁵ The conference was one of the most significant political events of the decade, and European newspapers were full of news and opinion pieces concerning the con-

ference and related colonial issues. Attending the conference at the invitation of the German "Iron Chancellor" Otto von Bismarck were high-ranking representatives of all the major European powers and the United States. Germany was not a significant colonial power in 1884, having just established its first African colony that year; Bismarck may have called the conference in order to give legitimacy to Germany's new imperialist leanings. In fact, although the official report of the conference called for free trade in the Congo basin,¹⁶ this never occurred; what may really have been decided was how the colonial powers would divide the continent of Africa among themselves.¹⁷

Since the West Africa Conference was held in Berlin, and the central issue was the Congo—an exotic locale to Europeans in 1885 and a name that was on the tip of every tongue—it is not surprising that a Berlin dye company (AGFA) gave the name Congo to a sensational new dye debuting at the very same time. The name was an effective marketing tool. AGFA filed a patent for a modification of the Congo red dye on March 17, 1885, less than a month after the conference ended; this patent application mentions that Congo red was already "well known."¹⁸

It might be imagined that production of Congo red required raw materials from Africa, or that the dyestuff was named in honor of colorful native African textiles. The available evidence does not support these arguments. The chemicals used in making Congo red and the other aniline dyes were primarily derived from the coal-tar waste products of the coal gas and steel industries in Germany's Ruhr Valley. Traditional native textiles from the Congo River basin are typically black and rarely red (M. Taylor, Information Officer of The Textile Museum, Washington, DC, oral communication, June 1999). The marketing hypothesis is further supported by the debut of other textile dyes with African names during the same era, such as Sudan black and Somalia yellow.³

AGFA, I.G. FARBEN, AND WORLD WAR II

By the end of the 20th century, the German dye and chemical industry was mired in more unproductive conflicts like the one over the Congo red patent.¹⁹ In 1904, 3 of the largest chemical manufacturers (AGFA, BASF, and Bayer) joined many of their operations in a cooperative venture called the *Interessengemeinschaft*, a "Community of Interests." In 1925, this trust was expanded; the 8 largest chemical firms in Germany merged into a giant corporation named *I.G. Farbenindustrie AG* ("Interessengemeinschaft Farbenindustrie Aktiengesellschaft"), commonly known as I.G. Farben. I.G. Farben was critical to the German military effort during the Second World War, and its factories were heavily bombed during the Allied air campaign in 1944–1945.²⁰ Sixty-five Allied air raids were carried out on the former BASF facilities at Ludwigshafen and Oppenau; 33% of the buildings were completely destroyed, and 61% of the remaining structures were classified as "heavily damaged."²¹ With such extensive destruction of factories and offices, many corporate documents were lost. Thus, the fact that no documents exist directly linking the Berlin West Africa Conference to the marketing of Congo red is not surprising.

Following the Allied occupation of Germany in 1945, it was learned that the company had operated a forced-labor factory in the Nazi concentration camp at Auschwitz.²² I.G. Farben was viewed as threatening by the occupying Allied powers and was soon broken up into 3 large successor

companies: BASF AG in Ludwigshafen, Bayer AG in Leverkusen, and Hoechst AG, all of which are still large producers of chemicals and pharmaceuticals today. AGFA, the company that sold Congo red, was at first a subsidiary of Bayer, but it later merged with a Belgian photographic material company to form Agfa-Gevaert Gruppe; this group became part of Bayer again in 1981.²³

CONGO RED AS A HISTOLOGIC STAIN

During the era of active aniline dye discovery, many of the new textile stains were also tested on pathologic specimens.²⁴ Congo red was no exception. Its first scientific use was to determine if animals produce acid in their intestinal tracts²⁵; this experiment was published in 1886, only a year after the stain's textile debut. For this task, the tendency of the dye to change color with changes in pH was very useful. Congo red is still used as a pH indicator in some industrial processes. Later in 1886, Congo red was first used to stain tissue.²⁶

Although amyloidosis has been recognized as a pathologic entity since at least the 1840s,²⁷ it was not until 1922 that Congo red was found to bind avidly to amyloid protein.²⁸ Interestingly, the first diagnostic use of Congo red in amyloidosis was not as a histologic stain but as a procedure.²⁹ For several decades, it was standard practice to administer an intravenous bolus of Congo red to patients with suspected amyloidosis. If the amount of Congo red in a plasma sample drawn a few minutes after the bolus was given was lower than expected, the missing dye was presumed to have bound to amyloid fibrils in the patient's organs.

A Belgian neuropathologist studying degenerative changes in aging brains first noted the characteristic green birefringence of amyloid substance when stained with Congo red and viewed under polarized light.^{30,31} The discovery of this property markedly improved the specificity of histologic staining. More than 60 years later, the role of amyloid proteins in neurodegenerative diseases remains a very active research area.^{32,33}

At the dawn of the 21st century, the molecular basis of amyloidosis is well understood,³⁴ but the diagnostic test of choice has not changed in decades. In amyloidosis, Congo red still reigns as the "king of dyes."

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References

1. Jandl JH. *Blood: Textbook of Hematology*. 2nd ed. New York, NY: Little, Brown; 1996.
2. Kyle RA, Gertz MA. Amyloidosis. In: Wiernik PH, Canellos GP, Kyle RA, Schiffer CA, eds. *Neoplastic Diseases of the Blood*. 2nd ed. New York, NY: Churchill Livingstone; 1991:525-555.
3. Hummel JJ, Knecht E. Dyeing. In: Chisholm H, Hooper FH, eds. *The Encyclopaedia Britannica*. 11th ed. New York, NY: Encyclopaedia Britannica; 1910: 744-755.
4. Stout E. *Introduction to Textiles*. New York, NY: John Wiley and Sons; 1965.
5. Miller E. *Textiles: Properties and Behavior*. New York, NY: Theatre Arts; 1968.

6. Travis AS. *The Rainbow Makers: The Origins of the Synthetic Dyestuffs Industry in Western Europe*. Bethlehem, Pa: Lehig; 1993.
7. Pötsch WR. *Lexicon Bedeutender Chemiker [Dictionary of Important Chemists]*. Frankfurt am Main, Germany: Thun; 1989.
8. Verg E, Plumpe G, Schultheis H. *Meilensteine [Milestones]*. Leverkusen, Germany: Bayer AG; 1988.
9. Böttiger P. Deutsches Reichs Patent [German Imperial Patent] 28753. August 20, 1884.
10. Voistländer-Tetzner. *Chronik der BASF Ludwigshafen AG [Chronicle of BASF Company of Ludwigshafen]*. Date of composition unknown: 259-260. Available from: BASF AG archives.
11. Anonymous. Farben-Fabriken vorm. Friedr. Bayer u. Co. in Elberfeld [Dye-stuff factories formerly Friedr. Bayer and Company in Elberfeld]. *Allgemeine Börsen-Zeitung für Privat-Capitalisten und Rentiers*. November 18, 1885:1.
12. Duisberg C. *Meine Lebserinnerungen [My Life Memoirs]*. Leipzig, Germany: Philipp Reclam; 1933.
13. *Gutachten von Herrn Dr. Caro in Sachen Congoroth [Expert Opinion of Dr. Caro in the Case of Congo Red]*. *Firma Ewer & Pick zu Berlin w die Aktien-Gesellschaft für Anilin-Fabrikation zu Berlin*, (Mannheim First Civil Senate 1889).
14. Wegner HC. Process patents and *Ochiai*: return to Kongo-Rot. *Mealey's Litigation Reports: Intellectual Property*. 1996;4:1-21.
15. Crowe SE. *The Berlin West Africa Conference 1884-1885*. New York, NY: Longmans, Green; 1942.
16. Anonymous. Berlin West African Conference. In: McHenry R, ed. *Encyclopaedia Britannica*. 15th ed. Chicago, Ill; 1995 (available from 1999 update on CD-ROM).
17. Förster S, Mommsen WJ, Robinson R, eds. *Bismarck, Europe, and Africa. Papers of the German Historical Institute of London*. London, England: Oxford University Press; 1988.
18. AGFA. Deutsches Reichs Patent [German Imperial Patent] 35615. May 13, 1886.
19. Plumpe G. The political framework of structural modernisation: The I.G. Farbenindustrie AG, 1904-1945. In: Lee WR, ed. *German Industry and German Industrialisation: Essays in German Economic and Business History in the Nineteenth and Twentieth Centuries*. New York, NY: Routledge; 1991.
20. Churchill Sir W. *The Second World War: An Illustrated History*. New York, NY: Time; 1959.
21. BASF AG. Data available at: <http://www.basf-ag.basf.de/en/daten/geschichte/1953.htm>. Accessed November 6, 2000.
22. Dwork D, van Pelt RJ. *Auschwitz: 1270 to the Present*. New York, NY: Norton; 1996.
23. Anonymous. Agfa-Gevaert. In: McHenry R, ed. *Encyclopaedia Britannica*. 15th ed. Chicago, Ill; 1995 (available from 1999 update on CD-ROM).
24. Clark G, Kasten FH, eds. *The History of Staining*. 3rd ed. Baltimore, Md: Williams & Wilkins; 1983.
25. Schulz H. Über das Congorot als reagens auf freie säure [Concerning Congo red as a reagent for free acids]. *Centralblatt für die Medicinischen Wissenschaften*. 1886;29-30.
26. Griesbach H. Weitere untersuchungen über azofarbstoffe behufs tinction menschlicher und thierischer gewebe [Further studies of azo dyestuffs as a stain of human and animal tissues]. *Zeitschrift für Wissenschaftliche Mikroskopie und für Mikroskopische Technik*. 1886;3:358-385.
27. Rokitansky K. *Handbuch der Pathologischen Anatomie [Handbook of Pathological Anatomy]*. Vol 3. Wien, Austria: Braumüller and Seidel; 1842:311. Cited by: Cohen AS. History of amyloidosis. *J Int Med*. 1992;232:509-510.
28. Bennhold H. Eine spezifische amyloidfärbung mit Kongorot [Specific staining of amyloid with Congo red]. *Münchener Medizinische Wochenschriften*. 1922;69: 1537-1538.
29. Bennhold H. Excretion of intravenously injected Congo red in different diseases, especially amyloidosis [in German]. *Deutsches Archiv für Klinische Medizin*. 1923;142:32-46.
30. Divry P. Etude histochemique des plaques seniles [Histochemical study of senile plaques]. *J Belge de Neurologie et de Psychiatrie*. 1927;27:643-657.
31. Divry P. Confrontation morphologique et histo-chimique de l'amyloide et des productions analogues du cerveau sénile [Morphologic and histochemical comparison of amyloid and the analogous products of aging brain]. *J Belge de Neurologie et de Psychiatrie*. 1936;36:24-31.
32. Tanzi RE, Gusella JF, Watkins PC, et al. Amyloid beta protein gene: cDNA, mRNA distribution, and genetic linkage near the Alzheimer locus. *Science*. 1987; 235:880-884.
33. Lendon CL, Ashall F, Goate AM. Exploring the etiology of Alzheimer disease using molecular genetics. *JAMA*. 1997;277:825-831.
34. Osserman EF, Tatsuki K, Talal N. The pathogenesis of "amyloidosis": studies on the role of abnormal gamma globulins and gamma globulin fragments of Bence Jones type in the pathogenesis of "primary" and "secondary" amyloidosis, and the "amyloidosis" associated with plasma cell myeloma. *Semin Hematol*. 1964;1:3-85.